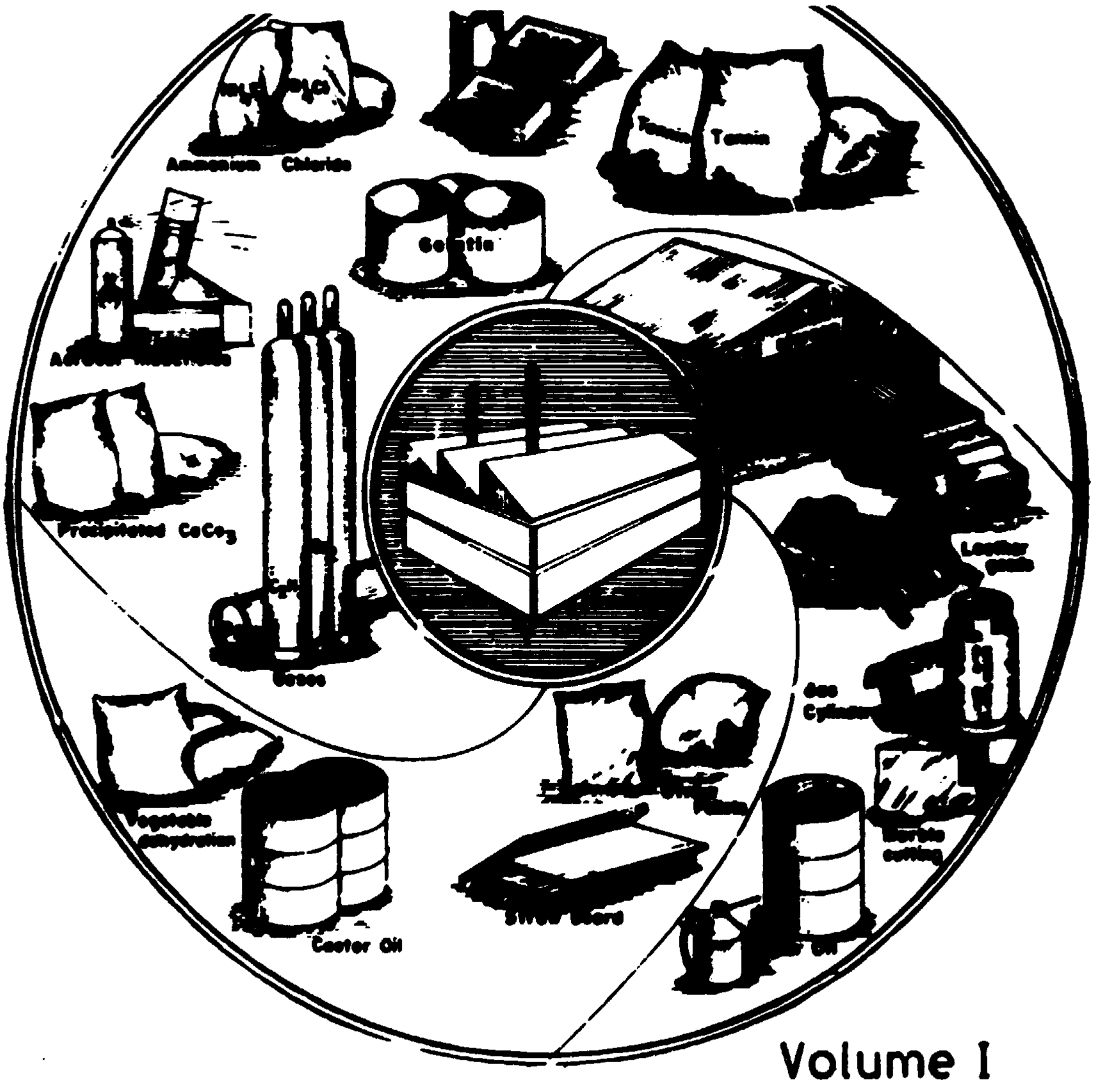
UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

17160 (1 of 5)



Volume I
Final Report

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

አዲስ አበባ ኢትዮጵያ
ADDIS ABABA ETHIOPIA

ቁጥር IPS/ 0525 /88
Ref. No

ቀን August 20, 1988
Date

Mr D. Gardellin, Head
Purchase and Contract Service
Department of Administration
UNIDO
P.O. Box 300
A-1400, Vienna
Austria

Subject: DP/ETH/85/004 - "Portfolio of Industrial Opportunity Studies" - Final Report.

Dear Mr. Gardellin,

We acknowledge the receipt of Mr. N. Suzuki's letter of 12 May 1988, received here on June 8, 1988, in which was enclosed UNIDO comments on the draft final report of the captioned project submitted by us on December 17, 1987.

We are pleased to enclose herewith 100 copies of the final report which has been prepared in two volumes. Volume I includes synopsis of the seventeen projects profile, analysis of economic benefits and investment promotion strategy and as such it is believed to be equivalent to an executive summary report. VolumeII, prepared in four parts, includes detailed profiles about each of the seventeen projects.

The report has been prepared by taking into consideration all UNIDO/DEPSA comments, with the exception of a few ones, which have called for our counter comments, a copy of which is enclosed herewith.

In this connection, we are pleased to bring to your attention the fact that we have prepared one extra opportunity study, namely, strawboard for building construction, in view of its attractiveness as an investment opportunity.

.../

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

አዲስ አበባ ኢትዮጵያ
ADDIS ABABA ETHIOPIA

ቴሌግራም
CABLE

ቴሌክስ
TELEX

ቁጥር
Ref. No

ቀን
Date August 20, 1988

Thanking you for the opportunity given us to handle this assignment and looking forward to receiving your acceptance of our final report,

We remain,

Sincerely yours,

Bruck Kebede
Manager

The People's Democratic Republic of Ethiopia
Development Project Studies Authority
Industrial Projects Service

cc:

Mr. N. Suzuki
Industrial Development Officer
Feasibility Studies Branch
UNIDO, Vienna
Austria

Development Project Studies Authority
Addis Ababa

SF/mg

COUNTER COMMENTS

1. **Paragraph 7:**

When a situation occurs where the net cash-flow is negative, it will be understood that the promoter should look for sources of finance - one possible source is a bank loan, either in the form of overdraft or long-term loan, though it was not explicitly mentioned in the report.

2. **Paragraph 8:**

The sales and distribution of the products of public owned enterprises are mainly handled by the Ethiopian Domestic Distribution Corporation. Consequently, individual plants make only little effort to sell and distribute their products, thereby enjoying a considerable sales and distributions cost reduction. Thus the sales cost element was not found significant to be treated as a separate cost item. Nevertheless, enough contingency to cover this and other unforseen costs has been included in the administrative and factory overheads for each project profile, though it was not explicitly indicated.

3. **Paragraph 12:**

The machinery and equipment of all the seventeen projects could be supplied from an European source. The Ethiopian shipping Lines usually calls at every major European port. Hence there is no danger in assuming that the cost of sea freight will be paid in Birr; on the other hand there is no logic in paying in foreign currency when these facilities are available from a local company.

4. **Paragraph 18**:

The presentation of the financial and economic analyses in the draft final report was very consistent. The analyses were carried out for the automated plant using only the <u>cost elements related to it</u> - no where in the analyses were included the cost elements related to the semi-automated plant or a combination of the two. That means both the financial and economic analyses were done exactly as you suggested. We don't know exactly where the misunderstanding occured. However, we suspected that it might be the labour cost (Birr 267,600) which you might have understood it to mean the average of the two options. If this was so, we would like to make it clear that it is the cost, which includes a 25% employment benefit, related to the automated plant only.

5. **Paragraph 30:**

The presentation of the strawboard project profile twice in the draft final report was inadvertent.

6. **Paragraph 37:**

The selling price of treated and pelletised straw assumed for the financial analysis in the draft final report was Birr 260/ton not Birr 600/ton. If you meant Birr 260/ton, the difference between the ex-factory price (Birr 200/ton) and the selling price arose as a result of the allowance made for the cost of transportation.

7. **Paragraph 22, 39 and 49**:

The compilation of adequate information pertinent to the research problem from various existing files, which are within the reach of the researcher, is of very crucial and prime importance in the market analysis of any project. If the search for relevant market data of this nature does not bring adequate and tangible results, the researcher will have to generate new data in order to objectively tackle the research problem. Such an approach, however, very often expends more time, money and manpower. Notwithstanding this, IPS has done all its best to generate new data whenever data from a secondary source were not available and adequate.

Regarding the export market analysis of marble cutting and polishing, vegetable dehydration and gelatin, while we appreciate your comments, information within our reach was not adequately available to provide a tangible market analysis and objective estimates of the size of the target markets. To do so requires a market field research in the crudely identified target markets, which is outside the scope of the T.O.R.

We believe the appropriate time to undertake a market analysis of this nature is during the feasibility study stage.

Nevertheless, we have once again revised the export market analysis of the above projects accommodating, as much as possible, your comments and that of DEPSA. Substantial improvements have been made in the market analysis of marble cutting and polishing and moderate improvements in the other two projects.

8. <u>Paragraph 45:</u>

The market study of the leather garments project has been completely revised. The project, which in the draft final report was assumed to cater for the domestic market, contrary to the finding of the market study, is now geared to produce for the export market. This alteration has been taken note of in reworking - out the financial and economic analyses of the project.

9. **Paragraph 52:**

Costs of raw materials could possibly be high compared to costs that may prevail in other countries. But the price adopted in the report is the Horticultural Development Corporation's selling price, which is much lower than that of other market outlets. The prices are fixed at Birr 800/ton for onion and Birr 300/ton for carrots and as such they are not allowed to behave like a free market price. These prices do not in any way indicate raw material shortages. It is mentioned in the report that the Horticultural Development Corporation can easily increase the area under cultivation should the market is capable of absorbing additional supply of vegetables.

10. **Paragraph 53:**

The ten year Horticultural Development Programme which was included as an appendix in the draft final report has now been omitted in the final report as it is found irrelevant to include planned production for periods which have already elapsed.

11. **Paragraph 54:**

The castor meal, without undergoing a process of detoxification, is a poisonous substance, but does not emit toxic substances which may create environmental pollution. As a measure of saftey, it suffices to store the meal out of the reach of children and livestock.

12. **Paragraph 58:**

The third party liability insurance has been included in the overhead costs, though it was not explicitly mentioned.

13. **Paragraph 69:**

The ammonium chloride production plant does not have residual wastes.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

DEVELOPMENT OF A PORFTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

VOLUME I

AUGUST 1988

INDUSTRIAL PROJECTS SERVICE

PROJECT NUMBER 001/40 - 79

TABLE OF CONTENTS

VOLUME I

VOLUME II-A | | PAGE

I. BACKGROUND

The Government of the People's Democratic Republic of Ethiopia has formulated a Ten-Year Perspective Plan which includes, among other sectoral and regional perspective plans, about 300 industrial projects to be realized during the coming decade. These projects are believed to bring economic benefits to society and to give an impetus to economic development in other related sub-sectors of the economy.

They are aimed at increasing the availability of basic consumer goods to society, strengthening both backward and forward linkages with other sectors of the economy, laying the basis for the expansion of heavy industries, increasing the foreign exchange saving and earning capability of the country, generating employment and contributing to balanced regional development.

However, most of these projects are still at the idea stage. The Government therefore wishes to pursue a logical stage-by-stage process of project selection, first undertaking "opportunity studies" before embarking on full-fledged feasibility study. Accordingly, the Development Project Study Authority (DEPSA), formerly called the Development Project Study Agency (DPSA), selected about 50 project ideas to undergo this process of project selection in order to provide the potential investor with a comprehensive profile of each investment projects.

The DEPSA categorized these projects into three major groups, namely,

a) Chemical, Agro and Allied Industries, comprising 20 projects;
b) Engineering Industries, including 14 projects, and
c) Projects Related to Existing Industrial Activities, consisting of 16 projects.

The DEPSA and the United Nations Industrial Devleopment Organization (UNIDO) invited a number of consultants, including the Industrial Projects Service (IPS), in a letter dated 23, July 1986, to submit a written proposal for the preparation of a Portfolio of Industrial Opportunity Studies for Existing Industries in Ethiopia. Specifically, the projects consist of those falling in group (c) above, namely,

. Precipitated Calcium Carbonate,
. Marble Cutting and Polishing,
. Motor Oil Regeneration,
. Aerosol Insecticide,
. Industial Gases,
. Gas Cylinders,
. Straw board,
. Straw Pelletising,
. Gelatin,
. Leather Garment,
. Vegetable Tannin,
. Vegetable Dehydration,
. Castor Oil,
. Cold Storage,
. Detergents, and
. Ammonium Chloride.

The Industrial Projects Service accepted the invitation and, as part of the proposal, conducted a preliminary survey of the 16 projects in order to assess and evaluate their potential local and foreign market size, the required raw materials and inputs, the manufacturing processes and the linkages with existing industries.

The basic proposal together with the result of the survey and containi g,

- Some comments and suggestions on the Terms of Reference submitted to IPS by UNIDO,
- the methodology and approach to be followed during the preparation of the portfolio, and
- all other relevant details,

was submitted to UNIDO on October 1, 1986, Ref. No. IPS/0039/86. After the exchange of a couple of comments and suggestions concerning some ammendements to be made on the basic proposal, UNIDO finally awarded the contract to IPS and the two parties signed a contract to that effect in February 1987.

Following the signing of the contract, IPS mobilised its in-house experts, who are proposed in the proposal as study team members, and also engaged WS Atkins International as an associate consultant to prepare the portfolio in accordance with the methodology, approach and work plan set forth in the proposal. The associate consultant was engaged in undertaking the study of raw materials, technology and engineering, man-power requirement and investment promotion strategy aspect of the projects; whilst the in-house experts were involved in market study, assessment of locally available inputs, financial and economic analysis and all other aspects of the study, including an independant studyof everything that WS Atkins was asked to do.

The task of preparing the profiles was difficult as background information for each project was either scanty or hardly available. With regard to the export potential of the products geared to export, reference to International Trade Centre (ITC) had to be made as the country did not have past experience in exporting some of the products. The T.O.R. which did not differ significantly from the type pertained to pre-feasibility and feasibility studies made the task even more difficult.

In spite of all these predicaments, this draft report of the Development of a Portfolio of Industrial Opportunity Studies for Existing Industries in Ethiopian has been prepared based on the inputs made by IPS and WS Atkins in conformity with the agreed upon T.O.R. and other work plan set forth in the proposal, and IPS is confident that both UNIDO and DEPSA would be satisfied with it.

II. SYNOPSIS OF THE SEVENTEEN PROJECT PROFILES

A. PRECIPITATED CALCIUM CARBONATE

The project is expected to produce precipitated calcium carboante which has a lot of industrial application, mainly as a filler material. Presently, the product is used in the paper industry, rubber industry, canvas and heavy duty shoes industries and paint industries of the country.

The future requirements of these industries are expected to grow from about 4900 tons in 1989 to about 8700 tons by the year 2003. The minimum scale of operation is far greater than the estimated future demand. The estimated demand could be met at only 55% capacity utilization of the MES plant.

The major raw material of the project is limestone, containing a high percentage of calcium carbonate, preferably 95%. Substantial reserves of limestones are known to exist in several regions of the country.

Precipitated calcium carbonate can be produced by several methods but only the carbonation process using limestone is commercially used as it is the simplest and most direct route. The objective of the process is to separate out the impurities in the raw limestone and form a purified calcium carbonate.

The investment in machinery and equipment of an independent automated plant is estimated to be about Birr 14.6 million, while that of a semi-automated plant is estimated to be about Birr 13.1 million. In both cases, the foreign currency component will be 80%. The number of workers needed to run the plant would be 60 persons for the automated plant and 109 persons for the semi-automated one.

The project is viable both financially and economically. The internal rate of return of the independent automated plant is estimated to be 15.61% with a net present value of Birr 6.25 million discounted at 10% p.a. When the project is integrated with the envisaged lime plant the IRR would turnout to be 29.53% with a net present value of Birr 12.4 million discounted at 10% p.a.

The economic rate of return turned-out to be 24.48% with a net present value of Birr 17.72 million discounted at 10% p.a. This rate will turn-out to be 45.94% with a net present value of Birr 25.47 million discounted at 10% p.a. if it is integrated with the lime plant.

B. MARBLE CUTTING AND POLISHING

The market for marble is highly competitive. The world market for marble not further worked other than roughly split or squared does not seem to show a tendency to expand. On the other hand, the market for worked marble seems to have a bright prospect of expansion except that the lions share of it is dominated by suppliers who have already established world reputation in marble technology. The Italians are by far the largest supplier of worked marble to the world market. Their equipment is world renown as well. In view of this, the establishment of a marble masonry operation with the assisatance of the Italian expertise could be of an advantage.

The proposed plant is capable of handling at least two blocks per day measuring 2.5 x 1.4 x 1 metre and weighing about 9.5 tons each. It can produce 1120 tiles per block per day or 373 stones per block per day assuming a 20% loss factor. This is equivalent to a capacity of 336,000 tiles and 111,900 stones a year on the basis of a 300 effective working days.

The process is relatively simple and involves basically three operations, namely, block cutting, title/stone cutting and polishing and bevelling, if required. It requires 36 employees to run it at full capacity.

The initial investment cost of the plant is estimated to be Birr 1.875 million, of which Birr 0.83 million is the cost of machinery and equipment. The foreign currency component of the total initial investment cost will be about 50%.

The project is highly viable both financially and economically. The internal rate of return and the net present vlaue discounted at 10% per annum amounted to 63.54% and Birr 12.34 million, respectivley. The economic rate of return turned out to be 63.56%, with a net present value of 10.12 million.

C. REGENERATION OF MOTOR OIL

The project envisages the establishment of a plant to regenerate used motor oil from passenger cars, heavy duty vehicles and industry.

The future demand for motor oil in general is estimated to range from about 19 million litres in 1989 to about 30 million litres by the year 2003. In this connection it is worth noting that a blending plant, with a capacity to meet the projected demand, is going to be established on a joint-venture basis in 1989. That means the products of the motor oil regenerating plant will have to compite with that of the blending plant. However, it is more likely that consumers prefer the products of the latter. Nevertheless, a plant with an input capacity of 1250 litres per hour in two shift operation has been proposed based on a collection rate of 20% of the estimated annual motor oil consumption of the country. The output is estimated to be 73.3% of the input. This is equivalent to holding only a market share of about 15%.

The total initial investment cost of the plant is estimated to be about Birr 5.98 million, about 50% of which is in foreign currency. About 69% of the total initial investment cost is required for the purchase of plant machinery and equipment. The project will create employment for 65 people.

The plant is not financially viable. The internal rate of return is estimated to be 8.11%, with a net present value of Birr -0.75 million discounted at 10% p.a. However, it is economically viable with an economic rate of return of 33.40% and a net present value of Birr 11.39 million discounted at 10% p.a.

D. AEROSOL INSECTICIDE

The project is envisaged to produce self-dispersing, pressurised and self-propelling product with the sole objective of killing mosquitos, flies, cockroaches, etc. It can also accommodate the production of room freshners.

There is a small local plant with installed capacity of 360,000 cans per year, though its level of current production is alarmingly low. The market for aerosol insecticide, on the other hand, is forecast to absorb a supply about six times as many. Therefore, one additional plant with a capacity of 900.000 cans per year, which is the minimum economic size, operating in two shifts, has been proposed.

The project totally depends on foreign source for raw material and other inputs.

Aerosol insecticide manufacturing is basically a packaging process involving the preparation of the insecticide spray and the can filling line.

The initial investment cost of the plant is estimated to be about Birr 1.11 million, of which only about 22% is allocated for the cost of machinery and equipment. The foreign currency component of the total investment cost will be about 42%.

The project is financially viable with an internal rate of return of 13.7% and a net present value of Birr 0.49 million discounted at 10% per annum. It is not economically viable, but creates employment for 43 people.

E. INDUSTRIAL GASES

The project profile has identified oxygen, acetylene and carbon dioxide as industrial gases that are presently being used in large quantities in Ethiopia.

The capacity of the existing plants for the production of carbon dioxide and oxygen greatly exceed the projected demand. There will only be a small shortfall in the supply of acetylene starting from the year 1995. However, the acetylene plant in Asmara has an adequae production capacity to meet the demand expected in and around Asmara upto the year 2000 and beyond. Thus to meet the shortfall created in Addis Ababa, the addiitonal capacity to be establsihed by the year 2000 will be only 15,000 kgs of acetylene. This quantity is so small that it is not justifiable to establish a new acetylene plant.

The study, however, without disputing the findings of the market study, provided technical information on plants which are designed to produce upto 145N m^3/hr of liquid oxygen and 50N m^3/hr of acetylene.

F. LPG CYLINDERS

Liquified Petroleum Gas (LPG) has long been in use in Ethiopia, particularly in major urban centres, as a domestic fuel. It is produced by the Petroleum Refinery at Assab, transported in bulk in special tankers to major distribution centres from where it is further distributed to individual consumers after being filled in steel cylinders with a standard domestic weight of between 10 and 15 kilograms.

Therefore, the demand for LPG cylinders largely depends on the availability of LPG, stoves that oeprate with LPG and disposable income of households. Currently the cylinders are imported and distributed to individual customers upon a deposite of a fixed amount of money for temporary ownership.

The estimated future demand in Ethiopia ranges from 12,600 units in 1989 to 15,300 units by the year 2003. It is now considered by LPG cylinder manufacturers that an annual production level of less than 500,000 cylinders is not economic. The estimated demand is obviously well below the expected level of production. In view of this, the project considers the assembly of the cylinders from bought in components.

The proposed technology involves the production of only two pieces of identical shape and dimension that form the cylinder head and bottom. The two pieces are first deep drawn from circular sheet metal blanks and then joined together at their open ends by an automatic sub-merged arc welding process. The plant will generate employment opportunity for 52 people.

The plant requires an initial investment cost of Birr 3.34 million. out of which Birr 2.34 million is in foreign currency. It is neither financially viable nor economically. The corresponding rates of returns are estimated to be -42.26% and 2%, respectively. The possibility of integrating it with a multipurpose workshop to be established by National Metal Works Corporation at Kaliti was also investigated and was still found not viable.

G. STRAWBOARD

This project investigates the techno-economic viability of producing strawboard, which has a range of uses, particularly as packing material of the corrugated paper-board type, folders and files covers and writing pad backing. It is thus believed to substitute leather and duplex board.

The size of the market is expected to grow from 750 tons in 1987 to about 2600 tons by the year 2003. A plant with a capacity of 10 tons per 24 hours has been proposed.

The total initial investment cost has been estimated to be about Birr 7.8 million, out of which the foreign currency component is Birr 5.96 million.

The plant, although it is capable of creating employment for 45 people, is not financially and economically viable.

H. STRAW TREATMENT AND PELLETISING

Ethiopia has one of the highest livestock population in the world. However, the animal feed supply in the country is characterized by scarcity and lack of nutritive value. In this regard, processed animal feed, including treated and pelleted straw, could play a major role in the development of animal husbandery and exploitation of the livestock sector.

Treated and pelleted straw is more palatable and nutritive than in its natural condition. The demand is conservatively estimated to be in the range of 80,000 and 2000,000 tons over the coming 15 years. In view of the problems associated with straw collection and transportation and marketing of the finished products, it is suggested that three plants of size 30,000 tons per annum are to be built in different locations rather than one vast plant.

The straw, mainly that of wheat and barley, is expected to be obtained from state farms and co-operative farms in Arsi and Bale Administrative Regions.

The manufacturing process of nutritionally improved straw consists of straw intaking, grinding, mixing, extruding and finishing.

The initial investment cost of the recommended plant (30,000 tpa) is estimated to be about Birr 6.3 million. The share of the foreign currency component is about 71%.

The project is financially and economically viable. The internal rate of return (IRR) is estimated to be 30.10% with a net present value of Birr 11.25 million discounted at 10% p.a. Similarly the economic rate of return turned-out to be 42.48% with a net present value of Birr 18.65 million.

I. GELATIN

This project profile considers the production of edible, pharmaceutical and technical gelatin for the export market as well as for the domestic market, with more emphasis given to edible gelatin. The present domestic demand for edible gelatin is practically nil. However, there exists a small market for gelatin used in the manufacture of pharmaceutical products.

The future world demand for edible gelatin, on the other hand, is expected to grow from about 46,500 tons in 1989 to 101,500 tons by the year 2003. The markets are mostly concentrated in the developed market economy countries. The very tight health regulations that these countries adopt in importing food items from developing countries like Ethiopia would perhaps make it difficult to easily penetrate the world market. Thus the technical capability of producing high quality edible gelatin at a sufficiently attractive price should be acquired to entere the export market. A minimum economic scale of a gelatin producing plant, which is 1000 tons a year, has been proposed.

The project is a capital intensive one, with an estimated initial investment cost of about Birr 16.8 million, 69% of which is in foreign currency.

The plant is not financially viable. The internal rate of return and the net present value discounted at 10% p.a. amounted to 6.23% and Birr -3.51 million, respectivley. The economic rate of return, however, turned out to be 12.59% with a net present value of Birr 3.12 million discounted at 10% p.a.

J. LEATHER GARMENTS

Leather garments are sophisticated products of finished leather, and generally appeal for consumers in the upper income brackets. The domestic demand for leather garment is rather limited, since the size of the population belonging to the upper income brackets is relatively small.

The future domestic demand is estimated to range from 18,000 pieces of jacket equivalent to 37,400 pieces in 1988 and 2003, respectively. The capacity of the existing private garment cottage factories, with minor expansion or extending the daily working hours, can easily meet the projected demand. That means the establishment of a new garment factory, which caters for the domestic market is not advisable. Instead, a leather garment plant, with an initial capacity equivalent to the demand level generated by the domestic market, has been proposed to cater for the export market.

The plant is to be integrated with the Universal Leather Goods Factory of the National Leather and Shoe Corporation as a production unit, so that it can benefit from both reduced overhead costs and acquired experiences in manufacturing and marketing of leather articles.

The initial investment cost of the plant is estimated to be Birr 0.44 million, of which about 39% represents the foreign currency component.

The project is financially and economically viable. The internal rate of return and the economic rate of return turned out to be 17.54% and 34.45%, with net present values of Birr 0.44 million and Birr 1.53 million discounted at 10% p.a., respectively.

K. VEGETABLE TANNIN

Tannins are a group of pale yellow to light-brown substances, which are produced in the form of powder, flakes or a spongy mass. They can be of vegetable, mineral or synthetic origin and are chiefly used in leather tanning. This project envisages the establishment of a plant which extracts tannins from mimosa bark.

The domestic demand for vegetable tannins is estimated to grow from 245 tons in 1987 to 570 tons by the year 2003. In view of this, a plant with a capacity of 450 tons per year has been proposed. The project, however, is a fairly long-term project for the plantation of mimosa tree requires about 15 years lead time.

The total initial investment cost is estimated to be Birr 3.5 million, of which about Birr 2.66 million is in foreign currency. About 86% of the total foreign currency requirement will be for machinery and equipment.

The plant will not be financially and economically viable. Its internal rate of return turned out to be -0.07% with a net present value of Birr -1.81 million discounted at 10% p.a. The economic rate of return is estimated to be 6.28% with a net present value of Birr -0.97 million discounted at 10% p.a.

L. VEGETABLE DEHYDRATION

This project envisages the production of dehydrated vegetables of various types for the export market.

The domestic market for vegetable dehydration is not significantly attractive. The export market, on the other hand, seems to have good prospects. It is expected to grow from about 102,700 tons in 1988 to about 137,300 tons by the year 2003, of which Ethiopia might be able to capture a size ranging from 1100 tons to 1500 tons during the same period. The project initially considers the dehydration of carrots and onions. The annual capacity of the plant proposed for this project profile is 1000 tons in the aggregate.

The total initial investment cost of the plant is estimated to be about Birr 2.4 million, out of which Birr 1.03 million will be in foreign currency. About 63% of the total foreign currency requirement will be for machinery and equipment.

The plant is not viable both financially and economically. The internal rate of return is well below zero with a net present value of Birr -9.82 million discounted at 10% p.a. Similarly the economic rate of return is -3.08% with a net present value of Birr -2.47 million discounted at 10% p.a.

M. CASTOR OIL

Castor oil, processed from castor beans, is used in various industries such as pharmaceutical, cosmetics, paints and paper industries. In the case of Ethiopia, though castor oil can find domestic application in the production of laundary soap, it seems more economical to process the product for the export market.

The demand for castor oil in the international market is generally stable. In view of the likely constraints in the supply of the castor beans a minimum economic size plant of 2350 tons per year has been proposed.

The envisaged volume of production is estimated to require 5,000 to 6,000 tons of castor beans per year. This quantity is anticipated to be met from collection of castor seeds from wild growing plants as well as through systematic cultivation.

The manufacturing process of the castor oil involves cleaning and preparation, pressing and filtering.

The plant is estimated to cost about Birr 2.3 million, out of which about Birr 1.44 million is in foreign currency. About 87% of the total foreign currency requirement will be for machinery and equipment.

The plant will not be financially viable. The internal rate of return was calculated to be -36.09% with a net present value of Birr -4.59 million discounted at 10% p.a. It is, however, economically viable with an economic rate of return of 23.04% and a net present value of Birr 2.117 million discounted at 10% p.a.

N. COLD STORAGE

In many developing countries including Ethiopia, numerous studies indicate that quite a considerable amount of perishable food items like meat, fish, vegetables and fruits are wasted annually due to lack of modern preservation techniques and facilties.

Presently, there are three public firms, namely, the Ethiopian Livestock Development and Meat Corporation, the Fish Production and Marketing Corporation and the Horticulture Development Corporation, which handles in bulk perishable food products. These firms already have cold storage units of their own at various production and distribution centres. Hence, the demand for commercially operated cold storage plants capable of providing storage services on hire is practically non-existent.

However, without disputing the findings of the market study, this profile provides technical and financial information on three cold store plants with a capacity of 11,000 tons, 1920 tons and 720 tons for a possible installation at Assab, Massawa and Bahr Dar, respectivley.

The total initial investment cost of the cold store proposed for Assab is estimated to be Birr 7.82 million, out of which Birr 3.8 million is in foreign currency.

The plant is not viable both financially and economically. The internal rate and the economic rate of returns turned out to be 6.78% and 7.86%, with a net present values of Birr -1.46 million and Birr -0.89 million, respectivley.

The other cold stores proposed for Massawa and Bahr Dar are more likely to result in much lower rates of returns because of their high operating costs and relatively lower storage capaciies.

O. DETERGENTS

A detergent is a combination of surfactants with other substances formulated to meet the requirements of the soiled substrate to be cleaned and the expected range of washing conditions. The current demand for soap and detergents is estimated to be 43,000 tons, reaching to about 115,000 tons by the year 2003. The existing plants will cover about 22-58% of the market if they operate at full capacity. The estimated unsatisfied demand thus ranges from about 23,200 tons in 1989 to about 90,000 tons in 2003.

Since consumer acceptability of detergent bars in the Ethiopian market has not yet been adequately tested, it has been recommended to start with a minimum economic plant of size 2400 tons per annum.

The main raw material, linear alkyd sulfonate, needs to be imported. The other raw materials like soda ash, sodium silicate, sodium chloride and sodium hydroxide are expected to be available locally.

The initial investment cost of the proposed plant is estimaed to be about Birr 1.5 million, of which about 63% is the cost of machinery and equipment. The foeign currency component of the total initial investment cost will be about 62%.

The project is highly viable both financially and economically. The internal rate of return and the economic rate of return turned out to be 55.44% and 180.7%, respectively, with a corresponding net present value of Birr 9.79 million and Birr 45.1 million discounted at 10% p.a.

P. AMMONIUM CHLORIDE

Ammonium chloride is an important chemical, particularly in the manufacture of dry-cell batteries. It is also used as a metal cleaner in soldering and as a flux in tinning and galvanising. Its present use in the country is in the manufacture of dry-cell batteries. The estimated future demand for ammoniuim chloride for the manufacture of dry-cell batteries ranges from 113 tons in 1989 to 228 tons by the year 2003.

It is possible to scale a plant at one ton per day of ammonium chloride using the ammonium sulphate/sodium chloride process route. This is equal to 300 tons per year on the basis of a 300 effective working days.

The initial investment cost of the plant is estimated to be about Birr 1.15 million, of which 46% is in foreign currency.

The project is not financially and economically viable. The internal rate of return is much below zero, while the economic rate of return turned out to be -10.55% with a net present value of Birr -1.74 million discounted at 10% p.a..

Q. STRAWBOARD FOR BUILDING CONSTRUCTION

The biggest potential use of straw is for making strawboard as a chipboard type of construction product. Because of its tightly compressed characteristic, it offers considerable resistance to fire. Moreover, it has a sound insulating property and can be used in varying climates.

The total future demand for strawboard/chipboard is estimated to grow from 7200 m^3 in 1988 to 19700 m^3 by the year 2002. The existing chipboard plant will only cover about 22-60% of the market demand during 1988-2002.

Strawboard is a new product to the Ethiopian market. In view of this it is suggested that the project should first consider the establishment of a plant with a capacity equivalent to the available minimum scale of operation (150,000 m^2 p.a.). The plant will operate in three shifts covering only 47% of the unsatisfied demand by the year 2002.

The product is produced on a semi-automatic machine in a continuous board. The basic raw material is subjected to heat and pressure during its progression through the machine and the resultant slab shape is covered with a smooth liner, such as stiff paper, which is automatically glued to all surfaces.

The initial investment cost of the plant is estimated to be Birr 9.47 million. The foreign currency component amounted to Birr 5.35 million, of which about 68% will be for the purchase of machinery and equipment.

The project is financially and economically viable. The corresponding rate of returns turned out to be 16.54% and 19.79%, respectively, with net present values of Birr 4.36 million and Birr 7.06 million discounted at 10% p.a.

III. ANALYSIS OF ECONOMIC BENEFITS OF THE SEVENTEEN PROJECTS

A. THE ROLE OF INDUSTRY IN THE NATIONAL ECONOMY

Ethiopia being a predominantly agricultural country, the contribution of the industrial sector to national income, employment and exports is quite modest. In the first half of the 1980's, for example, manufacturing industry accounted for an average of less than 8% of GDP at constant (1980/81) factor cost, the share of handicrafts and small-scale industries being less than 4%. Current employment in the manufacturing sector is less than90,000 out of a population of more than 46 million people. An industrial exports contribute less than 10% of the country's export earnings. On all counts, therefore, industry's role in the national economy is negligible. Moreover, no significant transformation having taken place in the structure of the economy, agriculture still looms large, a fact of enormous significance because of the poor showing of this sector in recent years, which has in turn imposed serious constraints on the development of the other sectors, including industry.

B. INDUSTRY IN THE TEN-YEAR PERSPECTIVE PLAN

It is widely recognized that a viable industrial sector can infuse dynamism into the economy through its application of modern technology and its linkages with other sectors. It is for this reason that the Ten Year Perspective Plan (TYPP) has set a fairly high target growth rate of 10.8% for industry as a whole, i.e. manufacturing, small-scale industries, handicrafts, mining and quarrying, construction, electricity and water (the rates for agriculture and services being 4.3% and 6.9%, respectively). The TYPP also anticipates that by the end of the plan period the share of industry in GDP will rise to 23.9%.

Of the total planned investment, industrial investment (Industry defined narrowly in this case) represents 13.8%, of Birr 4.4 billion. Of this sum, Birr 4.3 billion is allocated for establishing new state enterprises and for expanding and strengthening existing ones, while the remaining 0.1 billion is devoted to handicrafts and small-scale enterprises (their respective shares being Birr 84.7 million and Birr 15.6 million). Of the total investment planned for the manufacturing sector. the shares of the most important sub-sectors are: food (24.9%), chemicals (21.9%), textiles (17.5%) and metals (14.5%). This involves 216 projects, most of which are in chemicals (52), food (38), non-metallic minerals (33) and metals (32). Of the 216 projects, 164 are new while the remaining 52 involve expansion of existing plants. The fact that 71.9% of investment is allocated to new projects is an indication of the attention they have received in the plan.

The objectives of the industrial sector as articulated in the TYPP are satisfying domestic demand for basic commodities, strengthening handicrafts and small-scale industries, strengthening linkages with the agricultural and construction sectors, making available adequate quantities of materials for construction, laying the basis for heavy industry, saving and earning foreign exchange, generating employment and contributing to balanced regional development. It is against this background that the 17 projects included in these opportunity studies should be considered.

C. ANALYSIS OF ECONOMIC BENEFITS

More specifically, the following questions will be asked with respect to the projects in order to determine their aggregate effect on the national economy:

- What is the Profitability of These Projects

This involves looking at both their financial and economic rates of return-i.e., the internal rate of return and the economic rate of return. But since there is more to a project than profitability, other criteria should also be taken into consideration, the major ones being the following.

- What is the Size of Employment and the Magnitude of Incomes Generated by These Projects?

Ideally, the major criterion of national profitability is the contribution of a project to value added, a notable element in this regard being the size of the wage bill. At the level of opportunity studies, however, an examination of the number of jobs created (both direct and indirect, if possible) and the consequent increase in incomes would be adequate. In considering the number of jobs created, one should also look at the investment cost of providing each job.

- What is the Contribution of These Projects to Foreign Exchange Earning and/or Saving?

This involves looking at the foreign exchange component of both the initial investment cost as well as operating costs once the project is fully underway.

- How Strong Are the Linkages of the Projects ?

This requires looking at both backward and forward linkages, and for each project this means examining its links within the industrial sector as well as with the non-industrial sectors.

- <u>What Other Contributions do the Projects Make to the National Economy?</u>

To the extent possible this means taking into account the contribution of the projects to such objectives as balanced regional development, satisfying the demand for basic commodities, and the other objectives stated in the Ten Year Perspective Plan.

In what follows, an attempt will be made to answer these questions to the extent that the available information permits. A table summarizing the major economic characteristics of the projects appears at the end of this section.

1. Profitability

Judged by their profitability, the prospects of these projects leave much to be desired. Only six are both financially and economically viable (precipitated calcium carbonate, marble cutting & polishing, straw treatment and pelletizing, leather garments, strawboard for building construction, and soaps and detergents). One (aerosol insecticide) is financially, but not economically viable. This means that seven projects are neither financially nor economically viable. In most cases this is largely because there is no apparent demand for their products or because existing demand exceeds projected demand.

2. Employment and Income Generation

The projects included in this portfolio are essentially small-scale enterprises, their average employment not exceeding 60. Their contribution to employment generation is therefore modest, amounting to slightly less than 1,000 in the aggregate. Given a total investment cost of about Birr 116 million and employment of 996, investment cost per worker would amount to over Birr 100,000 per worker, a figure certainly on the high side given Ethiopia's factor endowments. There are, however, exceptions to the general picture. Noteworthy in this regard are the vegetable tannins project which provides the highest number of jobs (81) at a relatively low investment cost per job (about Birr 43,000) and the vegetable dehydration project (providing 79 jobs at an investment cost of Birr 30,000 per job). Incidentally, these are projects that are neither financially nor economically viable. Other projects with relatively low investment costs per job are leather garments, ammonium chloride, aerosol insecticide, and soaps and detergents. Those involving high investment costs are industrial gases, precipitated calcium carbonate, gelatin, cold storage and strawborad.

The aggregate annual wage bill is slightly upwards of Birr 4.2 million. This represents a direct addition to income to which must be added the indirect contributions through the multiplier effect, which are difficult to determine at this stage. Note must also be taken of the temporary employment effects of these projects, notably through the provision of jobs for construction and related activities. All told, however, the impact of these projects on employment and incomes should not be exaggerated.

3. Foreign Exchange Earning and /or Saving

Initially only two of these projects (vegetable dehydration and marble cutting and polishing) are intended exclusively for the export market, but IPS later included castor oil and leather garment in the list, one (gelatin) is intended for both the local and export markets while the remaining twelve are envisaged exclusively for the domestic market. In general, therefore, the foreign exchange earning impact of these projects is not significant. But to the extent that they contribute to import substitution, they may help to save foreign exchange. This is clear from the fact the products of nine of these projects are currently imported, while the products of four of them are partly imported and partly locally produced. In all, fourteen of the projects involve import substitution, and hence a potential for foreign exchange saving. But one should qualify this statment by pointing out that most of these projects have a heavy foreign exchange component in their cost structure.

As noted above, the initial investment cost of the projects has a sizable foreign exchange component, ranging from 39% to 79% and averaging 64% (see Table I). Although to a lesser extent, this is also true of production cost, granted the existence of wide variations. Thus the foreign exchange component of production cost ranges from as low as 3% for vegetable dehydration to as high as 81% for soaps and detergents. It is worth noting that the latter item is destined entirely for local consumption.

4. Linkages

The linkages of these projects with the domestic economy can be described as strong on the whole, largely because most of them are domestic-resource-based. The only ones that are heavily dependent on imported inputs are aerosol insecticide and soaps and detergents, while cold storage, LPG cylinders and ammonium chloride are moderately import-based. Therefore, the backward linkages of this portfolio of projects are substantial.

Of the projects intended for the domestic market four (LPG cylinders, aerosol, motor oil regeneration, soap and detergents) are addressed to the consumer, one (precipitated calcium carbonate) is intended for the consumer as well as for industries, and the remaining seven have other indusries as their markets. This means that about half of the projects have forward linkages with the rest of the economy, essentially with other industries.

The inter-industry relationships these projects involve are also quite substantial in that most of them either supply inputs to or receive them from other industries, three of them (strawboard, ammonium chloride and industrial gases) in fact doing both. Only soap and detergents and marble cutting and polishing have no relationship with other industries. In this sense, therefore, it is correct to describe these projects as "related to existing industries".

5. Other Benefits

The other objectives of indusrial development stated in the Ten Year Perspective Plan are contributing to balanced regional development, satisfying the demand for basic commodities, strengthening handicrafts and small scale industries, and making available adequate quantities of materials for construction.

In terms of location, not much can be expected from these projects in redressing the existing imbalance in the regional distribution of industries. While no specific locations have been recommended for a number of projects, for those for which preferences have been expessed, Addis Ababa is the location most frequently mentioned. The others are Kalliti, Asmara, Assab, Muger,Asela and Awash. Only in the case of the vegetable tannin project is the possibility of Bale or Illubabor entertained. It is thus clear that this portfolio of projects does not involve any departure from the existing pattern of industrial location.

With respect to the objective of providing basic commodities, although most projects are of the import-substituting type, the only project that can be meaningfully described as meeting the demand for basic commodities is that of soaps and detergents.

To the extent that all projects are small-scale ones, it can be said that they contribute to the strengthening of small-scale indusries, but only one project is involved in making materials available for building construction. Therefore, the secondary benefits of the projects are not substantial.

D. CONCLUSION AND RECOMMENDATIONS

One must conclude that, on the whole, the economic benefits to be derived from this portfolio of investment projects do not seem to be impressive. Seven of the projects are neither financially nor economically viable. Their employment-generating effects are generally low, and at fairly high investment cost per job at that. Most of them involve a high foreign exchange component, a fact which sets a limit to their capacity for earning and/or saving foreign exchange. But because most of them are domestic-resource-based, their linkages with the domestic economy should not be under-estimated. On balance, however, it seems safe to conclude that the aggregate economic benefits of these seventeen projects are likely to be negligible.

While this is the general picture, a closer examination of the projects shows that some deserve more attention than others. One category that deserves closer consideration is made up of projects that are both financially and economically viable, and involves other benefits as well. These are:

- Precipitated calcium carbonate
- Marble cutting and polishing
- Straw treatment and pelletizing
- Leather garments,
- Soaps and detergents
- Strawboard for building construction

The precipitated calcium carbonate deserves further consideration, because it is highly domestic resource based, involves a relatively low foreign exchange component in working capital and production cost and has the potential for substituting import, thereby having a positive impact on foreign exchange saving. The marble cutting and polishing is also based on doemstic rescurces and involves a low foreign exchange component, holding the potential for export market. The straw treatment and pelietising project deserves closer consideration in view of its potential contribution to the development of Ethiopia's livestock subsector, an area of enormous significance to the economy. The leather garments project, while weak on employment generation, is based on domestic resources and has a low foreign exchange component, even in terms of initial investment cost. It has, however, to face limited domestic demand and an export market that is highly competitive. Still, it is a project worthy of a second look. The major attraction of the soaps and detergenets project, despite its high foreign exchange component and poor linkages, is that it involves the produciton of commodities which are mass consumption goods. The strawboard for building construction, being the only project for use in the construction sector, is also based on domestic resources and deserves serious consideration.

In the second category are the four projects which are either financially or economically viable, namely:

- Regeneration of motor oil
- Aerosol insecticide
- Gelatin
- Castor oil

Since none of these seems to have other, strongly redeeming characteristics, there is no ground to place them high on the priority list.

The third category includes projects that are neither financially nor economically viable. While they all fail the test of viability, some deserve a closer look because of other potential contributions. These include:

- Straw board
- Vegetable tannins
- Vegetable dehydration
- Cold storage
- Ammonium chloride

The first is less attractive but, over the long haul, it may make an important contribution to import substitution. The second is domestic-resource-based, has relatively high employment-generating effects at low investment cost per job, and contributes - however marginally-to regional diversification. The third, also domestic-resource-based, may contribute to foreign exchange earining. The cold storage project may be indispensable in the long-run. The last project has low initial investment cost and may contribute to foreign exchange saving in the long run.

The projects whose prospects seem rather bleak at the moment are LPG cylinders and industrial gases. The cylinders project faces a severely constrained market, its minimum scale of operations being far in excess of current or projected demand. The industrial gases project, in addition to the market problem, involves a high initial investment cost of nearly Birr 26 million, which also means high investment cost per job.

Accordingly, the following order of priorities is recommended for project categories:

<u>Category 1: High Priority</u>

- Precipitated calcium carbonate
- Marble cutting and polishing
- Straw treatment and pelletising
- Leather garments
- Soaps and detergents
- Strawboard for building construction

<u>Category 2: Second Order Priority</u>

- Regeneration of motor oil
- Aerosol insecticide
- Gelatin
- Castor oil

<u>Category 3: Low Priority</u>

- Strawboard
- Vegetable tannin
- Vegetable dehydration
- Cold storage
- Ammonium chloride

<u>Category 4: Lowest Priority</u>

- LPG cylinders
- Industrial gases

TABLE 1

SUMMARY OF ECONOMIC CHARACTERISTICS OF PROJECTS

Projects	Initial Investment Cost (Million Birr)	Recommended Location	Foreign Exchange Component of (%)			Employment (No. of Persons)	Annual Wage Bill (Million Birr)	Investment Cost Per Job (Birr)	Financial Viability	Economic Viability	Linkages	Remarks
			Investment Cost	Working Capital	Production Cost							
1. Precipitated calcium carbonate	17.28	Mugar or Dire Dawa	72	15	28	60[a]	0.28	288,000	viable	viable	domestic - resource-based	High order priority project
2. Marble cutting and Polishing	1.88	Awash	50	3	7	36	0.16	52,222	viable	viable	" "	Potential for export, but market highly competitive. High order priority.
3. Regeneration of motor oil	5.98	A.A	50	77	65	65	0.25	92,000	not viable	viable	based on waste	Clear impact on foreign exchange saving. Second order priority.
4. Aerosol Insecticide	1.11	A.A	42	89	60	43	0.18	25,814	viable	not viable	import-based	Heavy foreign exchange component. Second order priority.
5. Industrial Gases	25.51	A.A	79			66	0.27	386,515	no analysis	no analysis	acetylene production is import based	Existing capacity covers demand for next fifteen years. Lowest priority.
6. LPG Cylinders	3.34	Kalliti	70	22	28	52	0.26	64,231	not viable	not viable	low-carbon steel can be produced locally	Minimum scale far in excess of demand. High investment cost per job, lowest priority
7. Strawboard	7.79	Assela	77	11	50	45	0.19	173,111	not viable	not viable	domestic-resource-based	Low capacity utilization due to low demand. Low order priority.
8. Straw Treatment and Pelletizing	6.25	Assasa & Bale	71	2	20	65	0.28	96,154	viable	viable	"	Important for development of livestock industry. High priority.
9. Gelatin	16.75		69	23	35	80	0.35	209,375	not viable	viable	"	Demand lower than minimum economic scale, but possibilities for export. High initial investment cost. Second order priority.
10. Leather Garments	0.44	A.A	38	25	10	38	0.14	11,579	viable	viable	domestic-resource-based	Existing capacity covers demand for next fifteen years. Export market highly competitive, possibility of reduced overhead costs. High priority.

TABLE 1 (Cont'd)

Projects	Initial Investment Cost (Million Birr)	Recommended Location	Foreign Exchange Component of (%): Investment Cost	Foreign Exchange Component of (%): Working Capital	Foreign Exchange Component of (%): Production Cost	Employment (No. of Persons)	Annual Wage Bill (Million Birr)	Investment Cost Per Job (Birr)	Financial Viability	Economic Viability	Linkages	Remarks
11. Vegetable tannins	3.51	Bale or Illubabor	76	15	36	81	0.25	43,333	not viable	not viable	domestic - resource-based	Low investment cost per job, contributes to regional diversification, long-term project. Low order priority.
12. Vegetable Dehydration	2.39	Nura Era	43	7	3	79	0.34	30,253	not viable	not viable	"	Limited domestic market, hence intended for export. Low priority.
13. Castor Oil	2.28		63	1	5	61	0.26	37,377	not viable	viable	"	Possibility of export, but should be weighed against alternative of exporting castor seed. Second order priority.
14. Cold Storage	9.84	Assab, Massawa, Bahr Dar	49[b]	43[b]	37[b]	52	0.35	189,231	not[b] viable	not[b] viable	no raw material inputs required	Low priority.
15. Soaps and Detergents	1.50	A.A or Asmara	62	91	81	35	0.08	42,857	viable	viable	Import-based	Heavy foreign exchange component, but low investment cost per job, basic good high priority.
16. Ammonium Chloride	1.15	Assab	46	87	32	42	0.18	27,381	not viable	not viable	moderately domestic-resource-based	Minimum economic scale exceeds demand. Heavy foreign exchange component. Low priority.
17. Strawboard for Building Construction	9.47	Arsi	64	22	35	96	0.35	98,646	viable	viable	Domestic-resource-based	Important for replacement of chipboard. High priority.
Total/Average	116.47		64[c]	38[a]	33	996	4.17	116,938				

Notes:

a. 109, if semi-automated.

b. Applies to Assab plant only.

c. Excluding Industrial Gases.

IV. INVESTMENT PROMOTION STRATEGY

A. INTRODUCTION

It should be noted from the outset that today the number of countries wishing to promote investments in their countries is many times more than the number of countries with the potential and/or interest to go into joint ventures. Consequently, this has made investment promotion not an easy exercise with one country after another coming out with more attractive incentive packages. Under such circumstances the potential foreign joint venture partner has more opportunities to choose from which make his terms and condition of becoming a partner more onerous.

The strategy that has so far been widely employed by many government for investment promotion purposes covers the provision of basic country data, government policy and legislation regarding incentives, names and addresses of responsible government agencies for invesment promotion and publicizing such information through appropriate channels and inviting potential investors to come forward. An integral part of the strategy is, of cource, the preparation of a well - documented profile of the particular project that is to be promoted and the submission of same to the identified potential collaborators.

In connection to these more often general strategy, the following specific features regarding investment promotion are provided in this chapter:

- Description of some approaches to investment promotion adopted by other countries with comments on their relevance to Ethiopia,
- Discussion on the issues likely to affect the formulation of light industrial investment promotion strategy in Ethiopia,
- Comments on steps to be taken in promoting the sixteen projects,
- Names and addresses of three possible commercial contacts for each project.

B. APPROACH TO INVESTMENT PROMOTION

1. Why Promote Investment?

If markets in the world operated perfectly, there never would be the need to promote, as knowledge would be easily available to everybody. Markets, however, are imperfect and this applies to investment as well as any other.

The principal reasons for promoting projects to the investment community are:

- to impart some information about a project which appears to have favourable characteristics for investors;

- to reduce risk and uncertainty factors;

- to address monetary and social distortions in the economy such as:

    - the balance of payments
    - excessively high real rates of interest
    - unemployment
    - regional inequalities in income and wealth distribution

- to encourage the developments and/or utilisation of infrastructure resources;

- to meet political requirements such as:

    - prestige/national pride
    - strategic importance
    - military importance.

This section discusses some procedures in relation to the dissemination of information. The major part, however, is devoted to promotion through the provision of investment incentives.

2. Dissemination of Information

In spreading knowledge about a project, it is important to identify the potential investment sources. For instance, if foreign capital and support is required then the methodology is usually supplemented by a broader publicity campaign about the country itself, so as to familiarise the interested parties about the customs and culture as well as the economic conditions of the country.

Many of the projects considered in this assignment need foreign inputs in terms of technology transfer as well as possible funding. Such projects can be thrust into the international arena by using the services of multi-national aid organisations. For example, UNIDO has an Industrial Investment Division whose aims are to promote the flow of resources to industry in developing countries. In its roles as an 'honest broker' it has in place four outlets for promoting projects, namely:

- investment promotion meetings held in the developing country;
- country presentations held in industrialised countries;
- INPRIS, a global database system that attempts to bring togehter proejcts with potential investors and development agencies;
- investment promotion services which have been so far set up in the Federal Republic of Germany, France, Japan, Austria, Poland, Switzerland and the USA.

Another organisation is the Centre for the Development of Industry (CDI) which is the aid agency of the Commission of European Communities.

CDI encourages investment and transfer of technology by firms in the EEC in any of the 66 African, Caribbean and Pacific (ACP) countries that fall under the ACP-EEC Lome Convention. Ethiopia is included.

More details on the UNIDO's Industrial Investment Division and on CDI are given in Appendix I.

3. Investment Incentives

There are two main classes of incentives that can be described as non-tax and tax. Typical non-tax concessions would include:

- low interest loans
- training schemes
- infrastructure provision
- relaxation of foreign exchange controls.

The bulk of government incentives, however, relate to tax. These would be, for example:

- tariffs on imported competing products/services to protect the new industry (infant industry argument)

- exemptions or tax reductions on:

    - imported materials inputs and capital equipment items for the project
    - profits
    - sales
    - labour

- liberal depreciation allowances or investment grants.

Below is discussed the investment promotion approaches adopted by five developing countries (see details in Appendix II), namely:

Brazil, Kenya, Nigeria, Tanzania and Yemen Arab Republic

Their approaches vary depending on the specific economic and financial conditions, and the prevailing government philosophy. Tanzania and Nigeria, for example, currently have policies which give the impression that they do not feel the need to specifically promote investment. Brazil, Kenya and the Yemen Arab Republic, in contrast, offer considerable incentives to certain types of investment.

Investment promotion is often seen as necessary in order to offset other shortcomings of the economy, which are keeping investment levels below what they 'should' be. Conversely, stimulating investment is also seen as means of overcoming other deficiencies, particularly exports, import substitution and regional development. Kenya and Tanzania emphasise exports, while the Yemen Arab Republic and Brazil emphasise both exports and import substitution. Brazil also emphasises regional development, as does Nigeria to a lesser extent.

Investment promotion is a 'second best' policy if it is established to treat the symptoms arising from various economic problems. The first best policy is to deal directly with the underlying causes of the problems. Governments ofen find the second best methods necessary due to political constraints, lack of information, or other obstacles which prevent the implementation of first best policies.

The relevance of these approaches to Ethiopia therefore depends on the reasons for promoting investment. The two key reasons underlying the investment promotion activities of the five countries are balance of payments and regional development.

a. Balance of Payments: Export Generating/Import Substitution

Many countries use a variety of incentives to promote investment in export industries, but each incentive can have side effects. Kenya and Brazil offer certain tax allowances and deductions on buildings, plant and machinery and other fixed capital. Similarly the Yemen Arab Republic (YAR) and Brazil exempt many capital goods from duty. Although encouraging exports, this also has the effect of encouraging capital intensive projects and technology at the expense of employment generating labour intensive projects and technology.

Brazil, YAR, Kenya, and to a lesser extent Tanzania and Nigeria offer duty reductions on inputs imported to produce goods for export. While encouraging exports this discourages the setting up or expansion of import substitution industries (especially thos using local inputs).

Kenya and Brazil make available low interest loans to further encourage exports. Not only do these discourage less capital intensive forms of exports, they also discourage other forms of productive investment if such schemes reduce the total supply of finance available.

An alternative way to improve the balance of trade is to pay a 'bounty' (subsidy) on every dollar of foreign exchange earned, in order to encourage exports from both new and existing ventures.

A foreign exchange 'bounty' has the advantage of not having adverse side effects of many investment promotion schemes. In particular, it does not penalise employment generating labour intensive projects, or projects that save foreign exchange by using local inputs.

The major problem with bounties is that it involves the government paying out monies which, in turn, demands higher taxation and possibility for distortions in the economy.

Brazil and YAR encourage import substitution by taxing foreign exchange (in other words placing tariffs on imports). Unless this form of protectionism is in support of infant industry development where there are economies of scale and learn curve effects to be realised, tariffs can lead to a misallocation of country resources and in particular, can prejudice development in the agricultural and livestock sectors.

b. Regional Development

If Ethiopia were contemplating investment promotion to stimulate regional development, it should first consider what form of 'regional development' it considers to be lacking. For instance:

- not enough jobs
- not engough people to exploit potential natural resources
- low incomes and wealth distribution.

Brazil is particularly keen on developing the Amazon region in the north and north east parts of the country.

The most generous of the regional investment incentives in Brazil are found in the city and river part of Manaus which is a free zone. This implies that:

- imports can enter the zone free of duties if intended for use in industrial processes or services (subject to a quota level);
- goods manufactured or assembled in the zone are exempted from value added tax when on-sold elsewhere in Brazil;
- reductions are given in goods circulation tax for imports into the zone and goods re-exported;
- suspension of exchange operations tax is permitted for components imported for PROEX, a special export programme;
- provision of land and services is offered in industrial areas at nominal rates for factory and warehouse use;
- corporation tax holidays range for periods of 10 to 15 years;
- complete income tax exemption is allowed for enterprises whose activities use local raw materials;
- there is access to cheap finance throughout the Amazon Investment Fund (FIDAM).

The idea of free zones was popularly promoted by the United Nations during the seventies and now they exist in both the developing and industrialised parts of the world. Economists argue, however, that such incentives as exampled by Manuas, distort the economy by establishing isolated pockets of development in otherwise poor areas. The problems of a region are best solved by direct grants and capital expenditure in infrastructure. The problem governments have with this advise is how to raise the finance to commit to grant aid and capital expenditure programmes without creating other distortions in their economies.

C. ISSUES IN FORMULATION OF PROMOTION STRATEGY

The issues discussed relating to the formulation of industrial investment promotion strategy are grouped under the following principal headings:

- selection of suitable projects
- direct controls
- foreign participation
- institutional support.

1. Selection of Suitable Projects

The first stage in the task of promoting light industrial investment is the identification of projects that reflect a stated strategy for industrial development.

It is assumed that an industrial development strategy in Ethiopia is already in existence and that this is in line with Government economic policy. Here though, is indicated the types of selection criteria against which projects are measured. The criteria are chosen to reflect the objectives of the overall policy; for instance, the raising of social and economic standards of living.

Associated with this broad aim, there may be a number of sub-objectives. For example:

- to move towards an equalisation of the distribution of income and wealth;

- to provide improved opportunities of employment in activities of higher productivity;

- to improve the future prospects of the nation's balance of payment;

- to reduce the nation's dependence on imported goods and services;

- to reduce the nation's dependence on exports of commodity products in international markets subject to enormous price fluctuations;

- to exploit unused natural resources.

Objectives like these lead to industrial development strategies that favour some projects over others that have been identified. Priority may be given to projects which more closely conform to the required goals. The following provide examples of selection criteria directed at specific purposes:

- employment creation:

  . capital intensity measured by investment per head
  . numbers employed

- markets:

  . export orientation
  . import substitution
  . growth potential
  . degree of competition

- resource utilisation
  . materials: local versus imported
  . Manpower skills
  . utilities
  . infrastructure

- Comparative advantage:
  - backward and forward links with existing industry
  - location
  - technology related to skill base

- financing:
  - size of investment
  - potential foreign debt requirement
  - foreign exchange exposure

- regional development
  - location
  - infrastructure

- commercial rating:
  - need to be profitable versus the need to meet socio economic requirements.

2. Direct Controls

In the process of industrialisation, Governments often intervene directly to stimulate investment and to optimise its effect on the development of the nation's economy. Licensing is relied upon in many countries to encourage desirable manufacturing activities within the limits of a set of social and economic objectives. These objectives vary from country to country but may include one or more of the following:

- priority investments - licensing authority in some countries apply quantitative criteria in determining priorities (e.g. foreign exchange costs benefit ratio; fixed assets per unit of wage/salary; value added coefficients at domestic and world prices; indigenous raw material coefficient; indices of backward/forward linkages). Others rely on subjective grounds (e.g. does it meet pressing consumer need? use a vital raw material? save foreign exchange?). Conversely, licensing can prevent the duplication of existing capacities;

- economies of scale - high levels of effective protection often leads to the establishment of manufacturing units of sub optimal size. Licensing authority can prevent such misallocation of resources so as to ensure long run production efficiency by approving only projects of minimum economic scale;

- control of monopolies - in the process of industrialisation, entrepreneurial talent is often scarce and the capital markets are limited. As a result, ownership of industrial assets tends to concentrate in the hands of a small number of individuals and families. Rather than attempt to regulate actual monopolistic behaviour, some countries have placed limits on the number of licences granted to any one group of investors;

- regional balance - industrial licensing is frequently used to achieve a geographically distribution of manufacturing activity. This objective is particularly relevant in countries where the thought of better employment prospects has caused a significant migration of workers from rural and semi-rural areas to congested urban areas;

- establishing national participation in investment - foreign investment is regulated to some degree in most countries for various motives. It may be part of a deep felt sentiment of nationalism or the belief that foreign business interests restrict the chances for domestic entrepreneurial skills to grow and flourish. Another aspect is the need to make the foreign investor aware of and response to national policies and objectives. National controls also allow a local subsidiary some autonomy therefore making it less vulnerable to the corporate fortunes of the foreign partner;

- regional integration - countries which belong to an economic union of some kind, may utilise licensing to obtain an efficient allocation of industrial activity throughout the union.

Another form of direct intervention by governments which has a bearing on investment promotion strategy, is that of price controls. The purposes of such controls on prices are often quoted as being:

- to imnprove the equitable distribution of consumption in society by assuring low prices for basic manufactured goods;

- to assure a steady flow of matrials to goernment run enterprises by giving favourable prices;

- to moderate inflationary pressures

- to counter balance a monopoly situation.

The practice of direct controls is usually coupled with a range of investment incentives such as those mentioned earlier. Economists have been criticall of direct control policies suggesting that in many cases they are not the first best solution to socio economic adjustment. Table I summarises alternative policies to direct controls which can achieve the same objecties at lower social costs.

TABLE I

POLICY ALTERNATIVES TO DIRECT CONTROLS IN THE INDUSTRIAL SECTOR

Objectives	Policies Superior to Direct Controls
Licensing:	
Control of monopolies	Antitrust legislation, tariff policy, wealth and estate taxes
Industrialisation of backward areas	Wage subsidies, investment credits, provision of public infrastructure
Development of small-scale industry	Public infrasturcture, provision of credit
Selection of priority industries	Coordination of tariff and domestic indirect taxes, cash subsidies
Price Control:	
Equity	Cash subsidies, fiscal policy
Control of inflation	Monetary and trade policies
Subsidies to user industries	Cash subsidies

SOURCE: Policies for Industrial Progress in Developing Countries, editors John Cody, Helen Hughes & David Wall (Oxford University Press)

3. Foreign Participation

It is generally recognised that in industrialising, developing countries require foreign participation in the provision of capital and technology. Whilst inflows of capital and technology undoubtedly boost the local economy and support its currency, developing countries have had bad experiences and have been exploited by multinational corporations. The dangers with respect to such circumstances are:

- the multinational subsidiary, with access to capital abroad, may ignore local financial directives and may escape national taxes by transfer pricing at other than competitive prices (e.g. buying imported materials from an associate company at above world prices or selling exports to an associate company at below world prices);

- direct political pressure may be placed on the host country's government by the parent company's government;

- multi-nationals may attempt to exert local political pressure (by threatening to withdraw, for example) in order to gain economic advantages such as monopoly power and high effective rates of protection;

- in the past, some developing countries, regardless of the relative abundance of their capital and labour resources, have tended to choose highly complex and capital hungry technology;

- the price paid for technology may reflect the monopoly situation of the supplier of the technology.

Direct foreign investment, however, has been beneficial in many instances, especially for countries which have learnt to manage the situation (e.g. by insisting on some local equity participation) to ensure that the benefits outweight the costs and that the loss of political sovereignty is avoided.

Generally speaking, the political advantage moves from the multi-national to the host country the more the multi-national becomes committed to its investment in the host country. With this in mind, developing countries are receptive to foreign investment. Further, they recognise that there are a number of risks to the foreign investor. Most developing countries, in attracting foreign capital, allow to varying degrees for the repatriation of interests, profits and even capital, guarantee compensation payments in the case of nationalisation and sometimes, through tariffs or licensing, provide secure domestic markets.

4. Institutional Support

Any industrial investment promotion strategy has to be expressed within the framework of institutional support backing up the industrial development programme. This support can be provided in many ways, such as:

- project champion
- financial and fiscal incentives
- credit facilities
- training infrastructure
- infrastructure.

a. Project Champion

For projects to 'get off the ground' and become reality requires a project champion. This champion may take many forms such as an influential politician, a commercially successful investor, a tenacious scientist. It may also be an organisation whose purpose is to promote and implement apparently viable projects.

Success of any organisation in this field is dependent on a number of factors, particularly:

- autonomy: the organisation must have wide powers to approve projects for implementaiton. It must have a strong belief in the project that it is to promote. It should be in a position of influence the country's leaders, local and foreign banks and other providers of finance, and other institutions controlling resources (e.g. labour unions) and not be in a position to be influenced by them;

- expertise: the organisation should have a substantial range of expertise in legal, technical and financial matters. This range could be extended to include training, sociology and other personnel aspects.

The role of such an organisation may be described as one or more of the following activities:

- a catalyst, promoting projects among potential investors and financial institutions;

- a financier, providing equity and/or loan finance;

- a facilitator, providing support services to the interested parties, for example:

    - advising the local investors on the legal mechanisms and the financial implicaitons concerning loan agreements, technology transfer arrangements and business contracts;

    - Assisting export projects through an information and advice service to exporters; the provision of financial aid in subsidising missions;

    - establishing manufacturing standards;

    - helping with training and management development programmes.

- an administrator of government industrial development policy, approving the investment incentives for given projects and monitoring their progress.

b. Financial and Fiscal Incentives

Where economies of scale are significant, the protection of infant industries is essential. This is usually achieved through a tariff. Other forms of incentives include offers of investment allowances and grants, tax-free periods, liberation from payment of import duties on capita` plant and equipment and on materials, liberal depreciation allowances, free or cheaply priced land sometimes with services (for example, electricity, gas, water and administration).

c. Credit Facilities

Many governments offer export credit guarantees and tax concessions on exports. The credit scheme is an insurance against non-payment by foreign customers. This is a particularly useful incentive to exporters of capital plant, machinery and equipment where payment is normally spread over along period of time and the probability of the importer running out of money due to unforeseen circumstances is greater.

In some developing countries, the banking systems are weak and overdraft facilities to meet short term fluctuations in working capital are not readily available particularly to small companies and new projects. As a consequence the companies and projects are burdened by financing excessively larger amounts of working capital with equity or long term debt. A solution has been to provide lines of short term credit similar to that given to farmers through rural/agricultural government banks.

d. Training

The availability of good general training facilities improves the investment climate. Training in basic engineering and processing skills is essential so that new projects can draw upon a competent workforce that only require specific training with respect to the product to be made.

Effeciently run projects, however, require specialist skills and managerial abilities. The so-called 'mature' economies offer scholarship to the developing world to gain advance education. It is now possible in some cases through distance learning programmes for the teaching to take place without the need to travel abroad.

e. Infrastructure

Investment is more easily attracted if projects are planned in areas of abundant or even adequate infrasturcture. Support may be given in a number of ways, such as:

- provision of industrial estates sometimes with standard factory units ready for occupation;
- provision of ample supply of energy and water;
- provision of roads suitable to withstand heavy vehicle traffic;
- provision of other transport facilities: airports, sea ports, railways;
- provision of waste disposal facilities.

D. PROMOTION STEPS

This section examines in turn the sixteen projects and suggests, where applicable, steps for their promotion and provides at least three possible commercial contacts.

The first step that applies to any project is to clarify the sources of aid assistance available.

1. Sources of Aid Assistance

Funding and technical assistance is widely available from the industrialised countries, from most petroleum exporting countries and in some cases, from developing countries themselves.

Each country runs its own aid programme and through export credit guarantee schemes fund 85 percent of offshore costs on reasonable lending terms. Many contribute to multilateral aid programmes, the most renown being the World Bank.

The World Bank is a group of three institutions, the International Bank for Recosntruction and Development (IBRD), the International Development Association (IDA) and the International Finance Corporation (IFC). The first two finance the

TABLE II

DETAILS ON THE WORLD BANK

	International Bank for Reconstruction and Development (IBRD)	International Development Association (IDA)	International Corporation (IFC)
Objectives of the	To promote economic progress in developing countries by providing financial and technical assistance, mostly for specific projects in both public and private sectors		To promote economic progress in developing countries by helping to mobilise domestic and foreign capital to stimulate the growth of the private sector
Year established	1945	1960	1956
Number of member countries (April 1985)	148	133	127
Types of countries assisted	Developing countries other than the very poorest - some countries borrow a 'blend' of IBRD loans and IDA credits	The poorest: 80% of IDA credits go to countries with annual per capita incomes below $410 - many of these countries are poor to be able to borrow part or any of their requirements on IBRD terms	All developing countries, from the poorest to the more advanced
Types of activities	Agriculture and rural development, energy, education, transportation, telecommunications, industry, mining, development finance companies, urban development, water supply, sewerage, population, health and nutrition. Some non-project lending, including structural adjustment		Agribusiness, development finance companies, energy, fertiliser, manufacturing, mining, money and capital markets institutions, tourism and services, utilities
Lending commitments (fiscal 1985)	$11,358 million	$3,028 million	$937 million
Equity investments (fiscal 1985)	IBRD and IDA do not make equity investments		$60,970 million

	International Bank for Reconstruction and Development (IBRD)	International Development Association (IDA)	International Corporation (IFC)
Number of operations (fiscal 1985)	131	105	75
Terms of lending:			
Average maturity period	Generally 15 to 20 years	50 years	7 to 12 years
Grace period	Generally 3 to 5 years	10 years	An average of [illegible] years
Interest rate	In line with market rates	0.0% or very small	In line with market [illegible]
Other charges	Front-end fee of 0.25% on loan Commitment charge of 0.75% on disbursed amount of loan	Annual commitment charge of 0.5% on undisbursed amounts of the credit	Commitment fee of 1% [illegible] year on undisbursed amount of loan
Recipients of financing	Governments, government agencies and private enterprises which can get a government guarantee for the IBRD loan	Governments - but they may relend the funds to state or private organisations	Private enterprises, government organisations that assist the private sector
Government guarantee	Essential	Essential	Neither sought nor accepted
Main method of raising funds	Borrowings in world capital markets	Grants from governments	Borrowings and [illegible] capital, subscribed by member governments
Main sources of funds	Financial markets in US, Germany, Japan and Switzerland	Governments of US, Japan, Germany, UK, France, other OECD countries, and certain OPEC countries	Borrowings from IBRD

same kind of projects but the IBRD makes loans at a commercial rate while IDA make 'soft' loans to the poorer countries in which Ethiopia would be included.

The IFC is legally and financially separate from the Bank. Its role is to further economic development by encouraging the growth of productive private enterprise in member countries. In association with private investors, the IFC assists both equity and loan financing. Table II gives more details on the World Bank.

The European Devleopment Fund (EDF) is the corner-stone of EEC's aid programme which finances at attractive rates of interest projects in the 66 African-Caribbean-Pacific (ACP) countries (includes Ethiopia). A quarter of EDF funds are directed to industrialisation.

The European Investment Bank is an independent public institution within the EEC which contributes to financing ACP projects in energy, industry, mining and tourism. The interest rates are at commercial levels although sometimes the EDF sub-sidise the interest payable.

The Arab aid agencies are major aid donors although less so now than in the early eighties. 18 percent of their aid has gone to Africa. Generally, Arab aid is untied and international procurement is the norm. Co-financing of projects with the World Bank or EDF is common.

Some of the agencies are national bodies such as the Kuwait Fund for Arab Economic Development; some are multi-national such as the Arab Fund for Economic and Social Development.

Owing to their small administrative resources the agencies often favour very large projects often jointly financed with other donors. Table III gives details on these Arab aid agencies.

The Scandinavian countries offer aid supported packages although these are tied to procurement of capital goods and services from Scandinavian companies. The Nordic Investment Bank in particular offer long term loans (up to 15 years) at low rates of interest and with substantial grace periods.

TABLE III

DETAILS ON THE ARAB AID AGENCIES

Aid agency	Abu Dhabi Fund for Arab Economic Development (ADFAED)	Arab Bank for Economic Development in Africa (BADEA)	Arab fund for Technical Assistance to African and Arab countries (AFAAC)	Islamic Development Bank (ISDB)	Kuwait Fund for Arab Economic Development (KFAED)	OPEC Fund for International Development
Address	N E Said Ghobash Bldg Tourist Club Area PO Box 814 Abu Dhabi United Arab Emirates	PO Box 2640 Khartoum Democratic Republic of Sudan	37 Kheireddine Pacha St Tunis Tunisia	PO Box 5925 Jeddah	PO Box 2921 Kuwait	PO Box 995 1011 Vienna Austria
Telephone	822865	73646/73709/70498	890100	636 2086/636 0011	439075/9	531664-0
Telex	2287 Fund EM	22248 SD 22739 SD	13242 JAMIA (Tunisia)	401137/401407 BISLAM SJ	22025 ALSUNDUK 22613 KFAED KT	1-31734 1-34831 Fund A
Year established	1971 (started operations in 1974)	1974 (started operations in 1975)	1975 (started operations in 1976)	1974 (started operations in 1975)	December 1961	1976 (OPEC Special Fund in 1980 became OPEC fund)
Purpose	To offer loans & economic assistance to Arab, Asia and African countries	To contribute to the development of African countries which are members of the Organisation of African Unity and are not members of the Arab League, to promote and stimulate private Arab investment in African countries and provide technical assistance for Africa's development	To provide technical assistance for development projects in African and Arab countries. It does not provide direct financial assistance for this purpose but it does provide grants for scholarships and training.	To foster development and social progress of member countries and Muslim communities individually as well as jointly in accordance with the principles of Islamic law.	To assist Arab and other developing countries in developing their economies, and to provide financial and technical assistance for the execution of their development programmes.	To provide concessional financial assistance to other developing countries in addition to the aid already extended by OPEC members individually.
Terms of lending	Interest rate of 4-6% plus ½% service charge. Repayment period of 10-15 years Grace period of 3-5 years Repayment is in UAE dirhams No more than 50% of total project cost can be loaned The Fund cannot commit more than 10% of its capital to any one project.	Determined by the economic situation of the recipient countries and the nature of the projects. High grant element included in the assistance.		Under Islamic law the Bank does not charge interest on loans. It makes a service charge based on actual administrative costs.	On average, the repayment period is 25 years with a 5 year grace period and an interest rate of 3½%. The average grant element is 45 . However these amounts vary with the economic conditions of the country borrowing.	Mostly interest free. Repayment period is 15 years for programme and 20 years for project loans, including a 5 year grace period. Service charge of 0.75 .
Type of project assisted	Primarily for manufacturing, energy and extractive industries	High priority is given to economic infrastructure. Agriculture, industry, energy and Development Finance Corporations are also supported.		Industry, transportation, agriculture, development finance institutions, social infrastructure	There are no limitations, but previously assistance has been given mostly to agriculture and irrigation, transport and storage, power and industry. Priority is given to supporting the poorest countries.	Funds are geographically distributed more widely than the other Arab Funds. Mainly for projects in energy, transportation, agriculture development finance institutions, industry and social infrastructure.

Finally, the United Nations Development Program administers a number of special funds of which the UN Capital Development Fund is of relevance with respect to industrial investment promotion.

2. Comments on Promotion of the 16 Projects

a. Precipitated Calcium Carbonate (PCC)

The holder of the carbonation process technology are the main producers of PCC and therefor involvement by one of them is essential. A first step, therefore, to promoting this project would be an approach to one of these companies. The three most important are given in the profile and repeated here:

J & E Sturge Ltd
Lifford Chemical Works
Lifford Lane
Birmingham 830 3JW
UK

Pfizer Inc
235 East 42nd Street
New York NY s10017
USA

Mississipi Lime Company
St Genevieve
Missouri
USA

As the international markets for PCC are stable or marginally declining, these companies may not be keen on increasing world supply. If they are interested, they would also probably arrange for the plant to be built accordingly to their design specifications, provide technical assistance in running the plant and offer to train personnel.

It is less likely that they would invest in the project given the international market situation unless the project presents them with the opportunity of entering an otherwide closed market.

b. Marble Cutting and Polishing

Both the process and product technology is readily available from the cutting and equipment manufacturers. In this regard, the Italians are the world leaders and names and addresses of some of the Italian suppliers are presented below.

The project's investment cost is significantly under US$1 million and therefore should be suitable for promotion among national investors. If it is intended to export a substantial proportion of its output, then it would be advisable to have some kind of link with a foreign supplier of marble tiles and stones, preferably Italian. The link need not be equity participation. Instead, it could be a production agreement to make a particular style of tile or a marketing agreement where the supplier augments his product range.

The cutting machinery and equipment manufacturers would probably assist in introducing the Ethiopian owners of the project to foreign outlets for the products.

Terzago SpA
28025 Gravellona Toce
Via XX Settembre 107
Italy
Telex: 200461 TERZAG 1

Tema Longinotti SpA
Stab E Uffice
Via Aurelia 3
PO Box 239
54033 CARRARA
Italy
Telex: 500236 TEMA 1

FOMA SpA
Via Trieste N 104
PO Box 72
64022 Giuilianova Lido
Italy
Telex: 600092 FOMAG 1

BISSO SpA
PO Box 5
1-16047 Ferrada di Moconesi
Genova
Italy
Telex: 271151 BISSO 1

Ravelli Pier Luigi SnC Via Valroveto
24069 ENTRATICO
Italy
Telex: 302232 CAV BG

A Scottish company which can offer a fully range of machinery is:

Anderson Stone Machinery
Taymouth Engineering Works
Carnoustie DD7 7LZ
Scotland
Telex: 76118

In addition the following marble process machinery company is installing an operation in the Awash area of Ethiopia on behalf of Elmico:

F Lli Mordenti
PO Box 292
19100 La Spezia
Italy
Telex: 281041 MORDEN 1

c. Motor Oil Regeneration

Being an energy related project with significant implications for the balance of payments, it should be well r ceived by aid agencies. It is possibly too small to attract Arab funding but the IFC may be interested in providing both equity and "soft" loan finance.

The Centre for the Development of Industry could play a major role in the promotion of this project. The leading process technology is European and there are a number of European (within the EEC) holders of product technology who could be interested in a joint venture or licensing arrangement (see below). The CDI through the EDF/EIB could probably supply a generous line of credit to the project.

Commercial contracts are:

- Process Technology

  Georg Fischer GMBH
  PO Box 100369
  4020 Mettmann
  Federal Republic of Germany
  Telex: 8581120 gftb d

- Product Technology

  Burmah Oil Company Ltd
  Burmah House
  Pipers Way
  Swindon
  UK

  Midland Oil Refineries
  Shelah Road
  Halesowen B63 3PN
  UK
  Telex: 337520 A/B MORHAL G

d. Aerosol Insecticides

This is a relatively small project in terms of capital cost and employment generation. Promotion could be among national investors and loans could be secured in the form of export credits from the country supplying the key items of equipment.

A UK company, DH Industries, is quoted in the profile as a supplier of the equipment. In fact much of their equipment comes from Sitzerland, namely:

Pamasol Willi Mader AG
8808 Pfaffikon/SZ
Switzerland
Telex: 875602

It will be almost essential to bring in a major insecticide company to provide product technology. These companies may not be interested in taking an equity stake. Instead, their preference is for the project to produce an aerosol insecticide under their licence and they would supply the materials. The Ethiopian investor should ensure that the arrangements offered by these companies are competitive and that the project does not totally commit itself to the one supplier for a long period of time.

Two companies to approach are:

ICI Plant Protection Division
Fernhurst
Haslemere GU27 ?JE
UK
Telex: 858270 ICI PPF

BASF
Carl-Bosch Str
D-6700 Ludwigshafen
Federal Republic of Germany
Telex: 449221 Burcas g

e. Industrial Gases

This project is one of the most expensive in terms of capital cost of the sixteen evaluated. The main item of investment is in cylinders.

A joint venture may be possible to establish with a major supplier of industrial gases. BOC Cyroplants is given in the profile as a supplier of both the product and process technology. Its parent company, BOC Group, manufactures and markets industrial gases in various parts of the world. The contact address is:

BOC Group
Chertsey Road
Windlesham
Surrey GU20 6HJ
UK

BOC would probably be interested in the acetylene production as well as oxygen although the plant and technology would come from:

Rexarc Inc
West Alexandria
Ohio
USA

Other industrial gas companies that could be approached are:

EI DuPont de Nemours & Company
1007 Market Street
Wilmington DE 19898
USA

Argon SA
Orense 11
28020 Madried
Spain

Compagnie Francaise de Produits Oxygenes
Cryobiologie
Sassenage
France

Air Products & Chemicals Inc
Allentown
Pennsylvania
USA

Given the European element in the providers of technology, CDI may again be an appropriate catylist for the project's promotion. Furthermore, again the EDF/EIB may be willing to support the project with a long term "soft" loan.

f. LPG Cylinders

In its present form, this project is not viable and therefore cannot be promoted. If it were viable, the capital investment would be higher (because the scale of operation would be much higher) at around US$10 million.

Equity finance for the project will probably have to come from Ethiopia and given the size of investment, from the Government. Export credits may be available from the governments of the plant manufacturers which are:

Merloni Progetti
Viale Certosa 247
20151 Milano
Italy

PCIC 348 New Palasia
Indore
India

The key product technology can be supplied by:

Calor Consulting
33 Mespil Road
Dublin E
Ireland

It is unlikely that Calor would want to invest in the project.

g. Strawboard

The product and process technology of strawboard as a building material is the proprietary of Stramit International whose address is:

Tomo House
Tomo Industrial Estate
Creeting Road
Stowmarket
Suffolk IP14 5AY
UK

Stramit offers a composite package which includes installing and commissioning the plant, training personnel and managing operations. The company would consider equity participation, indicated at up to 10 percent.

The project would probably be favourably received by the aid agencies with respect to funding, given the "low cost" housing implications. CDI may financially support a feasibility study if a local equity sponsor can be found (e.g. Ethiopian Government's Department of Housing).

A similar technology using wood chips has been developed in Austria. Contact address being:

Rogner GMBH
Wickmanng 43
9500 Villach
Austria

If a paperboard product is rquired from straw, the Japanese have perfected small-scale mills. The product and process technology and possible participation may be available from:

Kaga Paper Manufacturing Co Ltd
111 Nishi Kanazawa 1-chome
Kanazawa
1 Shikawa - pref 921
JAPAN

Yagi Iron Works Co Ltd
8 Tonoki
Fuji-Shi
Shizuoka - Pref
JAPAN

h. Straw Pelletisation

This project could be promoted among the existing animal feed producers in Ethiopia. Alternatively, international animal feed companies could be invited to participate. These may include:

Cargill Inc
45 Broadway
New York NY 10006
USA

or

15407 McCinty Road West
Minnetonka MN 55343
USA

Anderson Clayton & Co
Feed Division
Abilene
Texas
USA

Dalgety PLC
19 Hanover Square
London W1R 9DA
UK

Given the intrinsic advantages of the project which like strawboard, makes use of a discarded local material and would provide employment opportunities in rural areas, the project would probably appeal to the aid agencies. Their support could be in the form of low interest long term loans and technical assistance and training.

A source of product and process technology is the Unilever comapny:

BOCM Silcock Ltd
Basing View
Basingstoke
Hants RG21 2EQ
UK
Telex: 858429

Alternatively process technology is available from:

A Milne & Sons (Millwrights) Ltd
Bannermill
Aberdeen AB9 2QT
Scotland
Telex: 73488 NEF ABN

i. <u>Gelatin</u>

This project requires a relatively high capital outlay. Local promotion, as a result, may be limited to government run industries. Promotion could be directed at existing gelatin producers on a joint venture basis. Such companies can provide not only the product technology but the marketing organisation to infiltrate international markets.

Companies that could be approached, include:

Gelatin Products Ltd
Clifton Road
Sutton Weaver
Runcorn WA7 3EH
UK

Tessenderio Chemie
Square de Meeus 1
Bruxelles 1040
Belgium

Italgelatine SpA
Strada Statale Alba-Bra 201
12060 Cinzano de Santa Vittoria d'Alba

Dalgety PLC
19 Hanover Square
London WIR 9DA
UK

Alternatively, with just local equity investment, the project could get-off the ground by using specialist consultants to design and manage the plant and train personnel. One such type of consultant is:

GT Gelatin Technology Ltd
5-7 Museum Place
Cardiff CF1 3BD
UK

As the project will make use of livestock wastes which may be currently discarded, support could be sought from the World Bank (IDA), the EEC (EDF) and other sources of "low cost" finance such as BADEA (the Arab Bank for Economic Development in Africa) and KFAED (the Kuwait Fund for Arab Economic Development).

j. Leather Goods

This project has a relatively low level of capital investment and could therefore be promoted within Ethiopia; for example, among the existing garment makers.

As the output is intended for export, however, it would be wise to secure marketing/production agreements with foreign leather clothing manufacturers. Further, such contacts would be sources of clothing design. The Italians are world renowned for their leather garment industry and so it is suggested that the project is promoted among them. For instance:

FOURPEL CONFEZ
Zona Ind San Zeno
Strada B13
52100 AREZZO
Telex: 571467

SEM LORY
Via Scarabelli Zunti 33/a
43100 PARMA

PETER PELL
Via E Fermi 33/b
50053 SOVIGNANA-VINCI (DI)

ROBRIK
Via della Repubblica 101
50053 EMPOLI (FI)

COMPAGNIE DELLE PELLI
Via lucchese 149/d
50053 EMPOLI (DI)
Telex: 572022

EL-BA
Via Fiorentina 40
51017 PESCIA (PT)

k. Vegetable Tannin

This project, in its present form, is not viable, although, with investment costs of around US$1 million, it could conceivably be promoted among internal investors.

With the need for product and process technology, project promotion could include existing foreign manufacturers. Approaches may therefore be considered to:

Tannin International
3 rue de Teheran
75008 Pairs
France
Telex: 643550

Esseodue SpA
Via S Cassiano
28069 San Martino di Trecate
Italy
Telex: 200369

The Kawamata Chemical Co Ltd
Tokyo
Japan
Telex: 26308

East African Tanning & Extract Co Ltd
PO Box 190
Eldoret
Kenya
Telex: 35048

Tanac SA
R Duilio Calderari
270 Hugo Lange
Curitiba
Brazil
Telex: 412176

Natal Tanning Extract Co
PO Box 39
Pietermaritzburg
South Africa
Telex 643392

As mentioned in the profile Process technology can be obtained from:

NIRO Atomiser Ltd
305 Gladsaxevej
Copenhagen
DK-2860 Soeborg
Denmak

p. Vegetable Dehydration

Promotion of this project, which is considered not to be viable, depends on the market targets. If the product is intended for industrialised country markets then the project needs the support of a large international commodity house such as:

Gill & Duffus Landauer Ltd
201 Borough High Street
London ES1 1HK
UK

or an international food processing company, such as:

Dalgety PLC
19 Hanover Square
London WIR 9DA
UK

Unilever PLC
PO Box 68
Blackfriars
London EC4P 4BQ
UK

Their support is used to secure distribution channels into these markets and possibly product technology to guarantee quality standards and not necessarily for financing purposes as the equity can probably be raised within Ethiopia.

Product technology could be obtained perhaps from smaller organisations such as:

Legumbres SACIFIA
Cerrito 1136
Buenos Aires
Argentina

Being an agro-processing and labour-intensive project to be located in all probabilities in a rural area, the aid agencies would likely been keen to support the project on the condition that it is viable, providing technical and financial assistance.

m. <u>Castor Oil</u>

The aid agencies wil probably like this project for much the same reasons as the vegetable dehydration project, but more so because it appears to be more feasible and it is not using vegetables which could otherwise be consumed locally.

It is conceivable that this project could be promoted locally (capital costs of under US$1 million). Foreign participation in terms of training and product technology could be bought-in in terms of consultancy services. One such centre is:

Instituto de Tecnologia de Alimentos
Av Brasil 2880
Campinas
Brazil
Telex: 191009 inta

Alternatively, this support could be provided by the existing producers of castor oil such as:

Anderson Clayton SA Industria E Commercio
Av Maria Coelho Aguiar 215 BL 'C' 7/8
St Amaro
CEP 05804
Sao Paulo - SP
Brazil
Telex: 11 23994

Imbasa - Ind Mamona Bahia SP
Av Estadoa Unidos 340 S/805
Salvador - SA
Brazil
Telex: 71 1041 IMAB

Sanbra - Sociedade Albodoeira do Nordeste Brasileiro.SA
Av Maria Coelho Aguiar 215 BL 'D' 5/8
St Amaro
CEP 05804
Sao Paulo - SP
Brazil
Telex: 11 37885 SANB

China National Cereals Oils & Foodstuffs
82 Donganmen Street
Beijing
China
Telex: 22281

n. Cold Storage

This project should be promoted within government circles, probably with the institution in charge of livestock and fisheries. The Government could seek aid support for the project from CDI and UNIDO and "soft" loans from the World Bank (IDA), EDF (17 percent of EDF funds are for rural production projects) or BADEA.

If the products, which are to be cold stored, are intended for export the equity investor should look for means of distribution. These could be through commodity houses such as:

Dalgety Lonsdale Ltd
Lonsdale House
20/21 Long Lane
London ECLA 9JE

or through catering firms in Arabia such as:

- Arabian Catering & Services Co in Saudi Arabia and Abu Dhabi
  (Telex 870039 and 23561 respectively)

- Gulf Hotel & Catering Services in Doha, Qatar (Telex 4168)

- Kuwait Catering Services in Safat, Kuwait (Telex 44336).

Much can be learnt about frozen meat storage and transportation from international suppliers especially from Australia and South America.

For example:

Australian Meat & Livestock Corp
68 Grenfell Street
Adelaide SA
Australia

Industries Frigorificas Nelson SA
Florida 890
1005 Buenos Aires
Argentina

Swift-Armour
Av LN Alern 986
1001 Buenos Aires
Argentina

Frigorifico San Jacinto (Nirea SA)
Juncal 1305, Pl
Montevideo
Uruguay

o. Detergent Bars

The project, which is of relatively low capital cost, could be promoted locally (e.g. to the existing soap manufacturers or to the Naitonal Chemical Company).

Product technology and possible equity participation could be obtained by approaching such companies as:

Unilever Research Port Sunlight Laboratory
Quarry Road East
Bebington
Wirral L63 3JW
UK

Proctor & Gamble
Ivorydale Technical Center
Cincinnati
Ohio 45217
USA
Telex: 4333043 pgite

Henkel JG
Henkelstrasse 67
4000 Dusseldorf 13
Federal Republic of Germany
Telex: 85817 ohdd

Alternatively both process and product technology is available from:

Britannia Soap Machienry
Battle Road
Heathfield
Newton Abbot TQ12 6XT
UK
Telex: 42577

As the raw materials (DDBS) will have to be imported the project is unlikely to gain as much support from aid agencies as some of the others mentioned above. However, much of the plant equipment could be financed by export credits.

p. Ammonium Chloride

This project appears not to be viable. It is also difficult to launch technically as there is no off-the-peg plant available. Chemical design engineers would have to work with manufacturers of the various items of equipment, especially the rotary vacuum drum filter.

As the project is aimed at supplying ammonium chloride specifically for the dry cell battery company in Ethiopia, this company seems to be the obvious candidate to be the owner of the project.

The capital cost requirements are not large. Savings in site and building costs may be possible if the plant can be accommodated within the existing battery factory complex. Export credits are obtainable with respect to the imported capital goods.

With respect to contacts, and given that chemical engineering consultants would need to design the plant, product technology may be given by the major chemical companies such as:

ICI PLC
Hexagon House
Blackleg
Manchester M9 3QA
UK

BASF
Carl-Bosch Str 38
D-6700 Ludwigshafen
Federal Republic of Germany

Equipment manufacturers include:

- Rotary Vacuum Drum Filter

  Door-Oliver Inc
  77 Havemeyer Lane
  Stamford
  Connecticut 06904
  USA

  Stockdale Filtration Systems Ltd
  Waters Green House
  Macclesfield
  Cheshire SK11 6LF

  Eimco Process Equipment Ltd
  PO Box 300
  Salt Lake City
  Utah 84110
  USA

- Dryers

  APV Mitchell Dryers Ltd
  Denton Holme
  Carlisle
  Cumbria CA2 5DU
  UK

  Buss Ltd
  Hohenrainstrade 10
  4133 Pratteln 1
  Switzerland

  Gatz-Corporation
  120 South Riverside Plaza
  Chicago
  Ilinois 60606
  USA

- Providing details of financing agencies willing to provide loan and equity capital on favourable terms.

APPENDIX A

COMMON ASSUMPTIONS FOR FINANCIAL AND ECONOMIC ANALYSES OF THE SEVENTEEN PROJECTS

1. Financial Evaluation

- **Buildings and Civil Works Cost**

The buildings and Civil Works Cost estimated was Birr 900/m². To that was added 12% for site preparation, land development, design and others.

- **Plant Machinery and Equipment**

The prices of the machinery and equipment indicated in this study are based on 1987 prices quoted by consultants, W/S Atkins International. Insurance cost was estimated at 2% of C and F while the other local expenses such as inland transport, port handling, bank charges etc. were estimated at 10.5% of C & F.

- **Pre-Production Period**

For the purpose of the financial and economic analyses, a two year pre-production period was assumed.

- **Repairs and Maintenance**

For the calculation of the annual cost of repair and maintenance, the following rates of the respective fixed investments were used.

- Buildings and Civil Works	2%
- Plant Machinery and Equipment	5%
- Vehicles	10%

- **Employees Benefits**

This cost was assumed to be 25% of the basic wages and salaries and is included in the salaries and wages shown in the operating cost.

- **Overhead Cost**

The overhead cost includes expenses such as insurance, office supplies, audit fees, communications etc. In the computation of the insurance, the following rates, based on data from the Ethiopian Insurance Corporation, were used.

- Office Building	0.45%	of Value
- Vehicles	5%	of Value

- **Tax Rate**

An income tax rate of 50% has been applied for the project profiles in accordance with proclamation No. 155 of 1978, Article 5, Sub Article C.

- **Depreciation and Amortization**

A straight line method was adopted using the following rates:

Buildings and civil works	5%
Office furniture and equipment	10%
Service facilities - transport and material handling equipment	20%
Plant machinery and equipment	10%
Pre-production expenditures	20%

- <u>Capital Charge</u>

This was not included in the cost of production. Since it is a form of a return to the Government on its equity investment.

- <u>Contingencies</u>

A physical contingency of 10% was assumed on the fixed investment. No price contingency is considered.

- <u>Life of project and capital recovery</u>

The life of the projects was assumed to be 15 years. At the end of the project life some portion of the initial fixed investment might be recovered. In this study the terminal value has been assumed to be equal to the book value of the fixed investment.

2. Economic Evaluation

The viability of the projects from the national economic point of view was assessed using the guidelines set by the Development Projects Study Agency (DPSA). The following standard factors were used to convert the market prices to accounting prices.

Items	Conversion Factors
Imported goods and service	1.00
Local goods and service	0.75
Skilled Labour	0.75
Unskilled Labour	0.50
Taxes and Subsidies	0

Net Working Capital

The net working capital was estimated without giving any provision for spare parts. This is done on the assumption that an amount sufficient for 2-3 years consumption has been included in the cost of machinery and equipment.

APPENDIX B

INVESTMENT PROMOTION CHANNELS

1. Industrial Investment Division of UNIDO

The Industrial Investment Division (IID) aims to promote the flow of resources to industry in developing countries by helping:

- industrial project sponsors in developing countries find foreign partners who can supply needed inputs - finance, plant, technical and managerial skills, market access

- industrial firms (particularly small and medium-scale) in more advanced countries to find profitable business opportunities in developing countries.

IID's objective is therefore to identify, prepare and promote viable industrial projects in developing countries with the ultimate goal of their implementation.

In the area of promotion, IID is active in:

- disseminating information on projects in developing countries and on potential foreign partners seeking investment opportunities

- bringing potential investors and local sponsors face-to face

- assisting developing countries in creating a favourable investment climate

- carrying out project promotion programmes in a single industrial subsector

- Providing details of financing agencies willing to provide loan and equity capital on fabourable terms

In carrying out its 'honest broker' function, IID has developed powerful promotional tools:

- 'Investment Promotion Meetings' (IPMs) held in developing countries

- 'Country Presentations' held in industrialised countries

- INPRIS - investment promotion information system - global detabase listing:

  . industrial investment projects
  . potential investors
  . banks and investment corporations
  . development agencies and ministries.

In order to strengthen its promotional base, UNIDO has created a number of business-oriented 'Investment Promotion Services' (IPSs).

The IPSs are set up under agreements between UNIDO and the host country governments, and financed by a special contribution to UNIDO's Industrial Development fund.

Positive evaluation of the IPSs achievements by independent consultants has led to renewal of these agreements upon their expiry for a further term.

The IPSs objectives are to:

- put project sponsors in developing countries in touch with suitable industrial partners

- identify investment opportunities in developing countries for industrial firms wishing to expand overseas

- locate sources of finance worldwide for pre-investment studies, equity participation, loans

- supply up-to-date documentation on the investment climate, incentives, profit remittances, etc.

The IPSs operate by:

- encouraging potential partners in their host countries to attend forthcoming IPSs and supply advance details of project to be presented at them

- organising Country Presentations at which project opportunities and investment related topics in a selected developing country are discussed

- mobilising UNIDO's technical assistance resources-studies on industrial subsectors of specific developing countries; evaluation of new and rehabilitation projects; preparation of feasibility studies; selection of appropriate technology

- working closely with bilateral technical cooperation agencies and with industry associations in their countries in promoting investment partnerships

- offering guidance and advice to small and medium scale industrial firms which are considering an engagement in the Third World.

IPSs operate an 'on the job' orientation programme for delegates from developing countries.

Participants spend 1-3 years working in an IPS, promoting priority investment projects brought from their own countries. They help organise IPMs and Country Presentations, thereby building a direct link to potential partners in the industrialised countries.

After returning home, orientation programme alumni often attain influential positions in government or industry, continue to serve as a focal point for investment promotion - project identification and follow-up, preparation of IPMs. Thanks to their first hand experience they can often help improve the investment climate in their countries.

IPSs offices are currently in Cologne (Federal Republic of Germany), Paris (France), Tokyo (Japan), Vienna (Austria), Warsaw (Poland), Washington DC (USA) and Zurich (Switzerland).

For further information contact:

M Jean-Luc Jeanroy
Director
Industrial Investment Division
UNIDO
PO Box 300
A-1400 Vienna
Austria

Telephone: 26310 Telex: 135612

2. Centre for the Development of Industry

The Centre for the Development of Industry (CDI) was set up in 1977 under the Lome Convention. Its role is help to establish or strengthen small and medium sized industries in 66 African, Caribbean and Pacific (ACP) countries, in cooperation with EEC industrialists.

For this purpose it offers a range of assistance including identification of partners, the co-financing of feasibility studies, help with negotiations and marketing, contributions to start-up costs, the provision of diagnostic studies and technical expertise.

CDI-assisted projects must meet the general priorities of ACP countries, such as job creation, substantial (manufacturing) value-added, maximum exploitation of local resources/raw materials, foreign currency earnings/savings.

CDI lists among the priority industries:

- cold storage
- leather industries (relevant for the leather garments and projects)
- low-cost housing (relevant for the strawboard project)
- feed milling (relevant for the straw pelleting project).

For more information, contact:

Dr. I A Akinrele
Centre for the Development of Industry
rue de l'Industrie 28
1040 Brussels
Belgium

Telephone: 5134100
Telex: 61427 cdib

APPENDIX C

INVESTMENT PROMOTION STRATEGY

IN SELECTED COUNTRIES

1 Brazil

The investment incentives can be grouped into non-tax and tax allowances.

a. Non Tax Incentives

A number of incentives are available in Brazil.

It is sometimes possible in certain municipalities to obtain land for industrial development at reduced prices. These grants are normally dependent on an undertaking by the investor to provide certain levels of employment.

An important aspect in studying an investment incentive relates to the possibilities of export potential of the Brazilian company. Brazil offers substantial financial as well as income tax incentives for those companies national or foreign owned which export manufactured goods from Brazil.

b. Tax Incentives

Incentives, principally tax related, fall under six major categories:

- regional incentives in the northeastern and northern regions of the country

- industry incentives for fishing, tourism, forestation and agriculture. There are also incentives for specific projects that are considered to be of national interest as approved by the CDI (Industrial Development Council) such as reduction of import taxes and accelerated depreciation

- incentives for exporters of manufactured products

- an addiitional tax deduction is available in respect of expenditure on approved employee training and meals programmes. Also exemption from a government training levy is available

- corporate income taxpayers may invest part of tax monies due in government approved investment projects

- Manaus free trade zone.

Certain states also offer favourable treatment in relation to value added sales tax (ICM) in the form of financing assistance of projects.

c. <u>Import Tax Exemption</u>

The Industrial Development Council (CDI) may grant exemptions or reductions in taxes arising on the importation of plant and equipment for approved industrial projects considered to be of national interest. In this connection, CDI may also authorise the utilisation of accelerated depreciation, which is deductible for income tax purposes, and preferential financing. Projects considered to be of national interest are generally those which involve definitive transfer of new technology, import substitution and increased exports. The principal industries benefitted are usually capital goods, shipbuilding, metallurgical, cellulose, chemical and petrochemicals and aircraft.

The CDI also ecnourages import substitution by authorising reductions in taxes on importation of raw materials to industries which udnertake to achieve 'nationalisation' (Brazilian substitution) targets for their products. Preferential financing from government sources is also authorised.

d. Export Incentives

Various incentives are available to exporters of manufactured products, these may be summarised as follows:

- exclusion from taxable income of an amount arrived by applying 'exploration (exploitation) profit' (as defined in the legislation) the proportion of the net income attributable to export sales which gross export sales of approved manufactured products bear to total sales

- exemption from withholding tax on export commissions paid to overseas agents

- exemption in certain cases from withholding tax on remittances of interest and other financial expenses related to exports

- deductibility of expenses incurred in the maintenance of foreign branch offices and for foreign market surveys and advertising (not available on remittances from a Brazilian subsidiary to its parent company abroad)

- exemption from excise tax (IPI) and sales tax (ICM) on exports of manufactured products

- approved export programmes by samll and medium businesses receive unpredictable benefits of up to 90 percent reduction of import duty and sales tax on machinery and equipment

- CACEX (the foreign trade department of the Banco do Brasil) has a fund 'FINEX', which provides finance on 20 to 40 percent of the value of goods exported in the previous year, and gives cheap (8 percent when inflation is more than that) loans to trading companies.

2. Kenya

Industrial incentives include:

- investment allowance of up to 20 percent of fixed capital investment

- accelerated depreciation on industrial buildings plant and machinery of different types

- 20 percent of FOB value of certain goods imported as inputs to manufactured export

- training grants

- reduced duty on imported inputs for exports

- exemption from ban on repatriation of profits, principal and interest on loans

The Industrial and Commercial Development Corporation (ICDC) provides low interest equity participation in projects.

The Industrial Development Bank is similar to the ICDC but for large projects.

The Kenya Industrial Estates is similar to the ICDC but for small projects.

Development Finance Company of Kenya provides finance, udnertakes feasibility studies and matches foreign and local resources.

3. Nigeria

The investment incentives are:

- exemption from tax on interest on foreign loans if they are long term (7 years or more)

- new large or Nigerian-controlled 'pioneering' public companies are exempted tax on profits, and withholding tax on dividends, for three years plus possible extensions

- less high tariffs for a few industries, based on distance from a port.

4. Tanzania

The investment incentives are:

- exemption from 'Business Licences Fee' ($70 - $900) at Minister's discretion

- exemption from duties on some imports for export, e.g. agricultural machinery, spare parts

- probable eventual compensation for nationalisation

- exemption to some exporters from ban on spending foreign exchange.

Repatriation of foreign capital requires the prior approval of the Bank of Tanzania.

Appointment of non-resident directors by any company incorporated in Tanzania rquires the prior approval of the Bank of Tanzania.

5. Yemen Arab Republic

The investment incentives are carried by Law 18 of 1975.

Profits can be transferred.

Capital can be repatriated (if liquidation occurs)

Nationalisation is to be compensated.

Workers can be brought in.

Investment requires permission.

Machinery equipment spare parts and building materials are exempt from taxes and customs and import dutis for 5 to 8 years (excluding port dues and other service charges).

Raw or primary products are given reduced customs duties and import taxes and duties 'to the extent of 25 pecent of their CIF value' for 5 years.

Projects are exempted commercial industrial or business taxes for 5 years, indsutrial projects may also be exempt from export duty tax.

The Government may ban imports/exports in order to protect new proejcts.

To qualify the project should demonstrate:

- savings in foreign exchange
- be sensible, sound, authorised and registered
- employ many Yemeni and train them
- minimum capital investment levels excluding land and buildings are:

	National Capital Projects (YR '000)	Foreign Capital Projects (US$ '000)	Joint Capital Projects (US$ '000)
Industrial	250	250	125
Agricultural	500	1,000	500
Livestock	500	1,000	500
Tourism Capital	5,000	5,000	2,500

Further, the investor:

- must give 6 monthly reports, and let officials visit
- must only use exempted items for the project
- must sell in the local market at price laid down by Law.

APPENDIX D

TERMS OF REFERENCE

1. BACKGROUND INFORMATION

1.1 The Development Projects study Agency (DPSA)

The Development Projects study Agency (DPSA) was established in 1980 under the Office of the National Committee for Central Planning (ONCCP) as the focal body for project preparation and appraisal in Ethiopia. Specifically, the principal purpose of the Agency, as laid down in Proclamation No. 175 of 30 January 1980, is:

(a) to identify, study and prepare projects which are relevant to the implementation of the central plan;

(b) to fix standards to be satisfied by all projects;

(c) to ensure that the projects which are identified, studied and prepared by other Government institutions satisfy the regional standards; and

(d) to provide consultancy services, upon request, to other government institutions engaged in the identification, study and preparation of investment proposals.

To fulfill these tasks, the DPSA is mandated to undertake the following activities:

1. **Identifying investment projects and preparing project profiles;**

2. **Preparing pre-feasibility and feasibility studies;**

3. **Carrying out appraisals of investment projects, including joint-venture proposals;**

4. Establishing methodologies for project appraisal as well as for the preparation of profiles, pre-feasibility and feasibility studies;

5. Identifying relevant technologies and options for unpackaging of technology;

6. Establishing an information system on matters related to investment and technology choice for the benefit of the DPSA itself and of other government institutions;

7. Preparing and implementing training programmes for professionals within and outside the DPSA; and

8. Providing assistance to other government institutions with respect to plant rehabilitation, technology choice, finance, marketing, etc.

During the 1981-83 period, the DPSA evaluated and/or reformulated more than 85 different investment projects. At the same time, it carried out two complete feasibility studies which, if sub-contracted to outside consultants, would have cost $150,000 to 200,000 each. Thus, substantial progress has been made during this period with UNIDO technical assistance. The DPSA, however, continues to receive technical assistance on a substantial scale in the following fields:

1. The Perspective Ten Year Development Plan includes a long and detailed list of potential investment projects which are to be realised during the coming decade. The DPSA is expected to play a central role in preparing and appraising these projects.

2. The DPSA is planning to expand its professional staff by more than 50% by the end of 1986.

3. Towards the end of 1983 an Apple III computer was delivered to DPSA and in mid 1985 an additional IBM PC/XT was acquired. A small group of professionals on the DPSA staff has received initial training in the use of the UNIDO Computer Model for Feasibility Analysis and Reporting (COMFAR). (The write-up on COMFAR is attached as Annex I). Further training in the use of COMFAR in project preparation is needed.

4. The mandate of the DPSA has recently been expanded to include also investment promotion, particualrly in the context of the Joint Venture Proclamation of Jnauary, 1985. Additional training is, therefore, required to build up the necessary expertise in the new field among the DPSA staff members.

1.2 Investment Projects and Proposed Profiles

As mentioned above, the Government has formulated a Ten-Year Perspective Plan in which about 300 industrial projects have been identified for implementation. However, most of these projects are still at the idea stage. The Government wishes to pursue a logical stage-by-stage process of project selection, first undertaking "opportunity studies" before embarking on full-fledged feasibility studies. The DPSA is currently being assisted by UNDP/UNIDO in building up national expertise in the above mentioned four different areas under DP/ETH/84/005-Assistance to the Development Projects study Agency, Phase II. However, its capability continues to be limited and the DPSA is certainly unable to cope with the workload generated by the ten year perspective plan, particularly in preparation of investment projects.

The Government has negotiated an IDA credit line and some portion of foreign currency has been allocated to the DPSA. In addition, UNDP also approved a US$360,000 contribution to the DPSA in order to share the costs with the Government for compiling at least 50 investment project profiles utilizing the integral part of the allocated funds.

The group of studies to be covered in the compilation of a portfolio are as follows:

(a) Chemical, Agro and Allied Industries;
(b) Engineering Industries;
(c) Projects Related to Existing Industrial Activities.

This terms of reference is prepared for compiling 16 investment profiles for projects related to existing industries. The projects are listed as Annex II.

The DPSA intends to compile each investment project profile in a comprehensive manner in order to provide the information as accurate as possible to the potential investors. The scope of the study is, therefore, to cover a financial and economic analysis as well as a detailed explanation of the selected technology and market analysis.

Each profile should consist of the following ten chapters. The length of each study report will be about 30 pages plus appendices.

1. Summary and Conclusion
2. Project Background and History
3. Market and Plant Capacity
4. Materials and Inputs

5. Location
6. Project Engineering
7. Plant Organization and Overhead Costs
8. Manpower
9. Implementaiton Schedule
10. Financial and Economic Evaluation.

An explanation ofeach Chapter is given in Annex III.

1.3 DPSA's Available Facilities and Professional Support

The DPSA has been developing self-reliance capabilities in the preparation of investment projects applying COMFAR for financial/economic analysis. They also adopted the UNIDO Manual for the Preparation of Indutrial Feasibility Studies as a conceptual basis of project preparation. Presently three DPSA staff members are fully abreast with COMFAR operations and most of the professional staff members who are engaged in project prepartion and appraisal have a sound professional basis in this field. Due to heavy commitments of individual staff members of the DPSA to the ongoing activities, however, substantial participation of DPSA staff in compilation of each opportunity study may not be feasible.

However, DPSA would agree to avail COMFAR facilities and DPSA staff members to run COMFAR to the extent possible for financial and economic analyses, should the selected foreign consulting firm deem this necessary and appropriate.

Furthermore, the DPSA continues to require training of their new staff members in mastering specific consultancy techniques in project preparation. In this respect, the DPSA is willing to assign their staff members to work together with the foreign consultants in the course of implementation of the entire consulting service not only for financial and economic analysis but also for data collection, technology selection, technical report writing etc. Specific proposals to involve DPSA staff members in the compilation of the portfolio are deemed valuable in terms of training DPSA staff members.

II. OBJECTIVES

The project is aimed at strengthening the Government's capacity to allocate its scarce investment resources in a rational and consistent manner. Specifically, it is aimed at providing the Government with the basis for a sound investment decision and practical promotional tools through the preparation of industrial opportunity studies.

III. SCOPE OF CONTRACTUAL SERVICE

1. **Complete 16 project profiles along the lines explained in the background information and Annex III and feed the necessary data to the summary sheets provided by DPSA during the field assignment.**

2. **Recommended practical investment promotion strategies and means of introducing identified projects to potential investors.**

IV GENERAL TIME SCHEDULE

A team of consultants will be fielded in May, 1986. The actual compilation of the profiles will be followed and is scheduled to be completed by the end of 1986. The allocation of man/months (m/m) in the home office and in the project area depends on the assessment of:

(a) time required for collecting technical data in the home office and field survey in the project area for the compilation of each profile.

(b) training elements of DPSA staff members, and

(c) utilization of DPSA COMFAR facilities or other financial analysis computer package already in use by the invitees.

Point A below is anticipated to be within four weeks after the closing date of the tender.

(a)	Award of the contract	A
(b)	Team leader arrives in Vienna (briefing)	A + 0.5 months
(c)	Consultants initiate field work	A + 0.6 months
(d)	Completion of the final report attaching the project profiles and project summary sheet	A + 7.0 months
(e)	Debriefing/submission of draft final report to UNIDO and DPSA	A + 7.5 months
(f)	Submission of final report	Within 30 days after receipt of comments on the draft final report.

V. <u>REPORTS</u>

A draft final report (in English) in three copies will be submitted to UNIDO and three copies will be submitted to the DPSA. 20 sets of the final report will be submitted to UNIDO after receipt of the comments of DPSA and UNIDO.

Annex II

List of Projects Related to Existing Industries

1. Cold storage
2. LPG cylinders
3. Vegetable dehydration for export
4. Leather garments
5. Strawboard
6. Castor oil
7. Gelatin for export
8. Straw treatment and pelletizing
9. Aerosol-insecticides, cleaners
10. Ammonium chloride
11. Indusrial gases
12. Regeneration of motor oil
13. Vegetable tannin
14. Detergents and other cleaning preparations
15. Lime stone based industries
16. Marble cutting & polishing for export.

Annex III

OUTLINE OF PROFILE PREPARED BY CONSULTANT

1. Summary and Conclusions

This section should summarize all conclusions and recommendations covering all critical aspects of the study.

2. Introduction and Project Description

State:

Name and address of project promoter
Project orientation: market or raw material oriented
Market orientation: domestic and or export
Economic and indsutrial policies supporting the project
Project background and description.

3. Market and Plant Capacity

Describe market potential and plant capacity, and list annual data on:

Demand analysis - domestic and export
Price analysis
Product quality
Projected sales
Production programme
Plant capacity

4. **Materials and Inputs**

Describe general availability of:

Raw materials
Auxiliary materials
Factory supplies
Utilities

List annual supply requirements of material inputs

5. **Location**

Describe location and state plant site if possible

6. **Project Engineering**

Describe layout and scope of the project
State technology recommended
Summarize equipment recommended
Describe required civil engineering works
Sources of technology

7. **Plant Organization**

Outline the organization

8. **Manpower**

State selected type and size of labour force
State selected type and size of staff
Identify training requirements

9. <u>Implementation Scheduling</u>

Duration of plant erection and installation

10. <u>Financial and Economic Evaluation</u>

Total investment costs:

List major investment data in local and foreign exchange, as needed, for:

Land and site preparation
+ Civil engineering works
+ Technology and equipment
+ Pre-production capital costs
+ Working capital

= Total investment costs

Total production or manufacturing costs (at feasible normal capacity)

List annual data for:

Factory costs
+ Administrative overheads
+ Sales and distribution costs

= Operating costs
+ Financial costs
+ Depreciation

= Total production or manufacturing costs

Financial evaluation:

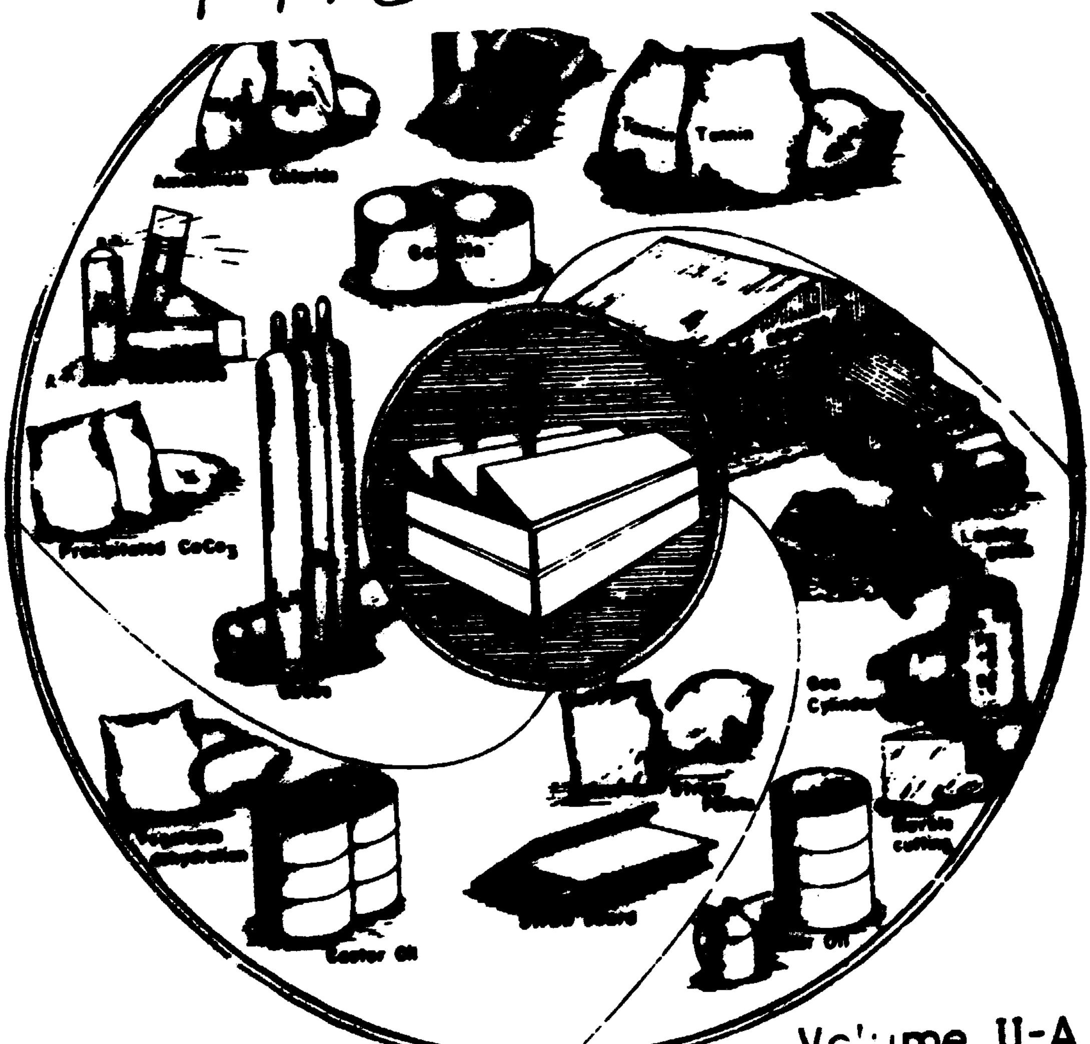
Net present value
Internal rate of return
Pay-back period
Simple rate of return
Break-even analysis
Sensitivity analysis
Required financial statements
Financial ratios

Economic Evaluation appraise the project proposal from the national economic point of view.

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

17160 (2of5)



Volume II-A
Final Report

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

VOLUME II - A

AUGUST 1988

INDUSTRIAL PROJECTS SERVICE

PROJECT NUMBER 001/40 - 79

TABLE OF CONTENTS

VOLUME I

- A -

PRECIPITATED CALCIUM CARBONATE

TABLE OF CONTENTS

I. SUMMARY

The precipitated calcium carbonate project is expected to produce pure calcium carbonate which has a lot of industrial application, mainly as filler material. At the present time, the volume of calcium carbonate imported into the country is in the order of 3100 tons a year.

Limestone deposit which is available in 10 of the 14 regions of the country in abundant quantity is the sole raw material used to produce precipitated calcium carbonate.

The investment in machinery and equipment of an independent automated plant is estimated at about Birr 14.6 million, while that of a semi-automated plant is estimated to be about Birr 13.1 million. The foreign currency component will be about 80% in both cases.

The direct contribution of the project in the form of employment will depend on the level of automation adopted. If an automated plant is considered the number of workers would be around 60 persons. However, if the plant considered is a semi-automated one then the number of workers could be as high as 109, with corresponding wage bill variations.

The building size was estimated at 2,000 m^2.

The internal rate of return of the independent automated plant was estimated to be 15.61% with a net present value of Birr 6.25 million discounted at 10% pa. When the project is integrated within the envisaged lime plant the IRR would turnout to be 29.53% with a net present value of Birr 12.4 million discounted at 10% p.a. because of a reduction in fixed investment cost as a result of the integration.

The economic rate of return of the independent automated plant turned out to be 24.48 with a net present value of Birr 17.72 million discounted at 10% p.a. This rate of return is estimated to be 45.94% with a net present value of Birr 25.47 million discounted at 10% p.a. under the integration.

II. INTRODUCTION

Precipitated calcium carbonate is an important chemical in many industrial processes, such as paper, plastics and rubber industries. However, due to the low level of development of these basic industries in Ethiopia, the demand for PCC has remained relatively low.

Due to the nature of the raw material, which is limestone and as well as the final product PCC, the project is raw material oriented. The project is an import substituting one and will be completely based on local raw material.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

In its natural state calcium carbonate, mainly chalk, marble or limestone, is found in various qualities and quantities in many countries throughout the world. Many of these rocks are composed of the skeletal remains of tiny sea-creatures. Limestones may be produced by the cementation of carbonate sand grains derived by erosion from a former carbonate landform (hill, platform). Limestone might also result from direct precipitation in seawater, in which case it is a chemical rock, like salt, whose formation has been governed by such factors as water, temperature, pressure and the concentration of the solution.

Since the three types of carbonate sediments may be mixed while they are still in the depositional environment or may be modified by various post-depositional changes, the final product may be a rock with a very complicated history. They represent about 20% of all sedimentary rocks and occur in all continents.

In Ethiopia, limestone is found in large deposits in the Harrerghe, Shewa, Sidamo, Bale, Gojjam, Tigrai, Arssi, Wellega, Wello and Eritrea regions. It is extracted in many quarries in the country to manufacture cement, lime, etc.

Calcium carbonates have a variety of economic uses. As building stone, limestones and dolomites (limestone containing more than 5% magnesium carbonate) are used for monuments, exterior and interior facings and flooring of several kinds. Crushed rock is used for railroad ballast, riprap fill (broken rock used to protect structures from the natural process of erosion) around the bases of dams and piers, filter beds in sewage treatment and for surfacing of airports. The heating of limestones and magnesium limestones to a temperature of 900°C - 1000°C will dissociate limestone into lime and carbon dioxide. Lime has major applications in the construction industries, for the manufacture of glass and for agricultural purposes. Cabronate rocks are also common host rocks for many ore deposits, because they are easily attacked by high temperature solution that precipitate ore minerals.

Although, the envisaged project is on limestone based industries, lime and chalk are produced in the country in sufficient quantities for the local market. This study is specifically on calcium carbonate which has many industrial applications. The chemical, paper and rubber industries are expected to boost their production in the near future by increasing the current output and at the same time creating new capacities. This activity will result in a significant increase in the demand for calcium carbonate as filler/extender material.

The traditional application of fillers and extenders was to reduce the cost of the compound by lessening the amount of the expensive resin required to make it a functional part. The conventional role of fillers still exists, although the stress on fillers has gradually shifted toward physical property modification and improvement. Mineral fillers are being evaluated with the aim of creating compound properties which are not obtainable without them.

Calcium carbonate continues to play a crucial role in the filler market. It is available in different particle sizes. It is white, non-toxic, easily dispersed when used. Natural ground limestones can be purchased in various grades and sizes. Surface treated compounds of both ground natural and precipitated calcium carbonate are also available.

The coarser, and cheaper grade of calcium carbonate can be considered strictly as fillers since their primary function is to extend the resin. The finer grades, however, offer a physical property improvement and can be considered as functional fillers of particle size.

Generally speaking, calcium carbonate is extracted by an open cast mining method, whether they be marble, chalk or limestone. Thereafter, the processing is determined by the quality of the raw material as well as the end-use of the refined product.

The paper industry is increasingly using calcium carbonate in slurry form, while manufacturers of paint, rubber and plastics generally opt for dry powder.

The application of calcium carbonate in the paper industry as a filler would improve the appearance of printing and writing papers. Without it, a high quality printing material would be difficult to attain.

Calcium carbonate is used in the manufacture of paper and board as a filler and as a surface coating to improve its printability. This product is also required to fill the interstices of the cellulose fibres which are the main constituents of a sheet of paper. The amount of filler material required varies considerably with the type of paper. For instance, a quality magazine page may contain upto 30% by weight.

Calcium carbonate is also used in the rubber, paint and plastics industries. In the rubber industry, it is used as fillers in particle size, and when fine, it gives strength and quality to the rubber. The paint industry uses calcium carbonate fillers as extenders, as they are commonly referred to, partially to replace expensive prime pigments.

Plastics however, represents the most exciting field. Recent filler evaluations in polymer systems and end-use applications, which traditionally were unfilled, indicates this shift in interest. Lately, in order to improve the quality of weatherable PVC compound, fine particle sizes of precipitated calcium carbonate have been used. The current application areas in the plastics industry include polyester moulding compound, vinyl plastisols, elastomers, PVC, vinyl floor tiles, flexible and rigid PVC, polypropylene, urethanes and polyethylene.

2. Past and Future Demand Analysis

As mentioned earlier in this study,there are many applications for calcium carbonate. These applications include additives in animal feedstuff, coating of some fertilizers, in the production of insecticides and herbicides, and as filler material in the pulp and paper, paint, plastic and rubber industries. In this study, therefore, the demand for calcium carbonate was basically assessed by taking into account the anticipated production plans of paper and pulp, paint, plastics, and canvas and heavy duty shoes.

According to the Plastics Sector Survey undertaken by the Industrial Projects Service (IPS), the present requirement of precipitated calcium carbonate by the paint, paper, plastics and rubber industries is estimated at 3060 tons per year.

This demand level is anticipated to increase significantly in the near future. The increase in demand is assumed to result from the substantial increase in the production of those outputs which require precipitated calcium carbonate in the production processes. The most important projects which would require precipitated calcium carbonate are the implementation of a bagasse pulp project, and in the plastic industry, the introduction of new product lines, such as flexible PVC land drainage pipes, rigid PVC pressure pipes for water distribution and PVC bottles for edible oil and mineral water. Thus a combination of these plans will increase the requirement of precipitated calcium carbonate.

The demand assessment for precipitated calcium carbonate was, thus, carried out taking into account the following requirements:

- The filler material requirement in the plastics industry was estimated by taking into consideration past plastics production and the volume of precipitated calcium carbonate consumed in the same period. The amount of calcium carbonate used during the same period amounted to an average of 15% in weight and it was assumed that this consumption rate will continue in the future.

- The amount of calcium carbonate consumed in the paint industry represented about 23% per unit of output. This percentage was applied to the production anticipated in the Ten-Year Perspective Plan to estimate the future requirement of precipitated calcium carbonate for paint production. The anticipated production of paint, starting from 3900 tons in 1985, reaches 10,500 tons[1] in 1988 and remains at this level until the end of the Plan period.

---

1 Source: ONCCP.

- The consumption coefficients of calcium carbonate for heavy duty and canvas shoes was estimated to be 250 and 320 grams per pair of shoes, respectively. These figures were supplied by the National Leather and Shoe Corporation.

The demand projection for precipitated calcium carbonate was carried out on the basis of the anticipated requirement by the industries indicated in Table I. According to this projection, the demand starts at 4603 tons in 1988, increasing to 8658 tons in the year 2003 (See Table I).

It is worth noting at this juncture that the projected demand level is subject to the anticipated increase in the production volume of the various items, that use calcium carbonate as an input, the introduction of new product lines and, the implementation of the projects indicated in the preceding paragraphs. But, without the realization of these plans, the demand projection shown in Table I will be on the high side.

3. Pricing

The current FOB price of precipitated calcium carbonate ranges from US$450 to US$800 per ton, depending on the grade and whether it is coated or not. However, Addis Tyre Co., S.C. which uses PCC as a filler material in the production of tyres, purchased it at a price (landed cost) ranging from Birr 943.22/ton to Birr 1020/ton in 1987[1].

---

1 Addis Tyre Co. S.C., Addis Ababa.

TABLE I

DEMAND FORECAST FOR CALCIUM CARBONATE

(TONS)

Year	PROJECTED DEMAND				
	Paper Industries	Paint Industries	Canvas & Heavy Duty Shoes	Plastics Industries	Total
1988		2415	1727	461	4603
1989		2415	1914	539	4868
1990		2415	2122	631	5168
1991	392	2415	2353	738	5898
1992	445	2415	2610	864	6334
1993	485	2415	2896	1011	6807
1994	505	2415	3215	1182	7317
1995	525	2415	3541	1382	7863
1996	525	2415	3541	2065	8546
1997	525	2415	3541	2177	8658
1998	525	2415	3541	2177	8658
1999	525	2415	3541	2177	8658
2000	525	2415	3541	2177	8658
2001	525	2415	3541	2177	8658
2002	525	2415	3541	2177	8658
2003	525	2415	3541	2177	8658

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The demand estimate for precipitated calcium carbonate reachs 8658 tons by 2003, whilest the minimum economic scale of a precipitated calcium carbonate plant is 15,000 tons per year.

In other words, the projected demand volume represents 58% of the minimum economic scale. To make the project a viable proposition, however, it may be necessary to consider two lime products, namely, quicklime and hydrated lime, which result from calcium carbonate manufacturing.

These two products have a wide range of applications, of which the important for the Ethiopian economy are a bonding agent in kraft paper production, bleaching of paper pulp, raw material for alkali manufacture (e.g. soda ash, bicarbonate of soda and caustic soda), raw material in the production of calcium carbide and as a filler in insecticides, absorbant for chlorine, in water treatment, as a sanitation aid in treatment of sewage and industrial waste, raw material in the production of glass, refractories, sand-lime bricks, cellular concrete products, in food production (e.g. production of sugar, gelatin), to dehair hides in leather tanning, as fertilizer, and as a flux in road construction.

The production of PCC could be incorporated into a complex, manufacturing other limestone products (e.g. quicklime and hydrated lime). One good opportunity to integrate the production of PCC is in the envisaged lime plant at Dire Dawa (120,000 tps) to be implemented by the Ethiopian Cement Corporation (ECC).

It is conceivable that the plant could produce only 9000 tpa of PCC within the complex of the lime plant. Thus in addition to a stand-alone PCC plant, an alternative costing has been worked out (for financial and economic analyses) on the basis of the planned lime manufacturing complex.

2. Production Programme

Assuming that the envisaged plant would start production in 1992, the capacity utilization of the plant would be 42% in the first year. The capacity utilization will reach 45% in the second year. After seven years of the start-up, the demand for PCC will reach 8658 tons and the plant would be operating at 58% of its full capacity. The production programme and the capacity utilization are given in Table II.

TABLE II

PRODUCTION PRGORAMME AND CAPACITY UTILIZATION

Year	Projected Demand (Tons)	Production Programme (Tons)		Capacity Utilization (%)
		Dry Form	Slurry Form	
1992	6334	5889	445	42
1993	6807	6322	485	45
1994	7317	6812	505	49
1995	7863	7338	525	52
1996	8546	8021	525	57
1997	8658	8133	525	58
1998	8658	8133	525	58
1999	8658	8133	525	58
2000	8658	8133	525	58
2001	8658	8133	525	58
2002	8658	8133	525	58
2003	8656	8133	525	58

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

1. Limestone

Ethiopia has enormous reserves of limestone to meet any future requirements. Limestone deposits in Ethiopia have a wide geographic distribution and a large stratigraphic range. The stratigraphic relations have been surveyed by a number of geologists and it is known that the age of these limestones ranges from Jurassic to Quaternary .

Substantial amounts of Jurassic limestone have been found in the Tigrai, Shewa and Harrerghe Administrative Regions , but the largest zone is located in the Ogaden.

Most of the quarries are located near the Addis Ababa - Asmara road. Other small quarries are located in various parts of the country. The major limestone deposits in the country are discussed briefly below .

a) Arssi

Limestone deposits are known to exist at about 150 km south-east of Addis Ababa.

b) Gojjam

Light-grey limestone deposits are found at the southern embarkment of the Blue Nile, 200 km from Addis Ababa.

c. Harrerghe

Substantial reserves of limestone are known to exist near Dire Dawa, where a cement factory is located. The variety is dark gray, compact and finely crystalline, and breaks with a conchoidal fracture.

d. Shewa

The largest deposit in Shewa is located in Mugher with a potential reserve of more than 25,000,000 tons. A relatively large deposit of limestone occurs in Ambo, 130 km from Addis Ababa.

e. Sidamo

The limestone of the Eastern Plateau can be reached by the Addis Ababa - Kebre Mengist - Neghele road. The material dresses easily and has an attractive appearance.

f. Tigrai

Considerable deposits of limestone are found in Tigrai.

In general the estimated reserves in Harrerghe, Tigrai, Bale, Shewa, Wello and Arssi could meet the total requirement for liemstone for many years to come.

2. OTHER MATERIALS

Other raw materials required in small quantities are oil and greases, salt and laboratory chemicals.

B. INPUTS

1. Utilities

a. Water

The consumption of water per ton of PCC is estimated at 10 m^3.

b. Electricity

The electric consumption will depend on the market need for a dry product as opposed to the filter cake. As a rule of thumb, the cake contains about 40% PCC. Therefore, 1.5 tons of water has to be removed to get 1 ton of water-free PCC. The energy required is around 1,500 kWh per ton of dried product.

c. Fuel Oil

The fuel oil requirement per ton of end-product was assumed at 0.1 ton. It must be noted that the production process is energy intensive. As such, attention to energy saving and recovery methods will be important in the plant design. Furthermore, good maintenance practices and careful monitoring of the operation will be essential to keep the costs under control.

C. RAW MATERIAL REQUIREMENT AND SUPPLY PROGRAMME

1. Limestone

For the production of precipitated calcium carbonate (PCC), the principal raw material is limestone. The plant needs a regular supply of limestone, containing a high percentage of calcium carbonate, preferably 95%. The purer the liemstone, the more efficient will be the productivity of the plant, (e.g. less impurities to dispose of, more calcium cabonate being burnt). A good raw material to final product yield will be 1.1:1, allowing for a 5% loss during the process and the elimination of impurities.

2. Resins, Fatty Acids, Wetting Agents

Resins, fatty acids and wetting agents are used for PCC coating, depending on the application of the final product.

The annual supply programme of the principal raw material, i.e. limestone has been worked out taking into account the planned production programme. (See Table III).

D. MATERIAL AND INPUT COSTS

1. Cost of Raw Material

The cost of the limestone was estimated at Birr 40/ton. The annual cost of other minor materials (oil and greases, salt laboratory chemicals) was estimated at Birr 62,100/year.

TABLE III

ANNUAL SUPPLY PROGRAMME OF LIMESTONE

INPUT	UNIT	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Limestone	ton	6967	7487	8048	8650	8823	9400	9523	9523	9523	9523	9523	9523

2. Cost of Utilities

Electricity

The cost of electric power will be Birr 0.22/kWh.

Fuel Oil

The cost of fuel oil will be Birr 581/ton.

Packing Materials

Packing costs for PCC in 50 kg sacks will amount to about Birr 114,000/year.

Fuel For Vehicles

The total annual cost of fuel for vehicles was estimated at Birr 20,000.

V. LOCATION

The location of the proposed plant should be preferably near the source of the major raw material. It is thus recommended that the plant be located either at Mugher or Dire Dawa, where large reserve of limestone is available. The former location has the advantage of proximity to the market as the main end-users of PCC are concentrated in Addis Ababa, while in the latter case, the plant can be built as an attachment to the envisaged lime plant to make the production competitive. However, the production of PCC and other refined minerals in general involves the use of very large amounts of energy - much more than with many other industries (See Chapter IV, B) and if the plant is to be integrated within the envisaged lime plant at Dire Dawa, additional infrastructural cost will have to be considered as the vailable power at Dire Dawa does not meet the required energy to run the plant. Alternatively, other cheap sources of power (e.g. heavy fuel oils) and low energy processes for drying PCC should be investigated at the feasibility stage of the study.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Manufacturing Process

PCC was first produced in 1850 by J & E Sturge Ltd. in Birmingham, UK. This company still operates the technology although it is now part of the large multi-national mining company, Rio Tinto Zinc. Its main competitor as far as technology is concerned is Pfizer Inc., a large American chemical company.

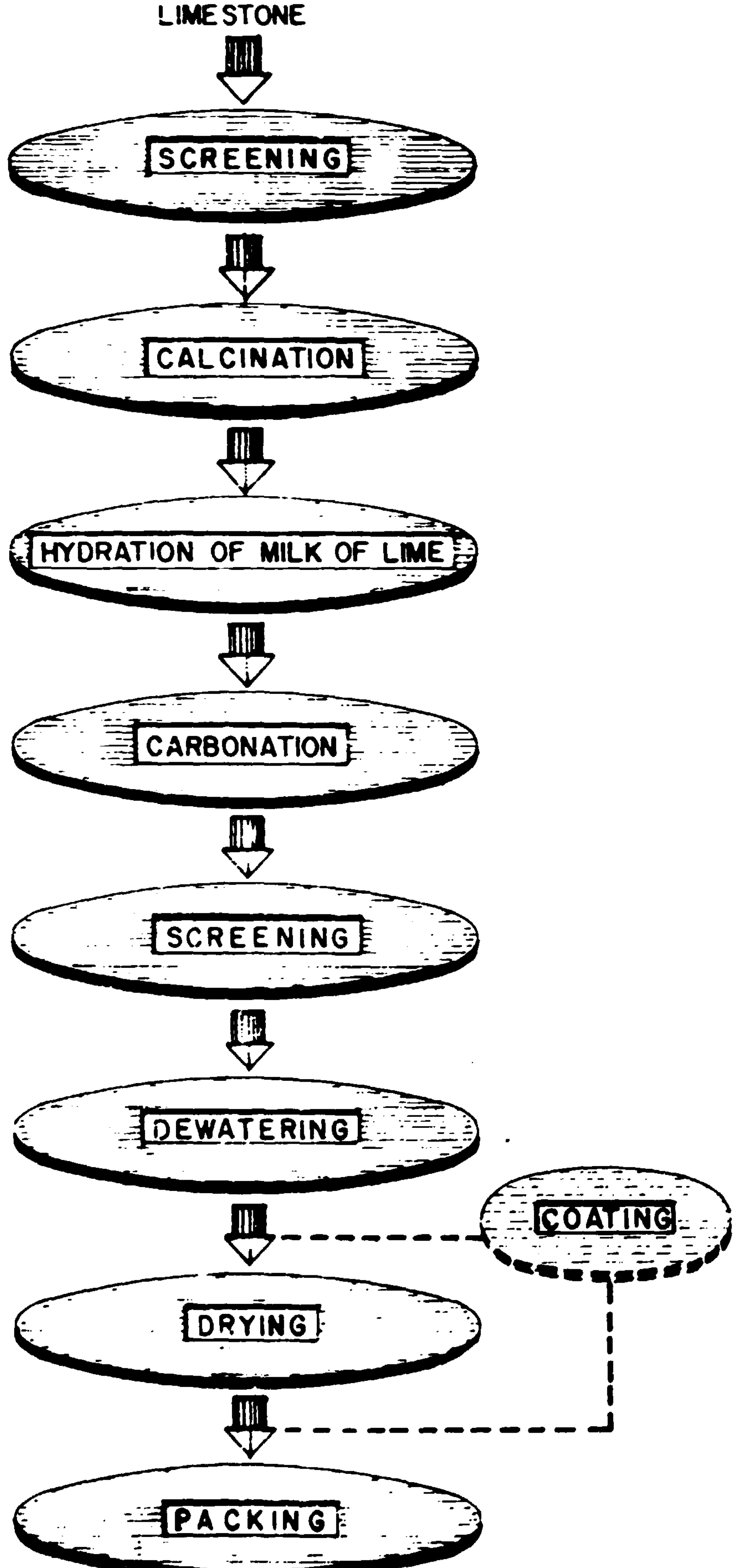
PCC can be produced by several methods but only the carbonation process is commercially used as it is the simplest and most direct route using limestone which is a readily available and relatively low cost raw material. In this connection, it must be noted that about 16,000 tons of precipitated calcium carbonate will be made available as by-product when the envisaged caustic soda plant starts production in 1990. However, it will be recycled to be used as a raw material of the plant.

The limestone should be low in iron and magnesium, especially if colour is an important end use factor, e.g. for paint.

The objective of the process is to separate out the impurities in the raw limestone and form a purified calcium carbonate. The steps, which are summarised in Figure I are as follows:

FIGURE I

PROCESS FLOW CHART OF PRECIPITATED CALCIUM CARBONATE (PCC) PRODUCTION



a. Calcination

The limestone is calcined in a kiln using a clean fuel such as natural gas or LPG, to obtain carbon dioxide and quicklime. Both these products are recovered and purified.

b. Hydration or Slaking

The quicklime is mixed with water to produce a milk-of-lime or hydrated lime.

c Carbonation

After being cooled and purified, the carbon dioxide gas is bubbled through the milk-of-lime in a reactor. When the calcium hydroxide has been converted to the carbonate, the PCC is made and exists in a slurry of water and impurities awaiting separation.

d. Screening

The impurities remaining in the slurry are coarse particles in comparison to the micro-sized PCC and therefore can be easily sieved out of the mixture.

e. Dewatering

The mixture is thickened by using, a pressure belt filter or a rotary vacuum filter or both.

f. Drying

After dewatering, the filter cake contains 25% and 60% of solids. The final drying, if necessary in a cake form acceptable in some applications, is carried out in one of a range of drying types, viz., rotary, tunnel, spray or flash.

g. Coating and Packing

Some grades are coated with fatty acids, resins and wetting agents depending on the application. The coating can be applied before or after the drying process. The material may be milled if the size of grain is critical to the end use. Then the product is either stored in bins awaiting bulk shipment, or filled into 25 kg bags A typical specification for the paint industry for example is:

Minimum % $CaCO_3$	: 98% (water free)
Maximum % H_2O volatiles	: 1%
Fineness	: below 20 microns
Maximum % retained No. 325 sieve:	1%
Maximum alkalinity NaOH per/g.	: 0.5 mg

2. Source of Technology

The international markets for PCC are stable or marginally declining. As a result, companies are not keen to license new production which effectively increases the world supply and reduces the market share of the existing producers. Similarly, a joint venture production is not favoured at present. On the other hand, Sturge and Pfizer may possibly respond positively to an invitation to build such a plant.

Their addresses are:

J. & E Sturge Ltd.
Lifford Chemical Works
Lifford Lane
Birmingham B30 3JW
UK

Pfizer Inc.
235 East 42nd Street
New York, NY s10017
USA

B. ENGINEERING

1. Machinery and Equipment

The key items of equipment are the kiln, the drier and rotary vacuum filter. These alone account for 60% of the capital costs.

The costs vary according to the level of automation. The latest technology is completely automatic requiring only a 'minder' to monitor the production process. Less automated systems are available, although the capital cost saving is relativley small. Therefore the automated plant is recommended in this study. (See Table IV for details of the capital investment).

2. Plant Layout

The building size was estimated at 2,000 m^2. The site has to be 3 times to accommodate storage yards, transport and maintenance facilities, lorry movements, settlement beds and storage depots.

TABLE IV

TOTAL FIXED INVESTMENT COST

('000 BIRR)

Description	Semi-Automated Plant			Automated Plant		
	F.C	L.C	Total	F.C	L.C	Total
Lime kiln	3,105	-	3,105	3,105	-	3,105
Reactor	1,242	-	1,242	1,242	-	1,242
Flash dryer	2,277	-	2,277	2,277	-	2,277
Rotary drum vacuum Filter	828	-	828	828	-	828
Other equipment (e.g screens, conveyors depending on the level of automation)	828	-	828	1863	-	1863
Spares	372	-	372	465	-	465
Total Equipment Cost	8,652 (4,305)	-	8,652 (4,305)	9,780 (5,433)	-	9,780 (5,433)
Freight (10% of FOB)		865 (430)	865 (430)	-	978 (543)	978 (543)
Total Machinery & Equipment	8,652 (4,305)	865 (430)	9,517 (4,735)	9,780 (5,433)	978 (543)	10,758 (5,976)
Erection	840 (447)	360 (191)	1,200 (638)	840 (447)	360 (191)	1,200 (638)
Local Cost (12.5% of C & F)	-	1,189 (591)	1,189 (591)	-	1,344 (747)	1,344 (747)
Total cost of machinery equipment (incl. 10% contingency)	10441 (5,227)	2655 (1,333)	13096 (6,560)	11682 (6,468)	2950 (1,629)	14632 (8,097)

NOTE: Figures in brackets are cost estimates (without lime kiln and reactor) for a PCC plant within a lime manufacturing complex.

Table IV (Cont'd)

Description	Cost ('000 BIRR)		
	F.C	L.C	TOTAL
BUILDING AND CIVIL WORKS			
Building Cost	540	1,260	1,800
Site Development (2% of building cost)		36	36
Outdoor Works (Sewage, drainage, piping etc. 10% of building cost)		180	180
Total building and Civil Works Cost (incl. 10% contingency)	594	1,624	2,218
SERVICE EQUIPMENT			
Office Furniture and Equipment	15	35	50
VEHICLES			
Service car	18	7	25
Pick-up	28	12	40
Total vehicle cost includ-ing 10% contingency)	50	22	72

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of a plant capable of producing 15,000 tons a year of PCC is given in Figure II.

The plant would be headed by a Plant Manager who would be responsible for the overall activities of the factory. It will have a Production Division, Accounts Division, Administration Division and Commercial Division.

B. MANPOWER

The manpower requirements vary according to the degree of automation. The difference between a fully automated and a semi-automated plant is given in Table V.

It is assumed that the plant will operate for 330 days a year on a 24 hour basis. This will require 4 shift production team. The number of packers depends on the amount required to be bagged. A nominal number has been suggested. They will work one 8-hour shift a day.

The production head and the five laboratory technicians will require about 3 months training on the properties of the product and how to achieve them. There are about 15 variables which can be manipulated to produce different grades of PCC.

The supervisors and operators can be trained during the plant commissioning.

FIGURE II

ORGANIZATION CHART OF PCC MANUFACTURING PLANT

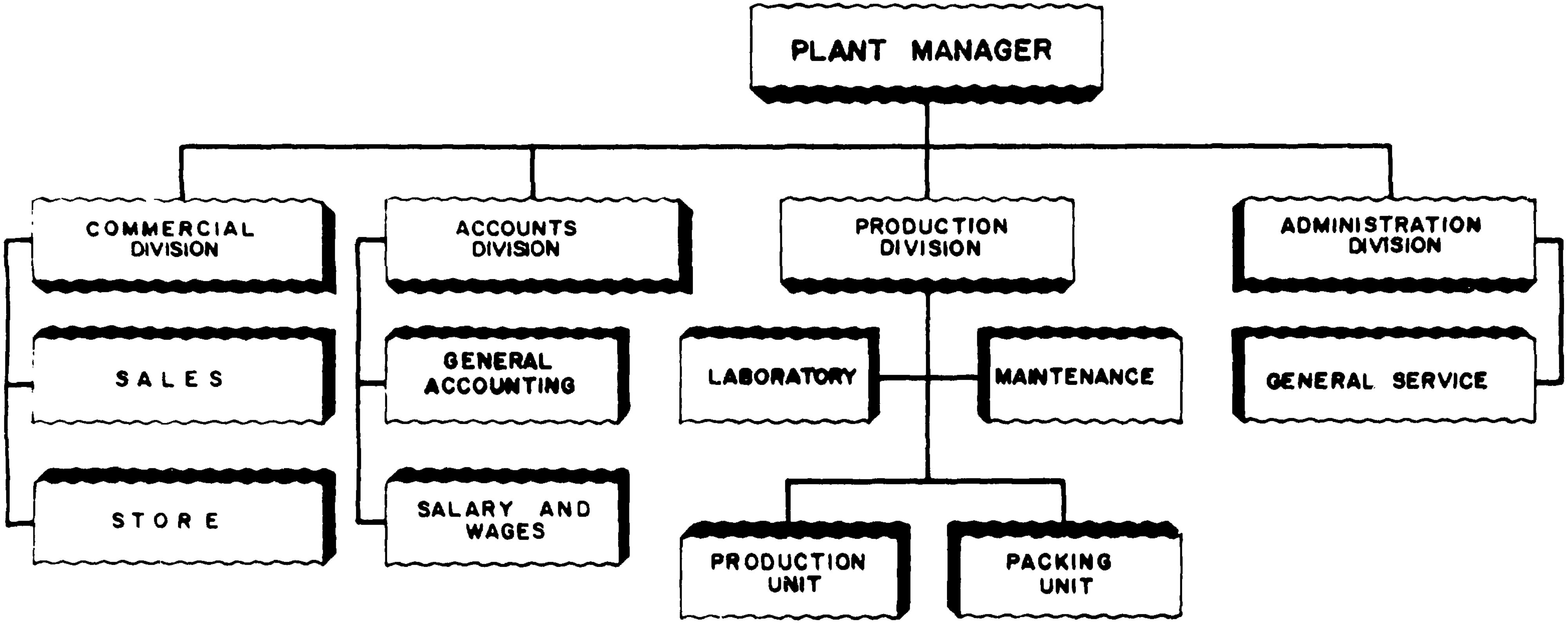


TABLE V

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. of Shifts	Automated Number Of Employees	Semi-Automated Number Of Employees	Skill Level (BIRR)	Monthly Salary/ Person (BIRR)	Total Annual Salary (Birr)	Remark
Plant Manager	1	1	1	Proj./Tech.	1200	14,400	
Secretary	1	1	1	Sk	350	4,200	
Production Manager	1	1	1	Proj./Tech.	1000	12,000	
Accountant (Chief)	1	1	1	SK	700	8,400	
Accountant	1	1	1	SK	450	5,400	
Clerk	1	2	2	SK	250	6,000	
Administrator	1	1	1	SK	600	7,200	
General Service	1	2	2	SK	350	8,400	
Commercial, Head	1	1	1	SK	600	7,200	
Sales	1	1	1	SK	450	5,400	
Storekeeper	1	1	1	SK	250	3,000	
Shift Supervisor	4	-	4	SK	500	24,000	
Operator	4	4	48	SSK	150	7,200	(automated)
						86,400	(semi-automated)
Packer - bagging	1	3	3	SSK	120	4,320	
- bulk	1	1	1	SSK	120	1,440	
Labourer/loader	4	16	20	USK	90	17,280	(automated)
						21,60	(semi-automated)

TABLE V (Cont'd)

Personnel	No. of Shifts	Automated Number Of Employees	Semi-Automated Number Of Employees	Skill Level	Monthly Salary/ Person (BIRR)	Total Annual Salary (Birr)	Remark
Maintenance, Head	1	1	1	SK	700	8,400	
Maintenance Personnel*	4	5	5	SK	450	27,000	
Laboratory Technician	1	5	2	SK	450	27,000	(automated)
						10,800	(semi-automated)
Driver	1	2	2	SK	250	6,000	
Guard	3	6	6	USK	90	6,648	
Cleaner	1	2	2	USK	70	1,680	
Messenger	1	2	2	USK	70	7,680	
TOTAL (Incl. 25% employment benefit)		60	109			267,600	(automated)
						351,750	(semi-automated)

* Extra fitter on the main day shift.

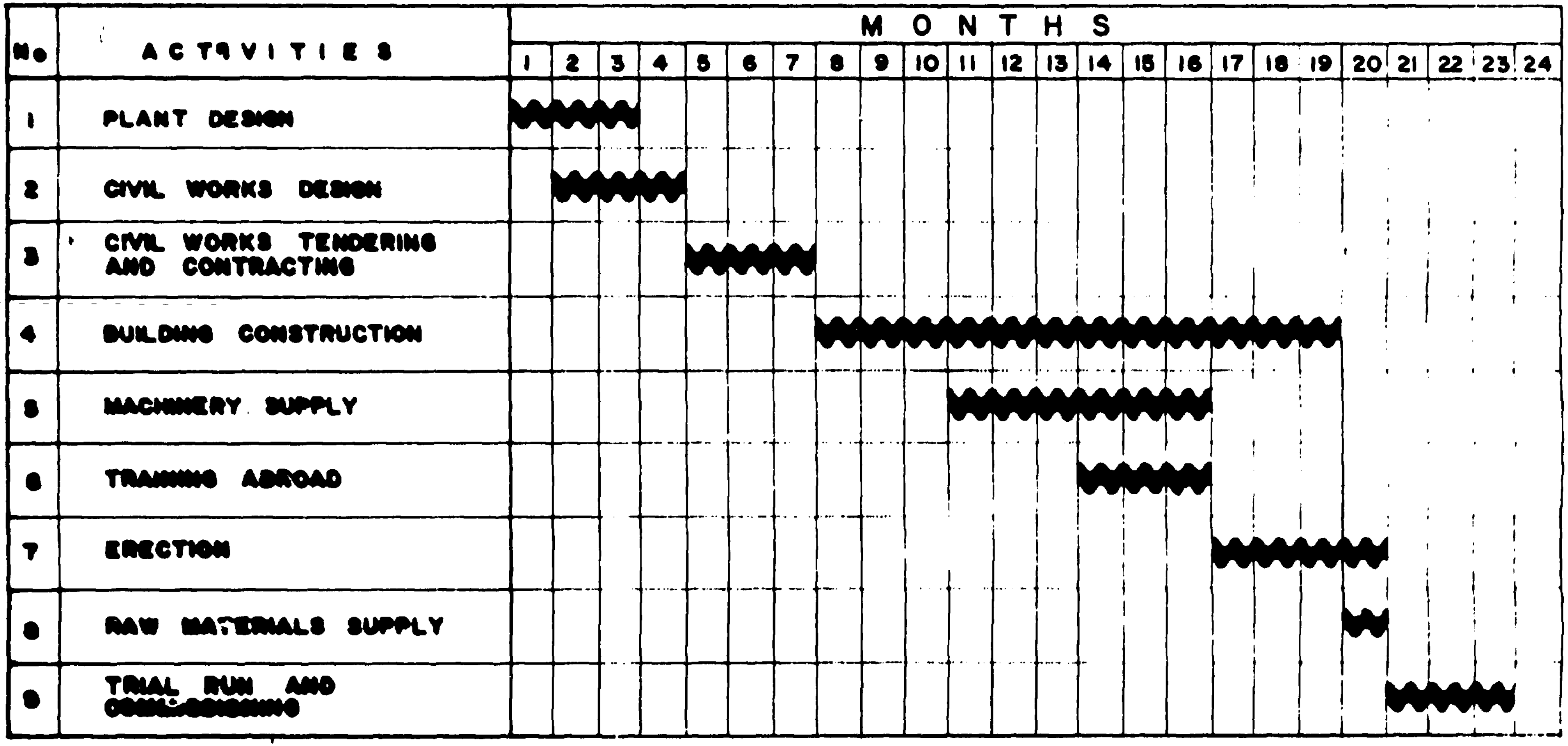
Skill distribution	Automated	Percent	Semi-Automated	Percent
Professional/technical	2	3.3	2	1.8
Skilled (SK)	24	40	25	23
Semi-skilled (SMSK)	8	13.3	52	47.7
Unskilled (USK)	26	43.3	30	27.5
TOTAL	60	100	109	100

VIII. IMPLEMENTATION SCHEDULE

An indicative implementation schedule depicting the main activities has been worked out and is given in Figure III. The establishment of the plant starting from the plant design to the trial run and commissioning will take about 23 months.

FIGURE III

IMPLEMENTATION SCHEDULE OF PCC PLANT



IX. FINANCIAL AND ECONOMIC EVAUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost for the automated plant is shown in Table VI.

TABLE VI
SUMMARY OF THE INITIAL INVESTMENT COST
('000 BIRR)

	Currency		
	Foreign	Local	Total
Buildings and Civil Works	594.00	1624.00	2218.00
Plant Machinery and Equipment	11682.00	2950.00	14632.00
Office Furniture and Equipment	15.00	35.00	50.00
Vehicles	50.00	22.00	72.00
Preproduction Expenditure	30.49	274.41	304.90
Total	12371.49	4905.41	17276.90

The foreign currency component of the total initial investment cost will be about 72%. About 94% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the net working capital requirements of the precipitated calcium carbonate plant.

Item	Months of Coverage
1. Cash in hand	0.5
2. Accounts Receivable	1.0
3. Raw Materials	1.0
4. Work in progress	0.5
5. Finished products	1.0
6. Accounts payable	1.0

The net working capital requirement on the 7th year of production amounted to Birr 0.69 million. About Birr 0.10 million of the total net working capital will be rquired in foreign currency. This represents about 15% of the total net working capital requirements.

3. Production Costs

The detailed production cost estimation is given together with other required financial statements.

The total production cost on the fifth year of production amounts to Birr 4.81 million, out of which about 28% is in foreign currency.

4. Internal Rate of Return (IRR)

The financial analysis of the precipitated calcium carbonate plant was worked out under two alternatives.

The first alternative was to establish an independent calcium carbonate plant at Mugher. Under this alternative the internal rate of return calculated was 15.61% with a net present value of Birr 6.25 million discounted at 10% p.a.

The second alternative considered was the integration of the precipitated calcium carbonate plant within the envisaged lime plant at Dire Dawa. The fixed investment cost will reduce by Birr 2.64 million if the integration is to be adopted. The internal rate of return calculated was 29.53% with a net present value of Birr 12.4 million discounted at 10% p.a.

In this study the selling price assumed for the financial analysis was Bir 1240 per ton. It was built up based on the F.O.B. price of US $450 per ton. In fact the current FOB price of precipitated calcium carbonate ranges from US$ 450 to US$ 800 per ton, depending on the grade and whether it is coated or not. For this project US$450 has been used as a base to establish the domestic selling price based on the experience of Addis Tyre Co., S.C. Addis Tyre Co. S.C. uses PCC as a filler material in the production of Tyres. It purchased PCC at a landed cost ranging from Birr 943.22/ton to Birr 1020/ton in 1987.

The sensitivity of the project to a decrease in the selling price was also analyzed. If the selling price of PCC is assumed to be Birr 980 per ton, the internal rate of return will become 9.1%. In order to make the project viable the selling price should, therefore, be more than Birr 1000 per ton.

5. Breakeven Analysis

Taking the 6th year of production as a base, the breakeven point would be reached at a production of 3800 tons of precipitated calcium carbonate. The total revenue generated at the breakeven point would be Birr 4.71 million. The breakeven point could be reached at a lower produciton level provided the plant is to be integrated with the envisaged lime plant at Dire Dawa.

B. ECONOMIC ANALYSIS

The economic rate of return of the independent PCC plant turned out to be 24.48%, with a net present value of Birr 17.72 million discounted at 10% p.a. On the other hand,the economic rate of return of the integrated PCC plant calculated was 45.94%, with a net present value of Birr 25.47 million discounted at 10% p.a.

The project will create employment for about 60 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

PCC Automated Plant - Independent
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	17276.90	71.607 % foreign
current assets:	0.00	0.000 % foreign
total assets:	17276.90	71.607 % foreign

Source of funds during construction phase

equity & grants:	17276.90	71.607 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	17276.90	71.607 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	4037.57	4206.70	4389.06
depreciation :	1654.48	1654.48	1654.48
interest :	0.00	0.00	0.00
production costs	5692.05	5861.18	6043.54
thereof foreign	32.02 %	31.14 %	30.24 %
total sales :	7854.16	8440.68	9073.08
gross income :	2162.11	2579.50	3029.54
net income :	1081.06	1289.75	1514.77
cash balance :	2155.33	2920.86	3144.05
net cashflow :	2155.33	2920.86	3144.05

Net Present Value at: 10.00 % = 6246.47
Internal Rate of Return: 15.61 %
Return on equity1: 7.55 %
Return on equity2: 15.61 %

Index of Schedules produced by COMFAR

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	887.00	1331.00
Auxiliary and service facilities	7.20	64.80
Incorporated fixed assets	5.00	45.00
Plant machinery and equipment	4389.00	10243.00
Total fixed investment costs	5288.20	11683.80
Pre-production capital expenditures	121.96	182.94
Net working capital	0.00	0.00
Total initial investment costs	5410.16	11866.74
Of it foreign, in %	69.49	72.57

TABLE A.3

Total Production Costs in '000 Birr

Year	3	4	5	6	7	8
% of nom. capacity (single product).	73.17	78.64	84.53	[illegible].84	98.73	100.00
Raw material 1	278.74	299.55	322.00	346.02	376.08	380.92
Other raw materials	128.86	138.48	148.86	159.97	173.86	176.10
Utilities	2176.63	2288.30	2408.71	2537.62	2698.87	2724.84
Energy	396.76	422.48	450.21	479.91	517.05	523.03
Labour, direct	267.60	267.60	267.60	267.60	267.60	267.60
Repair, maintenance	755.76	755.76	755.76	755.76	755.76	755.76
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	15.10	15.69	16.33	17.01	17.86	18.00
Factory costs	4019.45	4187.87	4369.47	4563.88	4807.08	4846.25
Administrative overheads	18.12	18.83	19.60	20.41	21.44	21.60
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	1654.48	1654.48	1654.48	1654.48	1654.48	1579.10
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	5692.05	5861.18	6043.54	6238.78	6483.00	6446.95
Costs per unit (single product)	0.90	0.86	0.83	0.79	0.76	0.74
Of it foreign, %	32.02	31.14	30.24	29.34	28.29	28.20
Of it variable,%	39.79	41.53	43.29	45.07	47.14	48.01
Total labour	267.60	267.60	267.60	267.60	267.60	267.60

- A42 -

COMFAR

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	9	10-12	13-17
% of nom. capacity (single product).	100.00	100.00	100.00
Raw material 1	380.92	380.92	380.92
Other raw materials	176.10	176.10	176.10
Utilities	2724.84	2724.84	2724.84
Energy	523.03	523.03	523.03
Labour, direct	267.60	267.60	267.60
Repair, maintenance	755.76	755.76	755.76
Spares	0.00	0.00	0.00
Factory overheads	18.00	18.00	18.00
Factory costs	4846.25	4846.25	4846.25
Administrative overheads	21.60	21.60	21.60
Indir. costs, sales and distribution	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00
Depreciation	1580.54	1593.50	125.30
Financial costs	0.00	0.00	0.00
Total production costs	6448.39	6461.35	4993.15
Costs per unit (single product)	0.74	0.75	0.58
Of it foreign, %	28.21	28.30	13.19
Of it variable,%	48.00	47.90	61.99
Total labour	267.60	267.60	267.60

COMFAR

TABLE A.4

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6	7
Coverage	mdc	coto					
Current assets &							
Accounts receivable	30	12.0	336.46	350.56	365.76	382.02	402.38
Inventory and materials	4	83.1	29.63	31.70	33.94	36.33	39.32
Energy	1	360.0	1.10	1.17	1.25	1.33	1.44
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	15	24.0	167.48	174.49	182.06	190.16	200.30
Finished products	30	12.0	336.46	350.56	365.76	382.02	402.38
Cash in hand	15	24.0	44.02	44.08	44.14	44.20	44.28
Total current assets			915.16	952.57	992.90	1036.07	1090.08
Current liabilities and							
Accounts payable	30	12.0	334.95	348.99	364.12	380.32	400.59
Net working capital			580.21	603.58	628.77	655.75	689.49
Increase in working capital			580.21	23.37	25.20	26.97	33.74
Net working capital, local			480.25	503.31	528.18	554.81	588.11
Net working capital, foreign			99.96	100.26	100.59	100.94	101.38

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.4 (Cont'd)

Net Working Capital in '000 Birr

	mdc	coto		
Year			8	9-17
Coverage	mdc	coto		
Current assets &				
Accounts receivable	30	12.0	405.65	405.65
Inventory and materials	4	83.1	39.80	39.80
Energy	1	360.0	1.45	1.45
Spares	0	---	0.00	0.00
Work in progress	15	24.0	201.93	201.93
Finished products	30	12.0	405.65	405.65
Cash in hand	15	24.0	44.29	44.29
Total current assets			1098.78	1098.78
Current liabilities and				
Accounts payable	30	12.0	403.85	403.85
Net working capital			694.93	694.93
Increase in working capital			5.43	0.00
Net working capital, local			593.47	593.47
Net working capital, foreign			101.45	101.45

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	5410.16	11866.74
Financial resources	5410.16	11866.74
Sales, net of tax	0.00	0.00
Total cash outflow	5410.16	11866.74
Total assets	5410.16	11866.74
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1650.46	3254.95
Outflow, local	1650.46	3254.95
Surplus (deficit)	0.00	0.00
Inflow, foreign	3759.70	8611.79
Outflow, foreign	3759.70	8611.79
Surplus (deficit)	0.00	0.00
Net cashflow	-5410.16	-11866.74
Cumulated net cashflow	-5410.16	-17276.90

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	8189.11	8454.71	9088.21	9766.32	10617.31	10736.70
Financial resources .	334.95	14.04	15.13	16.20	20.27	3.76
Sales, net of tax . .	7854.16	8440.68	9073.08	9750.12	10597.04	10733.44
Total cash outflow . .	6033.79	5533.85	5944.16	6383.14	6939.55	7026.99
Total assets	915.16	37.40	40.33	43.18	54.01	15.90
Operating costs . . .	4037.57	4206.70	4389.06	4584.30	4828.52	4867.85
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	1081.06	1289.75	1514.77	1755.67	2057.02	2143.24
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	2155.33	2920.86	3144.05	3383.18	3677.76	3709.71
Cumulated cash balance	2155.33	5076.19	8220.24	11603.42	15281.18	18990.89
Inflow, local	8138.52	8454.52	9088.00	9766.09	10617.02	10736.66
Outflow, local	5276.04	4923.79	5331.49	5767.70	6320.53	6403.03
Surplus (deficit) .	2862.48	3530.73	3756.51	3998.40	4296.49	4333.63
Inflow, foreign . . .	50.60	0.20	0.21	0.23	0.29	0.05
Outflow, foreign . . .	757.75	610.07	612.67	615.45	619.02	623.97
Surplus (deficit) .	-707.15	-609.87	-612.45	-615.22	-618.74	-623.92
Net cashflow	2155.33	2920.86	3144.05	3383.18	3677.76	3709.71
Cumulated net cashflow	-15121.57	-12200.71	-9056.66	-5673.48	-1995.72	1713.99

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	10733.44	10733.44	10733.44	10733.44	10733.44	10733.44
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	10733.44	10733.44	10733.44	10733.44	10733.44	10733.44
Total cash outflow . .	7075.18	7003.90	7003.90	7003.90	7745.20	7802.80
Total assets	64.80	0.00	0.00	0.00	7.20	64.80
Operating costs . . .	4867.85	4867.85	4867.85	4867.85	4867.85	4867.85
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	2142.52	2136.04	2136.04	2136.05	2870.15	2870.15
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	3658.26	3729.54	3729.54	3729.54	2988.24	2930.64
Cumulated cash balance	22649.15	26378.70	30108.24	33837.79	36826.03	39756.68
Inflow, local . . .	10733.44	10733.44	10733.44	10733.44	10733.44	10733.44
Outflow, local	6411.33	6385.05	6385.05	6385.05	7121.35	7138.95
Surplus (deficit) .	4322.11	4348.39	4348.39	4348.39	3612.09	3594.49
Inflow, foreign . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	663.85	618.85	618.85	618.85	623.85	663.85
Surplus (deficit) .	-663.85	-618.85	-618.85	-618.85	-623.85	-663.85
Net cashflow	3658.26	3729.54	3729.54	3729.54	2988.24	2930.64
Cumulated net cashflow	5372.25	9101.79	12831.34	16560.88	19549.13	22479.77

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	10733.44	10733.44	10733.44
Financial resources	0.00	0.00	0.00
Sales, net of tax	10733.44	10733.44	10733.44
Total cash outflow	7738.00	7738.00	7738.00
Total assets	0.00	0.00	0.00
Operating costs	4867.85	4867.85	4867.85
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	2870.15	2870.15	2870.15
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	2995.44	2995.44	2995.44
Cumulated cash balance	42752.12	45747.57	48743.01
Inflow, local	10733.44	10733.44	10733.44
Outflow, local	7119.15	7119.15	7119.15
Surplus (deficit)	3614.29	3614.29	3614.29
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	618.85	618.85	618.85
Surplus (deficit)	-618.85	-618.85	-618.85
Net cashflow	2995.44	2995.44	2995.44
Cumulated net cashflow	25475.21	28470.66	31466.11

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:
   Net present value .... -2658.95 at 10.00 %
   Internal Rate of Return (IRRE1) .. 7.55 %
b) Net Worth versus Net cash return:
   Net present value .... 6246.47 at 10.00 %
   Internal Rate of Return (IRRE2) .. 15.61 %
c) Internal Rate of Return on total investment:
   Net present value .... 6246.47 at 10.00 %
   Internal Rate of Return (IRR) .. 15.61 %
Net Worth = Equity paid plus reserves

TABLE A.6

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	7854.16	8440.68	9073.08	9750.12	10597.04
Less: variable costs, incl. sales tax	2264.86	2433.99	2616.35	2811.58	3055.80
Variable margin	5589.30	6006.69	6456.73	6938.54	7541.24
As % of total sales	71.16	71.16	71.16	71.16	71.16
Non-variable costs, incl. depreciation	3427.19	3427.19	3427.19	3427.19	3427.19
Operational margin	2162.11	2579.50	3029.54	3511.34	4114.04
As % of total sales	27.53	30.56	33.39	36.01	38.82
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	2162.11	2579.50	3029.54	3511.34	4114.04
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	2162.11	2579.50	3029.54	3511.34	4114.04
Tax	1081.06	1289.75	1514.77	1755.67	2057.02
Net profit	1081.06	1289.75	1514.77	1755.67	2057.02
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1081.06	1289.75	1514.77	1755.67	2057.02
Accumulated undistributed profit	1081.06	2370.80	3885.57	5641.25	7698.27
Gross profit, % of total sales	27.53	30.56	33.39	36.01	38.82
Net profit, % of total sales	13.76	15.28	16.70	18.01	19.41
ROE, Net profit, % of equity	6.26	7.47	8.77	10.16	11.91
ROI, Net profit+interest, % of invest.	6.05	7.21	8.46	9.78	11.45

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	10733.44	10733.44	10733.44	10733.44	10733.44
Less: variable costs, incl. sales tax.	3095.14	3095.14	3095.14	3095.14	3095.14
Variable margin	7638.30	7638.30	7638.30	7638.30	7638.30
As % of total sales	71.16	71.16	71.16	71.16	71.16
Non-variable costs, incl. depreciation	3351.81	3353.25	3366.21	3366.21	3366.21
Operational margin	4286.49	4285.05	4272.09	4272.09	4272.09
As % of total sales	39.94	39.92	39.80	39.80	39.80
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	4286.49	4285.05	4272.09	4272.09	4272.09
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	4286.49	4285.05	4272.09	4272.09	4272.09
Tax	2143.24	2142.52	2136.04	2136.04	2136.05
Net profit	2143.24	2142.52	2136.04	2136.04	2136.05
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	2143.24	2142.52	2136.04	2136.04	2136.05
Accumulated undistributed profit	9841.51	11984.04	14120.08	16256.13	18392.17
Gross profit, % of total sales	39.94	39.92	39.80	39.80	39.80
Net profit, % of total sales	19.97	19.96	19.90	19.90	19.90
ROE, Net profit, % of equity	12.41	12.40	12.36	12.36	12.36
ROI, Net profit+interest, % of invest.	11.92	11.87	11.84	11.84	11.84

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	10733.44	10733.44	10733.44	10733.44	10733.44
Less: variable costs, incl. sales tax.	3095.14	3095.14	3095.14	3095.14	3095.14
Variable margin	7638.30	7638.30	7638.30	7638.30	7638.30
As % of total sales	71.16	71.16	71.16	71.16	71.16
Non-variable costs, incl. depreciation	1898.01	1898.01	1898.01	1898.01	1898.01
Operational margin	5740.29	5740.29	5740.29	5740.29	5740.29
As % of total sales	53.48	53.48	53.48	53.48	53.48
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	5740.29	5740.29	5740.29	5740.29	5740.29
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	5740.29	5740.29	5740.29	5740.29	5740.29
Tax	2870.15	2870.15	2870.15	2870.15	2870.15
Net profit	2870.15	2870.15	2870.15	2870.15	2870.15
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	2870.15	2870.15	2870.15	2870.15	2870.15
Accumulated undistributed profit	21262.32	24132.46	27002.61	29872.75	32742.89
Gross profit, % of total sales	53.48	53.48	53.48	53.48	53.48
Net profit, % of total sales	26.74	26.74	26.74	26.74	26.74
ROE, Net profit, % of equity	16.61	16.61	16.61	16.61	16.61
ROI, Net profit+interest, % of invest.	15.90	15.84	15.84	15.84	15.84

COMFAR

TABLE A.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	5410.16	17276.90
Fixed assets, net of depreciation	0.00	5410.16
Construction in progress	5410.16	11866.74
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	5410.16	17276.90
Equity capital	5410.16	17276.90
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

COMFAR ©

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	18692.91	19996.69	21526.60	23298.47	25375.76	27522.27
Fixed assets, net of depreciation	15622.42	13967.94	12313.46	10658.98	9004.50	7425.40
Construction in progress	0.00	0.00	0.00	0.00	0.00	7.20
Current assets	871.14	908.49	948.76	991.87	1045.80	1054.49
Cash, bank	44.02	44.08	44.14	44.20	44.28	44.29
Cash surplus, finance available	2155.32	5076.19	8220.24	11603.42	15281.18	18990.89
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	18692.91	19996.69	21526.60	23298.47	25375.76	27522.27
Equity capital	17276.90	17276.90	17276.90	17276.90	17276.90	17276.90
Reserves, retained profit	0.00	1081.06	2370.80	3885.57	5641.25	7698.27
Profit	1081.06	1289.75	1514.77	1755.67	2057.02	2143.24
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	334.95	348.99	364.12	380.32	400.59	403.85
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	334.95	348.99	364.12	380.32	400.59	403.85
Equity, % of liabilities	92.42	86.40	80.26	74.15	68.08	62.77

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	29664.79	31800.84	33936.88	36072.93	38943.07	41813.22
Fixed assets, net of depreciation	5852.06	4323.36	2729.86	1136.36	1011.06	892.96
Construction in progress	64.80	0.00	0.00	0.00	7.20	64.80
Current assets	1054.49	1054.49	1054.49	1054.49	1054.49	1054.49
Cash, bank	44.29	44.29	44.29	44.29	44.29	44.29
Cash surplus, finance available	22649.15	26378.70	30108.24	33837.79	36826.03	39756.68
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	29664.79	31800.84	33936.88	36072.93	38943.07	41813.22
Equity capital	17276.90	17276.90	17276.90	17276.90	17276.90	17276.90
Reserves, retained profit	9841.51	11984.04	14120.08	16256.13	18392.17	21262.32
Profit	2142.52	2136.04	2136.04	2136.05	2870.15	2870.15
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	403.85	403.85	403.85	403.85	403.85	403.85
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	403.85	403.85	403.85	403.85	403.85	403.85
Equity, % of liabilities	58.24	54.33	50.91	47.89	44.36	41.32

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	44683.36	47553.51	50423.65
Fixed assets, net of depreciation	832.46	707.16	581.86
Construction in progress	0.00	0.00	0.00
Current assets	1054.49	1054.49	1054.49
Cash, bank	44.29	44.29	44.29
Cash surplus, finance available	42752.12	45747.57	48743.01
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	44683.36	47553.51	50423.65
Equity capital	17276.90	17276.90	17276.90
Reserves, retained profit	24132.46	27002.61	29872.75
Profit	2870.15	2870.15	2870.15
Long and medium term debt	0.00	0.00	0.00
Current liabilities	403.85	403.85	403.85
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	403.85	403.85	403.85
Equity, % of liabilities	38.67	36.33	34.26

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	4996.50	11043.56
Financial resources .	4996.50	11043.56
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	4996.50	11043.56
Total assets	4996.50	11043.56
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1236.80	2431.77
Outflow, local	1236.80	2431.77
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	3759.70	8611.79
Outflow, foreign . . .	3759.70	8611.79
Surplus (deficit) .	0.00	0.00
Net cashflow	-4996.50	-11043.56
Cumulated net cashflow	-4996.50	-16040.06

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	7050.89	7294.08	7840.61	8425.63	9159.51	9264.38
Financial resources	273.51	10.59	11.42	12.22	15.29	2.46
Sales, net of tax	6777.38	7283.49	7829.19	8413.41	9144.22	9261.92
Total cash outflow	4054.17	3456.29	3596.26	3745.90	3938.57	3941.26
Total assets	753.90	28.25	30.46	32.61	40.79	13.77
Operating costs	3300.27	3428.04	3565.80	3713.29	3897.78	3927.49
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	2996.72	3837.79	4244.35	4679.74	5220.94	5323.12
Cumulated cash balance	2996.72	6834.51	11078.86	15758.59	20979.53	26302.65
Inflow, local	7000.29	7293.88	7840.39	8425.40	9159.22	9264.34
Outflow, local	3296.42	2846.22	2983.59	3130.45	3319.55	3317.29
Surplus (deficit)	3703.87	4447.66	4856.80	5294.95	5839.67	5947.04
Inflow, foreign	50.60	0.20	0.21	0.23	0.29	0.05
Outflow, foreign	757.75	610.07	612.67	615.45	619.02	623.97
Surplus (deficit)	-707.15	-609.87	-612.45	-615.22	-618.74	-623.92
Net cashflow	2996.72	3837.79	4244.35	4679.74	5220.94	5323.12
Cumulated net cashflow	-13043.34	-9205.55	-4961.20	-281.47	4939.47	10262.59

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	9261.92	9261.92	9261.92	9261.92	9261.92	9261.92
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	9261.92	9261.92	9261.92	9261.92	9261.92	9261.92
Total cash outflow	3992.29	3927.49	3927.49	3927.49	3934.69	3992.29
Total assets	64.80	0.00	0.00	0.00	7.20	64.80
Operating costs	3927.49	3927.49	3927.49	3927.49	3927.49	3927.49
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	5269.63	5334.43	5334.43	5334.43	5327.23	5269.63
Cumulated cash balance	31572.28	36906.71	42241.14	47575.57	52902.80	58172.43
Inflow, local	9261.92	9261.92	9261.92	9261.92	9261.92	9261.92
Outflow, local	3328.44	3308.64	3308.64	3308.64	3310.84	3328.44
Surplus (deficit)	5933.48	5953.28	5953.28	5953.28	5951.08	5933.48
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	663.85	618.85	618.85	618.85	623.85	663.85
Surplus (deficit)	-663.85	-618.85	-618.85	-618.85	-623.85	-663.85
Net cashflow	5269.63	5334.43	5334.43	5334.43	5327.23	5269.63
Cumulated net cashflow	15532.22	20866.65	26201.08	31535.51	36862.74	42132.37

Cashfl les, production in '000 Birr

Year	15	16	17
Total cash inflow	9261.92	9261.92	9261.92
Financial resources	0.00	0.00	0.00
Sales, net of tax	9261.92	9261.92	9261.92
Total cash outflow	3927.49	3927.49	3927.49
Total assets	0.00	0.00	0.00
Operating costs	3927.49	3927.49	3927.49
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	5334.43	5334.43	5334.43
Cumulated cash balance	63506.86	68841.29	74175.72
Inflow, local	9261.92	9261.92	9261.92
Outflow, local	3308.64	3308.64	3308.64
Surplus (deficit)	5953.28	5953.28	5953.28
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	618.85	618.85	618.85
Surplus (deficit)	-618.85	-618.85	-618.85
Net cashflow	5334.43	5334.43	5334.43
Cumulated net cashflow	47466.80	52801.23	58135.66

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	9377.95	at	10.00 %
Internal Rate of Return (IRRE1) ..	17.62 %		

b) Net Worth versus Net cash return:

Net present value	17724.26	at	10.00 %
Internal Rate of Return (IRRE2) ..	24.48 %		

c) Internal Rate of Return on total investment:

Net present value	17724.26	at	10.00 %
Internal Rate of Return (IRR) ..	24.48 %		

Net Worth = Equity paid plus reserves

TABLE A.9

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	2428.00	5669.00
Financial resources .	2428.00	5669.00
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	2428.00	5669.00
Total assets	2428.00	5669.00
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	488.00	1141.00
Outflow, local	488.00	1141.00
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	1940.00	4528.00
Outflow, foreign . . .	1940.00	4528.00
Surplus (deficit) .	0.00	0.00
Net cashflow	-2428.00	-5669.00
Cumulated net cashflow	-2428.00	-8097.00

TABLE A.9 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	8189.11	8454.71	9088.21	9766.32	10617.31	10736.70
Financial resources	334.95	14.04	15.13	16.20	20.27	3.26
Sales, net of tax	7854.16	8440.68	9073.08	9750.12	10597.04	10733.44
Total cash outflow	6456.18	5956.24	6366.55	6805.53	7361.94	7411.69
Total assets	915.16	37.40	40.33	43.18	54.01	15.90
Operating costs	4037.57	4206.70	4389.06	4584.30	4828.52	4867.85
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	1503.45	1712.14	1937.16	2178.06	2479.41	2527.95
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1732.94	2498.47	2721.66	2960.79	3255.37	3325.01
Cumulated cash balance	1732.94	4231.41	6953.07	9913.86	13169.23	16494.24
Inflow, local	8138.52	8454.52	9088.00	9766.09	10617.02	10736.66
Outflow, local	5698.43	5346.18	5753.88	6190.09	6742.92	6787.73
Surplus (deficit)	2440.09	3108.34	3334.12	3576.00	3874.10	3948.93
Inflow, foreign	50.60	0.20	0.21	0.23	0.29	0.05
Outflow, foreign	757.75	610.07	612.67	615.45	619.02	623.97
Surplus (deficit)	-707.15	-609.87	-612.45	-615.22	-618.74	-623.92
Net cashflow	1732.94	2498.47	2721.66	2960.79	3255.37	3325.01
Cumulated net cashflow	-6364.06	-3865.59	-1143.93	1816.86	5072.23	8397.24

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	10733.44	10733.44	10733.44	10733.44	10733.44	10733.44
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	10733.44	10733.44	10733.44	10733.44	10733.44	10733.44
Total cash outflow	7459.88	7388.60	7388.60	7388.60	7800.65	7858.25
Total assets	64.80	0.00	0.00	0.00	7.20	64.80
Operating costs	4867.85	4867.85	4867.85	4867.85	4867.85	4867.85
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	2527.23	2520.75	2520.75	2520.75	2925.59	2925.59
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	3273.56	3344.84	3344.84	3344.84	2932.79	2875.19
Cumulated cash balance	19767.80	23112.64	26457.49	29802.33	32735.13	35610.32
Inflow, local	10733.44	10733.44	10733.44	10733.44	10733.44	10733.44
Outflow, local	6796.03	6769.75	6769.75	6769.75	7176.80	7194.40
Surplus (deficit)	3937.41	3963.69	3963.69	3963.69	3556.64	3539.04
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	663.85	618.85	618.85	618.85	623.85	663.85
Surplus (deficit)	-663.85	-618.85	-618.85	-618.85	-623.85	-663.85
Net cashflow	3273.56	3344.84	3344.84	3344.84	2932.79	2875.19
Cumulated net cashflow	11670.80	15015.64	18360.49	21705.33	24638.13	27513.32

TABLE A.9 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	10733.44	10733.44	10733.44
Financial resources	0.00	0.00	0.00
Sales, net of tax	10733.44	10733.44	10733.44
Total cash outflow	7793.45	7793.45	7793.45
Total assets	0.00	0.00	0.00
Operating costs	4867.85	4867.85	4867.85
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	2925.59	2925.59	2925.59
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	2939.99	2939.99	2939.99
Cumulated cash balance	38550.31	41490.30	44430.30
Inflow, local	10733.44	10733.44	10733.44
Outflow, local	7174.60	7174.60	7174.60
Surplus (deficit)	3558.84	3558.84	3558.84
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	618.85	618.85	618.85
Surplus (deficit)	-618.85	-618.85	-618.85
Net cashflow	2939.99	2939.99	2939.99
Cumulated net cashflow	30453.32	33393 31	36333.31

COMFAR

TABLE A.9 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	8310.00	at	10.00 %
Internal Rate of Return (IRRE1) ..	23.30 %		

b) Net Worth versus Net cash return:

Net present value	12400.76	at	10.00 %
Internal Rate of Return (IRRE2) ..	29.53 %		

c) Internal Rate of Return on total investment:

Net present value	12400.76	at	10.00 %
Internal Rate of Return (IRR) ..	29.53 %		

Net Worth : Equity paid plus reserves

TABLE A.10

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	2306.00	5383.75
Financial resources	2306.00	5383.75
Sales, net of tax	0.00	0.00
Total cash outflow	2306.00	5383.75
Total assets	2306.00	5383.75
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	366.00	855.75
Outflow, local	366.00	855.75
Surplus (deficit)	0.00	0.00
Inflow, foreign	1940.00	4528.00
Outflow, foreign	1940.00	4528.00
Surplus (deficit)	0.00	0.00
Net cashflow	-2306.00	-5383.75
Cumulated net cashflow	-2306.00	-7689.75

FIGURE II

ORGANISATION CHART

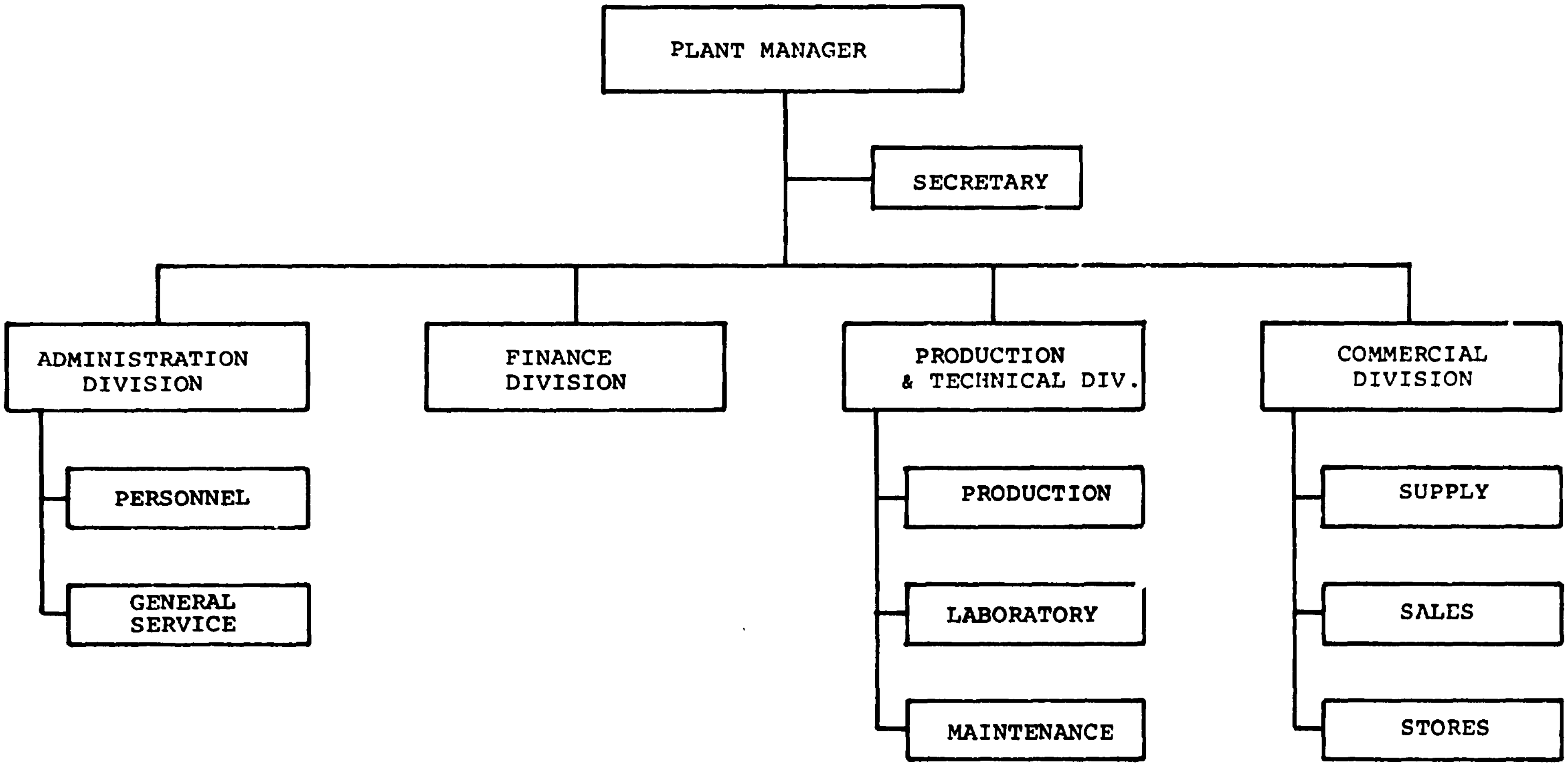


TABLE VI

MANPOWER REQURIEMENT

Post	Persons Per Shift	No.of Shifts	Total No.of Persons	Salary (Birr/Month Person	Total (Birr/ Month	Qualification
Plant Manager	1	1	1	1200	1200	Degree in Mgt.
Sectretary	1	1	1	400	400	Diploma
Administration Head	1	1	1	700	700	Degree or Diploma with experience
Personnel Clerk	1	1	1	400	400	Diploma
General Services	1	1	1	300	300	Technical Certificate
Financial Head	1	1	1	700	700	Diploma with experience or degree
Accounting Clerks	2	1	2	250	500	Commercial Certificate
Production & technical	1	1	1	1000	1000	Chemical Engineer + training
Production Clerk	1	1	1	250	250	Commercial Certificate
Chemist	1	1	1	700	700	Degree
Lab.technician	1	1	1	250	250	Certificate
Shift Supervisors	1	2	2	500	1000	Diploma in industrial chemistry
Operators	4	2	8	150	1200	Skilled
Labourers	10	2	20	60	1200	Unskilled

TABLE VI CON'TD

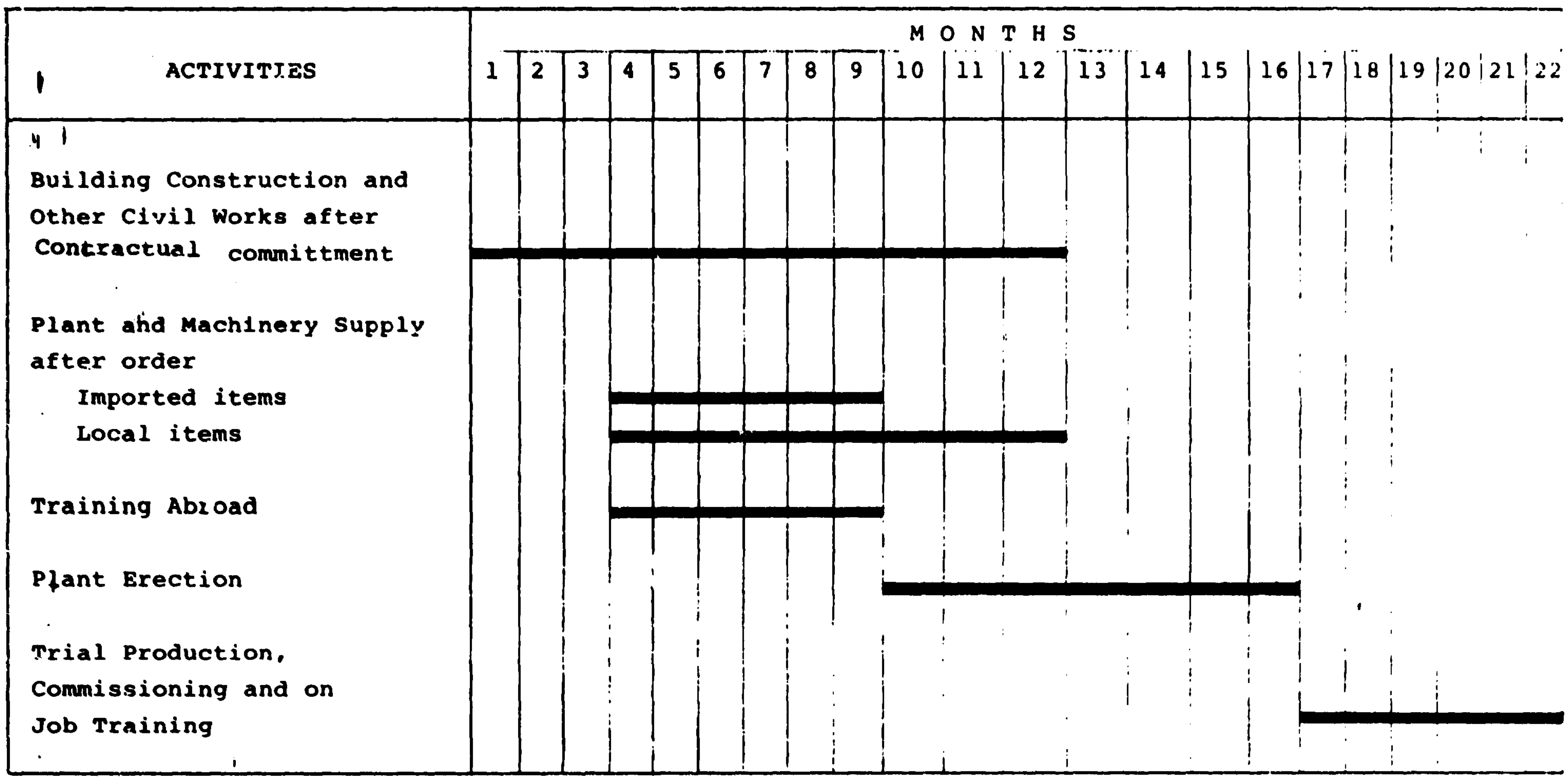
Post	Persons per shift	No.of Shifts	Total No.of Persons	Salary Birr/month person	Total (Birr/ Month)	Qualification
Chief Mechanic	1	1	1	500	500	Poly graduate
Welder	1	1	1	350	350	Skilled
Electrician	1	2	2	350	700	Skilled
Fitter	1	2	2	350	700	Degree
Commercial Head	1	1	1	700	700	Degree
Commercial Clerk	1	1	1	250	250	Commercial Certificate
Supply Officer	1	1	1	500	500	Diploma
Sales Officer	1	1	1	500	500	Diploma
Store Keeper	1	1	1	350	350	Certificate
Drivers	7	1	7	250	1750	Driving License
Guards	1	4	4	60	240	Unskilled
Cleaners	2	1	1	60	120	Unskilled
Total	-	-	65	-	16450	

VIII. IMPLEMENTATION SCHEDULE

As shown in Figure III, the implementation is estimated to take 22 months after the necessary financial arrangements are made and commercial/contractual committments are entered into. A more detail scheduling of the implementation shown in Figure III can be carried out at a later stage, first during the feasibility study stage. It must be, however, noted at this stage that the erection will require a relatively longer time, for a considerable amount of the assembly work has to be carried out at the site.

FIGURE III

IMPLEMENTATION SCHEDULE



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table VII .

TABLE VII

SUMMARY OF THE INITIAL INVESTMENT COST

('000 Birr)

	Foreign	Local	Total
Buildings and civil works	314.16	733.04	1047.20
Plnt machinery and equipment	2264.79	1885.51	4150.30
Office furniture and equipment	11.38	34.12	45.50
Vehicles	372.90	248.60	621.50
Pre-production expenditure	11.63	104.60	116.23
Total	2974.86	3005.87	5980.73

The foreign currency component of the total initial investment cost will be about 50%. About 76% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the net working capital requirements of the motor oil regeneration plant.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	0.5
3. Raw materials - foreign	3.0
4. Raw materials - local	2.0
5. Work in progress	0.07
6. Finished products	0.50
7. Accounts payable	1.0

The net working capital requirement on the fifth year of production will be Birr 0.81 million, of which about 77% will be required in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The total production cost on the fifth year of operation amounts to Birr 4.63 million, out of which about 65% is in foreign currency.

4. Internal Rate of REturn (IRR)

The internal rate of return of the motor oil regeneration plant was calculated to be 8.11% with a net present value of Birr -0.75 million discounted at 10% p.a. This was arrived at by assuming an average selling price of Birr 1.64 per litre. In order to make the project viable the minimum selling price should be Birr 1.75 per litre. This will result in an internal rate of return of 11.22% with a net present value of Birr 0.50 million discounted at 10% p.a.

5. Breakeven Analysis

The breakeven point would be reached provided the plant could generate a total revenue of Birr 3.56 million. The fifth year of operation was taken as the basis for breakeven point determination.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 33.40% with a net present value of Birr 11.39 million discounted at 10% p.a. The motor oil regeneration plant is, therefore, economically viable.

The project will create employment for about 65 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

Regeneration of Motor Oil Plant
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	5980.73	49.741 % foreign
current assets:	0.00	0.000 % foreign
total assets:	5980.73	49.741 % foreign

Source of funds during construction phase

equity & grants:	5980.73	49.741 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	5980.73	49.741 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	3497.32	3624.47	3751.78
depreciation :	619.49	619.49	619.49
interest :	0.00	0.00	0.00
production costs	4116.80	4243.96	4371.27
thereof foreign	63.99 %	64.11 %	64.22 %
total sales :	4365.61	4549.06	4732.74
gross income :	248.81	305.11	361.47
net income :	124.41	152.55	180.74
cash balance :	51.47	743.62	771.77
net cashflow :	51.47	743.62	771.77

Net Present Value at: 10.00 % : -747.25
Internal Rate of Return: 8.11 %
Return on equity1: 0.51 %
Return on equity2: 8.11 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

COMFAR

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	418.89	628.31
Auxiliary and service facilities	248.60	372.90
Incorporated fixed assets	18.21	27.29
Plant machinery and equipment	1660.12	2490.18
Total fixed investment costs	2345.82	3518.68
Pre-production capital expenditures	46.49	69.74
Net working capital	0.00	0.00
Total initial investment costs	2392.31	3588.42
Of it foreign, in %	49.74	49.74

- C35 -

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5	6	7	8
% of nom. capacity (single product).	61.31	63.89	66.47	69.05	71.63	74.21
Raw material 1	505.82	527.07	548.36	569.64	590.92	612.20
Other raw materials	2419.25	2520.91	2622.70	2724.48	2826.28	2928.07
Utilities	100.51	104.08	107.66	111.24	114.82	118.40
Energy	148.80	148.80	148.80	148.80	148.80	148.80
Labour, direct	20.58	20.58	20.58	20.58	20.58	20.58
Repair, maintenance	269.42	269.42	269.42	269.42	269.42	269.42
Spares	0.06	0.00	0.00	0.00	0.00	0.00
Factory overheads	14.97	15.27	15.58	15.88	16.18	16.48
Factory costs	3479.35	3606.14	3733.09	3860.04	3987.01	4113.96
Administrative overheads	17.97	18.33	18.69	19.05	19.42	19.78
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	619.49	619.49	619.49	619.49	619.49	471.94
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	4116.80	4243.96	4371.27	4498.58	4625.91	4605.68
Costs per unit (single product)	1.55	1.53	1.51	1.50	1.49	1.43
Of it foreign, %	63.99	64.11	64.22	64.33	64.43	64.92
Of it variable,%	73.50	74.30	75.04	75.75	76.42	79.52
Total labour	20.58	20.58	20.58	20.58	20.58	20.58

Total Production Costs in '000 Birr

Year	9	10	11	12	13	14
% of nom. capacity (single product)	76.79	79.37	81.94	84.52	89.68	94.84
Raw material 1	633.49	654.77	676.02	697.31	739.87	782..4
Other raw materials	3029.86	3131.64	3233.30	3335.09	3538.67	3742.25
Utilities	121.98	125.56	129.14	132.72	139.88	147.04
Energy	148.80	148.80	148.80	148.80	148.80	148.80
Labour, direct	20.58	20.58	20.58	20.58	20.58	20.58
Repair, maintenance	269.42	269.42	269.42	269.42	269.42	269.42
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	16.78	17.09	17.39	17.69	18.29	18.90
Factory costs	4240.91	4367.86	4494.66	4621.61	4875.51	5129.43
Administrative overheads	20.14	20.50	20.86	21.23	21.95	22.68
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	521.66	596.24	596.24	596.24	176.66	176.66
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	4782.71	4984.61	5111.76	5239.07	5074.12	5328.76
Costs per unit (single product)	1.43	1.45	1.44	1.43	1.30	1.29
Of it foreign, %	64.95	64.95	65.03	65.10	66.14	66.22
Of it variable,%	79.24	78.58	79.11	79.62	87.23	87.84
Total labour	20.58	20.58	20.58	20.58	20.58	20.58

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	15	16-17
% of nom. capacity (single product)	97.42	100.00
Raw material 1	803.72	825.00
Other raw materials	3844.04	3945.83
Utilities	150.62	154.20
Energy	148.80	148.80
Labour, direct	20.58	20.58
Repair, maintenance	269.42	269.42
Spares	0.00	0.00
Factory overheads	19.20	19.50
Factory costs	5256.38	5383 33
Administrative overheads	23.04	23.40
Indir. costs, sales and distribution	0.00	0.00
Direct costs, sales and distribution	0.00	0.00
Depreciation	176.66	176.66
Financial costs	0.00	0.00
Total production costs	5456.08	5583.39
Costs per unit (single product)	1.29	1.29
Of it foreign, %	66.26	66.30
Of it variable,%	88.12	88.39
Total labour	20.58	20.58

TABLE A.4

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6	7
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	145.72	151.02	156.32	161.63	166.93
Inventory and materials	81	4.4	658.14	685.80	713.49	741.18	768.87
Energy	[illegible]	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	19.33	20.03	20.74	21.44	22.15
Finished products	15	24.0	145.72	151.02	156.32	161.63	166.93
Cash in hand	15	24.0	13.46	13.48	13.51	13.54	13.57
Total current assets			982.37	1021.35	1060.39	1099.42	1138.46
Current liabilities and Accounts payable	30	12.0	289.95	300.51	311.09	321.67	332.25
Net working capital			692.42	720.84	749.29	777.75	806.21
Increase in working capital			692.42	28.42	28.45	28.45	28.46
Net working capital, local			161.32	167.75	174.19	180.62	187.06
Net working capital, foreign			531.10	553.09	575.11	597.12	619.14

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Net Working Capital in '000 Birr

Year	mdc	coto	8	9	10	11	12
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	172.24	177.54	182.85	188.15	193.45
Inventory and materials	81	4.4	796.56	824.25	851.94	879.60	907.29
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	22.86	23.56	24.27	24.97	25.68
Finished products	15	24.0	172.24	177.54	182.85	188.15	193.45
Cash in hand	15	24.0	13.59	13.62	13.65	13.68	13.70
Total current assets			1177.49	1216.52	1255.56	1294.54	1333.57
Current liabilities and Accounts payable	30	12.0	342.83	353.41	363.99	374.55	385.13
Net working capital			834.66	863.11	891.57	919.39	948.44
Increase in working capital			28.45	28.45	28.45	28.42	28.45
Net working capital, local			193.50	199.93	206.37	212.80	219.23
Net working capital, foreign			641.16	663.18	685.20	707.19	729.21

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

COMFAR

TABLE A.4 (Cont'd)

Net Working Capital in '000 Birr

Year			13	14	15	16	17
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	204.06	214.67	219.98	225.28	225.28
Inventory and materials	81	4.4	962.67	1018.06	1045.75	1073.44	1073.44
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	27.09	28.50	29.20	29.91	29.91
Finished products	15	24.0	204.06	214.67	219.98	225.28	225.28
Cash in hand	15	24.0	13.76	13.82	13.84	13.87	13.87
Total current assets			1411.64	1489.71	1528.74	1567.78	1567.78
Current liabilities and Accounts payable	30	12.0	406.29	427.45	438.03	448.61	448.61
Net working capital			1005.35	1062.26	1090.71	1119.16	1119.16
Increase in working capital			56.91	56.91	28.45	28.45	0.00
Net working capital, local			232.11	244.98	251.41	257.85	257.85
Net working capital, foreign			773.24	817.28	839.30	861.31	861.31

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	2392.31	3588.42
Financial resources	2392.31	3588.42
Sales, net of tax	0.00	0.00
Total cash outflow	2392.31	3588.42
Total assets	2392.31	3588.42
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1202.35	1803.52
Outflow, local	1202.35	1803.52
Surplus (deficit)	0.00	0.00
Inflow, foreign	1189.96	1784.90
Outflow, foreign	1189.96	1784.90
Surplus (deficit)	0.00	0.00
Net cashflow	-2392.31	-3588.42
Cumulated net cashflow	-2392.31	-5980.73

TABLE A.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	4655.56	4559.63	4743.32	4927.00	5110.70	5294.38
Financial resources	289.95	10.57	10.58	10.58	10.58	10.58
Sales, net of tax	4365.61	4549.06	4732.74	4916.42	5100.12	5283.80
Total cash outflow	4604.09	3816.01	3971.56	4127.05	4282.57	4760.43
Total assets	982.37	38.98	39.03	39.03	39.04	287.63
Operating costs	3497.32	3624.47	3751.78	3879.10	4006.42	4133.74
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	124.41	152.55	180.74	208.92	237.11	339.06
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	51.47	743.62	771.77	799.95	828.13	533.95
Cumulated cash balance	51.47	795.09	1566.86	2366.81	3194.95	3728.89
Inflow, local	4462.70	4552.43	4736.12	4919.80	5103.49	5287.17
Outflow, local	1565.87	1386.15	1455.16	1524.15	1593.14	1835.35
Surplus (deficit)	2896.83	3166.28	3280.96	3395.65	3510.35	3451.83
Inflow, foreign	192.86	7.20	7.21	7.21	7.21	7.21
Outflow, foreign	3038.22	2429.86	2516.40	2602.91	2689.42	2925.09
Surplus (deficit)	-2845.36	-2422.66	-2509.19	-2595.70	-2682.21	-2917.88
Net cashflow	51.47	743.62	771.77	799.95	828.13	533.95
Cumulated net cashflow	-5929.26	-5185.64	-4413.87	-3613.92	-2785.78	-2251.83

COMFAR

TABLE A.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	5478.06	5661.74	58[illegible].18	6028.87	6406.81	6774.19
Financial resources	10.58	10.58	10.57	10.58	21.16	21.16
Sales, net of tax	5467.48	5651.16	5834.61	6018.29	6385.65	6753.03
Total cash outflow	5015.37	4760.68	4915.93	5071.48	5879.89	6315.21
Total assets	411.93	39.03	38.98	39.03	326.67	450.97
Operating costs	4261.05	4388.37	4515.52	4642.83	4897.46	5152.10
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	342.39	333.28	361.43	389.61	655.76	712.13
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	462.69	901.06	929.25	957.39	526.92	458.98
Cumulated cash balance	4191.58	5092.65	6021.89	6979.29	7506.21	7965.19
Inflow, local	5470.85	5654.53	5837.98	6021.66	6392.39	6759.77
Outflow, local	1929.20	1811.74	1880.63	1949.63	2406.65	2594.35
Surplus (deficit)	3541.66	3842.80	3957.35	4072.03	3985.75	4165.42
Inflow, foreign	7.21	7.21	7.20	7.21	14.42	14.42
Outflow, foreign	3086.17	2948.94	3035.30	3121.85	3473.25	3720.85
Surplus (deficit)	-3078.97	-2941.73	-3028.10	-3114.64	-3458.83	-3706.43
Net cashflow	462.69	901.06	929.25	957.39	526.92	458.98
Cumulated net cashflow	-1789.14	-888.08	41.17	998.56	1525.48	1984.46

Regeneration of Motor Oil Plant --- Financial Analysis - July 1988

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	6947.29	7130.97	7120.39
Financial resources	10.58	10.58	0.00
Sales, net of tax	6936.71	7120.39	7120.39
Total cash outflow	6058.77	6214.26	6175.23
Total assets	39.03	39.03	0.00
Operating costs	5279.42	5406.73	5406.73
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	740.32	768.50	768.50
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	888.52	916.71	945.16
Cumulated cash balance	8853.71	9770.42	10715.57
Inflow, local	6940.08	7123.76	7120.39
Outflow, local	2504.38	2573.37	2563.56
Surplus (deficit)	4435.70	4550.39	4556.83
Inflow, foreign	7.21	7.21	0.00
Outflow, foreign	3554.39	3640.90	3611.67
Surplus (deficit)	-3547.18	-3633.69	-3611.67
Net cashflow	888.52	916.71	945.16
Cumulated net cashflow	2872.98	3789.69	4734.85

TABLE A.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-3337.71	at	10.00 %
Internal Rate of Return (IRRE1) ..	0.51 %		

b) Net Worth versus Net cash return:

Net present value	-747.25	at	10.00 %
Internal Rate of Return (IRRE2) ..	8.11 %		

c) Internal Rate of Return on total investment:

Net present value	-747.25	at	10.00 %
Internal Rate of Return (IRR) ..	8.11 %		

Net Worth = Equity paid plus reserves

COMFAR

TABLE A.6

-- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	4365.61	4549.06	4732.74	4916.42	5100.12
Less: variable costs, incl. sales tax.	3025.94	3153.09	3280.40	3407.72	3535.04
Variable margin	1339.68	1395.97	1452.34	1508.71	1565.08
As % of total sales	30.69	30.69	30.69	30.69	30.69
Non-variable costs, incl. depreciation	1090.87	1090.87	1090.87	1090.87	1090.87
Operational margin	248.81	305.11	361.47	417.84	474.21
As % of total sales	5.70	6.71	7.64	8.50	9.30
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	248.81	305.11	361.47	417.84	474.21
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	248.81	305.11	361.47	417.84	474.21
Tax	124.41	152.55	180.74	208.92	237.11
Net profit	124.41	152.55	180.74	208.92	237.11
Divid[illegible] paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	124.41	152.55	180.74	208.92	237.11
Accumulated undistributed profit	124.41	276.96	457.70	666.62	903.72
Gross profit, % of total sales	5.70	6.71	7.64	8.50	9.30
Net profit, % of total sales	2.85	3.35	3.82	4.25	4.65
ROE, Net profit, % of equity	2.08	2.55	3.02	3.49	3.96
ROI, Net profit+interest, % of invest.	1.86	2.28	2.69	3.09	3.49

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	5283.80	5467.48	5651.16	5834.81	6018.29
Less: variable costs, incl. sales tax.	3662.36	3789.67	3916.99	4044.14	4171.45
Variable margin	1621.44	1677.81	1734.18	1790.47	1846.84
As % of total sales	30.69	30.69	30.69	30.69	30.69
Non-variable costs, incl. depreciation	943.32	993.04	1067.62	1067.62	1067.62
Operational margin	678.12	684.77	666.56	722.85	779.22
As % of total sales	12.83	12.52	11.80	12.39	12.95
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	678.12	684.77	666.56	722.85	779.22
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	678.12	684.77	666.56	722.85	779.22
Tax	339.06	342.39	333.28	361.43	389.61
Net profit	339.06	342.39	333.28	361.43	389.61
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	339.06	342.39	333.28	361.43	389.61
Accumulated undistributed profit	1242.79	1585.17	1918.45	2279.87	2669.48
Gross profit, % of total sales	12.83	12.52	11.80	12.39	12.95
Net profit, % of total sales	6.42	6.26	5.90	6.19	6.47
ROE, Net profit, % of equity	5.67	5.72	5.57	6.04	6.51
ROI, Net profit+interest, % of invest.	4.80	4.59	4.45	4.80	5.16

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	6385.65	6753.03	6936.71	7120.39	7120.39
Less: variable costs, incl. sales tax.	4426.08	4680.72	4808.04	4935.35	4935.35
Variable margin	1959.57	2072.31	2128.67	2185.04	2185.04
As % of total sales	30.69	30.69	30.69	30.69	30.69
Non-variable costs, incl. depreciation	648.04	648.04	648.04	648.04	648.04
Operational margin	1311.53	1424.27	1480.63	1537.00	1537.00
As % of total sales	20.54	21.09	21.34	21.59	21.59
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	1311.53	1424.27	1480.63	1537.00	1537.00
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	1311.53	1424.27	1480.63	1537.00	1537.00
Tax	655.76	712.13	740.32	768.50	768.50
Net profit	655.76	712.13	740.32	768.50	768.50
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	655.76	712.13	740.32	768.50	768.50
Accumulated undistributed profit	3325.25	4037.38	4777.70	5546.20	6314.69
Gross profit, % of total sales	20.54	21.09	21.34	21.59	21.59
Net profit, % of total sales	10.27	10.55	10.67	10.79	10.79
ROE, Net profit, % of equity	10.96	11.91	12.38	12.85	12.85
ROI, Net profit+interest, % of invest.	8.35	8.59	8.90	9.21	9.21

TABLE A.7

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	2392.31	5980.73
Fixed assets, net of depreciation	0.00	2392.31
Construction in progress	2392.31	3588.42
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	2392.31	5980.73
Equity capital	2392.31	5980.73
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	6395.08	6558.20	6749.52	6969.02	7216.70	7566.35
Fixed assets, net of depreciation	5361.24	4741.76	4122.27	3502.79	2883.30	2411.36
Construction in progress	0.00	0.00	0.00	0.00	0.00	248.60
Current assets	968.91	1007.87	1046.87	1085.88	1124.89	1163.89
Cash, bank	13.46	13.48	13.51	13.54	13.57	13.59
Cash surplus, finance available	51.47	795.09	1566.86	2366.81	3194.95	3728.90
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	6395.08	6558.20	6749.52	6969.02	7216.70	7566.35
Equity capital	5980.73	5980.73	5980.73	5980.73	5980.73	5980.73
Reserves, retained profit	0.00	124.41	276.96	457.70	666.62	903.72
Profit	124.41	152.55	180.74	208.92	237.11	339.06
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	289.95	300.51	311.09	321.67	332.25	342.83
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	289.95	300.51	311.09	321.67	332.25	342.83
Equity, % of liabilities	93.52	91.19	88.61	85.82	82.87	79.04

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	7919.31	8263.17	8635.16	9035.35	9712.27	10445.56
Fixed assets, net of depreciation	2138.30	1914.96	1318.72	722.48	545.82	617.76
Construction in progress	372.90	0.00	0.00	0.00	248.60	372.90
Current assets	1202.90	1241.91	1280.86	1319.87	1397.88	1475.89
Cash, bank	13.62	13.65	13.68	13.70	13.76	13.82
Cash surplus, finance available	4191.59	5092.65	6021.90	6979.29	7506.21	7965.19
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	7919.31	8263.17	8635.16	9035.35	9712.27	10445.56
Equity capital	5980.73	5980.73	5980.73	5980.73	5980.73	5980.73
Reserves, retained profit	1242.79	1585.17	1918.45	2279.87	2669.48	3325.25
Profit	342.39	333.28	361.43	389.61	655.76	712.13
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	353.41	363.99	374.55	385.13	406.29	427.45
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	353.41	363.99	374.55	385.13	406.29	427.45
Equity, % of liabilities	75.52	72.38	69.26	66.19	61.58	57.26

TABLE A.7 (Cont'd)

COMFAR

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	11196.46	11975.54	12744.04
Fixed assets, net of depreciation	814.00	637.34	460.68
Construction in progress	0.00	0.00	0.00
Current assets	1514.90	1553.91	1553.91
Cash, bank	13.84	13.87	13.87
Cash surplus, finance available	8853.71	9770.42	10715.58
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	11196.46	11975.54	12744.04
Equity capital	5980.73	5980.73	5980.73
Reserves, retained profit	4037.38	4777.70	5546.20
Profit	740.32	768.50	768.50
Long and medium term debt	0.00	0.00	0.00
Current liabilities	438.03	448.61	448.61
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	438.03	448.61	448.61
Equity, % of liabilities	53.42	49.94	46.93

COMFAR 2.1 UNIDO

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	2027.45	3041.11
Financial resources	2027.45	3041.11
Sales, net of tax	0.00	0.00
Total cash outflow	2027.45	3041.11
Total assets	2027.45	3041.11
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	871.94	1307.89
Outflow, local	871.94	1307.89
Surplus (deficit)	0.00	0.00
Inflow, foreign	1155.51	1733.22
Outflow, foreign	1155.51	1733.22
Surplus (deficit)	0.00	0.00
Net cashflow	-2027.45	-3041.11
Cumulated net cashflow	-2027.45	-5068.56

COMFAR 2.1 UNIDO

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	3399.45	3415.63	3553.39	3691.15	3828.92	3966.68
Financial resources .	125.23	3.83	3.83	3.83	3.83	3.83
Sales, net of tax . .	3274.21	3411.80	3549.56	3687.32	3825.09	3962.85
Total cash outflow . .	1863.14	1575.03	1621.29	1667.54	1713.80	1953.95
Total assets	346.86	12.55	12.57	12.57	12.57	206.48
Operating costs . . .	1516.29	1562.48	1608.73	1654.98	1701.23	1747.48
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	1536.30	1840.60	1932.10	2023.61	2115.13	2012.73
Cumulated cash balance	1536.30	3376.90	5308.99	7332.60	9447.73	11460.46
Inflow, local	3346.94	3414.32	3552.09	3689.85	3827.62	3965.38
Outflow, local	1079.96	924.20	954.81	985.42	1016.03	1091.38
Surplus (deficit) .	2266.98	2490.13	2597.27	2704.43	2811.59	2874.00
Inflow, foreign . . .	52.50	1.30	1.30	1.30	1.30	1.30
Outflow, foreign . . .	783.18	650.83	666.48	682.12	697.77	862.57
Surplus (deficit) .	-730.68	-649.53	-665.18	-680.82	-696.47	-861.27
Net cashflow	1536.30	1840.60	1932.10	2023.61	2115.13	2012.73
Cumulated net cashflow	-3532.26	-1691.66	240.43	2264.04	4379.17	6391.90

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	4104.44	4242.20	4379.79	4517.55	4796.90	5072.43
Financial resources .	3.83	3.83	3.83	3.83	7.66	7.66
Sales, net of tax . .	4100.61	4238.37	4375.96	4513.72	4789.24	5064.77
Total cash outflow . .	2097.16	1852.54	1898.72	1944.98	2243.95	2433.42
Total assets	303.44	12.57	12.55	12.57	219.04	316.00
Operating costs . . .	1793.73	1839.97	1886.17	1932.41	2024.91	2117.41
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	2007.28	2389.66	2481.07	2572.57	2552.95	2639.02
Cumulated cash balance	13467.74	15857.40	18338.46	20911.04	23463.98	26103.00
Inflow, local	4103.14	4240.90	4378.40	4516.25	4794.29	5069.83
Outflow, local	1144.37	1107.84	1138.40	1169.02	1282.33	1365.93
Surplus (deficit) .	2958.77	3133.05	3240.00	3347.23	3511.96	3703.90
Inflow, foreign . . .	1.30	1.30	1.30	1.30	2.61	2.61
Outflow, foreign . . .	952.79	744.70	760.31	775.96	961.62	1067.49
Surplus (deficit) .	-951.49	-743.39	-759.01	-774.66	-959.01	-1064.88
Net cashflow	2007.28	2389.66	2481.07	2572.57	2552.95	2639.02
Cumulated net cashflow	8399.18	10788.84	13269.91	15842.48	18395.42	21034.44

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	5206.36	5344.12	5340.29
Financial resources .	3.83	3.83	0.00
Sales, net of tax . .	5202.53	5340.29	5340.29
Total cash outflow . .	2176.23	2222.48	2209.91
Total assets	12.57	12.57	0.00
Operating costs . . .	2163.66	2209.91	2209.91
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	3030.14	3121.65	3130.38
Cumulated cash balance	29133.13	32254.78	35385.16
Inflow, local	5205.06	5342.82	5340.29
Outflow, local	1322.05	1352.65	1345.30
Surplus (deficit) .	3883.01	3990.16	3994.99
Inflow, foreign . . .	1.30	1.30	0.00
Outflow, foreign . . .	854.18	869.82	864.61
Surplus (deficit) .	-852.88	-868.52	-864.61
Net cashflow	3030.14	3121.65	3130.38
Cumulated net cashflow	24064.57	27186.22	30316.60

TABLE A.8 (Cont'd) ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	10896.81	at	10.00 %
Internal Rate of Return (IRRE1) ..	34.49 %		

b) Net Worth versus Net cash return:

Net present value	11392.85	at	10.00 %
Internal Rate of Return (IRRE2) ..	33.40 %		

c) Internal Rate of Return on total investment:

Net present value	11392.85	at	10.00 %
Internal Rate of Return (IRR) ..	33.40 %		

Net Worth : Equity paid plus reserves

- D -

AEROSOL INSECTICIDE

TABLE OF CONTENTS

I. SUMMARY

Aerosol insecticide project is envisaged to produce self-dispersing, pressurized and self-propelling product with the sole objective of killing mosquitos, flies, cockroaches, flea, etc.

The major raw material is insecticide chemical. However there are other materials such as container, valve, actuator and accessories which are vital parts of the final product. All these materials will be imported as they are not locally manufactured. This project is totally dependent, at least in the short-run, on foreign source for raw material and other components.

The initial investment cost was estimated at about Birr 1.11 million. The foreign currency component of the total investment cost will be about 42%.

The project will generate employment for about 38 people. Factory building space requirement was estimated at 500m², while the total area of the premises will be about 1500m².

This project is financially viable with an internal rate of return (IRR) of 13.7% and a net present value of Birr 0.49 million discounted at 10% per annum. This result was obtained assuming that each insecticide can will be sold at Birr 2.00.

II. INTRODUCTION

Pocketable type of pressurized insecticide was developed during the World War II for American soldiers fighting in the tropical jungles to protect themselves especially against malaria.

Since its inception, aerosol insecticide has evolved considerably to meet changing consumer needs. The development of pocketable type of pressurized aerosol insecticide has revolutionized the concept of packing many products.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Aerosols are self-dispersing, pressurized, self-propelling products. They are dispersed by using a liquified, non-liquifiable or non-condensable gas. It is a colloidal system in which finely divided liquids or solids, usually within 10-15 are dispersed in a gas. The major item which characterizes aerosols as unique is the propellant.

The development of pocketable type of pressurized insecticide directly resulted from American soldiers fighting in the tropical jungles during the Second World War. Faced with the need to deal with malaria in the tropical jungles, the U.S. soldiers had to be provided with pressurized insecticides containers.

Since its first inception, aerosol insecticide has evolved considerably to meet changing consumer needs. The main targets are mosquitos flies and cockroaches the development of pocketable type of pressurized aerosol insecticide has revolutionized the concept of packing of many products. It was only after the development of this new way of packing insecticide that a countless number of commercial products started to appear in the market with the same mode of packaging. These include, hair sprays, household insecticides, garden insecticides, deodorants, perspiration inhibitors, paints, glass cleaners, perfumes, medical products and food products. It is estimated that 6 billion cans of aerosol type products are produced in the world today.

There are different types of aerosol insecticides coming into the country legally as well as illegally. It was only in 1983 that a private insecticides packing plant with a daily capacity of 1200[1] can, corresponding to 360 thousand cans per year, was established.

Since its establishment, the plant is plagued by shortage of packing material as well as chemicals. According to the plant management, the highest production volume so far attained amounted to 3477 cans, corresponding to only 0.9% capacity utilization (See Table I). The reporting must have been highly underestimated for various reasons.

TABLE I

PRODUCTION OF AEROSOL INSECTICIDES

(CANS)

Year	Output
1983	2,580
1984	2,250
1985	-
1986	3,477

SOURCE: The plant management

2. Past and Future Demand Analysis

In the past, the import of aerosol was reported with different insecticide imports. The quantity of aerosol cans imported could not thus be identified from the total import figures of insecticides. However, the Ethiopian Import-Export Corporation has been lately importing aerosol insecticides.

---

1 Handicraft and Small Scale Industry Development Agency (HASIDA)

According to information from the Corporation, the import was not based on the demand but on the availability of foreign exchange. The import of aerosol insecticides by the Ethiopian Import-Export Corporation (ETMIX) is shown in Table II.

TABLE II
AEROSOL INSECTICIDES IMPORT BY ETIMEX
(CANS)

Year	Quantity
1984	1,142,406
1985	476,832
1986	1,000,000

SOURCE: Ethiopian Import-Export Corporation

At this juncture it is worth noting that a large quantity of aerosol insecticides is imported illegally but it is difficult to estimate its quantity. When the official import figure and the quantity produced locally are added to that, the aggregate supply of aerosol insecticides would become considerably large. In view of this, this project mainly engages in the production of aerosol insecticides, mainly for killing insects. Thus, the expected market for the product comprises urban households, urban oriented rural households, particularly those who can be categorised as sub-urbans,and commercial enterprises such as hotels and bars, restaurants etc. Other organizations such as government offices, large private enterprises and other non-government offices usually use room freshners and not insecticides.

Thus to estimate the size of the demand for aerosol insecticides, the urban households, hotels & bars, snack bars and restaurants were considered under the following basic assumptions.

- Each household in urban centres is assumed to use at least two aerosol insecticide cans per year.

- Hotels & bars are assumed to use one per month, while the annual consumption of snack bars and resturants are roughly assumed to be four cans each.

These assumptions, though they seem to be arbitrary fixed, are quite reasonable in view of the bulkiness of the aggregate supply of aerosol insecticides.

The number of urban households are expected to grow from 1,109,694 in 1988 to 1,537,305 by the year 2003, corresponding to an average annual growth rate of 2.2%. The total number of hotels and bars and restaurants together with snack bars are estimated to be 7423 and 4900, respectively. These data are incorporated with those assumptions indicated above to give a demand estimates of aerosol insecticides, ranging from 2328 thousand in 1988 to 3183 thousand by the year 2003. The installed capacity of the existing plant, which is 360 thousand cans/year, has to be subtracted from the projected demand in order to estimate the level of the unsatisfied demand. Accordingly the unsatisfied demand is estimated to vary between 1968 thousand and 2823 thousand over the forecast period (See Table III).

TABLE III

AEROSOL INSECTICIDES DEMAND PROJECTION

USING END-USE APPROACH

('000 CANS)

Year	Projected demand	Local Installed Capacity	Unsatisfie demand
1988	2328	360	1968
1989	2372	360	2012
1990	2417	360	2057
1991	2464	360	2104
1992	2513	360	2153
1993	2563	360	2203
1994	2616	360	2256
1995	2671	360	2311
1996	2727	360	2367
1997	2786	360	2426
1998	2846	360	2486
1999	2909	360	2549
2000	2974	360	2614
2001	3042	360	2682
2002	3111	360	2751
2003	3183	360	2823

3. Pricing

According to the Ethiopian Import-Export Corporation, the current FOB import price of an aerosol is Birr 1.16 per can while the CIF price is Birr 1.35 per can. Aerosol is imported duty free.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The minimum economic scale of a plant for aerosol production of one type only is about 0.9 million cans a year operating in a single 8-hour shift, 300 days a year. Such a plant would meet the country's short to medium term supply needs operating in two shifts, while the introduction of a third shift for new products, such as room cleaners and air freshners would meet the longer term demand. Alternatively, the capacity of the plant can be increased. The production units are flexible and allow modular expansion to the extent that the existing equipment can be incorporated in larger bench sets.

2. Production Programme

The production of aerosol insecticide is basically a packaging operation. The plant could start operation in two shifts in 1991 at 80% capacity utilization. It increases its capacity utilization to 90% in the second year of operation and reaches full capacity in the following year (See Table IV).

TABLE IV

PRODUCTION PROGRAMME FOR

AERESOL INSECTICIDE PLANT

Year	Estimated Demand Gap ('000 Cans)	Production Programme ('000 Cans)	Capacity Utilization (%)
1991	2104	1440	80
1992	2153	1620	90
1993	2203	1800	100
1994	2256	1800	100
1995	2311	1800	100
1996	2367	1800	100
1997	2426	1800	100
1998	2486	1800	100
1999	2549	1800	100
2000	2614	1800	100
2001	2682	1800	100
2002	2751	1800	100
2003	2823	1800	100

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

An aerosol comprises three components:-

- Insecticide,
- Propellant system, and
- Hardware, i.e. the container, valve, actuator and other accessories.

1. Insecticide

The insecticide or active component can be any of the commercially used insecticides such as allethrin, dichlorvos, fenitrothion etc. The active ingredients must be soluble in alcohol, carbon tetrachloride, kerosene and nitromethane. The choice of insecticide to use is an important factor as some can be harmful to human and other warm-blooded animal life and plants. Pyrethrum is a natural insecticide coming from the seeds of a variety of the chrysanthemum flower family. Synthetic derivatives have been created.

Among the first and commonly used in aerosols is allethrin. It is the generic name for 2-allyl-4-hydroxy-3-methyl-2 cyclopentan-1-one ester of chrysanthemum monocarboxylic acid. It is a clear, amber-coloured, viscous liquid, derived from glycerine, acetylene and ethyl acetoacetate. Newer synthetic pyrethroids, for example permethrin, decamethrin flenvalerate are now available which offer substantial improvements over natural pyrethrins and allethrin as they are more persistent and can be applied in smaller quantities.

The insecticide is dispersed with a synergist and perhaps aromatic essences. A commonly used synergist is piperonyl butoxide. This chemical is used in an amount about twice as much as the active ingredient in the insecticide formulation to impart a synergistic effect upon application. Thus, the effectiveness of the active components will be more than additive.

2. Propellant System

A propellant is a compressed gas used to expel the contents of containers in the form of aerosols. Until recently chlorofluorcarbons 11 and 12 have been widely used because of their non-flammability and non-toxicity. However, due to the strong possibility that they may contribute to depletion of the ozone layer of the upper atmosphere, their use for this purpose has decreased. Other propellants used are hydrocarbon gases such as butane, propane and isobutane. They are the cheapest propellants but are flammable.

The alternatives are compressed gas propellants such as CO_2, N_2O and N_2. They are non-toxic, non-flammable, relatively low in cost and very inert. The vapour pressure in the container however, falls as the contents are depleted which may cause changes in the rate and characteristics of the spray. Although they are still a subject of much research, they are not regarded as efficient for spraying insecticides.

3. Hardware

Pressure containers are made either from tinplated steel or aluminium. The former are three-piece cans while aluminium containers are usually of a monobloc (one-piece) construction. Thin resin coatings line the containers to avoid detrimental reactions to the insecticide and possible damage to the can.

The key to the aerosol system is the dispensing valve and actuator (See Figure I). The valve consists basically of seven pieces:

- Actuator,
- Stem,
- Mounting cap,
- Gasket,
- Housing,
- Spring, and
- Dip tube.

The valve has to meet the specific needs of the insecticide product. Manufacturers, however, produce a wide range of standard valves of which one will probably be acceptable.

B. UTILITIES

The utility requirements of the aerosol insecticide plant are as follows:-

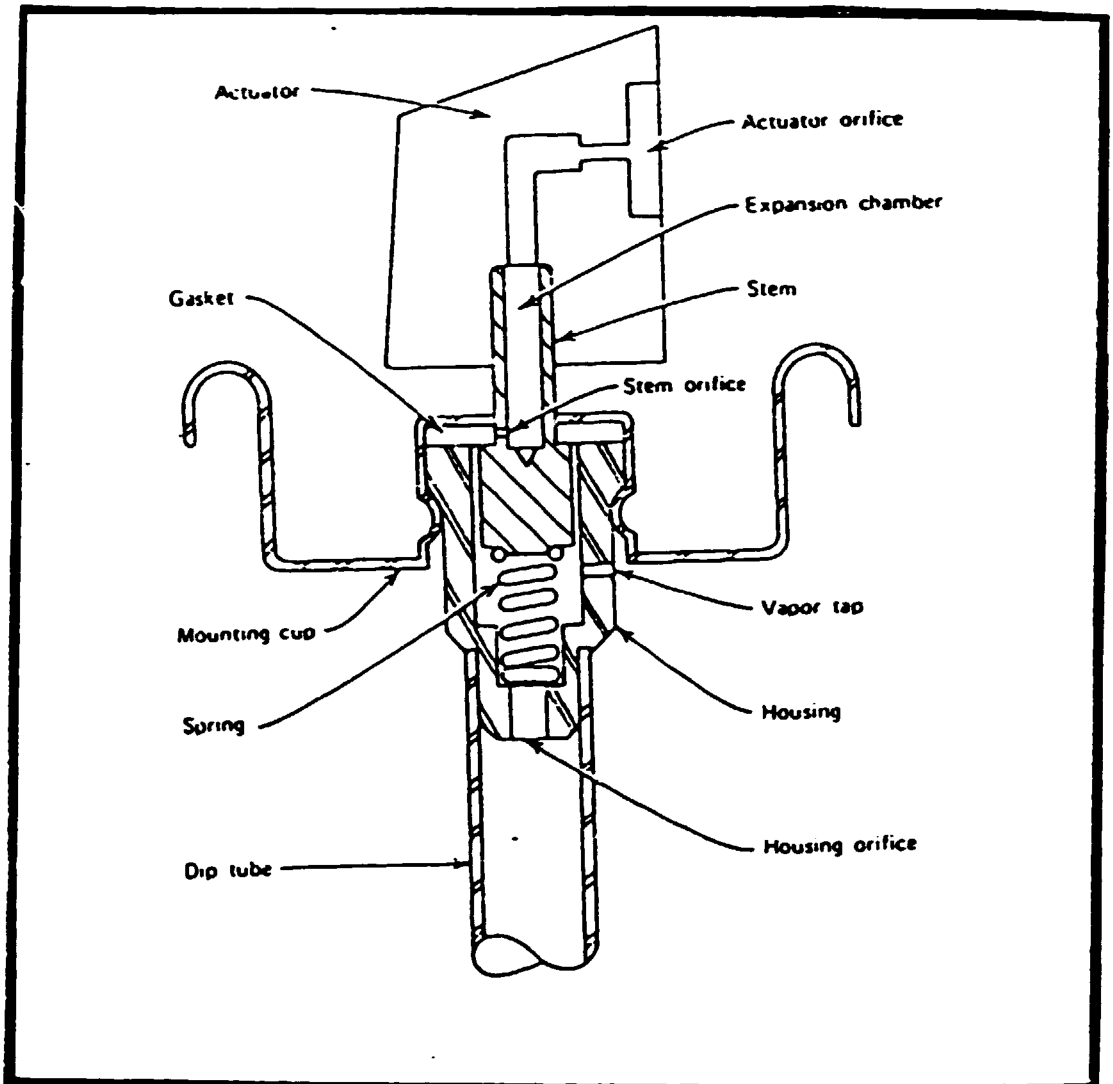
Electricity	100 kwh/day
Water	$4m^3$/day

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

For the anticipated production of 1.8 million aerosol insecticides annually, the following raw materials will be required:

FIGURE I

AEROSOL DISPENSING VALVE AND ACTUATOR



Insecticide extract - Allethrin 3.6t pa
Synergist 21.6t pa
Aromatic essence 9t pa
Propellant Dependent on system*
Cans sets (containers, valves, actuators etc.) 1.8 million/year

The raw material requirements according to the envisaged production programme are given in Table V.

TABLE V

ANNUAL RAW MATERIALS SUPPLY PROGRAMME

Input	Unit	Year 1	Year 2	Year 3 and onwards
Insecticide Extract	ton	2.88	3.24	3.6
Synergist	"	17.28	19.44	21.6
Armatic Essence	"	7.2	8.1	9.0
Propellant**				
cans sets	pcs	1,440,000	1,620,000	1,800,000

* The aerosol insecticide is based on a hydrocarbon propellant, but the type of the insecticide concentration determines the requirement of the propellant.

** A hydrocarbon propellant is to be used. The annual requirement is to be determined at the feasibility stage.

D. MATERIAL AND INPUT COSTS

1. Cost of Raw Materials

The total annual cost of the imported raw materials, i.e. insecticide extract, synergist, propellant, aromatic essence and accessories for the hardware will amount to about Birr 1,407,000. It is assumed that the cans (without the accessories) would be locally manufactured and supplied to the plant. The total cost of the cans is estimated at Birr 1,260,000/year*.

2. Cost of Utilities

Electricity

The cost of electricity will be Birr 0.22/kwh

Water

Water for process and potable uses will cost Birr 0.5/m^3

3. Other Costs

Fuel for Vehicles

The total annual fuel cost for vehicles is estimated to be Birr 10,000.

Packing Materials

The cost of packing materials will be about Birr 36,000/year.

---

* Unit Price per can is estimated by a private producer to be between Birr 0.7 - 0.8.

V. LOCATION

An aerosol insecticide manufacturing plant should be located well away from towns and public and private buildings and residences should not be in the immediate vicinity of the plant.

Taking economical and technical aspects as the most relevant factors in the choice of location, Addis Ababa is considered to be the most appropriate location for the aerosol insecticide plant, for:

- Cans may be supplied by the Ethiopian Crown Cork S.C. located in the outskirts of Addis Ababa. There is also a private plant in Addis Ababa which can supply the cans made out of tin.

- The plastic caps to be mounted on the cans could be produced at the Ethiopian Plastics Factory or at the Addis Ababa Foam and Plastics Factory; and

- The market outlets for the product are urban areas of which Addis Ababa would be the major centre.

The exact site of the plant has to be evaluated at the stage of the feasibility study taking into consideration the factors mentioned above.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Manufacturing Process

Since their development for the control of insects during the early years of the Second World War, aerosol insecticides have become indispensable for a sanitary living environment. The manufacture of aerosol insecticides is basically a packaging process involving the preparation of the insecticide spray and the can filling line.

a. Preparation

The insecticide raw material is blended with a synergist and other ingredients such as an aromatic essence to a given formulation. The blend is then filtered to remove any impurities. Alternatively, ready blended aerosol concentrate can be bought in and diluted.

The cans should be inspected on receipt and later air blast cleaned before the filling operation.

b. Filling

The product filler and crimper/gaser are mounted on an operating bench which has an integral extraction system. At this level of production, the cans are fed manually into the enclosures of both machines. It is also possible to employ automatic enclosure systems, which produce 12-15 cans a minute. This is equivalent to about 2 million cans a year on a single s[illegible] The insecticide solution is pumped from the storage [illegible] to the filling machine where the cans are filled. They are then passed to the crimper/gaser where they are filled with the propellant and sealed tight by fitting an inner stopper and cap.

The propellant is filtered before being pumped into the filler machine fitted with gas detection equipment. Finally the caps are mounted on the cans which are then packed in carton boxes for despatch after inspection. The process flow chart for aerosol insecticide manufacturing is illustrated in Figure II .

2. Source of Technology

The process technology is standard and readily available from such plant manufacturers as:-

DH Industries Ltd.
Sullivan House,
Abbey Wharf,
Kingsbridge Road,
Barking IGT OHA,
UK

Insecticide formualtion may be obtained under a licensing agreement from one of the major producers of insecticides such as:-

ICI Plant Protection Division,
Fernhurst,
Haslemere GU27 3JE,
Telex No.858270 ICI PPF

B. ENGINEERING

1. Machinery and Equipment

The main items of machinery and equipment together with the cost for a plant capable of producing 0.9 million cans a year on a single shift basis is given in Table VI.

FIGURE II

PROCESS FLOW CHART FOR AEROSOL INSECTICIDE MANUFACTURING

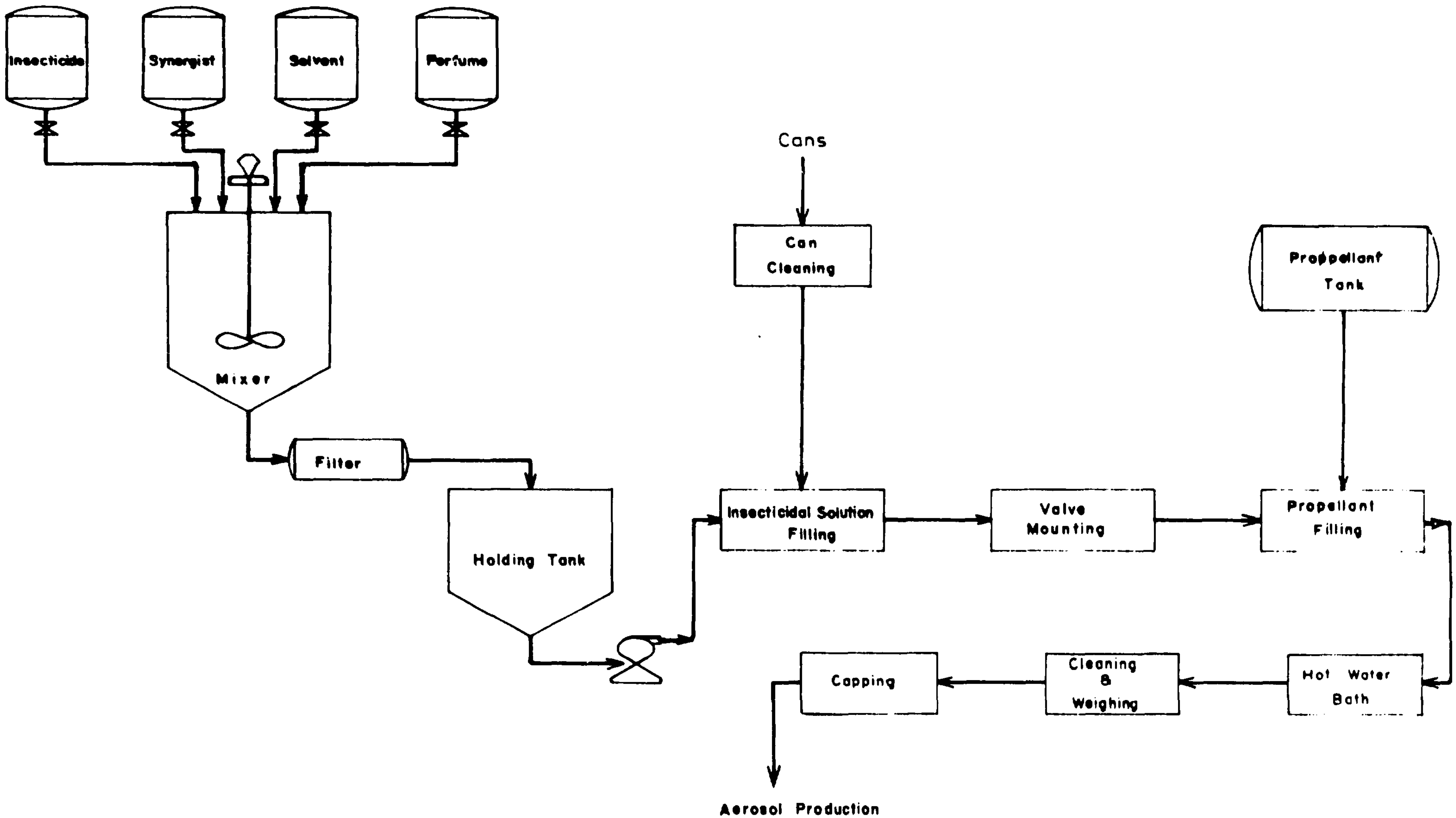


TABLE VI

TOTAL FIXED INVESTMENT COST

DESCRIPTION	(COST '000 BIRR) F.C.	L.C.	TOTAL
A. MACHINERY AND EQUIPMENT			
1. Blending Tanks	20.7	-	20.7
2. Product and Propellant Filling Machines mounted on Bench with Manual Enclosures and Air Blast Cleaner	45.5	-	45.5
3. Compressor and Pumps	22.8	-	22.8
4. Conveyors, control equipment and other accessories and spares	14.5	-	14.5
Total Equipment Cost	103.5		103.5
Freight	-	10	10
Total Machinery Cost (C & F)	103.5	10	113.5
Technology Fee	93		93
Local Cost (12,5% of C&F)	-	14	14
Total Cost of Machinery and Equipment (Including 10% Contingency)	216	26	242

TABLE V. CONT'D

DESCRIPTION	COST ('000 BIRR) F.C.	L.C.	TOTAL
BUILDING AND CIVIL WORKS			
1. Building cost(including fire prevention and fighting equipment	155	295	450
2. Site Development(2% of building cost)	-	9	9
3. Outdoor works(sewerage, water piping etc., 10% of building cost)	-	45	45
Total Building and Civil Works Cost (including 10% contingency)	170	384	554
C. SERVICE EQUIPMENT			
1. Office Furniture and Equipment	9	14	23
D. VEHICLES			
1. Pick-up (one)	28	12	40
2. Service car (one) (incl.10% contingency)	17	8	25
SUB-TOTAL	50	22	72

2. Plant Layout

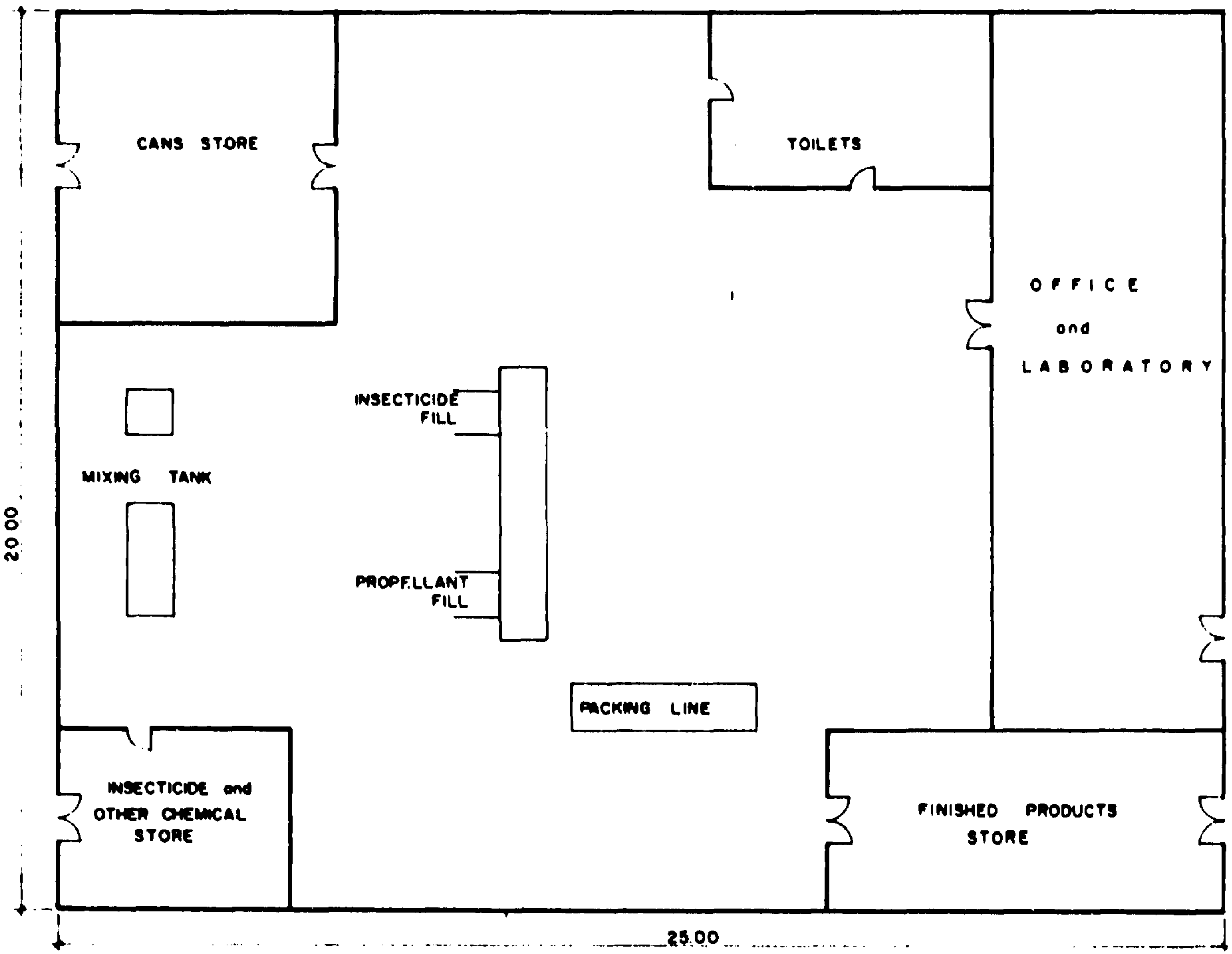
The factory size will be about 500 m^2 on a land area of 1,500m^2. The store for the hydrocarbon propellant should be located far away from the production hall in case of fire. However, the main building and the store could be constructed in the same building, provided non-combustible materials such as concrete is used for the walls. The ceiling of building should be slated roofing. The required area can be divided as follows:-

	m^2
Insecticide and other Chemical store	20
Finished products store	34
Cans store	42
Production hall	300
Laboratory, Offices and toilets	24

The layout is shown in Figure III.

FIGURE III

LAYOUT OF AEROSOL INSECTICIDE PRODUCTION



- D23 -

INDUSTRIAL PROJECTS SERVICE

PROJECT	Drawn by	Sign	Date	CLIENT
	Checked by			
	Approved by			

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of the proposed plant is given in Figure IV. The chart is based on a functional classification, namely production, administration, commercial, maintenance and accounts.

The plant will be headed by a manager, who will report directly to the National Chemicals Corporation.

B. MANPOWER

The total manpower requirement will be 43 (See Table VII. The plant manager should have a formal education in chemical engineering and the production/maintenance engineer in mechanical engineering. Both require an intensive training of 1-3 months at the premises of the supplier of the technology. The insecticide licensor should provide on the-job training and technical assistance during the start up of operations.

TABLE VII

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. Employed	Skill Level	Monthly Salary/ Person (Birr)	Total Annual Salary
Plant manager	1	Professional/ tech.	1200	14000
Secretary	1	Skilled	350	4200
Administrator	1	Skilled	600	7200
Chief Accountant	1	Skilled	700	8400
Commercial Section	1	Skilled	600	7200
Sales	1	Skilled	400	4800
Purchaser	1	Skilled	400	4800
Production/ Maintenance Engineer	1	Professional/ tech.	800	9600
Tester	2	Skilled	400	9600
Accountant	1	Skilled	350	4200
General Service	1	Skilled	250	3000
Secretary	2	Skilled	300	7200
Storekeeper	3	Skilled	400	4800
Operator	6	Semi-skilled	150	10800
Mechanic	2	Skilled	350	8400
Electrician	2	Skilled	350	8400
Labourer	6	Unskilled	190	13680
Driver	1	Skilled	250	3000
Guard	6	Unskilled	100	7200
Cleaner	3	"	70	2520
Total (Incl. 25% employment benefits)	43			178750

Skilled distribution	No.	%
Professional	2	4.6
Skilled	20	46.5
Semi-skilled	6	14.0
Unskilled	15	34.8
Total	43	100

TABLE VII

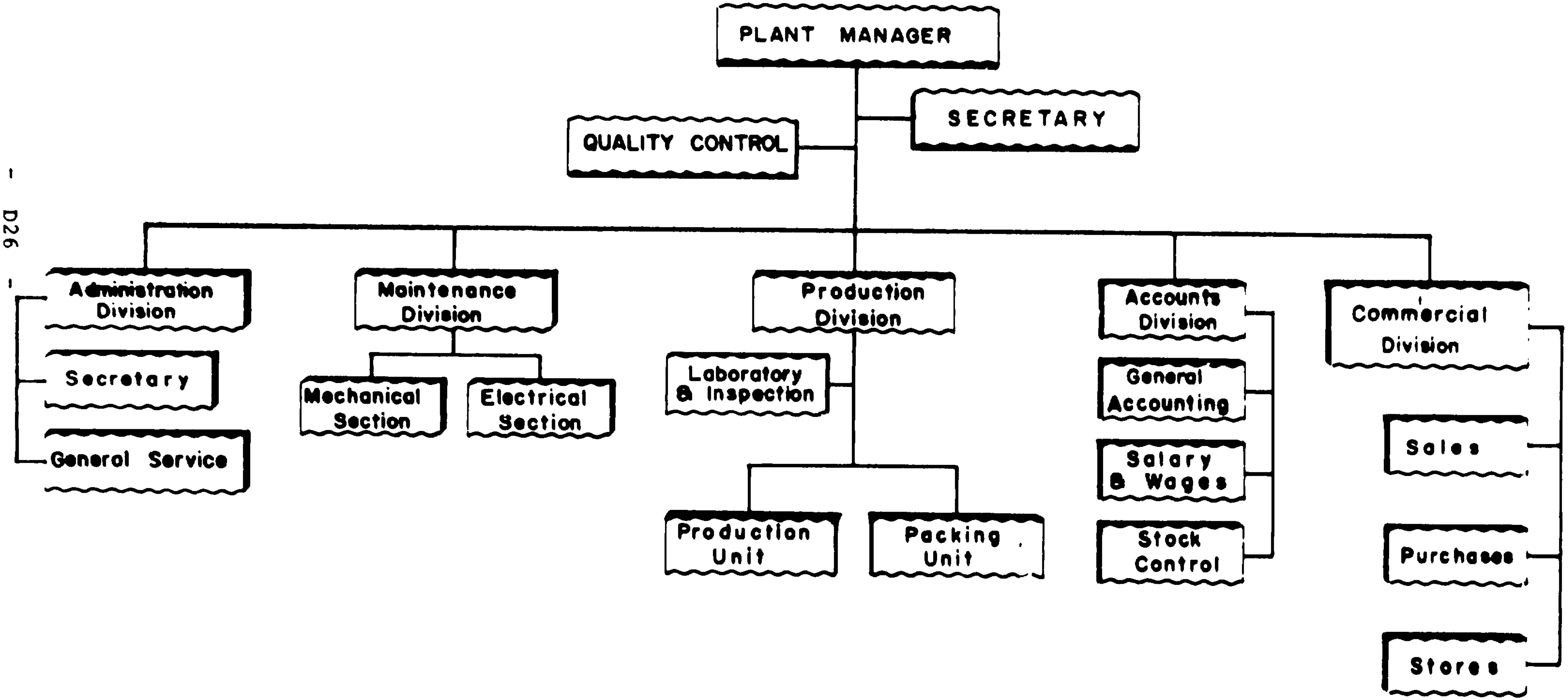
MANPOWER REQUIREMENT AND SALARIES

Personnel	No. Employed	Skill Level	Monthly Salary/ Person (Birr)	Total Annual Salary
Plant manager	1	Professional/ tech.	1200	14000
Secretary	1	Skilled	350	4200
Administrator	1	Skilled	600	7200
Chief Accountant	1	Skilled	700	8400
Commercial Section	1	Skilled	600	7200
Sales	1	Skilled	400	4800
Purchaser	1	Skilled	400	4800
Production/ Maintenance Engineer	1	Professional/ tech.	800	9600
Tester	2	Skilled	400	9600
Accountant	1	Skilled	350	4200
General Service	1	Skilled	250	3000
Secretary	2	Skilled	300	7200
Storekeeper	3	Skilled	400	4800
Operator	6	Semi-skilled	150	10800
Mechanic	2	Skilled	350	8400
Electrician	2	Skilled	350	8400
Labourer	6	Unskilled	190	13680
Driver	1	Skilled	250	3000
Guard	6	Unskilled	100	7200
Cleaner	3	"	70	2520
Total (Incl. 25% employment benefits)	43			178750

Skilled distribution	No.	%
Professional	2	4.6
Skilled	20	46.5
Semi-skilled	6	14.0
Unskilled	15	34.8
Total	43	100

Figure IV

ORGANIZATION CHART OF AEROSOL INSECTICIDE PLANT



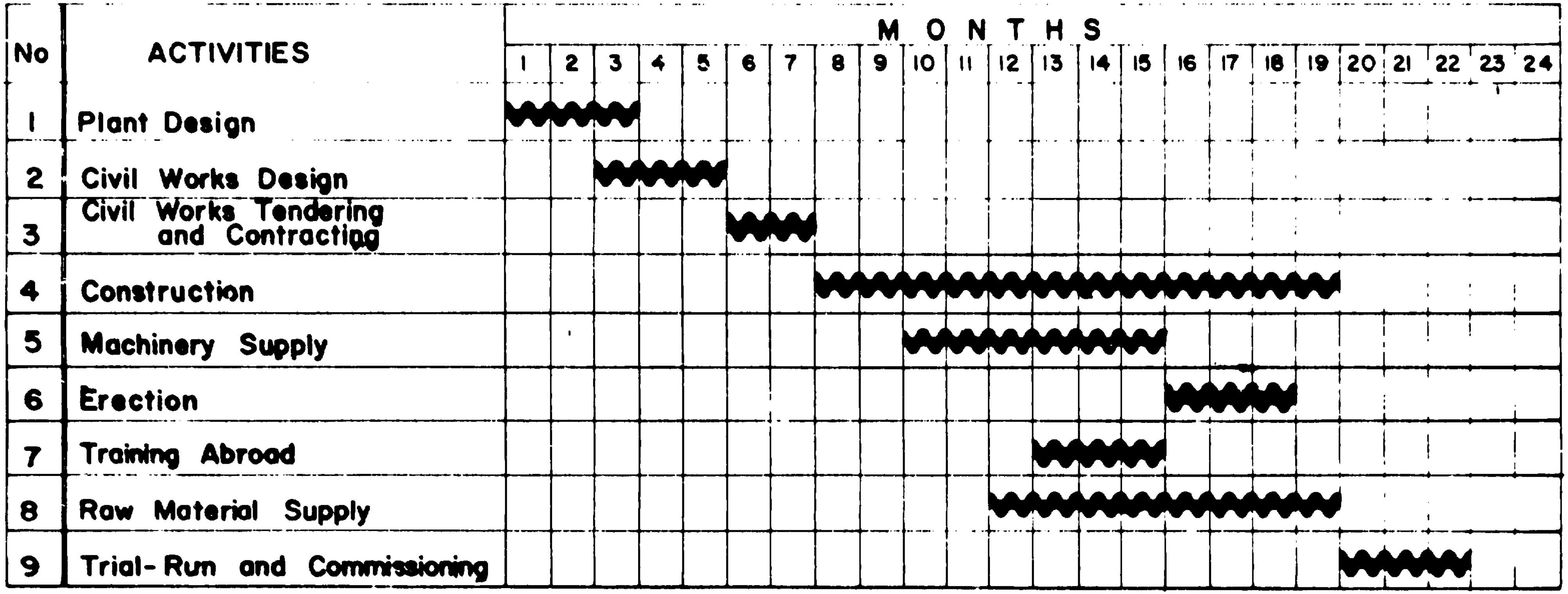
- D26 -

VIII. IMPLEMENTATION SCHEDULE

A general schedule for the construction of the proposed plant for the production of aerosol insecticide is presented in Figure V. Accordingly the time needed to set up the aerosol insecticide plant is estimated to be about 22 months. However, it must be noted that the implementation of the project could be realized in a shorter time than indicated above, provided appropriate measures are taken in the construction of the building.

Figure V

Implementation Schedule of Aerosol Insecticide Plant



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table VIII.

TABLE VIII

SUMMARY OF THE INITIAL INVESTMENT COST ('000 BIRR)

Cost Items	Foreign	Currency Local	Total
Buildings and Civil Works	170.00	384.00	554.00
Plant Machinery and Equipment	216.00	26.00	242.00
Office furniture and equipment	9.00	14.00	23.00
Vehicles	50.00	22.00	72.00
Pre-production expenditure	21.60	194.48	216.08
Total	466.60	640.48	1107.08

The foreign currency component of the total initial investment cost will be about 42%. About 46% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirement

The following parameters were used to estimate the working capital requirements of the aerosol insecticide plant.

	Items	months of Coverage
1.	Cash in hand	0.5
2.	Accounts receivable	0.5
3.	Raw Matrials - Foreign	6.0
4.	Raw Materials - Local	1.0
5.	Finished Products	1.5
6.	Accounts Payable	1.0

The maximum working capital requirement will be Birr 1.26 million, of which Birr 1.12 million will be required in foreign currency.

3. Production Costs

The detailed production cost estimation is given together with other required financial statements. The production cost at full capacity amounts to Birr 3.04 million, out of which about 60% is in foreign currency.

4. Internal Rate of Return (IRR)

The aerosol insecticide plant will be financially viable with an IRR of 13.70% and a net present value of Birr 0.49 million discounted at 10% p.a. The selling price assumed was Birr 2 per container.

5. Breakeven Analysis

The breakeven point would be reached at a production of 727,573 cans of aerosol insecticides. The total revenue generated at the breakeven point would be Birr 1.46 million. In a nut shell the plant would breakeven at a capacity utilza-tion of about 40%.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be -12.48, with a net present value of Birr -3.40 million.

Furthermore, it will create employment for about 49 people when operating at full capacity.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

Aerosol Insecticide Plant
Financial Analysis - June 1986
Opportunity Studies - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	1107.08	42.147 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1107.08	42.147 % foreign

Source of funds during construction phase

equity & grants:	1107.08	42.147 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	1107.08	42.147 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	2433.07	2708.40	2983.73
depreciation :	111.82	111.82	111.82
interest :	0.00	0.00	0.00
production costs	2544.89	2820.22	3095.55
thereof foreign	58.58 %	59.19 %	59.69 %
total sales :	2880.00	3240.00	3600.00
gross income :	335.11	419.78	504.45
net income :	167.56	209.89	252.23
cash balance :	-729.82	198.23	240.57
net cashflow :	-729.82	198.23	240.57

Net Present Value at: 10.00 % : 491.34
Internal Rate of Return: 13.70 %
Return on equity1: 19.24 %
Return on equity2: 13.70 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	154.00	400.00
Auxiliary and service facilities	0.00	72.00
Incorporated fixed assets	0.00	23.00
Plant machinery and equipment	75.00	167.00
Total fixed investment costs	229.00	662.00
Pre-production capital expenditures.	69.84	146.24
Net working capital	0.00	0.00
Total initial investment costs	298.84	808.24
of it foreign, in %	24.09	48.82

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5-7	8	9-12	13-17
% of nom. capacity (single product)	80.00	90.00	100.00	100.00	100.00	100.00
Raw material 1	2133.60	2400.30	2667.00	2667.00	2667.00	2667.00
Other raw materials	28.80	32.40	36.00	36.00	36.00	36.00
Utilities	6.12	6.66	7.20	7.20	7.20	7.20
Energy	22.14	24.57	27.00	27.00	27.00	27.00
Labour, direct	178.71	178.71	178.71	178.71	178.71	178.71
Repair, maintenance	33.50	33.50	33.50	33.50	33.50	33.50
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	5.55	5.94	6.32	6.32	6.32	6.32
Factory costs	2408.43	2682.08	2955.73	2955.73	2955.73	2955.73
Administrative overheads	24.64	26.32	28.00	28.00	28.00	28.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	111.82	111.82	111.82	0.00	0.00	0.00
Financial costs	0.00	0.00	0.00	54.20	68.60	42.10
				0.00	0.00	0.00
Total production costs	2544.89	2820.22	3095.55	3037.93	3057.33	3025.83
Costs per unit (single product)	1.77	1.74	1.72	1.69	1.70	1.68
Of it foreign, %	58.58	59.19	59.69	60.35	60.40	60.18
Of it variable,%	86.55	87.86	88.94	90.63	90.20	90.99
Total labour	178.71	178.71	178.71	178.71	178.71	178.71

COMFAR

TABLE A.4

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	15	24.0	101.38	112.85	124.32	124.32
Inventory and materials	129	2.8	775.20	872.10	969.00	969.00
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	0	---	0.00	0.00	0.00	0.00
Finished products	48	7.5	323.22	361.04	398.85	398.85
Cash in hand	15	24.0	1[illegible]10	10.19	10.27	10.27
Total current assets			120[illegible]9	1356.17	1502.45	1502.45
Current liabilities and						
Accounts payable	30	12.0	200.70	223.51	246.31	246.31
Net working capital			1009.19	1132.66	1256.14	1256.14
Increase in working capital			1009.19	123.47	123.47	0.00
Net working capital, local			113.77	125.68	137.59	137.59
Net working capital, foreign			895.42	1006.98	1118.55	1118.55

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	298.84	808.24
Financial resources	298.84	808.24
Sales, net of tax	0.00	0.00
Total cash outflow	298.84	808.24
Total assets	298.84	808.24
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	226.86	413.62
Outflow, local	226.86	413.62
Surplus (deficit)	0.00	0.00
Inflow, foreign	71.98	394.62
Outflow, foreign	71.98	394.62
Surplus (deficit)	0.00	0.00
Net cashflow	-298.84	-808.24
Cumulated net cashflow	-298.84	-1107.08

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	3080.70	3262.80	3622.80	3600.00	3600.00	3600.00
Financial resources	200.70	22.80	22.80	0.00	0.00	0.00
Sales, net of tax	2880.00	3240.00	3600.00	3600.00	3600.00	3600.00
Total cash outflow	3810.52	3064.57	3382.23	3235.96	3235.96	3336.77
Total assets	1209.89	146.28	146.28	0.00	0.00	72.00
Operating costs	2433.07	2708.40	2983.73	2983.73	2983.73	2983.73
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	167.56	209.89	252.23	252.23	252.23	281.04
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-729.82	198.23	240.57	364.04	364.04	263.23
Cumulated cash balance	-729.82	-531.58	-291.01	73.03	437.07	700.31
Inflow, local	2960.24	3247.93	3607.93	3600.00	3600.00	3600.00
Outflow, local	1349.12	1314.11	1453.28	1433.44	1433.44	1484.24
Surplus (deficit)	1611.12	1933.82	2154.65	2166.56	2166.56	2115.75
Inflow, foreign	120.46	14.88	14.88	0.00	0.00	0.00
Outflow, foreign	2461.40	1750.46	1928.96	1802.52	1802.52	1852.52
Surplus (deficit)	-2340.94	-1735.58	-1914.08	-1802.52	-1802.52	-1852.52
Net cashflow	-729.82	198.23	240.57	364.04	364.04	263.23
Cumulated net cashflow	-1836.90	-1638.66	-1398.09	-1034.05	-670.01	-406.77

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	3600.00	3600.00	3600.00	3600.00	3600.00	3600.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3600.00	3600.00	3600.00	3600.00	3600.00	3600.00
Total cash outflow	3257.56	3257.56	3257.56	3257.56	3342.81	3270.91
Total assets	0.00	0.00	0.00	0.00	72.00	0.00
Operating costs	2983.73	2983.73	2983.73	2983.73	2983.73	2983.73
Cost of finance	0.00	0.00	0.[illegible]	0.00	0.00	0.00
Repayment	0.00	0.00	0.0[illegible]	0.00	0.00	0.00
Corporate tax	273.83	273.83	273.[illegible]	273.83	287.08	287.08
Dividends paid	0.00	0.00	0.[illegible]	0.00	0.00	0.00
Surplus (deficit)	342.44	342.44	342[illegible]	342.44	257.19	329.19
Cumulated cash balance	1042.74	1385.18	1727.[illegible]	2070.05	2327.23	2656.42
Inflow, local	3600.00	3600.00	3600.00	3600.00	3600.00	3600.00
Outflow, local	1455.04	1455.04	1455.04	1455.04	1490.29	1468.29
Surplus (deficit)	2144.96	2144.96	2144.96	2144.96	2109.71	2131.71
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	1802.52	1802.52	1802.52	1802.52	1852.52	1802.52
Surplus (deficit)	-1802.52	-1802.52	-1802.52	-1802.52	-1852.52	-1802.52
Net cashflow	342.44	342.44	342.44	342.44	257.19	329.19
Cumulated net cashflow	-64.34	278.10	620.53	962.97	1220.15	1549.34

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	3600.00	3600.00	3600.00
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	3600.00	3600.00	3600.00
Total cash outflow . .	3270.81	3270.81	3270.81
Total assets	0.00	0.00	0.00
Operating costs . . .	2983.73	2983.73	2983.73
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	287.08	287.08	287.08
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	329.19	329.19	329.19
Cumulated cash balance	2985.60	3314.79	3643.97
Inflow, local	3600.00	3600.00	3600.00
Outflow, local	1468.29	1468.29	1468.29
Surplus (deficit) .	2131.71	2131.71	2131.71
Inflow, foreign . . .	0.00	0.00	0.00
Outflow, foreign . . .	1802.52	1802.52	1802.52
Surplus (deficit) .	-1802.52	-1802.52	-1802.52
Net cashflow	329.19	329.19	329.19
Cumulated net cashflow	1878.52	2207.71	2536.89

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	704.91	at	10.00 %
Internal Rate of Return (IRRE1) ..	19.24 %		

b) Net Worth versus Net cash return:

Net present value	491.34	at	10.00 %
Internal Rate of Return (IRRE2) ..	13.70 %		

c) Internal Rate of Return on total investment:

Net present value	491.34	at	10.00 %
Internal Rate of Return (IRR) ..	13.70 %		

Net Worth : Equity paid plus reserves

TABLE A.6

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	2880.00	3240.00	3600.00	3600.00	3600.00
Less: variable costs, incl. sales tax.	2202.63	2477.96	2753.29	2753.29	2753.29
Variable margin	677.37	762.04	846.71	846.71	846.71
As % of total sales	23.52	23.52	23.52	23.52	23.52
Non variable costs, incl. depreciation	342.25	342.25	342.25	342.25	342.25
Operational margin	335.11	419.78	504.45	504.45	504.45
As % of total sales	11.64	12.96	14.01	14.01	14.01
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	335.11	419.78	504.45	504.45	504.45
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	335.11	419.78	504.45	504.45	504.45
Tax	167.56	209.89	252.23	252.23	252.23
Net profit	167.56	209.89	252.23	252.23	252.23
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	167.56	209.89	252.23	252.23	252.23
Accumulated undistributed profit	167.56	377.45	629.67	881.90	1134.13
Gross profit, % of total sales	11.64	12.96	14.01	14.01	14.01
Net profit, % of total sales	5.82	6.48	7.01	7.01	7.01
ROE, Net profit, % of equity	15.13	18.96	22.78	22.78	22.78
ROI, Net profit+interest, % of invest	7.92	9.37	10.67	10.67	10.67

TABLE A.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	3600.00	3600.00	3600.00	3600.00	3600.00
Less: variable costs, incl. sales tax.	2753.29	2753.29	2753.29	2753.29	2753.29
Variable margin	846.71	846.71	846.71	846.71	846.71
As % of total sales	23.52	23.52	23.52	23.52	23.52
Non variable costs, incl. depreciation	284.64	299.04	299.04	299.04	299.04
Operational margin	562.07	547.67	547.67	547.67	547.67
As % of total sales	15.61	15.21	15.21	15.21	15.21
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	562.07	547.67	547.67	547.67	547.67
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	562.07	547.67	547.67	547.67	547.67
Tax	281.04	273.83	273.83	273.83	273.83
Net profit	281.04	273.83	273.83	273.83	273.83
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	281.04	273.83	273.83	273.83	273.83
Accumulated undistributed profit	1415.16	1689.00	1962.83	2236.67	2510.50
Gross profit, % of total sales	15.61	15.21	15.21	15.21	15.21
Net profit, % of total sales	7.81	7.61	7.61	7.61	7.61
ROE, Net profit, % of equity	25.39	24.73	24.73	24.73	24.73
ROI, Net profit+interest, % of invest.	11.54	11.24	11.24	11.24	11.24

TABLE A.6 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	3600.00	3600.00	3600.00	3600.00	3600.00
Less: variable costs, incl. sales tax.	2753.29	2753.29	2753.29	2753.29	2753.29
Variable margin	846.71	846.71	846.71	846.71	846.71
As % of total sales	23.52	23.52	23.52	23.52	23.52
Non-variable costs, incl. depreciation	272.54	272.54	272.54	272.54	272.54
Operational margin	574.17	574.17	574.17	574.17	574.17
As % of total sales	15.95	15.95	15.95	15.95	15.95
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	574.17	574.17	574.17	574.17	574.17
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	574.17	574.1	574.17	574.17	574.17
Tax	287.08	287.08	287.08	287.08	287.08
Net profit	287.08	287.08	287.08	287.08	287.08
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	287.08	287.08	287.08	287.08	287.08
Accumulated undistributed profit	2797.59	3084.67	3371.76	3658.84	3945.93
Gross profit, % of total sales	15.95	15.95	15.95	15.95	15.95
Net profit, % of total sales	7.97	7.97	7.97	7.97	7.97
ROE, Net profit, % of equity	25.93	25.93	25.93	25.93	25.93
ROI, Net profit+interest, % of invest.	11.45	11.45	11.45	11.45	11.45

- D45 -

TABLE A.7

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, construction in 000 Birr

Year	1	2
Total assets	298.84	1107.08
Fixed assets, net of depreciation	0.00	298.84
Construction in progress	298.84	808.24
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	298.84	1107.08
Equity capital	298.84	1107.08
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

COMFAR

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in 000 Birr

Year	3	4	5	6	7	8
Total assets	2205.16	2239.62	2274.08	2235.29	2487.52	2768.55
Fixed assets, net of depreciation	995.26	883.45	771.63	659.82	548.00	493.80
Construction in progress	0.00	0.00	0.00	0.00	0.00	72.00
Current assets	1199.79	1345.99	1492.18	1492.18	1492.18	1492.18
Cash, bank	10.10	10.19	10.27	10.27	10.27	10.27
Cash surplus, finance available	0.00	0.00	0.00	73.03	437.07	700.31
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	2205.16	2239.62	2274.08	2235.29	2487.52	2768.55
Equity capital	1107.08	1107.08	1107.08	1107.08	1107.08	1107.08
Reserves, retained profit	0.00	167.56	377.45	629.67	881.90	1134.13
Profit	167.56	209.89	252.23	252.23	252.23	281.04
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	200.70	223.51	246.31	246.31	246.31	246.31
Bank overdraft, finance required	729.82	531.58	291.01	0.00	0.00	0.00
Total debt	930.52	755.09	537.33	246.31	246.31	246.31
Equity, % of liabilities	50.20	49.43	48.68	49.53	44.51	39.99

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	3042.39	3316.22	3590.06	3863.89	4150.98	4438.06
Fixed assets, net of depreciation	497.20	428.60	360.00	291.40	249.30	279.20
Construction in progress	0.00	0.00	0.00	0.00	72.00	0.00
Current assets	1492.18	1492.18	1492.18	1492.18	1492.18	1492.18
Cash, bank	10.27	10.27	10.27	10.27	10.27	10.27
Cash surplus, finance available	1042.74	1385.18	1727.61	2070.05	2327.23	2656.42
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	3042.39	3316.22	3590.06	3863.89	4150.98	4438.06
Equity capital	1107.08	1107.08	1107.08	1107.08	1107.08	1107.08
Reserves, retained profit	1415.16	1689.00	1962.83	2236.67	2510.50	2797.59
Profit	273.83	273.83	273.83	273.83	287.08	287.08
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	246.31	246.31	246.31	246.31	246.31	246.31
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	246.31	246.31	246.31	246.31	246.31	246.31
Equity, % of liabilities	36.39	33.38	30.84	28.65	26.67	24.95

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	4725.15	5012.23	5299.32
Fixed assets, net of depreciation	237.10	195.00	152.90
Construction in progress	0.00	0.00	0.00
Current assets	1492.18	1492.18	1492.18
Cash, bank	10.27	10.27	10.27
Cash surplus, finance available	2985.60	3314.79	3643.97
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	4725.15	5012.23	5299.32
Equity capital	1107.08	1107.08	1107.08
Reserves, retained profit	3084.67	3371.76	3658.84
Profit	287.08	287.08	287.08
Long and medium term debt	0.00	0.00	0.00
Current liabilities	246.31	246.31	246.31
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	246.31	246.31	246.31
Equity, % of liabilities	23.43	22.09	20.89

- D49 -

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	311.88	699.59
Financial resources	311.88	699.59
Sales, net of tax	0.00	0.00
Total cash outflow	311.88	699.59
Total assets	311.88	699.59
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	236.90	409.97
Outflow, local	236.90	409.97
Surplus (deficit)	0.00	0.00
Inflow, foreign	74.98	289.62
Outflow, foreign	74.98	289.62
Surplus (deficit)	0.00	0.00
Net cashflow	-311.88	-699.59
Cumulated net cashflow	-311.88	-1011.47

TABLE A.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1830.30	1897.51	2106.31	2088.00	2088.00	2088.00
Financial resources	159.90	18.31	18.31	0.00	0.00	0.00
Sales, net of tax	1670.40	1879.20	2088.00	2088.00	2088.00	2088.00
Total cash outflow	2931.75	2278.78	2499.70	2379.16	2379.16	2438.16
Total assets	994.44	120.54	120.54	0.00	0.00	59.00
Operating costs	1937.32	2158.24	2379.16	2379.16	2379.16	2379.16
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-1101.45	-381.27	-393.40	-291.16	-291.16	-350.16
Cumulated cash balance	-1101.45	-1482.72	-1876.12	-2167.28	-2458.44	-2808.60
Inflow, local	1729.98	1885.15	2093.95	2088.00	2088.00	2088.00
Outflow, local	879.74	821.10	893.72	878.64	878.64	887.64
Surplus (deficit)	850.24	1064.04	1200.22	1209.36	1209.36	1200.36
Inflow, foreign	100.33	12.36	12.36	0.00	0.00	0.00
Outflow, foreign	2052.01	1457.68	1605.98	1500.52	1500.52	1550.52
Surplus (deficit)	-1351.68	-1445.32	-1593.62	-1500.52	-1500.52	-1550.52
Net cashflow	-1101.45	-381.27	-393.40	-291.16	-291.16	-350.16
Cumulated net cashflow	-2112.92	-2494.19	-2887.59	-3178.75	-3469.91	-3820.07

- D50 -

TABLE A.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
cash inflow	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00
Total cash outflow	2379.16	2379.16	2379.16	2379.16	2438.16	2379.16
Total assets	0.00	0.30	0.00	0.00	59.00	0.00
Operating costs	2379.16	2379.16	2379.16	2379.16	2379.16	2379.16
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-291.16	-291.16	-291.16	-291.16	-350.16	-291.16
Cumulated cash balance	-3099.76	-3390.92	-3682.08	-3973.24	-4323.40	-4614.56
Inflow, local	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00
Outflow, local	878.64	878.64	878.64	878.64	887.64	878.64
Surplus (deficit)	1209.36	1209.36	1209.36	1209.36	1200.36	1209.36
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	1500.52	1500.52	1500.52	1500.52	1550.52	1500.52
Surplus (deficit)	-1500.52	-1500.52	-1500.52	-1500.52	-1550.52	-1500.52
Net cashflow	-291.16	-291.16	-291.16	-291.16	-350.16	-291.16
Cumulated net cashflow	-4111.23	-4402.39	-4693.55	-4984.71	-5334.87	-5626.03

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	2088.00	2088.00	2088.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	2088.00	2088.00	2088.00
Total cash outflow	2379.16	2379.16	2379.16
Total assets	0.00	0.00	0.00
Operating costs	2379.16	2379.16	2379.16
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	-291.16	-291.16	-291.16
Cumulated cash balance	-4905.72	-5196.88	-5488.04
Inflow, local	2088.00	2088.00	2088.00
Outflow, local	878.64	878.64	878.64
Surplus (deficit)	1209.36	1209.36	1209.36
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	1500.52	1500.52	1500.52
Surplus (deficit)	-1500.52	-1500.52	-1500.52
Net cashflow	-291.16	-291.16	-291.16
Cumulated net cashflow	-5917.19	-6208.35	-6499.51

TABLE A.8 (Cont'd)

- D53 -

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-2931.99	at	10.00 %
Internal Rate of Return (IRRE1) ..	not found		

b) Net Worth versus Net cash return:

Net present value	-3408.16	at	10.00 %
Internal Rate of Return (IRRE2) ..	-12.48 %		

c) Internal Rate of Return on total investment:

Net present value	-3408.16	at	10.00 %
Internal Rate of Return (IRR) ..	-12.48 %		

Net Worth = Equity paid plus reserves

- E -

INDUSTRIAL GASES

TABLE OF CONTENTS

SUMMARY

The project profile has identified oxygen, acetylene and carbon dioxide as industrial gases. Although each requires different process, different equipment and its own end cylinder, grouping in one has been made because of the generic name. In this profile, carbon dioxide is not fully covered because it is totally different.

The existing plants' capacity for the production of carbon dioxide and oxygen greatly exceed the projected demand volume. There will only be a shortfall in the supply of acetylene by 2000.

Main raw materials are calcium carbide for acetylene and air for oxygen and the latter is known to be energy-intensive.

Both plants are envisaged to be located in Addis Ababa to meet the shortfall in the supply in the future.

Total machinery and equipment investment for both plants estimated at 24,670,000 Birr is fairly high. Total site size is estimated to be 1500 m^2.

The project will generate employment for 66 people.

No financial and economic analysis has been made because of the low demand for the products.

I. INTRODUCTION

Present and future demand for industrial gases is not so large as to justify the setting of new plants. The two plants in Addis Ababa and Asmara, namely Chora and Fana supply a major portion of the market demand. Besides, there are plants owned by large organizations such as the Marine Authority, the private workshops which produce their own acetylene.

The oxygen and acetylene plants can be sited in the same area even if they use different process, and different equipment. This is to gain economies in marketing and distribution particularly if it is decided to run a fleet of trucks from the manufacturing plant. Carbon dioxide is totally different (e.g. even the end-users which could be food processors) and except for the market survey is not covered in this profile.

The minimum economic scale for an oxygen plant is 2.4 million cubic metres (1800 tonnes) per year at standard temperature and pressure on a continuous working basis for 330 days a year. If demand is smaller than this, it is recommended that the plant works continuously until the storage cylinders are full and then closed down until it is necessary to bring it on-stream again. It does not work so well under intermittent, say shift, working conditions.

The minimum economic scale for acetylene is up to 400,000 cubic metres per annum on a continuous basis.

Both require steel cylinders and their costs are included in the total investment.

Financial and economic analysis have not been made because of the low demand for the products. This profile is prepared to elaborate what an oxygen and acetylene plant consists of and to indicate the magnitude of investment required. Even if the project does not have a market at present, it may prove viable in the future as it will have considerably lower transport costs in supplying the market than the imported ones.

FIGURE II

ORGANISATION CHART

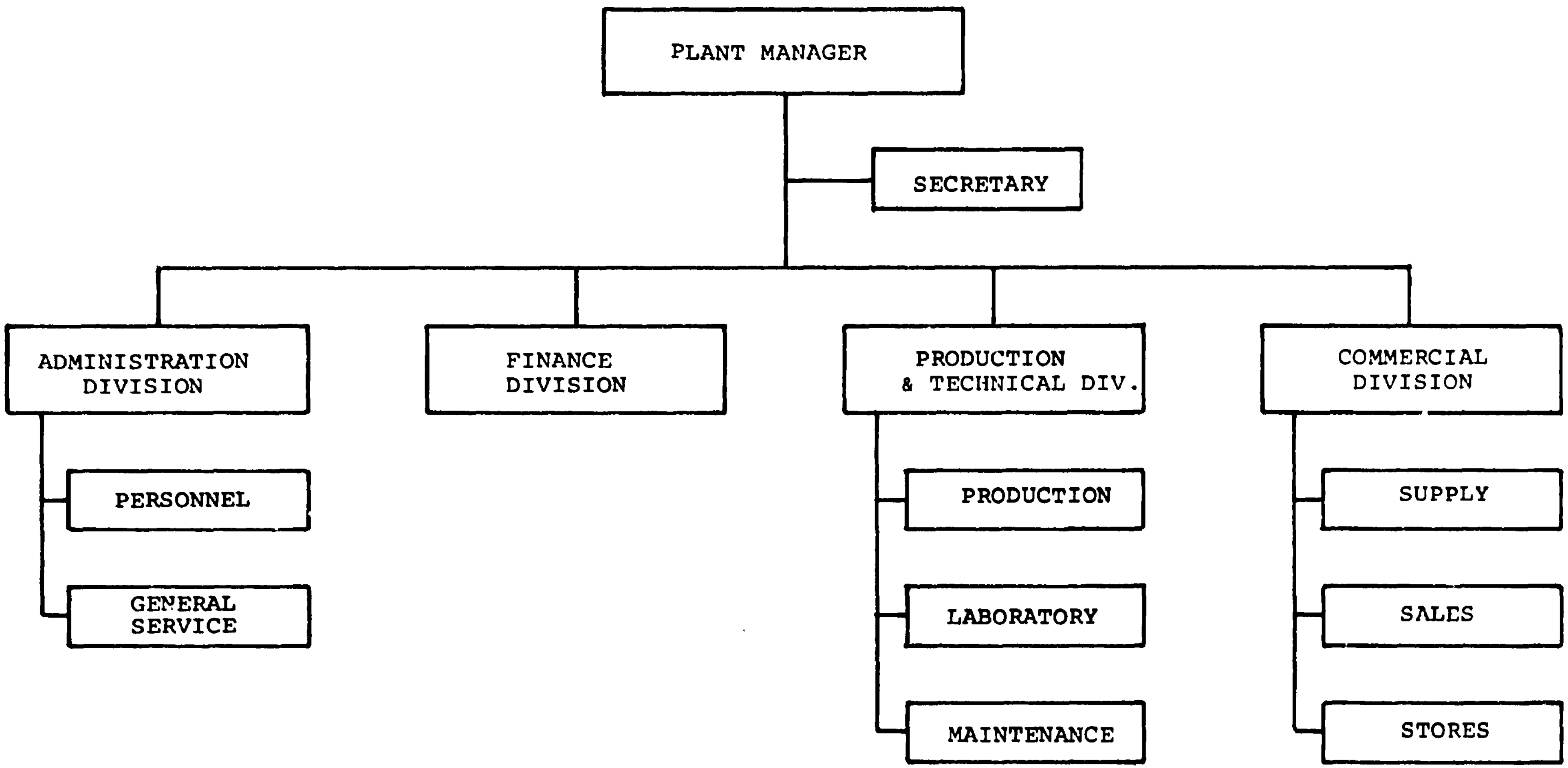


TABLE VI

MANPOWER REQURIEMENT

Post	Persons Per Shift	No. of Shifts	Total No. of Persons	Salary (Birr/Month Person	Total (Birr/ Month	Qualification
Plant Manager	1	1	1	1200	1200	Degree in Mgt.
Sectretary	1	1	1	400	400	Diploma
Administration Head	1	1	1	700	700	Degree or Diploma with experience
Personnel Clerk	1	1	1	400	400	Diploma
General Services	1	1	1	300	300	Technical Certifi- ficate
Financial Head	1	1	1	700	700	Diploma with experience or degree
Accounting Clerks	2	1	2	250	500	Commercial Certi- ficate
Production & technical	1	1	1	1000	1000	Chemical Engineer + training
Production Clerk	1	1	1	250	250	Commercial Certi- ficate
Chemist	1	1	1	700	700	Degree
Lab. technician	1	1	1	250	250	Certificate
Shift Supervisors	1	2	2	500	1000	Diploma in industrial chemistry
Operators	4	2	8	150	1200	Skilled
Labourers	10	2	20	60	1200	Unskilled

TABLE VI CON'TD

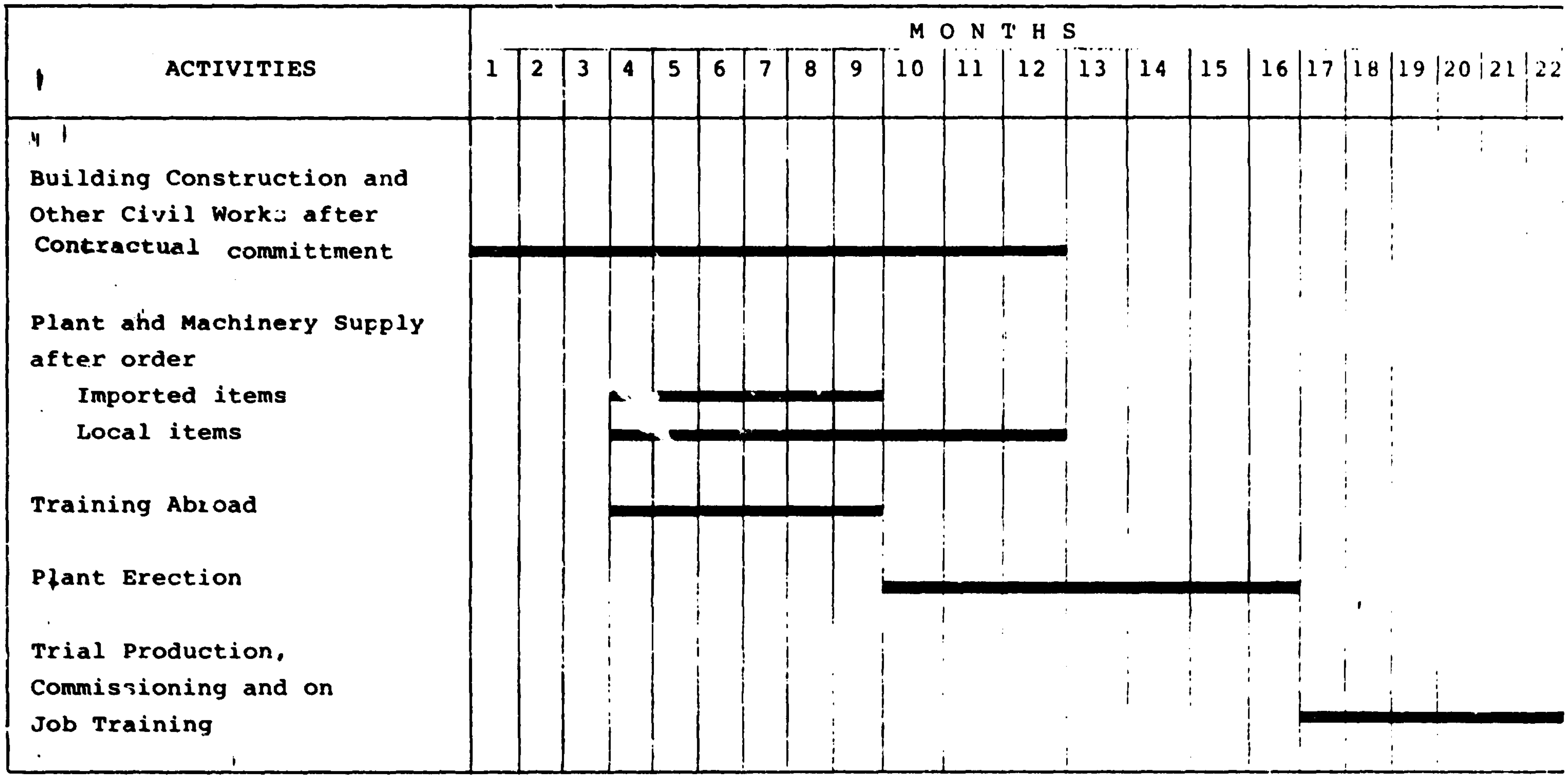
Post	Persons per shift	No. of Shifts	Total No. of Persons	Salary Birr/month person	Total (Birr/ Month)	Qualification
Chief Mechanic	1	1	1	500	500	**Poly graduate**
Welder	1	1	1	350	350	Skilled
Electrician	1	2	2	350	700	Skilled
Fitter	1	2	2	350	700	Degree
Commercial Head	1	1	1	700	700	Degree
Commercial Clerk	1	1	1	250	250	Commercial Certificate
Supply Officer	1	1	1	500	500	Diploma
Sales Officer	1	1	1	500	500	Diploma
Store Keeper	1	1	1	350	350	Certificate
Drivers	7	1	7	250	1750	Driving License
Guards	1	4	4	60	240	Unskilled
Cleaners	2	1	1	60	120	Unskilled
Total	-	-	65	-	16460	

VIII. IMPLEMENTATION SCHEDULE

As shown in Figure III, the implementation is estimated to take 22 months after the necessary financial arrangements are made and commercial/contractual committments are entered into. A more detail scheduling of the implementation shown in Figure III can be carried out at a later stage, first during the feasibility study stage. It must be, however, noted at this stage that the erection will require a relatively longer time, for a considerable amount of the assembly work has to be carried out at the site.

FIGURE III

IMPLEMENTATION SCHEDULE



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table VII .

TABLE VII

SUMMARY OF THE INITIAL INVESTMENT COST

('000 Birr)

	Foreign	Local	Total
Buildings and civil works	314.16	733.04	1047.20
Plnt machinery and equipment	2264.79	1885.51	4150.30
Office furniture and equipment	11.38	34.12	45.50
Vehicles	372.90	248.60	621.50
Pre-production expenditure	11.63	104.60	116.23
Total	2974.86	3005.87	5980.73

The foreign currency component of the total initial investment cost will be about 50%. About 76% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the net working capital requirements of the motor oil regeneration plant.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	0.5
3. Raw materials - foreign	3.0
4. Raw materials - local	2.0
5. Work in progress	0.07
6. Finished products	0.50
7. Accounts payable	1.0

The net working capital requirement on the fifth year of production will be Birr 0.81 million, of which about 77% will be required in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The total production cost on the fifth year of operation amounts to Birr 4.63 million, out of which about 65% is in foreign currency.

4. Internal Rate of REturn (IRR)

The internal rate of return of the motor oil regeneration plant was calculated to be 8.11% with a net present value of Birr -0.75 million discounted at 10% p.a. This was arrived at by assuming an average selling price of Birr 1.64 per litre. In order to make the project viable the minimum selling price should be Birr 1.75 per litre. This will result in an internal rate of return of 11.22% with a net present value of Birr 0.50 million discounted at 10% p.a.

5. Breakeven Analysis

The breakeven point would be reached provided the plant could generate a total revenue of Birr 3.56 million. The fifth year of operation was taken as the basis for breakeven point determination.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 33.40% with a net present value of Birr 11.39 million discounted at 10% p.a. The motor oil regeneration plant is, therefore, economically viable.

The project will create employment for about 65 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

Regeneration of Motor Oil Plant
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	5980.73	49.741 % foreign
current assets:	0.00	0.000 % foreign
total assets:	5980.73	49.741 % foreign

Source of funds during construction phase

equity & grants:	5980.73	49.741 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	5980.73	49.741 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	3497.32	3624.47	3751.78
depreciation :	619.49	619.49	619.49
interest :	0.00	0.00	0.00
production costs	4116.81	4243.96	4371.27
thereof foreign	63.99 %	64.11 %	64.22 %
total sales :	4365.61	4549.06	4732.74
gross income :	248.81	305.11	361.47
net income :	124.41	152.55	180.74
cash balance :	51.47	743.62	771.77
net cashflow :	51.47	743.62	771.77

Net Present Value at: 10.00 % = -747.25
Internal Rate of Return: 8.11 %
Return on equity1: 0.51 %
Return on equity2: 8.11 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

COMFAR

TABLE A.2

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	418.89	628.31
Auxiliary and service facilities	248.60	372.90
Incorporated fixed assets	18.21	27.29
Plant machinery and equipment	1660.12	2490.18
Total fixed investment costs	2345.82	3518.68
Pre-production capital expenditures.	46.49	69.74
Net working capital	0.00	0.00
Total initial investment costs	2392.31	3588.42
Of it foreign, in %	49.74	49.74

COMFAR 2.1 UNIDO

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5	6	7	8
% of nom. capacity (single product).	61.31	63.89	66.47	69.05	71.63	74.21
Raw material 1	505.82	527.07	548.36	569.64	590.92	612.20
Other raw materials	2419.25	2520.91	2622.70	2724.48	2826.28	2928.07
Utilities	100.51	104.08	107.66	11[illegible]	114.82	118.40
Energy	148.80	148.80	148.80	148.80	148.80	148.80
Labour, direct	20.58	20.58	20.58	20.58	20.58	20.58
Repair, maintenance	269.42	269.42	269.42	269.42	269.42	269.42
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	14.97	15.27	15.58	15.88	16.18	16.48
Factory costs	3479.35	3606.14	3733.09	3860.04	3987.01	4113.96
Administrative overheads	17.97	18.33	18.69	19.05	19.42	19.78
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	619.49	619.49	619.49	619.49	619.49	471.94
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	4116.80	4243.96	4371.27	4498.58	4625.91	4605.68
Costs per unit (single product)	1.55	1.53	1.51	1.50	1.49	1.43
Of it foreign, %	63.99	64.11	64.22	64.33	64.43	64.92
Of it variable,%	73.50	74.30	75.04	75.75	76.42	79.52
Total labour	20.58	20.58	20.58	20.58	20.58	20.58

- C36 -

COMFAR

TABLE A.3 (Cont'd) ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Total Production Costs in '000 Birr

Year	9	10	11	12	13	14
% of nom. capacity (single product).	76.79	79.37	81.94	84.52	89.68	94.84
Raw material 1	633 49	654.77	676.02	697.31	739.87	782.44
Other raw materials	3029.86	3131.64	3233.30	3335.09	3538.67	3742.25
Utilities	121.98	125.56	129.14	132.72	139.88	147.04
Energy	148.80	148.80	148.80	148.80	148.80	148.80
Labour, direct	20.58	20.58	20.58	20.58	20.58	20.58
Repair, maintenance	269.42	269.42	269.42	269.42	269.42	269.42
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	16.78	17.09	17.39	17.69	18.29	18.90
Factory costs	4240.91	4367.86	4494.66	4621.61	4875.51	5129.43
Administrative overheads	20.14	20.50	20.86	21.23	21.95	22.68
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	521.66	596.24	596.24	596.24	176.66	176.66
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	4782.71	4984.61	5111.76	5239.07	5074.12	5328.76
Costs per unit (single product)	1.43	1.45	1.44	1.43	1.30	1.29
Of it foreign, %	64.95	64.95	65.03	65.10	66.14	66.22
Of it variable,%	79.24	78.58	79.11	79.62	87.23	87.84
Total labour	20.58	20.58	20.58	20.58	20.58	20.58

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	15	16-17
% of nom. capacity (single product)	97.42	100.00
Raw material 1	803.72	825.00
Other raw materials	3844.04	3945.83
Utilities	150.62	154.20
Energy	148.80	148.80
Labour, direct	20.58	20.58
Repair, maintenance	269.42	269.42
Spares	0.00	0.00
Factory overheads	19.20	19.50
Factory costs	5256.38	5383 33
Administrative overheads	23.04	23.40
Indir. costs, sales and distribution	0.00	0.00
Direct costs, sales and distribution	0.00	0.00
Depreciation	176.66	176.66
Financial costs	0.00	0.00
Total production costs	5456.08	5583.39
Costs per unit (single product)	1.29	1.29
Of it foreign, %	66.26	66.30
Of it variable,%	88.12	88.39
Total labour	20.58	20.58

- C38 -

TABLE A.4

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6	7
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	145.72	151.02	156.32	161.63	166.93
Inventory and materials	81	4.4	658.14	685.80	713.49	741.18	768.87
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	19.33	20.03	20.74	21.44	22.15
Finished products	15	24.0	145.72	151.02	156.32	161.63	166.93
Cash in hand	15	24.0	13.46	13.48	13.51	13.54	13.57
Total current assets			982.37	1021.35	1060.39	1099.42	1138.46
Current liabilities and Accounts payable	30	12.0	289.95	300.51	311.09	321.67	332.25
Net working capital			692.42	720.84	749.29	777.75	806.21
Increase in working capital			692.42	28.42	28.45	28.45	28.46
Net working capital, local			161.32	167.75	174.19	180.62	187.06
Net working capital, foreign			531.10	553.09	575.11	597.12	619.14

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Net Working Capital in '000 Birr

Year	mdc	coto	8	9	10	11	12
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	172.24	177.54	182.85	188.15	193.45
Inventory and materials	81	4.4	796.56	824.25	851.94	879.60	907.29
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	22.86	23.56	24.27	24.97	25.68
Finished products	15	24.0	172.24	177.54	182.85	188.15	193.45
Cash in hand	15	24.0	13.59	13.62	13.65	13.68	13.70
Total current assets			1177.49	1216.52	1255.56	1294.54	1333.57
Current liabilities and							
Accounts payable	30	12.0	342.83	353.41	363.99	374.55	385.13
Net working capital			834.66	863.11	891.57	919.39	948.44
Increase in working capital			28.45	28.45	28.45	28.42	28.45
Net working capital, local			193.50	199.93	206.37	212.80	219.23
Net working capital, foreign			641.16	663.18	685.20	707.19	729.21

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.4 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year	mdc	coto	13	14	15	16	17
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	204.06	214.67	219.98	225.28	225.28
Inventory and materials	81	4.4	962.67	1018.06	1045.75	1673.44	1073.44
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	27.09	28.50	29.20	0.00	0.00
Finished products	15	24.0	204.06	214.67	219.98	23.91	29.91
Cash in hand	15	24.0	13.76	13.82	13.84	225.28	225.28
Total current assets			1411.64	1489.71	1528.74	13.87	13.87
Current liabilities and						1567.78	1567.78
Accounts payable	30	12.0	406.29	427.45	438.03	448.61	448.61
Net working capital			1005.35	1062.26	1090.71	1119.16	1119.16
Increase in working capital			56.91	56.91	28.45	28.45	0.00
Net working capital, local			232.11	244.98	251.41	257.85	257.85
Net working capital, foreign			773.24	817.28	839.30	861.31	861.31

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	2392.31	3588.42
Financial resources	2392.31	3588.42
Sales, net of tax	0.00	0.00
Total cash outflow	2392.31	3588.42
Total assets	2392.31	3588.42
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1202.35	1803.52
Outflow, local	1202.35	1803.52
Surplus (deficit)	0.00	0.00
Inflow, foreign	1189.96	1784.90
Outflow, foreign	1189.96	1784.90
Surplus (deficit)	0.00	0.00
Net cashflow	-2392.31	-3588.42
Cumulated net cashflow	-2392.31	-5980.73

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	4655.56	4559.63	4743.32	4927.00	5110.70	5294.38
Financial resources	289.95	10.57	10.58	10.58	10.58	10.58
Sales, net of tax	4365.61	4549.06	4732.74	4916.42	5100.12	5283.80
Total cash outflow	4604.09	3816.01	3971.56	4127.05	4282.57	4760.43
Total assets	982.37	38.98	39.03	39.03	39.04	287.63
Operating costs	3497.32	3624.47	3751.78	3879.10	4006.42	4133.74
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	124.41	152.55	180.74	208.92	237.11	339.06
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	51.47	743.62	771.77	799.95	828.13	533.95
Cumulated cash balance	51.47	795.09	1566.86	2366.81	3194.95	3728.89
Inflow, local	4462.70	4552.43	4736.12	4919.80	5103.49	5287.17
Outflow, local	1565.87	1386.15	1455.16	1524.15	1593.14	1835.35
Surplus (deficit)	2896.83	3166.28	3280.96	3395.65	3510.35	3451.83
Inflow, foreign	192.86	7.20	7.21	7.21	7.21	7.21
Outflow, foreign	3038.22	2429.86	2516.40	2602.91	2689.42	2925.09
Surplus (deficit)	-2845.36	-2422.66	-2509.19	-2595.70	-2682.21	-2917.88
Net cashflow	51.47	743.62	771.77	799.95	828.13	533.95
Cumulated net cashflow	-5929.26	-5185.64	-4413.87	-3613.92	-2785.78	-2251.83

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	5478.06	5661.74	5845.18	6028.87	6406.81	6774.19
Financial resources	10.58	10.58	10.57	10.58	21.16	21.16
Sales, net of tax	5467.48	5651.16	5834.61	6018.29	6385.65	6753.03
Total cash outflow	5015.37	4760.68	4915.93	5071.48	5879.89	6315.21
Total assets	411.93	39.03	38.98	39.03	326.67	450.97
Operating costs	4261.05	4388.37	4515.52	4642.83	4897.46	5152.10
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	342.39	333.28	361.43	389.61	655.76	712.13
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	462.69	901.06	929.25	957.39	526.92	458.98
Cumulated cash balance	4191.58	5092.65	6021.89	6979.29	7506.21	7965.19
Inflow, local	5470.85	5654.53	5837.98	6021.66	6392.39	6759.77
Outflow, local	1929.20	1811.74	1880.63	1949.63	2406.65	2594.35
Surplus (deficit)	3541.66	3842.80	3957.35	4072.03	3985.75	4165.42
Inflow, foreign	7.21	7.21	7.20	7.21	14.42	14.42
Outflow, foreign	3086.17	2948.94	3035.30	3121.85	3473.25	3720.85
Surplus (deficit)	-3078.97	-2941.73	-3028.10	-3114.64	-3458.83	-3706.43
Net cashflow	462.69	901.06	929.25	957.39	526.92	458.98
Cumulated net cashflow	-1789.14	-888.08	41.17	998.56	1525.48	1984.46

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	6947.29	7130.97	7120.39
Financial resources .	10.58	10.58	0.00
Sales, net of tax . .	6936.71	7120.39	7120.39
Total cash outflow . .	6058.77	6214.26	6175.23
Total assets	39.03	39.03	0.00
Operating costs . . .	5279.42	5406.73	5406.73
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	740.32	768.50	768.50
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	888.52	916.71	945.16
Cumulated cash balance	8853.71	9770.42	10715.57
Inflow, local	6940.08	7123.76	7120.39
Outflow, local	2504.38	2573.37	2563.56
Surplus (deficit) .	4435.70	4550.39	4556.83
Inflow, foreign . . .	7.21	7.21	0.00
Outflow, foreign . . .	3554.39	3640.90	3611.67
Surplus (deficit) .	-3547.18	-3633.69	-3611.67
Net cashflow	888.52	916.71	945.16
Cumulated net cashflow	2872.98	3789.69	4734.85

- C45 -

TABLE A.5 (Cont'd)

COMFAR 2.1 UNIDO

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-3337.71	at	10.00 %
Internal Rate of Return (IRRE1) ..	0.51 %		

b) Net Worth versus Net cash return:

Net present value	-747.25	at	10.00 %
Internal Rate of Return (IRRE2) ..	8.11 %		

c) Internal Rate of Return on total investment:

Net present value	-747.25	at	10.00 %
Internal Rate of Return (IRR) ..	8.11 %		

Net Worth = Equity paid plus reserves

TABLE A.6

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	4365.61	4549.06	4732.74	4916.42	5100.12
Less: variable costs, incl. sales tax.	3025.94	3153.09	3280.40	3407.72	3535.04
Variable margin	1339.68	1395.97	1452.34	1508.71	1565.08
As % of total sales	30.69	30.69	30.69	30.69	30.69
Non-variable costs, incl. depreciation	1090.87	1090.87	1090.87	1090.87	1090.87
Operational margin	248.81	305.11	361.47	417.84	474.21
As % of total sales	5.70	6.71	7.64	8.50	9.30
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	248.81	305.11	361.47	417.84	474.21
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	248.81	305.11	361.47	417.84	474.21
Tax	124.41	152.55	180.74	208.92	237.11
Net profit	124.41	152.55	180.74	208.92	237.11
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	124.41	152.55	180.74	208.92	237.11
Accumulated undistributed profit	124.41	276.96	457.70	666.62	903.72
Gross profit, % of total sales	5.70	6.71	7.64	8.50	9.30
Net profit, % of total sales	2.85	3.35	3.82	4.25	4.65
ROE, Net profit, % of equity	2.08	2.55	3.02	3.49	3.96
ROI, Net profit+interest, % of invest.	1.86	2.28	2.69	3.09	3.49

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	5283.80	5467.48	5651.16	5834.81	6018.29
Less: variable costs, incl. sales tax.	3662.36	3789.67	3916.99	4044.14	4171.45
Variable margin	1621.44	1677.81	1734.18	1790.47	1846.84
As % of total sales	30.69	30.69	30.69	30.69	30.69
Non-variable costs, incl. depreciation	943.32	993.04	1067.62	1067.62	1067.62
Operational margin	678.12	684.77	666.56	722.85	779.22
As % of total sales	12.83	12.52	11.80	12.39	12.95
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	678.12	684.77	666.56	722.85	779.22
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	678.12	684.77	666.56	722.85	779.22
Tax	339.06	342.39	333.28	361.43	389.61
Net profit	339.06	342.39	333.28	361.43	389.61
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	339.06	342.39	333.28	361.43	389.61
Accumulated undistributed profit	1242.79	1585.17	1918.45	2279.87	2669.48
Gross profit, % of total sales	12.83	12.52	11.80	12.39	12.95
Net profit, % of total sales	6.42	6.26	5.90	6.19	6.47
ROE, Net profit, % of equity	5.67	5.72	5.57	6.04	6.51
ROI, Net profit+interest, % of invest.	4.80	4.59	4.45	4.80	5.16

TABLE A.6 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	6385.65	6753.03	6936.71	7120.39	7120.39
Less: variable costs, incl. sales tax.	4426.08	4680.72	4808.04	4935.35	4935.35
Variable margin	1959.57	2072.31	2128.67	2185.04	2185.04
As % of total sales	30.69	30.69	30.69	30.69	30.69
Non-variabl. costs, incl. depreciation	648.04	648.04	648.04	648.04	648.04
Operational margin	1311.53	1424.27	1480.63	1537.00	1537.00
As % of total sales	20.54	21.09	21.34	21.59	21.59
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	1311.53	1424.27	1480.63	1537.00	1537.00
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	1311.53	1424.27	1480.63	1537.00	1537.00
Tax	655.76	712.13	740.32	768.50	768.50
Net profit	655.76	712.13	740.32	768.50	768.50
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	655.76	712.13	740.32	768.50	768.50
Accumulated undistributed profit	3325.25	4037.38	4777.70	5546.20	6314.69
Gross profit, % of total sales	20.54	21.09	21.34	21.59	21.59
Net profit, % of total sales	10.27	10.55	10.67	10.79	10.79
ROE, Net profit, % of equity	10.96	11.91	12.38	12.85	12.85
ROI, Net profit+interest, % of invest.	8.35	8.59	8.90	9.21	9.21

TABLE A.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	2392.31	5980.73
Fixed assets, net of depreciation	0.00	2392.31
Construction in progress	2392.31	3588.42
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	2392.31	5980.73
Equity capital	2392.31	5980.73
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

- C50 -

TABLE A.7 (Cont'd)

COMFAR 2.1 UNIDO

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	6395.08	6558.20	6749.52	6969.02	7216.70	7566.35
Fixed assets, net of depreciation	5361.24	4741.76	4122.27	3502.79	2883.30	2411.36
Construction in progress	0.00	0.00	0.00	0.00	0.00	248.60
Current assets	968.91	1007.87	1046.87	1085.88	1124.89	1163.89
Cash, bank	13.46	13.48	13.51	13.54	13.57	13.59
Cash surplus, finance available	51.47	795.09	1566.86	2366.81	3194.95	3728.90
Loss carried forward	0.00	0 00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	6395.08	6558.20	6749.52	6969.02	7216.70	7566.35
Equity capital	5980.73	5980.73	5980.73	5980.73	5980.73	5980.73
Reserves, retained profit	0.00	124.41	276.96	457.70	666.62	903.72
Profit	124.41	152.55	180.74	208.92	237.11	339.06
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	289.95	300.51	311.09	321.67	332.25	342.83
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	289.95	300.51	311.09	321.67	332.25	342.83
Equity, % of liabilities	93.52	91.19	88.61	85.82	82.87	79.04

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	7919.31	8263.17	8635.16	9035.35	9712.27	10445.56
Fixed assets, net of depreciation	2138.30	1914.96	1318.72	722.48	545.82	617.76
Construction in progress	372.90	0.00	0.00	0.00	248.60	372.90
Current assets	1202.90	1241.91	1280.86	1319.87	1397.88	1475.89
Cash, bank	13.62	13.65	13.68	13.70	13.76	13.82
Cash surplus, finance available	4191.59	5092.65	6021.90	6979.29	7506.21	7965.19
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	7919.31	8263.17	8635.16	9035.35	9712.27	10445.56
Equity capital	5980.73	5980.73	5980.73	5980.73	5980.73	5980.73
Reserves, retained profit	1242.79	1585.17	1918.45	2279.87	2669.48	3325.25
Profit	342.39	333.28	361.43	389.61	655.76	712.13
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	353.41	363.99	374.55	385.13	406.29	427.45
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	353.41	363.99	374.55	385.13	406.29	427.45
Equity, % of liabilities	75.52	72.38	69.26	66.19	61.58	57.26

Regeneration of Motor Oil Plant --- Financial Analysis - July 1988

COMFAR

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	11196.46	11975.54	12744.04
Fixed assets, net of depreciation	814.00	637.34	460.68
Construction in progress	0.00	0.00	0.00
Current assets	1514.90	1553.91	1553.91
Cash, bank	13.84	13.87	13.87
Cash surplus, finance available	8853.71	9770.42	10715.58
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	11196.46	11975.54	12744.04
Equity capital	5980.73	5980.73	5980.73
Reserves, retained profit	4037.38	4777.70	5546.20
Profit	740.32	768.50	768.50
Long and medium term debt	0.00	0.00	0.00
Current liabilities	438.03	448.61	448.61
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	438.03	448.61	448.61
Equity, % of liabilities	53.42	49.94	46.93

COMFAR 2.1 UNIDO

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	2027.45	3041.11
Financial resources .	2027.45	3041.11
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	2027.45	3041.11
Total assets	2027.45	3041.11
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	871.94	1307.89
Outflow, local	871.94	1307.89
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	1155.51	1733.22
Outflow, foreign . . .	1155.51	1733.22
Surplus (deficit) .	0.00	0.00
Net cashflow	-2027.45	-3041.11
Cumulated net cashflow	-2027.45	-5068.56

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	3399.45	3415.63	3553.39	3691.15	3828.92	3966.68
Financial resources	125.23	3.83	3.83	3.83	3.83	3.83
Sales, net of tax	3274.21	3411.80	3549.56	3687.32	3825.09	3962.85
Total cash outflow	1863.14	1575.03	1621.29	1667.54	1713.80	1953.95
Total assets	346.86	12.55	12.57	12.57	12.57	206.48
Operating costs	1516.29	1562.48	1608.73	1654.98	1701.23	1747.48
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1536.30	1840.60	1932.10	2023.61	2115.13	2012.73
Cumulated cash balance	1536.30	3376.90	5308.99	7332.60	9447.73	11460.46
Inflow, local	3346.94	3414.32	3552.09	3689.85	3827.62	3965.38
Outflow, local	1079.96	924.20	954.81	985.42	1016.03	1091.38
Surplus (deficit)	2266.98	2490.13	2597.27	2704.43	2811.59	2874.00
Inflow, foreign	52.50	1.30	1.30	1.30	1.30	1.30
Outflow, foreign	783.18	650.83	666.48	682.12	697.77	862.57
Surplus (deficit)	-730.68	-649.53	-665.18	-680.82	-696.47	-861.27
Net cashflow	1536.30	1840.60	1932.10	2023.61	2115.13	2012.73
Cumulated net cashflow	-3532.26	-1691.66	240.43	2264.04	4379.17	6391.90

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	4104.44	4242.20	4379.79	4517.55	4796.90	5072.43
Financial resources	3.83	3.83	3.83	3.83	7.66	7.66
Sales, net of tax	4100.61	4238.37	4375.96	4513.72	4789.24	5064.77
Total cash outflow	2097.16	1852.54	1898.72	1944.98	2243.95	2433.42
Total assets	303.44	12.57	12.55	12.57	219.04	316.00
Operating costs	1793.73	1839.97	1886.17	1932.41	2024.91	2117.41
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	2007.28	2389.66	2481.07	2572.57	2552.95	2639.02
Cumulated cash balance	13467.74	15857.40	18338.46	20911.04	23463.98	26103.00
Inflow, local	4103.14	4240.90	4378.48	4516.25	4794.29	5069.83
Outflow, local	1144.37	1107.84	1138.40	1169.02	1282.33	1365.93
Surplus (deficit)	2958.77	3133.05	3240.08	3347.23	3511.96	3703.90
Inflow, foreign	1.30	1.30	1.30	1.30	2.61	2.61
Outflow, foreign	952.79	744.70	760.31	775.96	961.62	1067.49
Surplus (deficit)	-951.49	-743.39	-759.01	-774.66	-959.01	-1064.88
Net cashflow	2007.28	2389.66	2481.07	2572.57	2552.95	2639.02
Cumulated net cashflow	8399.18	10788.84	13269.91	15842.48	18395.42	21034.44

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	5206.36	5344.12	5340.29
Financial resources	3.83	3.83	0.00
Sales, net of tax	5202.53	5340.29	5340.29
Total cash outflow	2176.23	2222.48	2209.91
Total assets	12.57	12.57	0.00
Operating costs	2163.66	2209.91	2209.91
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	3030.14	3121.65	3130.38
Cumulated cash balance	29133.13	32254.78	35385.16
Inflow, local	5205.06	5342.82	5340.29
Outflow, local	1322.05	1352.65	1345.30
Surplus (deficit)	3883.01	3990.16	3994.99
Inflow, foreign	1.30	1.30	0.00
Outflow, foreign	854.18	869.82	864.61
Surplus (deficit)	-852.88	-868.52	-864.61
Net cashflow	3030.14	3121.65	3130.38
Cumulated net cashflow	24064.57	27186.22	30316.60

- C57 -

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	10896.81	at	10.00 %
Internal Rate of Return (IRRE1) ..	34.49 %		

b) Net Worth versus Net cash return:

Net present value	11392.65	at	10.00 %
Internal Rate of Return (IRRE2) ..	33.40 %		

c) Internal Rate of Return on total investment:

Net present value	11392.65	at	10.00 %
Internal Rate of Return (IRR) ..	33.40 %		

Net Worth = Equity paid plus reserves

- D -

AEROSOL INSECTICIDE

TABLE OF CONTENTS

I. SUMMARY

Aerosol insecticide project is envisaged to produce self-dispersing, pressurized and self-propelling product with the sole objective of killing mosquitos, flies, cockroaches, flea, etc.

The major raw material is insecticide chemical. However there are other materials such as container, valve, actuator and accessories which are vital parts of the final product. All these materials will be imported as they are not locally manufactured. This project is totally dependent, at least in the short-run, on foreign source for raw material and other components.

The initial investment cost was estimated at about Birr 1.11 million. The foreign currency component of the total investment cost will be about 42%.

The project will generate employment for about 38 people. Factory building space requirement was estimated at 500m², while the total area of the premises will be about 1500m².

This project is financially viable with an internal rate of return (IRR) of 13.7% and a net present value of Birr 0.49 million discounted at 10% per annum. This result was obtained assuming that each insecticide can will be sold at Birr 2.00.

II. INTRODUCTION

Pocketable type of pressurized insecticide was developed during the World War II for American soldiers fighting in the tropical jungles to protect themselves especially against malaria.

Since its inception, aerosol insecticide has evolved considerably to meet changing consumer needs. The development of pocketable type of pressurized aerosol insecticide has revolutionized the concept of packing many products.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Aerosols are self-dispersing, pressurized, self-propelling products. They are dispersed by using a liquified, non-liquifiable or non-condensable gas. It is a colloidal system in which finely divided liquids or solids, usually within 10-15 are dispersed in a gas. The major item which characterizes aerosols as unique is the propellant.

The development of pocketable type of pressurized insecticide directly resulted from American soldiers fighting in the tropical jungles during the Second World War. Faced with the need to deal with malaria in the tropical jungles, the U.S. soldiers had to be provided with pressurized insecticides containers.

Since its first inception, aerosol insecticide has evolved considerably to meet changing consumer needs. The main targets are mosquitos flies and cockroaches the development of pocketable type of pressurized aerosol insecticide has revolutionized the concept of packing of many products. It was only after the development of this new way of packing insecticide that a countless number of commercial products started to appear in the market with the same mode of packaging. These include, hair sprays, household insecticides, garden insecticides, deodorants, perspiration inhibitors, paints, glass cleaners, perfumes, medical products and food products. It is estimated that 6 billion cans of aerosol type products are produced in the world today.

There are different types of aerosol insecticides coming into the country legally as well as illegally. It was only in 1983 that a private insecticides packing plant with a daily capacity of 1200[1] can, corresponding to 360 thousand cans per year, was established.

Since its establishment, the plant is plagued by shortage of packing material as well as chemicals. According to the plant management, the highest production volume so far attained amounted to 3477 cans, corresponding to only 0.9% capacity utilization (See Table I). The reporting must have been highly underestimated for various reasons.

TABLE I

PRODUCTION OF AEROSOL INSECTICIDES

(CANS)

Year	Output
1983	2,580
1984	2,250
1985	-
1986	3,477

SOURCE: The plant management

2. Past and Future Demand Analysis

In the past, the import of aerosol was reported with different insecticide imports. The quantity of aerosol cans imported could not thus be identified from the total import figures of insecticides. However, the Ethiopian Import-Export Corporation has been lately importing aerosol insecticides.

---

1 Handicraft and Small Scale Industry Development Agency (HASIDA)

According to information from the Corporation, the import was not based on the demand but on the availability of foreign exchange. The import of aerosol insecticides by the Ethiopian Import-Export Corporation (ETMIX) is shown in Table II.

TABLE II

AEROSOL INSECTICIDES IMPORT BY ETIMEX

(CANS)

Year	Quantity
1984	1,142,406
1985	476,832
1986	1,000,000

SOURCE: Ethiopian Import-Export Corporation

At this juncture it is worth noting that a large quantity of aerosol insecticides is imported illegally but it is difficult to estimate its quantity. When the official import figure and the quantity produced locally are added to that, the aggregate supply of aerosol insecticides would become considerably large. In view of this, this project mainly engages in the production of aerosol insecticides, mainly for killing insects. Thus, the expected market for the product comprises urban households, urban oriented rural households, particularly those who can be categorised as sub-urbans, and commercial enterprises such as hotels and bars, restaurants etc. Other organizations such as government offices, large private enterprises and other non-government offices usually use room freshners and not insecticides.

Thus to estimate the size of the demand for aerosol insecticides, the urban households, hotels & bars, snack bars and restaurants were considered under the following basic assumptions.

- Each household in urban centres is assumed to use at least two aerosol insecticide cans per year.

- Hotels & bars are assumed to use one per month, while the annual consumption of snack bars and resturants are roughly assumed to be four cans each.

These assumptions, though they seem to be arbitrary fixed, are quite reasonable in view of the bulkiness of the aggregate supply of aerosol insecticides.

The number of urban households are expected to grow from 1,109,694 in 1988 to 1,537,305 by the year 2003, corresponding to an average annual growth rate of 2.2%. The total number of hotels and bars and restaurants together with snack bars are estimated to be 7423 and 4900, respectively. These data are incorporated with those assumptions indicated above to give a demand estimates of aerosol insecticides, ranging from 2328 thousand in 1988 to 3183 thousand by the year 2003. The installed capacity of the existing plant, which is 360 thousand cans/year, has to be subtracted from the projected demand in order to estimate the level of the unsatisfied demand. Accordingly the unsatisfied demand is estimated to vary between 1968 thousand and 2823 thousand over the forecast period (See Table III).

TABLE III

AEROSOL INSECTICIDES DEMAND PROJECTION

USING END-USE APPROACH

('000 CANS)

Year	Projected demand	Local Installed Capacity	Unsatisfie demand
1988	2328	360	1968
1989	2372	360	2012
1990	2417	360	2057
1991	2464	360	2104
1992	2513	360	2153
1993	2563	360	2203
1994	2616	360	2256
1995	2671	360	2311
1996	2727	360	2367
1997	2786	360	2426
1998	2846	360	2486
1999	2909	360	2549
2000	2974	360	2614
2001	3042	360	2682
2002	3111	360	2751
2003	3183	360	2823

3. Pricing

According to the Ethiopian Import-Export Corporation, the current FOB import price of an aerosol is Birr 1.16 per can while the CIF price is Birr 1.35 per can. Aerosol is imported duty free.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The minimum economic scale of a plant for aerosol production of one type only is about 0.9 million cans a year operating in a single 8-hour shift, 300 days a year. Such a plant would meet the country's short to medium term supply needs operating in two shifts, while the introduction of a third shift for new products, such as room cleaners and air freshners would meet the longer term demand. Alternatively, the capacity of the plant can be increased. The production units are flexible and allow modular expansion to the extent that the existing equipment can be incorporated in larger bench sets.

2. Production Programme

The production of aerosol insecticide is basically a packaging operation. The plant could start operation in two shifts in 1991 at 80% capacity utilization. It increases its capacity utilization to 90% in the second year of operation and reaches full capacity in the following year (See Table IV).

TABLE IV

PRODUCTION PROGRAMME FOR AERESOL INSECTICIDE PLANT

Year	Estimated Demand Gap ('000 Cans)	Production Programme ('000 Cans)	Capacity Utilization (%)
1991	2104	1440	80
1992	2153	1620	90
1993	2203	1800	100
1994	2256	1800	100
1995	2311	1800	100
1996	2367	1800	100
1997	2426	1800	100
1998	2486	1800	100
1999	2549	1800	100
2000	2614	1800	100
2001	2682	1800	100
2002	2751	1800	100
2003	2823	1800	100

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

An aerosol comprises three components:-

- Insecticide,
- Propellant system, and
- Hardware, i.e. the container, valve, actuator and other accessories.

1. Insecticide

The insecticide or active component can be any of the commercially used insecticides such as allethrin, dichlorvos, fenitrothion etc. The active ingredients must be soluble in alcohol, carbon tetrachloride, kerosene and nitromethane. The choice of insecticide to use is an important factor as some can be harmful to human and other warm-blooded animal life and plants. Pyrethrum is a natural insecticide coming from the seeds of a variety of the chrysanthemum flower family. Synthetic derivatives have been created.

Among the first and commonly used in aerosols is allethrin. It is the generic name for 2-allyl-4-hydroxy-3-methyl-2 cyclopentan-1-one ester of chrysanthemum monocarboxylic acid. It is a clear, amber-coloured, viscous liquid, derived from glycerine, acetylene and ethyl acetoacetate. Newer synthetic pyrethroids, for example permethrin, decamethrin flenvalerate are now available which offer substantial improvements over natural pyrethrins and allethrin as they are more persistent and can be applied in smaller quantities.

The insecticide is dispersed with a synergist and perhaps aromatic essences. A commonly used synergist is piperonyl butoxide. This chemical is used in an amount about twice as much as the active ingredient in the insecticide formulation to impart a synergistic effect upon application. Thus, the effectiveness of the active components will be more than additive.

2. Propellant System

A propellant is a compressed gas used to expel the contents of containers in the form of aerosols. Until recently chlorofluorcarbons 11 and 12 have been widely used because of their non-flammability and non-toxicity. However, due to the strong possibility that they may contribute to depletion of the ozone layer of the upper atmosphere, their use for this purpose has decreased. Other propellants used are hydrocarbon gases such as butane, propane and isobutane. They are the cheapest propellants but are flammable.

The alternatives are compressed gas propellants such as CO_2, N_2O and N_2. They are non-toxic, non-flammable, relatively low in cost and very inert. The vapour pressure in the container however, falls as the contents are depleted which may cause changes in the rate and characteristics of the spray. Although they are still a subject of much research, they are not regarded as efficient for spraying insecticides.

3. Hardware

Pressure containers are made either from tinplated steel or aluminium. The former are three-piece cans while aluminium containers are usually of a monobloc (one-piece) construction. Thin resin coatings line the containers to avoid detrimental reactions to the insecticide and possible damage to the can.

The key to the aerosol system is the dispensing valve and actuator (See Figure I). The valve consists basically of seven pieces:

- Actuator,
- Stem,
- Mounting cap,
- Gasket,
- Housing,
- Spring, and
- Dip tube.

The valve has to meet the specific needs of the insecticide product. Manufacturers, however, produce a wide range of standard valves of which one will probably be acceptable.

B. UTILITIES

The utility requirements of the aerosol insecticide plant are as follows:-

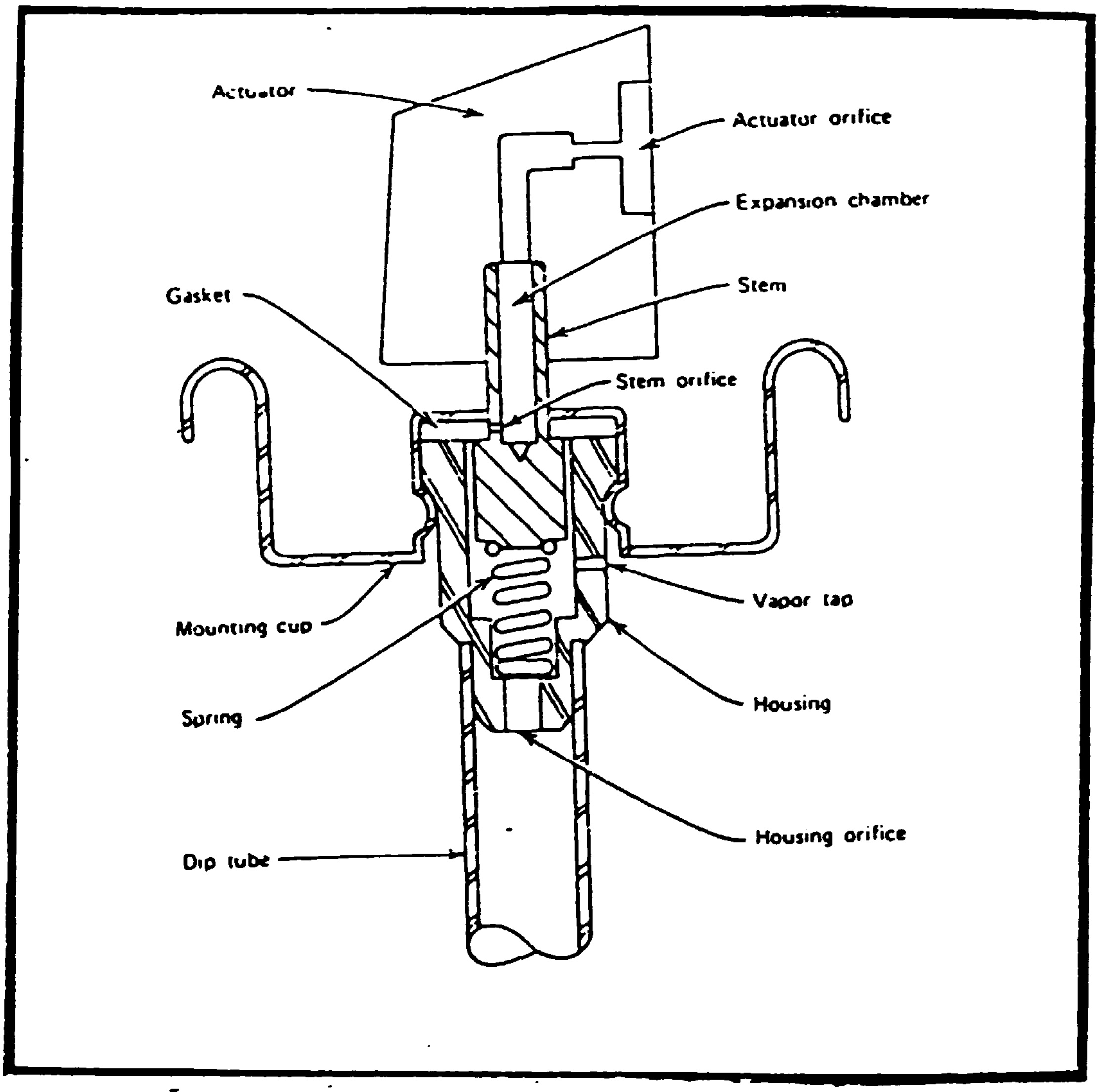
Electricity	100 kwh/day
Water	$4m^3$/day

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

For the anticipated production of 1.8 million aerosol insecticides annually, the following raw materials will be required:

FIGURE 1

AEROSOL DISPENSING VALVE AND ACTUATOR



Insecticide extract - Allethrin 3.6t pa
Synergist 21.6t pa
Aromatic essence 9t pa
Propellant Dependent on system*
Cans sets (containers, valves, actuators etc.) 1.8 million/year

The raw material requirements according to the envisaged production programme are given in Table V.

TABLE V

ANNUAL RAW MATERIALS SUPPLY PROGRAMME

Input	Unit	Year 1	Year 2	Year 3 and onwards
Insecticide Extract	ton	2.88	3.24	3.6
Synergist	"	17.28	19.44	21.6
Armatic Essence	"	7.2	8.1	9.0
Propellant**				
cans sets	pcs	1,440,000	1,620,000	1,800,000

* The aerosol insecticide is based on a hydrocarbon propellant, but the type of the insecticide concentration determines the requirement of the propellant.

** A hydrocarbon propellant is to be used. The annual requirement is to be determined at the feasibility stage.

D. MATERIAL AND INPUT COSTS

1. Cost of Raw Materials

The total annual cost of the imported raw materials, i.e. insecticide extract, synergist, propellant, aromatic essence and accessories for the hardware will amount to about Birr 1,407,000. It is assumed that the cans (without the accessories) would be locally manufactured and supplied to the plant. The total cost of the cans is estimated at Birr 1,260,000/year*.

2. Cost of Utilities

Electricity

The cost of electricity will be Birr 0.22/kwh

Water

Water for process and potable uses will cost Birr 0.5/m^3

3. Other Costs

Fuel for Vehicles

The total annual fuel cost for vehicles is estimated to be Birr 10,000.

Packing Materials

The cost of packing materials will be about Birr 36,000/year.

---

* Unit Price per can is estimated by a private producer to be between Birr 0.7 - 0.8.

V. LOCATION

An aerosol insecticide manufacturing plant should be located well away from towns and public and private buildings and residences should not be in the immediate vicinity of the plant.

Taking economical and technical aspects as the most relevant factors in the choice of location, Addis Ababa is considered to be the most appropriate location for the aerosol insecticide plant, for:

- Cans may be supplied by the Ethiopian Crown Cork S.C. located in the outskirts of Addis Ababa. There is also a private plant in Addis Ababa which can supply the cans made out of tin.

- The plastic caps to be mounted on the cans could be produced at the Ethiopian Plastics Factory or at the Addis Ababa Foam and Plastics Factory; and

- The market outlets for the product are urban areas of which Addis Ababa would be the major centre.

The exact site of the plant has to be evaluated at the stage of the feasibility study taking into consideration the factors mentioned above.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Manufacturing Process

Since their development for the control of insects during the early years of the Second World War, aerosol insecticides have become indispensable for a sanitary living environment. The manufacture of aerosol insecticides is basically a packaging process involving the preparation of the insecticide spray and the can filling line.

a. Preparation

The insecticide raw material is blended with a synergist and other ingredients such as an aromatic essence to a given formulation. The blend is then filtered to remove any impurities. Alternatively, ready blended aerosol concentrate can be bought in and diluted.

The cans should be inspected on receipt and later air blast cleaned before the filling operation.

b. Filling

The product filler and crimper/gaser are mounted on an operating bench which has an integral extraction system. At this level of production, the cans are fed manually into the enclosures of both machines. It is also possible to employ automatic enclosure systems, which produce 12-15 cans a minute. This is equivalent to about 2 million cans a year on a single shift. The insecticide solution is pumped from the storage tank to the filling machine where the cans are filled. They are then passed to the crimper/gaser where they are filled with the propellant and sealed tight by fitting an inner stopper and cap.

The propellant is filtered before being pumped into the filler machine fitted with gas detection equipment. Finally the caps are mounted on the cans which are then packed in carton boxes for despatch after inspection. The process flow chart for aerosol insecticide manufacturing is illustrated in Figure II .

2. Source of Technology

The process technology is standard and readily available from such plant manufacturers as:-

DH Industries Ltd.
Sullivan House,
Abbey Wharf,
Kingsbridge Road,
Barking IGT OHA,
UK

Insecticide formualtion may be obtained under a licensing agreement from one of the major producers of insecticides such as:-

ICI Plant Protection Division,
Fernhurst,
Haslemere GU27 3JE,
Telex No.858270 ICI PPF

B. ENGINEERING

1. Machinery and Equipment

The main items of machinery and equipment together with the cost for a plant capable of producing 0.9 million cans a year on a single shift basis is given in Table VI.

FIGURE II

PROCESS FLOW CHART FOR AEROSOL INSECTICIDE MANUFACTURING

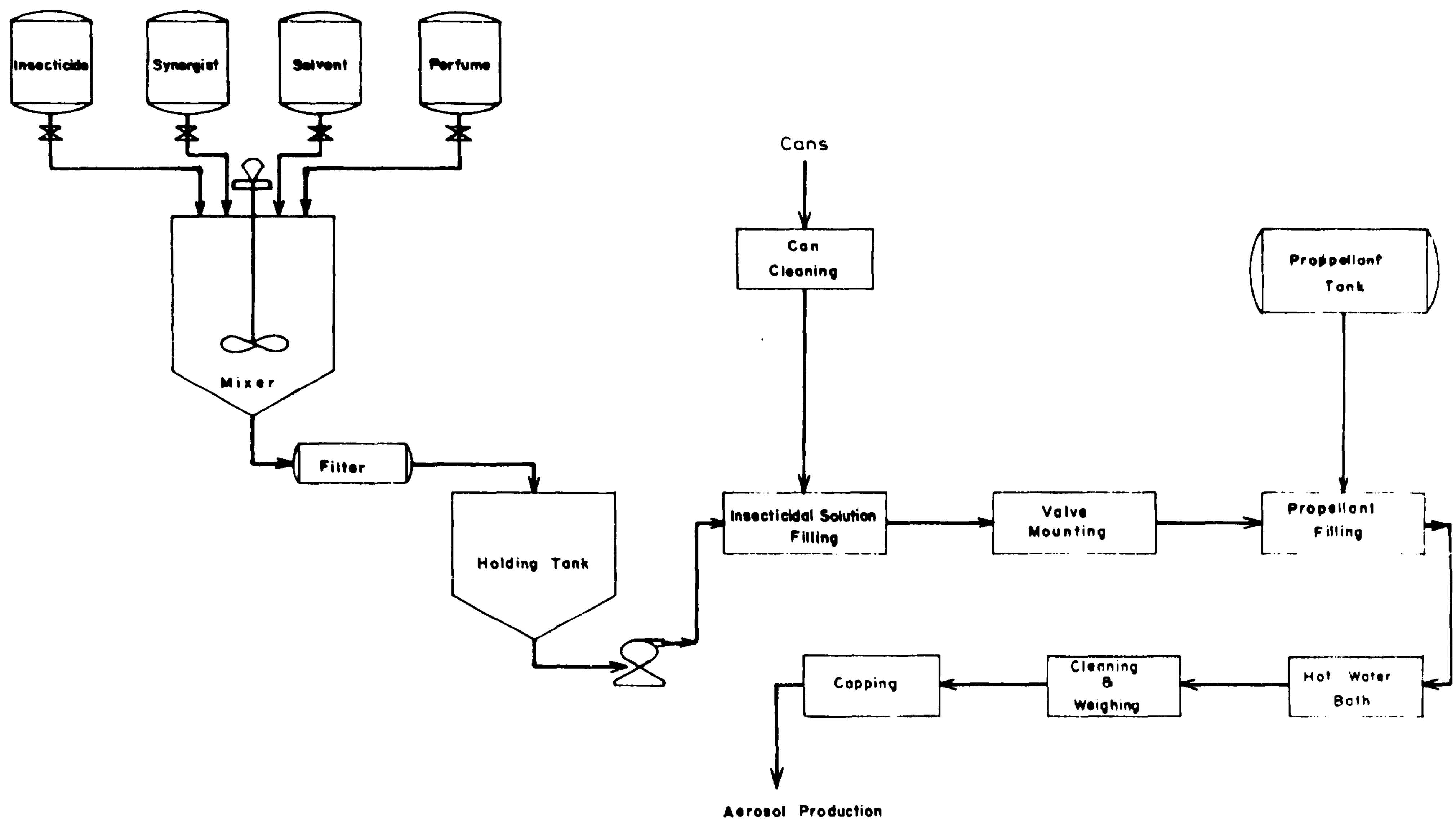


TABLE VI

TOTAL FIXED INVESTMENT COST

DESCRIPTION	(COST '000 BIRR)		
	F.C.	L.C.	TOTAL
A. MACHINERY AND EQUIPMENT			
1. Blending Tanks	20.7	-	20.7
2. Product and Propellant Filling Machines mounted on Bench with Manual Enclosures and Air Blast Cleaner	45.5	-	45.5
3. Compressor and Pumps	22.8	-	22.8
4. Conveyors, control equipment and other accesscries and spares	14.5	-	14.5
Total Equipment Cost	103.5		103.5
Freight	-	10	10
Total Machinery Cost (C & F)	103.5	10	113.5
Technology Fee	93		93
Local Cost (12,5% of C&F)	-	14	14
Total Cost of Machinery and Equipment (Including 10% Contingency)	216	26	242

TABLE V. CONT'D

DESCRIPTION	COST ('000 BIRR)		
	F.C.	L.C.	TOTAL
BUILDING AND CIVIL WORKS			
1. Building cost(including fire prevention and fighting equipment	155	295	450
2. Site Development(2% of building cost)	-	9	9
3. Outdoor works(sewerage, water piping etc., 10% of building cost)	-	45	45
Total Building and Civil Works Cost (including 10% contingency)	170	384	554
C. SERVICE EQUIPMENT			
1. Office Furniture and Equipment	9	14	23
D. VEHICLES			
1. Pick-up (one)	28	12	40
2. Service car (one) (incl.10% contingency)	17	8	25
SUB-TOTAL	50	22	72

2. Plant Layout

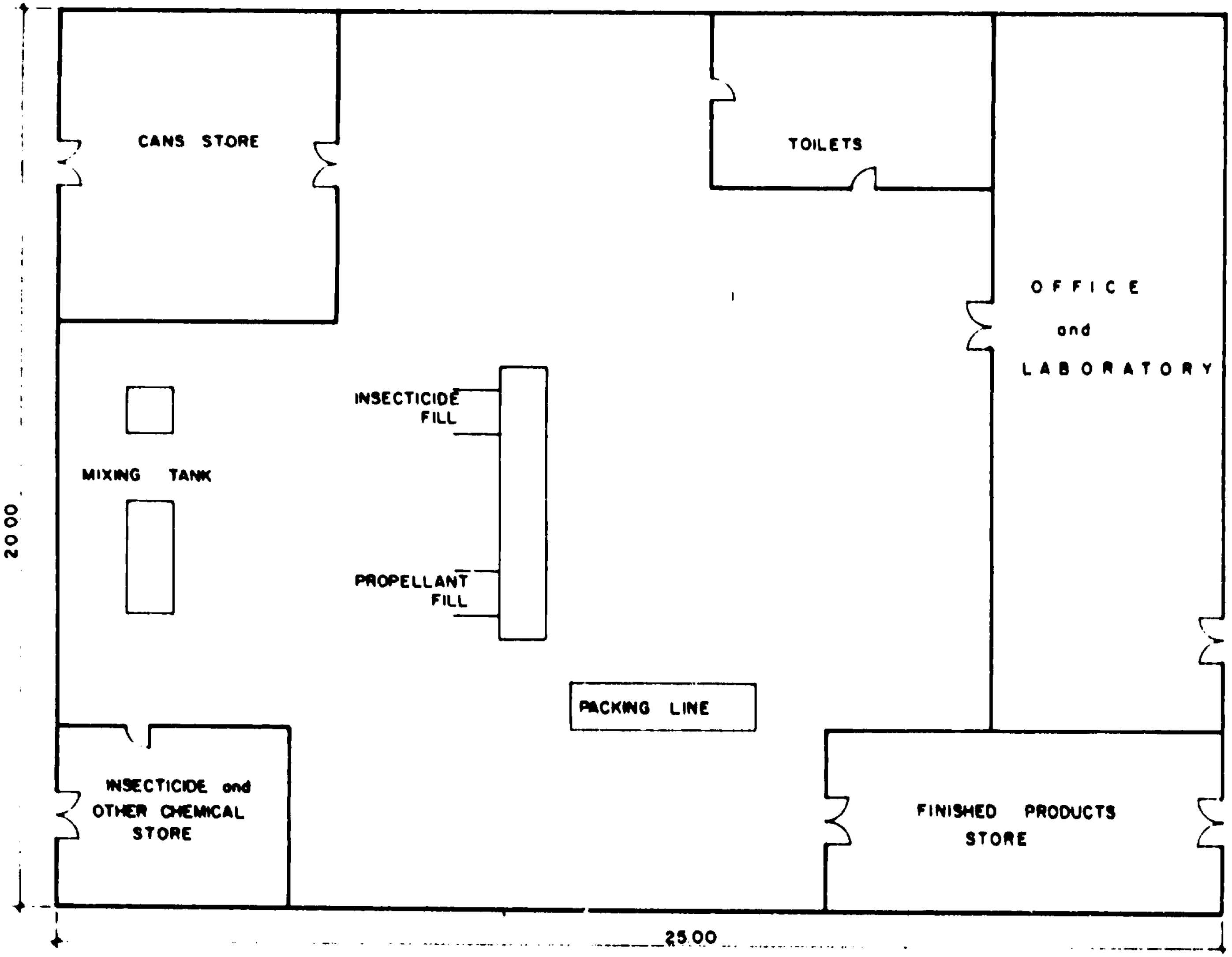
The factory size will be about 500 m^2 on a land area of 1,500m^2. The store for the hydrocarbon propellant should be located far away from the production hall in case of fire. However, the main building and the store could be constructed in the same building, provided non-combustible materials such as concrete is used for the walls. The ceiling of building should be slated roofing. The required area can be divided as follows:-

	m^2
Insecticide and other Chemical store	20
Finished products store	34
Cans store	42
Production hall	300
Laboratory, Offices and toilets	24

The layout is shown in Figure III.

FIGURE III

LAYOUT OF AEROSOL INSECTICIDE PRODUCTION



INDUSTRIAL PROJECTS SERVICE

PROJECT	Drawn by	Sign	Date	CLIENT
	Checked by			
	Approved by			

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of the proposed plant is given in Figure IV. The chart is based on a functional classification, namely production, administration, commercial, maintenance and accounts.

The plant will be headed by a manager, who will report directly to the National Chemicals Corporation.

B. MANPOWER

The total manpower requirement will be 43 (See Table VII. The plant manager should have a formal education in chemical engineering and the production/maintenance engineer in mechanical engineering. Both require an intensive training of 1-3 months at the premises of the supplier of the technology. The insecticide licensor should provide on the-job training and technical assistance during the start up of operations.

TABLE VII

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. Employed	Skill Level	Monthly Salary/ Person (Birr)	Total Annual Salary
Plant manager	1	Professional/ tech.	1200	14000
Secretary	1	Skilled	350	4200
Administrator	1	Skilled	600	7200
Chief Accountant	1	Skilled	700	8400
Commercial Section	1	Skilled	600	7200
Sales	1	Skilled	400	4800
Purchaser	1	Skilled	400	4800
Production/ Maintenance Engineer	1	Professional/ tech.	800	9600
Tester	2	Skilled	400	9600
Accountant	1	Skilled	350	4200
General Service	1	Skilled	250	3000
Secretary	2	Skilled	300	7200
Storekeeper	3	Skilled	400	4800
Operator	6	Semi-skilled	150	10800
Mechanic	2	Skilled	350	8400
Electrician	2	Skilled	350	8400
Labourer	6	Unskilled	190	13680
Driver	1	Skilled	250	3000
Guard	6	Unskilled	100	7200
Cleaner	3	"	70	2520
Total (Incl. 25% employment benefits)	43			178750

Skilled distribution	No.	%
Professional	2	4.6
Skilled	20	46.5
Semi-skilled	6	14.0
Unskilled	15	34.8
Total	43	100

TABLE VII

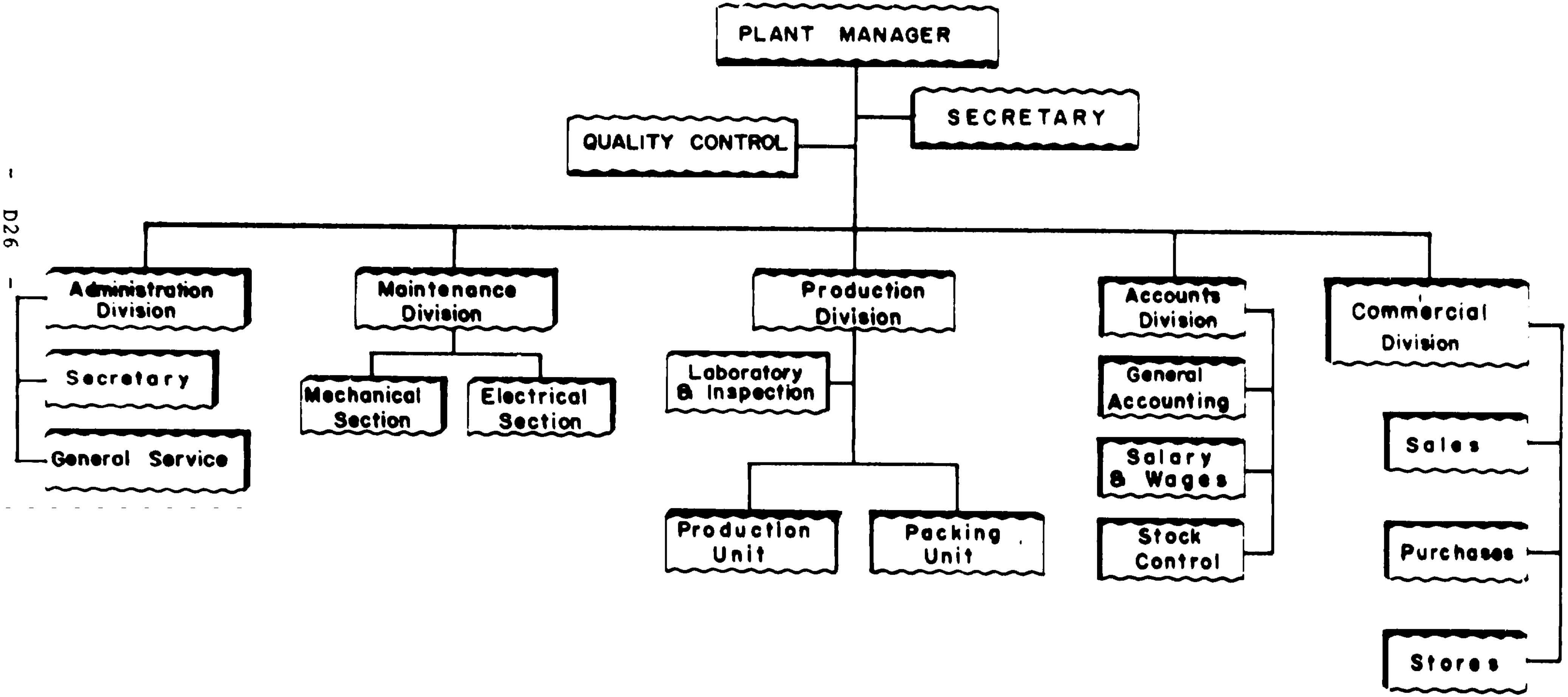
MANPOWER REQUIREMENT AND SALARIES

Personnel	No. Employed	Skill Level	Monthly Salary/ Person (Birr)	Total Annual Salary
Plant manager	1	Professional/ tech.	1200	14000
Secretary	1	Skilled	350	4200
Administrator	1	Skilled	600	7200
Chief Accountant	1	Skilled	700	8400
Commercial Section	1	Skilled	600	7200
Sales	1	Skilled	400	4800
Purchaser	1	Skilled	400	4800
Production/ Maintenance Engineer	1	Professional/ tech.	800	9600
Tester	2	Skilled	400	9600
Accountant	1	Skilled	350	4200
General Service	1	Skilled	250	3000
Secretary	2	Skilled	300	7200
Storekeeper	3	Skilled	400	4800
Operator	6	Semi-skilled	150	10800
Mechanic	2	Skilled	350	8400
Electrician	2	Skilled	350	8400
Labourer	6	Unskilled	190	13680
Driver	1	Skilled	250	3000
Guard	6	Unskilled	100	7200
Cleaner	3	"	70	2520
Total (Incl. 25% employment benefits)	43			178750

Skilled distribution	No.	%
Professional	2	4.6
Skilled	20	46.5
Semi-skilled	6	14.0
Unskilled	15	34.8
Total	43	100

Figure IV

ORGANIZATION CHART OF AEROSOL INSECTICIDE PLANT

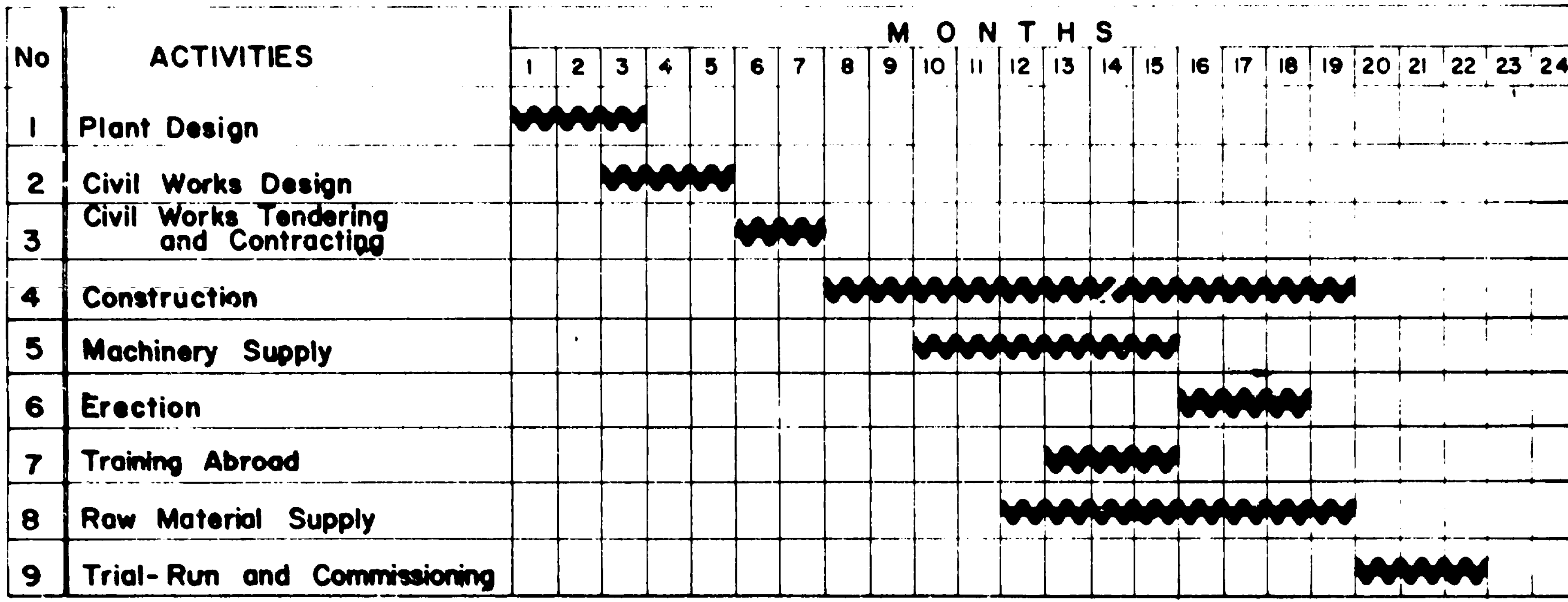


VIII. IMPLEMENTATION SCHEDULE

A general schedule for the construction of the proposed plant for the production of aerosol insecticide is presented in Figure V. Accordingly the time needed to set up the aerosol insecticide plant is estimated to be about 22 months. However, it must be noted that the implementation of the project could be realized in a shorter time than indicated above, provided appropriate measures are taken in the construction of the building.

Figure v

Implementation Schedule of Aerosol Insecticide Plant



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table VIII.

TABLE VIII

SUMMARY OF THE INITIAL INVESTMENT COST
('OOO BIRR)

Cost Items	Currency Foreign	Currency Local	Total
Buildings and Civil Works	170.00	384.00	554.00
Plant Machinery and Equipment	216.00	26.00	242.00
Office furniture and equipment	9.00	14.00	23.00
Vehicles	50.00	22.00	72.00
Pre-production expenditure	21.60	194.48	216.08
Total	466.60	640.48	1107.08

The foreign currency component of the total initial investment cost will be about 42%. About 46% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirement

The following parameters were used to estimate the working capital requirements of the aerosol insecticide plant.

	Items	months of Coverage
1.	Cash in hand	0.5
2.	Accounts receivable	0.5
3.	Raw Matrials - Foreign	6.0
4.	Raw Materials - Local	1.0
5.	Finished Products	1.5
6.	Accounts Payable	1.0

The maximum working capital requirement will be Birr 1.26 million, of which Birr 1.12 million will be required in foreign currency.

3. Production Costs

The detailed production cost estimation is given together with other required financial statements. The production cost at full capacity amounts to Birr 3.04 million, out of which about 60% is in foreign currency.

4. Internal Rate of Return (IRR)

The aerosol insecticide plant will be financially viable with an IRR of 13.70% and a net present value of Birr 0.49 million discounted at 10% p.a. The selling price assumed was Birr 2 per container.

5. Breakeven Analysis

The breakeven point would be reached at a production of 727,573 cans of aerosol insecticides. The total revenue generated at the breakeven point would be Birr 1.46 million. In a nut shell the plant would breakeven at a capacity utilza-tion of about 40%.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be -12.48, with a net present value of Birr -3.40 million.

Furthermore, it will create employment for about 49 people when operating at full capacity.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Aerosol Insecticide Plant
Financial Analysis - June 1986
Opportunity Studies - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	1107.08	42.147 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1107.08	42.147 % foreign

Source of funds during construction phase

equity & grants:	1107.08	42.147 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	1107.08	42.147 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	2433.07	2708.40	2983.73
depreciation :	111.82	111.82	111.82
interest :	0.00	0.00	0.00
production costs	2544.89	2820.22	3095.55
thereof foreign	58.58 %	59.19 %	59.69 %
total sales :	2880.00	3240.00	3600.00
gross income :	335.11	419.78	504.45
net income :	167.56	209.89	252.23
cash balance :	-729.82	198.23	240.57
net cashflow .	-729.82	198.23	240.57

Net Present Value at: 10.00 % = 491.34
Internal Rate of Return: 13.70 %
Return on equity1: 19.24 %
Return on equity2: 13.70 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

- 034 -

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	154.00	400.00
Auxiliary and service facilities	0.00	72.00
Incorporated fixed assets	0.00	23.00
Plant machinery and equipment	75.00	167.00
Total fixed investment costs	229.00	662.00
Pre-production capital expenditures	69.84	146.24
Net working capital	0.00	0.00
Total initial investment costs	298.84	808.24
Of it foreign, in %	24.09	48.82

COMFAR

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9-12	13-17
% of nom. capacity (single product).	80.00	90.00	100.00	100.00	100.00	100.00
Raw material 1	2133.60	2400.30	2667.00	2667.00	2667.00	2667.00
Other raw materials	28.80	32.40	36.00	36.00	36.00	36.00
Utilities	6.12	6.66	7.20	7.20	7.20	7.20
Energy	22.14	24.57	27.00	27.00	27.00	27.00
Labour, direct	178.71	178.71	178.71	178.71	178.71	178.71
Repair, maintenance	33.50	33.50	33.50	33.50	33.50	33.50
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	5.56	5.94	6.32	6.32	6.32	6.32
Factory costs	2408.43	2682.08	2955.73	2955.73	2955.73	2955.73
Administrative overheads	24.64	26.32	28.00	28.00	28.00	28.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	111.82	111.82	111.82	0.00	0.00	0.00
Financial costs	0.00	0.00	0.00	54.20	68.60	42.10
Total production costs	2544.89	2820.22	3095.55	3037.93	3052.33	3025.83
Costs per unit (single product)	1.77	1.74	1.72	1.69	1.70	1.68
Of it foreign, %	58.58	59.19	59.69	60.35	60.40	60.18
Of it variable,%	86.55	87.86	88.94	90.63	90.20	90.99
Total labour	178.71	178.71	178.71	178.71	178.71	178.71

TABLE A.4

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	15	24.0	101.38	112.85	124.32	124.32
Inventory and materials	129	2.8	775.20	872.10	969.00	969.00
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	0	---	0.00	0.00	0.00	0.00
Finished products	48	7.5	323.22	361.04	398.85	398.85
Cash in hand	15	24.0	10.10	10.19	10.27	10.27
Total current assets			1209.89	1356.17	1502.45	1502.45
Current liabilities and						
Accounts payable	30	12.0	200.70	223.51	246.31	246.31
Net working capital			1009.19	1132.66	1256.14	1256.14
Increase in working capital			1009.19	123.47	123.47	0.00
Net working capital, local			113.77	125.68	137.59	137.59
Net working capital, foreign			895.42	1006.98	1118.55	1118.55

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	298.84	808.24
Financial resources	298.84	808.24
Sales, net of tax	0.00	0.00
Total cash outflow	298.84	808.24
Total assets	298.84	808.24
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	226.86	413.62
Outflow, local	226.86	413.62
Surplus (deficit)	0.00	0.00
Inflow, foreign	71.98	394.62
Outflow, foreign	71.98	394.62
Surplus (deficit)	0.00	0.00
Net cashflow	-298.84	-808.24
Cumulated net cashflow	-298.84	-1107.08

COMFAR

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	3080.70	3262.80	3622.80	3600.00	3600.00	3600.00
Financial resources	200.70	22.80	22.80	0.00	0.00	0.00
Sales, net of tax	2880.00	3240.00	3600.00	3600.00	3600.00	3600.00
Total cash outflow	3810.52	3064.57	3382.23	3235.96	3235.96	3336.77
Total assets	1209.89	146.28	146.28	0.00	0.00	72.00
Operating costs	2433.07	2708.40	2983.73	2983.73	2983.73	2983.73
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	167.56	209.89	252.23	252.23	252.23	281.04
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-729.82	198.23	240.57	364.04	364.04	263.23
Cumulated cash balance	-729.82	-531.58	-291.01	73.03	437.07	700.31
Inflow, local	2960.24	3247.93	3607.93	3600.00	3600.00	3600.00
Outflow, local	1349.12	1314.11	1453.28	1433.44	1433.44	1484.24
Surplus (deficit)	1611.12	1933.82	2154.65	2166.56	2166.56	2115.75
Inflow, foreign	120.46	14.88	14.88	0.00	0.00	0.00
Outflow, foreign	2461.40	1750.46	1928.96	1802.52	1802.52	1852.52
Surplus (deficit)	-2340.94	-1735.58	-1914.08	-1802.52	-1802.52	-1852.52
Net cashflow	-729.82	198.23	240.57	364.04	364.04	263.23
Cumulated net cashflow	-1836.90	-1638.66	-1398.09	-1034.05	-670.01	-406.77

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	3600.00	3600.00	3600.00	3600.00	3600.00	3600.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3600.00	3600.00	3600.00	3600.00	3600.00	3600.00
Total cash outflow	3257.56	3257.56	3257.56	3257.56	3342.81	3270.81
Total assets	0.00	0.00	0.00	0.00	72.00	0.00
Operating costs	2983.73	2983.73	2983.73	2983.73	2983.73	2983.73
Cost of finance	0.00	0.00	0.[illegible]	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	273.83	273.83	273.[illegible]	273.83	287.08	287.08
Dividends paid	0.00	0.00	0.[illegible]	0.00	0.00	0.00
Surplus (deficit)	342.44	342.44	342[illegible]	342.44	257.19	329.19
Cumulated cash balance	1042.74	1385.18	1727.[illegible]	2070.05	2327.23	2656.42
Inflow, local	3600.00	3600.00	3600.00	3600.00	3600.00	3600.00
Outflow, local	1455.04	1455.04	1455.04	1455.04	1490.29	1468.29
Surplus (deficit)	2144.96	2144.96	2144.96	2144.96	2109.71	2131.71
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	1802.52	1802.52	1802.52	1802.52	1852.52	1802.52
Surplus (deficit)	-1802.52	-1802.52	-1802.52	-1802.52	-1852.52	-1802.52
Net cashflow	342.44	342.44	342.44	342.44	257.19	329.19
Cumulated net cashflow	-64.34	278.10	620.53	962.97	1220.15	1549.34

- D40 -

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	3600.00	3600.00	3600.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	3600.00	3600.00	3600.00
Total cash outflow	3270.81	3270.81	3270.81
Total assets	0.00	0.00	0.00
Operating costs	2983.73	2983.73	2983.73
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	287.08	287.08	287.08
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	329.19	329.19	329.19
Cumulated cash balance	2985.60	3314.79	3643.97
Inflow, local	3600.00	3600.00	3600.00
Outflow, local	1468.29	1468.29	1468.29
Surplus (deficit)	2131.71	2131.71	2131.71
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	1802.52	1802.52	1802.52
Surplus (deficit)	-1802.52	-1802.52	-1802.52
Net cashflow	329.19	329.19	329.19
Cumulated net cashflow	1878.52	2207.71	2536.89

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	704.91	at	10.00 %
Internal Rate of Return (IRRE1) ..	19.24 %		

b) Net Worth versus Net cash return:

Net present value	491.34	at	10.00 %
Internal Rate of Return (IRRE2) ..	13.70 %		

c) Internal Rate of Return on total investment:

Net present value	491.34	at	10.00 %
Internal Rate of Return (IRR) ..	13.70 %		

Net Worth : Equity paid plus reserves

- D42 -

TABLE A.6

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	2880.00	3240.00	3600.00	3600.00	3600.00
Less: variable costs, incl. sales tax.	2202.63	2477.96	2753.29	2753.29	2753.29
Variable margin	677.37	762.04	846.71	846.71	846.71
As % of total sales	23.52	23.52	23.52	23.52	23.52
Non variable costs, incl. depreciation	342.25	342.25	342.25	342.25	342.25
Operational margin	335.11	419.78	504.45	504.45	504.45
As % of total sales	11.64	12.96	14.01	14.01	14.01
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	335.11	419.78	504.45	504.45	504.45
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	335.11	419.78	504.45	504.45	504.45
Tax	167.56	209.89	252.23	252.23	252.23
Net profit	167.56	209.89	252.23	252.23	252.23
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	167.56	209.89	252.23	252.23	252.23
Accumulated undistributed profit	167.56	377.45	629.67	881.90	1134.13
Gross profit, % of total sales	11.64	12.96	14.01	14.01	14.01
Net profit, % of total sales	5.82	6.48	7.01	7.01	7.01
ROE, Net profit, % of equity	15.13	18.96	22.78	22.78	22.78
ROI, Net profit+interest, % of invest	7.92	9.27	10.67	10.67	10.67

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	3600.00	3600.00	3600.00	3600.00	3600.00
Less: variable costs, incl. sales tax	2753.29	2753.29	2753.29	2753.29	2753.29
Variable margin	846.71	846.71	846.71	846.71	846.71
As % of total sales	23.52	23.52	23.52	23.52	23.52
Non variable costs, incl. depreciation	284.64	299.04	299.04	299.04	299.04
Operational margin	562.07	547.67	547.67	547.67	547.67
As % of total sales	15.61	15.21	15.21	15.21	15.21
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	562.07	547.67	547.67	547.67	547.67
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	562.07	547.67	547.67	547.67	547.67
Tax	281.04	273.83	273.83	273.83	273.83
Net profit	281.04	273.83	273.83	273.83	273.83
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	281.04	273.83	273.83	273.83	273.83
Accumulated undistributed profit	1415.16	1689.00	1962.83	2236.67	2510.50
Gross profit, % of total sales	15.61	15.21	15.21	15.21	15.21
Net profit, % of total sales	7.81	7.61	7.61	7.61	7.61
ROE, Net profit, % of equity	25.39	24.73	24.73	24.73	24.73
ROI, Net profit+interest, % of invest.	11.54	11.24	11.24	11.24	11.24

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	3600.00	3600.00	3600.00	3600.00	3600.00
Less: variable costs, incl. sales tax.	2753.29	2753.29	2753.29	2753.29	2753.29
Variable margin	846.71	846.71	846.71	846.71	846.71
As % of total sales	23.52	23.52	23.52	23.52	23.52
Non-variable costs, incl. depreciation	272.54	272.54	272.54	272.54	272.54
Operational margin	574.17	574.17	574.17	574.17	574.17
As % of total sales	15.95	15.95	15.95	15.95	15.95
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	574.17	574.17	574.17	574.17	574.17
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	574.17	574.17	574.17	574.17	574.17
Tax	287.08	287.08	287.08	287.08	287.08
Net profit	287.08	287.08	287.08	287.08	287.08
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	287.08	287.08	287.08	287.08	287.08
Accumulated undistributed profit	2797.59	3084.67	3371.76	3658.84	3945.93
Gross profit, % of total sales	15.95	15.95	15.95	15.95	15.95
Net profit, % of total sales	7.97	7.97	7.97	7.97	7.97
ROE, Net profit, % of equity	25.93	25.93	25.93	25.93	25.93
ROI, Net profit+interest, % of invest.	11.45	11.45	11.45	11.45	11.45

TABLE A.7

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, construction in 000 Birr

Year	1	2
Total assets	298.84	1107.08
Fixed assets, net of depreciation	0.00	298.84
Construction in progress	298.84	808.24
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	298.84	1107.08
Equity capital	298.84	1107.08
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	2205.16	2239.62	2274.08	2235.29	2487.52	2768.55
Fixed assets, net of depreciation	995.26	883.45	771.63	659.82	548.00	493.90
Construction in progress	0.00	0.00	0.00	0.00	0.00	72.00
Current assets	1199.79	1345.99	1492.18	1492.18	1492.18	1492.18
Cash, bank	10.10	10.19	10.27	10.27	10.27	10.27
Cash surplus, finance available	0.00	0.00	0.00	73.03	437.07	700.31
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	2205.16	2239.62	2274.08	2235.29	2487.52	2768.55
Equity capital	1107.08	1107.08	1107.08	1107.08	1107.08	1107.08
Reserves, retained profit	0.00	167.56	377.45	629.67	881.90	1134.13
Profit	167.56	209.89	252.23	252.23	252.23	281.04
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	200.70	223.51	246.31	246.31	246.31	246.31
Bank overdraft, finance required	729.82	531.58	291.01	0.00	0.00	0.00
Total debt	930.[illegible]	755.09	537.33	246.31	246.31	246.31
Equity, % of liabilities	50.20	49.43	48.68	49.53	44.51	39.99

Aerosol Insecticide Plant --- Financial Analysis - June 1998

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	3042.39	3316.22	3590.06	3863.89	4150.98	4438.06
Fixed assets, net of depreciation	497.20	428.60	360.00	291.40	249.30	279.20
Construction in progress	0.00	0.00	0.00	0.00	72.00	0.00
Current assets	1492.18	1492.18	1492.18	1492.18	1492.18	1492.19
Cash, bank	10.27	10.27	10.27	10.27	10.27	10.27
Cash surplus, finance available	1042.74	1385.18	1727.61	2070.05	2327.23	2656.42
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	3042.39	3316.22	3590.06	3863.89	4150.98	4438.06
Equity capital	1107.08	1107.08	1107.08	1107.08	1107.08	1107.08
Reserves, retained profit	1415.16	1689.00	1962.83	2236.67	2510.50	2797.59
Profit	273.83	273.83	273.83	273.83	287.08	287.09
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	246.31	246.31	246.31	246.31	246.31	246.31
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	246.31	246.31	246.31	246.31	246.31	246.31
Equity, % of liabilities	36.39	33.38	30.84	28.65	26.67	24.95

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	4725.15	5012.23	5299.32
Fixed assets, net of depreciation	237.10	195.00	152.90
Construction in progress	0.00	0.00	0.00
Current assets	1492.18	1492.18	1492.18
Cash, bank	10.27	10.27	10.27
Cash surplus, finance available	2985.60	3314.79	3643.97
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	4725.15	5012.23	5299.32
Equity capital	1107.08	1107.08	1107.08
Reserves, retained profit	3084.67	3371.76	3658.84
Profit	287.08	287.08	287.08
Long and medium term debt	0.00	0.00	0.00
Current liabilities	246.31	246.31	246.31
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	246.31	246.31	246.31
Equity, % of liabilities	23.43	22.09	20.89

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	311.88	699.59
Financial resources	311.88	699.59
Sales, net of tax	0.00	0.00
Total cash outflow	311.88	699.59
Total assets	311.88	699.59
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	236.90	409.97
Outflow, local	236.90	409.97
Surplus (deficit)	0.00	0.00
Inflow, foreign	74.98	289.62
Outflow, foreign	74.98	289.62
Surplus (deficit)	0.00	0.00
Net cashflow	-311.88	-699.59
Cumulated net cashflow	-311.88	-1011.47

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1830.30	1897.51	2106.31	2088.00	2088.00	2088.00
Financial resources	159.90	18.31	18.31	0.00	0.00	0.00
Sales, net of tax	1670.40	1879.20	2088.00	2088.00	2088.00	2088.00
Total cash outflow	2931.75	2278.78	2499.70	2379.16	2379.16	2438.16
Total assets	994.44	120.54	120.54	0.00	0.00	59.00
Operating costs	1937.32	2158.24	2379.16	2379.16	2379.16	2379.16
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-1101.45	-381.27	-393.40	-291.16	-291.16	-350.16
Cumulated cash balance	-1101.45	-1482.72	-1876.12	-2167.28	-2458.44	-2808.60
Inflow, local	1729.98	1885.15	2093.95	2088.00	2088.00	2088.00
Outflow, local	879.74	821.10	893.72	878.64	878.64	887.64
Surplus (deficit)	850.24	1064.04	1200.22	1209.36	1209.36	1200.36
Inflow, foreign	100.33	12.36	12.36	0.00	0.00	0.00
Outflow, foreign	2052.01	1457.68	1605.98	1500.52	1500.52	1550.52
Surplus (deficit)	-1351.68	-1445.32	-1593.62	-1500.52	-1500.52	-1550.52
Net cashflow	-1101.45	-381.27	-393.40	-291.16	-291.16	-350.16
Cumulated net cashflow	-2112.92	-2494.19	-2887.59	-3178.75	-3469.91	-3820.07

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
cash inflow	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00
Total cash outflow	2379.16	2379.16	2379.16	2379.16	2438.16	2379.16
Total assets	0.00	0.00	0.00	0.00	59.00	0.00
Operating costs	2379.16	2379.16	2379.16	2379.16	2379.16	2379.16
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-291.16	-291.16	-291.16	-291.16	-350.16	-291.16
Cumulated cash balance	-3099.76	-3390.92	-3682.08	-3973.24	-4323.40	-4614.56
Inflow, local	2088.00	2088.00	2088.00	2088.00	2088.00	2088.00
Outflow, local	878.64	878.64	878.64	878.64	887.64	878.64
Surplus (deficit)	1209.36	1209.36	1209.36	1209.36	1200.36	1209.36
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	1500.52	1500.52	1500.52	1500.52	1550.52	1500.52
Surplus (deficit)	-1500.52	-1500.52	-1500.52	-1500.52	-1550.52	-1500.52
Net cashflow	-291.16	-291.16	-291.16	-291.16	-350.16	-291.16
Cumulated net cashflow	-4111.23	-4402.39	-4693.55	-4984.71	-5334.87	-5626.03

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	2088.00	2088.00	2088.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	2088.00	2088.00	2088.00
Total cash outflow	2379.16	2379.16	2379.16
Total assets	0.00	0.00	0.00
Operating costs	2379.16	2379.16	2379.16
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	-291.16	-291.16	-291.16
Cumulated cash balance	-4905.72	-5196.88	-5488.04
Inflow, local	2088.00	2088.00	2088.00
Outflow, local	878.64	878.64	878.64
Surplus (deficit)	1209.36	1209.36	1209.36
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	1500.52	1500.52	1500.52
Surplus (deficit)	-1500.52	-1500.52	-1500.52
Net cashflow	-291.16	-291.16	-291.16
Cumulated net cashflow	-5917.19	-6208.35	-6499.51

D53

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-2931.99	at	10.00 %
Internal Rate of Return (IRRE1)	not found		

b) Net Worth versus Net cash return:

Net present value	-3408.16	at	10.00 %
Internal Rate of Return (IRRE2)	-12.48 %		

c) Internal Rate of Return on total investment:

Net present value	-3408.16	at	10.00 %
Internal Rate of Return (IRR)	-12.48 %		

Net Worth = Equity paid plus reserves

- E -

INDUSTRIAL GASES

TABLE OF CONTENTS

SUMMARY

The project profile has identified oxygen, acetylene and carbon dioxide as industrial gases. Although each requires different process, different equipment and its own end cylinder, grouping in one has been made because of the generic name. In this profile, carbon dioxide is not fully covered because it is totally different.

The existing plants' capacity for the production of carbon dioxide and oxygen greatly exceed the projected demand volume. There will only be a shortfall in the supply of acetylene by 2000.

Main raw materials are calcium carbide for acetylene and air for oxygen and the latter is known to be energy-intensive.

Both plants are envisaged to be located in Addis Ababa to meet the shortfall in the supply in the future.

Total machinery and equipment investment for both plants estimated at 24,670,000 Birr is fairly high. Total site size is estimated to be 1500 m².

The project will generate employment for 66 people.

No financial and economic analysis has been made because of the low demand for the products.

1. INTRODUCTION

Present and future demand for industrial gases is not so large as to justify the setting of new plants. The two plants in Addis Ababa and Asmara, namely Chora and Fana supply a major portion of the market demand. Besides, there are plants owned by large organizations such as the Marine Authority, the private workshops which produce their own acetylene.

The oxygen and acetylene plants can be sited in the same area even if they use different process, and different equipment. This is to gain economies in marketing and distribution particularly if it is decided to run a fleet of trucks from the manufacturing plant. Carbon dioxide is totally different (e.g. even the end-users which could be food processors) and except for the market survey is not covered in this profile.

The minimum economic scale for an oxygen plant is 2.4 million cubic metres (1800 tonnes) per year at standard temperature and pressure on a continuous working basis for 330 days a year. If demand is smaller than this, it is recommended that the plant works continuously until the storage cylinders are full and then closed down until it is necessary to bring it on-stream again. It does not work so well under intermittent, say shift, working conditions.

The minimum economic scale for acetylene is up to 400,000 cubic metres per annum on a continuous basis.

Both require steel cylinders and their costs are included in the total investment.

Financial and economic analysis have not been made because of the low demand for the products. This profile is prepared to elaborate what an oxygen and acetylene plant consists of and to indicate the magnitude of investment required. Even if the project does not have a market at present, it may prove viable in the future as it will have considerably lower transport costs in supplying the market than the imported ones.

II. MARKET AND PLANT CAPACITY

A. MARKET

1. Plant Description and Application

Industrial and other gases, can be categorized into two main groups, namely those occuring in the earth's crust or atmosphere and those obtained through a manufacturing process. The first group, which are mainly recovered by the liquifaction of air, include oxygen, nitrogen, carbon dioxide, helium, argon, etc. The second group, which are manufactured, consist of gases such as hydrogen, carbon monoxide, acetylene, ammonia, sulphur dioxide, etc.

Industrial gases are used in a number of industries, among which the metallurgical, energy, construction, aerospace, beverage, medical, chemical and mining industries are the most important. Industrial gases are mainly used as intermediate products in the production of other products. Some of them, such as oxygen and carbon dioxide, however, are directly used in limited quantities. Most industrial gases are not used, at least not on commercial level, in industries in Ethiopia. Those that have industrial uses in large quantities in Ethiopia are carbon dioxide, oxygen and acetylene. Others are not expected to be used in large quantities in the short and medium terms. Hence this profile on industrial gases is limited to carbon dioxide, oxygen and acetylene.

In the following paragraphs the specific application and uses of each of these three industrial gases are discussed in detail.

4. Carbon Dioxide

Carbon dioxide, usually known as CO_2, is a colourless gas with pungent odour and sour (acid) taste. It is naturally found in fractional percentage in the earth's atmosphere, formed in the combustion of carbon containing materials, in fermentation and in respiration of animals. Carbon dioxide for industrial applications, however, is recovered from carbonous fuels, from lime kilns, as a by-product of the preparation of hydrogen for synthesis of ammonia, as a by-product in the production of beer (fermentation), and from other sources. CO_2 can be produced either in gas, liquid, or solid form.

Gaseous carbon dioxide is mainly used in the production of carbonated beverages. In addition to prevention of spoilage, the carbonation gives the beverage its sprinkles and tangy taste. Carbonation also makes the beverage useful in alleviating postoperative nausea as well as to ensure adequate liquid intake. Solid carbon dioxide is a convenient quick refrigerant used mainly for ice cream, meat products and frozen foods. Liquid carbon dioxide, on the other hand, is used as a blasting agent in coal mining and in fire extinguishers where the use of water is not appropriate.

CO_2 is also used in other industrial and non-industrial fields, such as in:

- Neutralizing the excess of caustic in textile manufacturing since it is easy to use and does not damage the fabric,
- Foaming rubber and plastics,
- Gas welding,
- Hardening moulds in foundries,

- Purging and filling industrial equipment with inert gas,
- Immobilizing animals for slaughtering,
- Promoting the growth of plants in green houses,
- Aerosol propellant,
- Municipal water treatment,
- Fracturing and acidizing oil wells,
- Chemical intermediates (carbonates, synthetic fibres, paraxylene, etc.) and
- Miscellaneous pressure sources, etc....

A large scale application of CO_2 in Ethiopia is today limited to carbonation of beverages. In this profile, however, its potential application as refrigerant and fire extinguishing agent was also examined.

b. Oxygen

Oxygen is the most abundant of all elements. In mass it represents about 20% of the earth's atmosphere, 46% of its crust and 86% of sea water. It is a colourless, odourless, and tasteless gas. It is also non-combustible, but actively supports combustion. Commercially, it is recovered from the atmosphere through separation of liquid air by fractional distillation. It may also be obtained as a by-product of the electolysis of water in the production of hydrogen. Globally, its major applications are in the metallurgical and chemical industries. A large quantity of oxygen is also consumed in the manufacture of industrial chemicals. Some of the specific uses of oxygen are in:

- The manufacture of industrial chemicals such as acetylene, ethylene oxide, methanol, etc.
- Copper smelting,

- Steel production,
- Blast furnaces,
- Hospitals for the artificial atmosphere, in oxygen tents and incubations and in the gaseous mixture of anesthetics,
- Torches for cutting and welding metals, and
- Waste water treatment.

In Ethiopia, the commercial application of oxygen is limited to oxyacetylene gas welding and cutting, and in medical uses. Large scale consumers of oxygen,such as basic metal and chemical industries, do not yet exist in the country.

c. Acetylene

Acetylene is a colourless inflammable gas. In its pure form, acetylene has a pleasant odour, but when it is derived from calcium carbonate it emits an unpleasant (garlic like) odour, for it contains traces of phosphine. It is derived by a number of ways, the main one being by bringing calcium carbide into contact with water. It is widely used as fuel in oxyacetylene welding and cutting of metals. The earliest use, however, was for illumination, for it burns with a white flame. A large quantity of acetylene is also consumed by the chemical industry for the production of such items as acetaldehyde, the synthetic rubber neoprene, water-base paints, vinyl fabric and floor coverings, dry-cleaning solvents, and aerosol insecticide sprays.

In Ethiopia, it is commercially produced for oxyacetelene torches only. It is widely used by industrial establishments, automotive service garages, and other metal workshops for repair and maintenance, and overlaying and joining sheet metals and smaller diameter pipes.

2. Product Demand Analysis and Estimate

a. Carbon Dioxide

(1) Past and Present Supply and Demand

As pointed out earlier, the sole consumer of carbon dioxide in commercial quantity in Ethiopia is the beverage industry. CO_2 is required as an input in the production of beer, mineral water, and carbonated soft drinks. Presently, the supply sources of carbon dioxide in the country are the Addis Gas Plant, the Addis Soft Drinks, 4 breweries and the Ambo Mineral Water Factory, all of which are under the Ethiopian Beverages Corporation.

The Addis Gas and Crates Factory is the major source of supply which was established to supply CO_2 commercially. Its production capacity is 250 kg. of CO_2 per hour. The other supply sources are captive plants which were established to meet the consumption requirements of their parent companies. One such plant is under the Addis Soft Drinks Factory with a production capacity of 70 kgs. per hour. The Ambo Mineral Water Factory (AMWF) also caters for its own requirement through degasification of the natural mineral water which contains CO_2 naturally. Breweries also produce, as a by-product of fermentation, a considerable quantity of CO_2. Breweries in Asmara and Dire Dawa supply the requirement of the soft drink plants in their vicinity whereas production from the other two plants (Meta and Addis Ababa Breweries) is virtually wasted.

Production of CO_2 by the Addis Gas and Crates Factory from 1976 to 86 is shown in Table I. As can be seen from the table, the production of the plant ranges from 206,000 kgs (1978) to 520,000 kgs (1986). For most of the years shown in the table, the production has been about 300,000 kgs. In 1985 and 1986, however, the production reached 419,000 kgs and 520,000 kgs, respectively, mainly due to the additional requirements by:

- Expansion of Abay Mesk Factory,
- Supplying to Meta Beer due to the reduction in the production of CO_2 by the brewery,
- Interruption in the production of CO_2 by the Dire Dawa Brewery, and
- Increase in the production of draught beer which, in turn, increased the consumption of CO_2.

In any case, the plant has utilized, taking even the peak level of the recorded production, only 37% of its attainable annual production capacity of 1,400,000 kgs. The consumption of CO_2 by soft drinks factories in Ethiopia (See Table II) amounted to about 900,000 kgs in 1985/86. Consumption records of the Ambo Mineral Water Factory are not kept, but its present level of consumption is estimated to be about 1 million kgs.

TABLE I

PRODUCTION OF CO_2

BY ADDIS GAS AND PLASTIC CRATE FACTORY

YEAR	KGS
1976	241,371
1977	285,830
1978	206,421
1979	307,787
1980	286,695
1981	315,420
1982	277,005
1983	253,922
1984	297,778
1985	419,203
1986	519,531

SOURCE: Ethiopian Beverages Corporation

TABLE 11

CONSUMPTION OF CO_2
BY SOFT DRINKS FACTORIES
(IN 1985/86)
(KGS)

Name of Plant	Consumption (Kgs)
Addis Soft Drinks	218,825
Abay Mesk Soft Drinks	379,908
Dire Dawa Soft Drinks	38,853
Babile Mineral Water	32,138
National Soft Drinks	188,893
Gondar Soft Drinks	1,344
Dessie Soft Drinks	23,070
Total consumption of CO_2	883,031

SOURCE: Ethiopian Beverages Cropration

(2) Future Demand Estimate

The demand for carbon dioxide in Ethiopia is directly related to the production volume of soft drinks, mineral water and beer. The Ambo Mineral Water Factories and the breweries are expected to meet their requirements from their own internal sources. The supply volume of CO_2 from breweries and other sources in Asmara and Harar have been also assumed to be adequate to meet the requirements of soft drinks and mineral water to be produced in these regions. Hence the CO_2 production from the Addis Gas and Crates Factory and the Addis Soft Drinks Factory will mainly be used by the following plants:

- Addis Soft Drinks
- Abay Mesk Soft Drinks
- Dessie Soft Drinks
- Tossa Carbonated Water
- Gondar Soft Drinks
- New plants to be installed in regions other than Asmara and Dire Dawa.

The production capacity of the above two sources is estimated to be about 1.7 million kgs/year. The average consumption coefficients of various types of soft drinks produced in the country are given in Table III.

The average weighted consumption coefficient, based on the planned production volume of soft drinks from 1979 to 1981 (1986/87 - 88/89), was used in the demand projection of CO_2.

TABLE III

CONSUMPTION COEFFICIENTS OF CO_2
BY VARIOUS TYPES OF SOFT DRINKS
PRODUCED IN ETHIOPIA

Type of Soft Drinks	Kgs. Per Case
Coca Cola	0.07
Fanta	0.04
Sprite	0.08
Tonic	0.05
Pepsi	0.07
Mirinda	0.05
Teem	0.07

The Gondar, Dessie, Addis and Abay Mesk Soft Drink plants are reported to be producing at their maximum capacities. The combined annual planned production by these plants from 1986/87 to 1988/89 will be about 11.8 million cases. Such a production volume calls for a consumption of 770,000 kgs of CO_2. By 1990, a new soft drink plant with a capacity of 3 million cases is envisaged to be operational and this will require an additional supply of about 200,000 kgs of CO_2. Hence by 1990, the CO_2 plants will be required to produce about 970,000 kgs of CO_2 which leaves an unutilized capacity of about 730,000 kgs of CO_2. This extra capacity would be adequate for a further production of about 11 million cases of soft drinks.

Based on information from the Ethiopian Beverages Corporation, the present demand for soft drinks is estimated at about [illegible] million cases. Assuming an annual demand growth rate of about 4% (the growth rate of the urban population), the supply of CO_2 from existing sources is estimated to be adequate for the production of soft drinks to a level that will satisfy the demand estimated for 2000 (about 28 million cases). If new sources of supply (e.g. the brewery to be installed at Buno Bedele) is considered, the coverage period would extend to year beyond 2000.

The demand for CO_2 for application other than in beverages has also been investigated. As mentioned earlier, CO_2 has been identified as having potential uses in Ethiopia as fire extinguishing agent and as refrigerant. With respect to the first, CO_2 has two distinct uses:

- As an aid to pressurize extinguishing agent (water or others) in their containers (cylinders)

- As extinguishing agent.

CO_2 has been used in the past as a pressurizing agent, but in a very small quantity. Its use as fire extingusing agent has been very minimal. Except for limited application for fire protection in some industrial establishments, CO_2 has never been used in the country for large scale fire. extinguishing. According to the Fire Brigade, the reason for this is that water can be used in most fire hazard situations in the country. CO_2 is generally recommended in situations where water or other fire extinguishing agents must not be used. Such a situation rarely occurs in Ethiopia. The Fire Brigade has indicated that it has no intention of introducing, at least in the short and medium term, CO_2 for application in fire extingushing. For its other application, it has a pilot plant which is considered more than adequate for the purpose.

Carbon dioxide as a refrigerant is a new product idea in the Ethiopian market. In other markets, especially in developed countries, solid carbon dioxide is used as a refrigerant for meat products, frozen foods, and ice cream during their transport and in smaller quantities as a convenient quick refrigerant. The market for frozen foods, including frozen meat, is not yet developed in Ethiopia. The market for ice cream is also very limited. Hence the demand for CO_2 as a reférigerant is reckoned to be not significant as it is a derived demand resulting from the demand for the above-mentioned products.

b. <u>Oxygen and Acetylene</u>

(1) <u>Past and Present Supply and Demand</u>

Except the application of oxygen in hospitals, these two products are complementary to each other in their applications in Ethiopia. Oxygen and acetylene are used in metal welding for repair and maintenance, in overlaying and joining sheet metals and small diameter pipes, and in oxyacetylene cutting.

Because of the simplicity of its production process, acetylene is produced by a number of private garages and industrial establishments. Some large organizations such as the Ethiopian Petroleum Corporation, the Air Force, the Ethiopian Road Transport Corporation, and Melka Wakena Electric Project also produce oxygen for their own consumption.

The commercial production of these products in the country, however, is carried out by two plants - Chora Chemical and Gas Factory (Addis Ababa) and Fana Chemical and Gas Factory (Asmara). The production capacities of these plants for each product type is as follows:

Chora Chemical and Gas Factory:

Oxygen : 660,000 m^3 per year

Acetylene : 29,000 kg per year

Fana Chemical and Gas Factory:

Oxygen : 115,000 m^3 per year

Acetylene : 29,000 m^3 per year

The above capacities were calculated on the basis of 300 working days and 80% working efficiency. The production of oxygen and acetylene by these two plants from 1978/79 to 1985/86 is given in Table IV. The production of oxygen in Addis Ababa has been steadily growing up to 1982/83, but since then it has started to decline continuously. Machine failures have been given as the major cause for the decline. A new machine with a much higher capacity has been installed and production decline due to machine breakdown is not expected in the future.

The production of oxygen by Fana (Asmara) showed a jump from about 11,800 kgs in 1980/81 to about 27,400 kgs in 1982/83; it has since remained at about the same level.

In the case of the acetylene production by Chora (Addis Ababa),appears to have been more stable than its production of oxygen. It produced about 16,000 kgs of acetylene annually until 1983/84. In 1983/84, 1984/85 and 1985/86 the production has been about 17,000 kgs, 14,000 kgs and 18,00 kgs respectively. The acetylene production in Asmara followed the same trend as that of oxygen, indicating a close relationship in their consumption. The production increased by more than twofold in the first two years and remained at a level of production between 6,300 kgs and 6,600 kgs thereafter. Based on the maximum production volume reported in the past, the capacity utilization of the oxygen and acetylene plants in Addis Ababa and Asmara is as follows:

Fana (Asmara):

Oxygen = 28%

Acetylene = 23%

Chora (Addis Ababa):

Oxygen = 20%

Acetylene = 62%

TABLE IV

PRODUCTION OF OXYGEN AND ACETYLENE

BY GAS PLANTS UNDER NATIONAL CHEMICALS CORPORATION

	OXYGEN		ACETYLENE	
	CHORA (A.A.)	FANA (ASMARA)	CHORA (A.A.)	FANA (ASMARA)
1978/79	127,879	N.A.	16,178	N.A.
1979/80	134,322	N.A.	16,896	N.A.
1980/81	147,354	11,483	16,173	2917
1981/82	168,442	15,500	15,655	3900
1982/83	168,508	27,420	16,135	6497
1983/84	131,573	27,442	17,243	6620
1984/85	119,374	32,011	13,998	6300
1985/86	111,686	27,281	18,028	6432

The above figures indicate that the potential supply of the products greatly exceed the demand volume for the products.

(2) [illegible] Demand Estimat

No change is anticipa[illegible] ith respect to the end-users of acetylene and oxygen in Ethiopia. Accordingly, the consumption (demand) of oxygen and acetylene in the future will be determined mainly by the growth rate of the activities in the industrial sector (manufacturing, construction, etc.). The growth in the health services also will have some influence in the demand for oxygen. An analysis of a two-month sales data (January and February 1987) indicates that the sales to hospitals represents about 18% of the total sales of oxygen. According to Chora this reflects the overall sales structure of the plant.

The demand for oxygen and acetylene has been projected on the basis of the following assumptions:

- The present proportion of supply between captive plants, those establishments which produce gases for their own requirements, and the commercial producers (Chora and Fana) will remain the same in the future. In other words, there will be no change in the market shares of the two sources of supply;

- The quantity of production budgeted for the year 1986/87 is a reflection of the demand volume for the production for that particular year; and

- The demand for acetylene and oxygen is assumed to grow with the same rate as the industrial growth rate of the country. A 7% growth rate has been adopted for this purpose based on the following calculation.

Growth in 1978 over 1977	=	6.4%
Annual growth rate used for 1986/87 - 1988/89 plan period	=	7.6%
Average of the above two growth rates	=	7%

The estimated future demand for oxygen and acetylene based on the above assumptions is given in Table V. The demand for oxygen is estimated to grow from 206,000 m^3 in 1987 to 531,000 m^3 in 2000 for regions to be supplied from Addis Ababa. In the case of Asmara, the demand for the respective years will be 32,000 m^3 and 77,000 m^3. Such a demand can be covered by the existing supply source in both regions. The present production capacities of the existing oxygen plants have been assessed to be 860,000 m^3 and 115,000 m^3 for Addis Ababa and Asmara, respectively.

With regard to acetylene, the future demand was estimated to be 43,400 kgs in 2000 for Addis Ababa. The corresponding demand level for Asmara will be about 15,400 kgs. Since the production capacity of the acetylene plants is 29,000 kgs for both the Addis Ababa and Asmara plants, it is to be expected that the supply shortfall will occur in Addis Ababa starting in 1995, whereas in Asmara there will be an adequate production capacity to meet demand upto 2000 and beyond. To meet the shortfall in Addis Ababa, the additional capacity to be created by 2000 will be only 15,000 kgs.

3. Pricing and Distribution

a. Carbon Dioxide

Carbon dioxide is packed and compressed in steel cylinders of 20 and 24 kgs capacity which are reusable for a long period. End users are directly supplied from the factory. The current ex-factory selling price of CO_2 is Birr 2.00 per kg. which comes to Birr 2000 per ton.

TABLE V

DEMAND ESTIMATE OF ACETYLENE AND OXYGEN

YEAR	OXYGEN (M^3)		ACETYELENE (kg)	
	Addis Ababa Region	Asmara Region	Addis Ababa Region	Asmara Region
1987	206,000	32,000	18,000	6,400
1988	236,000	34,000	19,300	6,800
1989	252,000	37,000	20,600	7,300
1990	270,000	39,000	22,100	7,800
1991	289,000	42,000	23,600	8,400
1992	309,000	45,000	25,200	9,000
1993	331,000	48,000	27,000	9,600
1994	354,000	51,000	28,900	10,300
1995	379,000	55,000	30,900	11,000
1996	405,000	59,000	33,100	11,800
1997	434,000	63,000	35,400	12,600
1998	464,000	67,000	37,900	13,500
1999	496,000	72,000	40,500	14,400
2000	531,000	77,000	43,400	15,400

b. Oxygen and Acetylene

Oxygen is supplied in 50 litres high pressure steel cylinders whereas acetylene is supplied in cylinders of 5 kgs. capacities each. The present selling prices of these products are:

Oxygen:

Birr 4.50/m^3 for hospitals

Birr 6.50/m^3 for others

Acetylene:

Birr 2000 per m^3.

B. PLANT CAPACITY

As identified in the market study, the three industrial gases required in Ethiopia are oxygen, acetylene and carbon-dioxide. The existing plants' capacity for the production of carbon dioxide and oxygen greatly exceed the projected demand volume for these two gases estimated for year 2000. There will only be a shortfall in the supply of acetylene amounting to about 15,000 kgs by 2000.

However, in accordance with the Terms of Reference on this profile, plants which can produce upto 145 N m^3/hr of liquid oxygen and 50 N m^3/hr of acetylene have been considered. Carbon dioxide is different and is therefore not covered in this study. Some general remarks, however, are given at the end of this profile.

The first two gases are considered in this profile as they can be located in the same plant, although each requires a different process, different equipment and their own cylinders. Therefore, the two gases will be considered separately.

The oxygen plant described is of a minimum economic scale and can produce upto 2.4 million cubic meters or 1800 tons per year of oxygen at standard temperature and pressure on a continuous working basis for 330 days a year.

The production of acetylene (minimum economic scale) amounts to 400,000 m^3/year or 1,331 kgs per day on continuous working.

IV. MATERIALS AND INPUTS

A. RAW MATERIALS

1. Oxygen

The only raw material to produce oxygen is air.

2. Acetylene

For the production of acetylene, the raw mterials are calcium carbide and water. Calcium carbide, (in the ratio of 2 kg/m^3 of product) the main raw material and other minor chemicals such as acetone and calcium chloride, are to be imported. A production facility for calcium carbide is planned.

B. UTILITIES

The utility requirements for the production of the two gases are as follows:

Electricity (oxygen plant):	2154 mWh/year
Electricity (acetylene plant):	200 mWh/year

Both processes require ample quantities of cooling water. The total consumption will be about 100 m^3/hr with the following breakdown:

Water (oxygen plant):	673,200 m^3/year
Water (acetylene plant):	118,800 m^3/year

C. MATERIAL AND INPUT COST

1. Cost of Raw Material

The total annual cost for the imported calcium carbide will amount to Birr 946,404.

2. Cost of Utilities

Electricity

The cost of electric power will be Birr 0.22/kWh.

Water

Cooling water as well as water for the acetylene production will cost Birr $0.5/m^3$.

V. LOCATION

It is recommended that the acetylene and oxygen plants be located in the same place, although each requires a different process technology, equipment and cylinders. Alternatively only an oxygen plant could be set up in Dire Dawa to meet the requirement of the industries and hospitals in the region. This would eliminate the transportation of empty cylinders over a very long distance. Another smaller plant may be set up for the Bahr Dar region for the same reason.

With regards to acetylene, the location should be Addis Ababa to meet the shortfall in the supply (about 15,000 kg) by 2000. Acetylene is highly flammable and it has dangerous fire risk. It's explosive limit in air is in the range of 2.5 - 80%. It also forms explosive compounds with silver, mercury and copper which should be excluded from contact with acetylene in transmission system. Thus careful consideration should be given to the location of an acetylene plant.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Oxygen Making Process

The main operations to produce oxygen, shown in Figure 1, are as follows:

- Air compression,
- Water separation,
- Gas separation,
- Cylinder filling,

a. Air Compression

Atmospheric air is filtered and then compressed in a three-stage reciprocation compressor to 35 bar. It is cooled in a water cooled interstage and after-coolers and finally reduced to 5°C in a freon cooler.

b. Water Separation

Moisture is initially removed in the water separater and the air is finally purified of moisture and carbon dioxide in the molecular sieve units to less than 1 vpm impurities. A manual changeover of the molecular sieve vessels is carried out every eight hours.

c. Gas Separation

The purified compressed air enters a cold box, which encloses all the remaining separation processes. The aim of this part of the process is to increase the pressure and decrease the temperature of the gas in such a way that the fractions, which liquefy at different temperatures, can be separated successfully.

The purified compressed air enters the cold box at between 5°C and 7°C and is further cooled in the main exchanger against waste nitrogen, and expanded to about 13 bar through the main expansion valve into the lower column of the ASU. The lower column separates the incoming air into rich liquid which collects at the bottom of the column, and poor liquid which collects at the top.

Both liquids are sub-cooled to below their saturation temperature in the sub-cooler against cold waste nitrogen before being expanded to about 4.2 bar into the upper column as reflux. The liquid oxygen product is taken from the reboiler bath in the centre of the column and sub-cooled again. The cold waste nitrogen leaves the upper column and, after passing through the sub-cooler, enters the cold end of the main exchanger where it is warmed before being expanded through the expansion turbine and back into the exchanger. Part of the waste nitrogen is also used for reactivation and recooling of the molecular sieves.

d. Cylinder Filling

When high pressure gaseous oxygen is required for cylinder filling, the liquid oxygen is pumped at pressure through an atmospheric vaporiser into the cylinder filling manifold. Liquid oxygen can be passed directly from the plant into a liquid storage.

The specification of oxygen is a density of 1,354 kg/m^3 at 15°C and 1,013 bar; it is liquefiable at - 182.96°C and at 1,013 bar.

The process flow chart of oxygen manufacturing is given in Figure I.

2. Acetylene Making Process

The process described is for continuous flow and can be operated continuously or intermittently, depending on the demand, without altering the quality of the final product. The main stages in the process are as follows.

- Hoppers,
- Water feed,
- Agitation,
- Automatic controls,
- Screw feed mechanism, and
- Cylinder filling.

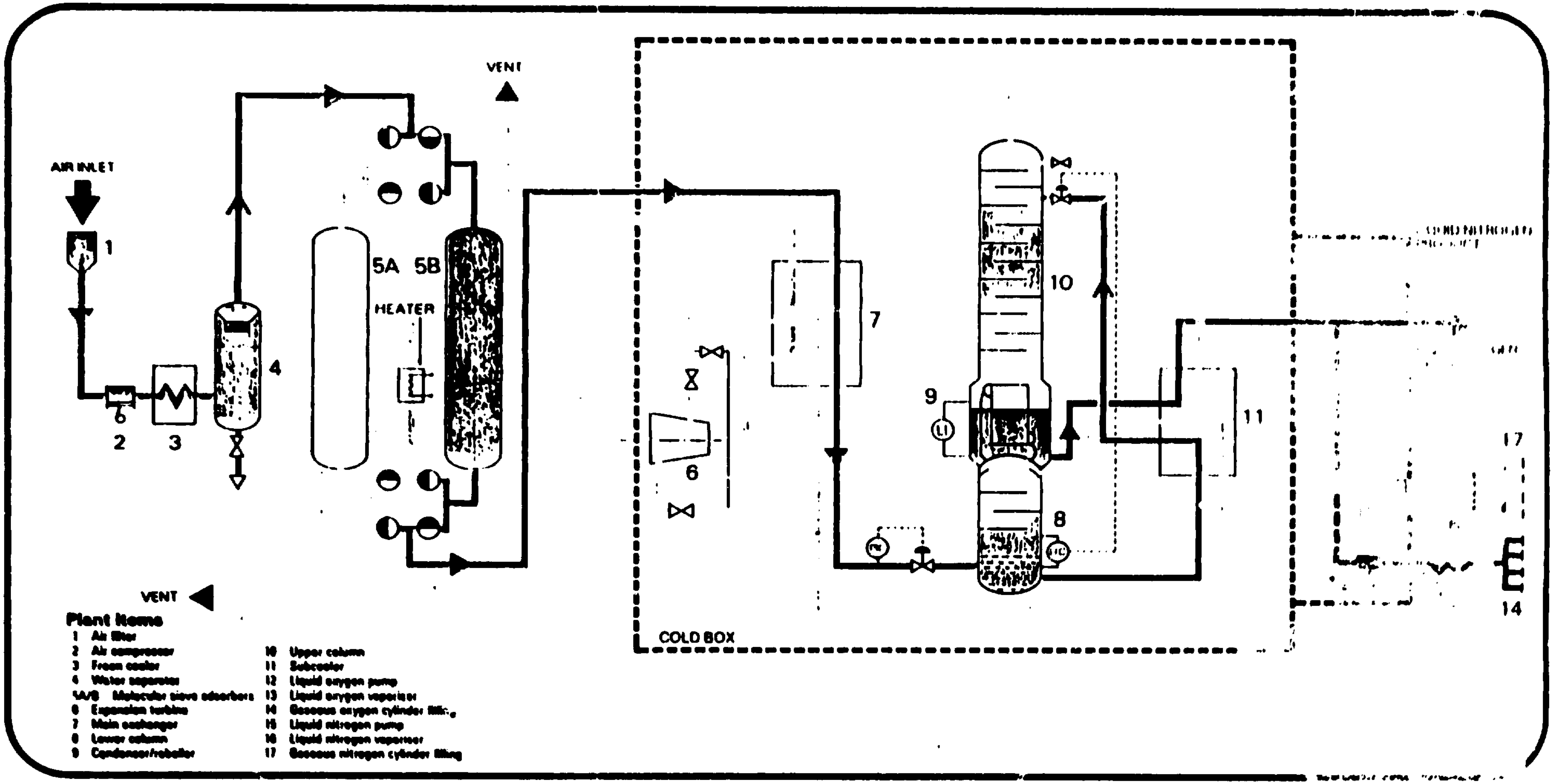


FIGURE I: Oxygen-making Process (NB The process can also recover nitrogen)

a. Hoppers

There are two carbide hoppers which alternatively fill the acetylene generator or are being refilled themselves. This changeover takes place automatically with no interruption or shut down. The carbide is run off the crusher and the generator can accept any size from 2" to dust.

The generator described operates at any pressure up to 13 psi, which is sufficient to supply acetylene adequately and safely either through a pipeline system or onto the cylinder charging manifold. The need for both gas holder and associated maintenance is removed.

b. Water Feed

There is a water inlet meter which measures the amount of water to be admitted to the tank at all times. A residue drain valve is controlled by a water level device that maintains a constant water level automatically. Water is metered into the tank while the generator is in operation, and residue is discharged simultaneously, by means of a pre-set automatic thermostat.

c. Agitation

The motor driven agitator keeps the residue in suspension at all times, automatically, providing greater acetylene yields and purity, convenience in operation and safety. There is an intermittent operation of the motor to drive the agitator for a predetermined period of 3-5 minutes every thirty minutes to keep the residue in suspension.

d. Automatic Controls

The machine described is equipped with simple, effective controls which tend to fail safe. The temperature signalling safety instrument controls the high water signal, and low water signal, and the high temperature alarm. These controls are mounted on an instrument panel near to the generator.

e. Screw Feed Mechanism

The carbide feed is automatic in relation to the acetylene demand. When the screw feed motor stops the carbide feeding, the spring loaded carbide valve closes the pressure tight instantly. This seals off the carbide supply from tank moisture, maintaining a dry atmosphere at all times in the screw feed tube, and within the carbide feeding mechanism. The hydraulic cylinder holds the carbide valve open while the screw feed mechanism is in operation.

f. Cylinder Filling

Cylinders will be in a manifold, so large numbers can be filled at a time. They cannot be filled at a pressure of more than 300 psi because the heat of absorption is too great. The cylinders will take ten hours to fill and should be sprayed with cold water to reduce the heat of compression. Acetylene specification is a density of 1,109 kg/m^3 at 15°C and 1,013 bar, sublimation point is 84°C at 1,013 bar.

3. Source of Technology

a. Acetylene Manufacturing Plant

The process described above is the standard methodology for making acetylene. The equipment, installation and transfer of technology is available from:

Rexarc Incorporated
Rexarc Place
West Alexandria
Ohio
USA

b. Oxygen Manufacturing Plant

The plant as described is a standard technology. It can be made provided on three skids. Both product and process technology is available from:

BOC Cyroplants Ltd
Angle Road
London N18 3BW
UK
Telephone 01-803 1300
Telex 263247

With respect to carbon dioxide, the standard technology is to derive it from burning fuel oil. The steps are:

Combustion of fuel oil,

- Water sprayed in gas cooler then absorbed in monoethanolamine (MEA) solution,

- CO_2 solution is column stripped, condensed and cooled,

- Separation of CO_2 and MEA by washing with a permanganate solution,

- CO_2 receives final water wash, and

- Pure CO_2 is then condensed, purified with activated carbon, dried, liquefied and then stored.

The minimum economic scale (MES) of such a plant is 25 kg/hr of condensed and purified CO_2. Capital costs are of the order of Birr 1,035,000.

B. ENGINEERING

1. Oxygen Making Machinery and Equipment

The plant is available, as a turnkey project with spares, training, technology fee and one year's guarantee. Future technical input can be arranged as a service and maintenance type contract if a joint venture is not envisaged.

The turnkey project cost is about Birr 3.318 million. The principal items of equipment are the cold box compressors, dehumidifiers and the control systems. Cylinders form a large percentage of the overall price and the distribution of the final product has to be considered. It may be desirable to handle the distribution from the factory, in which case trucks and cylinder pallets will be required. Another consideration is that welding equipment such as regulators, tubes and blow torches could be made available from the gas company through a shop outlet.

Cylinders, at full production, would cost about Birr 311 each for a 50 litre capacity. The number of cylinders required, which hold 8.48 m^3 of oxygen at STP, would be about 28,000, allowing for no existing stock, 15% out of commission for repair and maintenance and a 12 times turn-around. This would cost Birr 8.7 million.

2. Acetylene Making Machinery and Equipment

Like the oxygen equipment, suppliers provide the complete plant as a turnkey contract which includes spares, training and technology fee. The plant, in fact, comprises a single unit called a generator and tanks to store the acetylene. The turnkey project cost is about Birr 0.517 million.

A stronger cylinder is required for acetylene than for oxygen. The standard size holds 5.77 m^3 at STP. Assuming an annual turn-around of 6 times and 15% of the cylinder stock for repair and maintenance at one time, the plant would need about 13,500 cylinders. At a cost of Birr 414 each, this is an investment of Birr 5.6 million.

The required machinery and costs for both gases are outlined in Table VI .

TABLE [illegible]

TOTAL FIXED INVESTMENT COST

DESCRIPTION	COST ('000 BIRR)		
	F.C	L.C.	TOTAL
A. MACHINERY AND EQUIPMENT			
Oxygen plant and spares - turnkey	3,312		3,312
28,000 oxygen cylinders (if operating at full capacity	8,694		8,694
Acetylene plant and spares - turnkey	518		518
13,500 acetylene cylinders (if operating at full capacity)	5,600		5,600
Total plant, equipment and cylinder cost	18,124		18,124
Freight		1,812	1,812
Plant Cost (C&F)	18,124	1,812	19,936
Local Cost (12.5% of C & F)		2,492	2,492
Total cost of machinery and equipment (including 10% cont.)	19,936	4,734	24,670

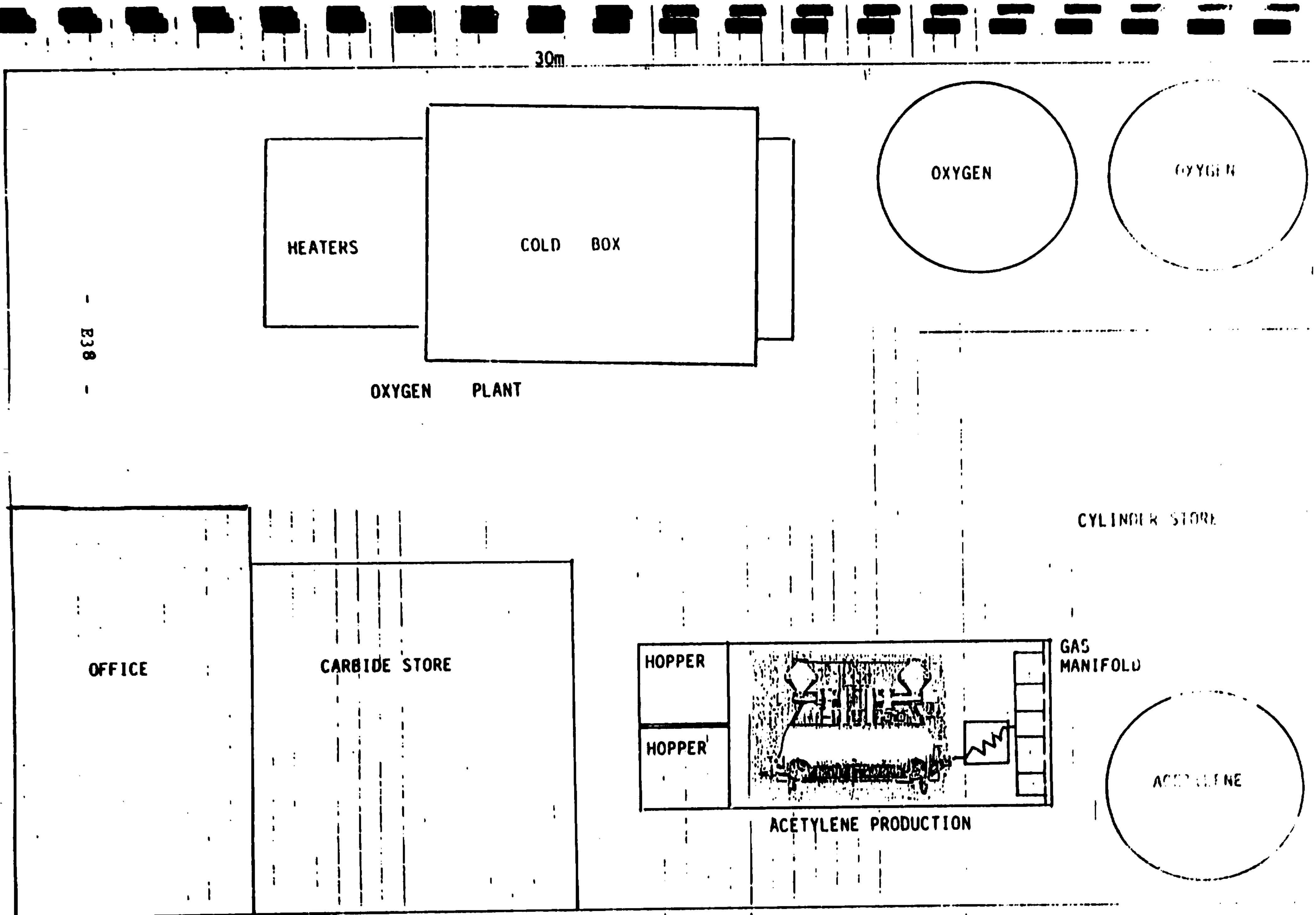
TABLE VI (Cont'd)

DESCRIPTION	COST ('000 BIRR)		
	F.C	L.C	TOTAL
B. <u>BUILDING AND CIVIL WORKS</u>			
Building Cost	162	378	540
Site Development (2% of building cost)		10.8	10.8
Outdoor Works (Sewage, drainage, piping etc., 10% of building cost)		54	54
Total building and civil works cost (incl. 10% contingency)	178	487	665
C. <u>SERVICE EQUIPMENT</u>			
Office Furniture and Equipment	12	30	42
D. <u>VEHICLES</u>			
Truck	77	33	110
Service car (two)	34	16	50
Total vehicle cost (incl. 10% contingency)	122	54	176

3. Plant Layout

A layout of the factory, which would measure 30 m x 20 m of hard standing, is given in Figure II . . Buildings for offices and stores would account for about 150 m^2. To allow for truck movements, the site size should be at least 1,500 m^2.

Separate stores must be provided for the incoming carbide and the outgoing acetylene for safety reasons. The oxygen and acetylene can be placed on the same plant so as to gain economies in marketing and distribution, particularly if it is decided to run a fleet of trucks from the manufacturing plant.


30m
HEATERS
COLD BOX
OXYGEN PLANT
OXYGEN
CYLINDER STORE
OFFICE
CARBIDE STORE
HOPPER
HOPPER
GAS
MANIFOLD
ACETYLENE PRODUCTION

VII. ORGANIZATION AND MANPOWER

A. ORGANIZATION

The plant will have its own manager to run its operations under the supervision of one Corporation. The proposed organization chart is indicated in Figure III.

B. MANPOWER AND TRAINING

The total number of employees required is 66 for 4 shifts. Break-down showing number of employees in shifts as well as skill level, monthly salary and annual total are shown in Table VII.

On the job training for both plants have to be supplied as part of the turnkey projects. In addition overseas training may be necessary for the manager, engineers and fitters. A key factor of the training is safety, and the establishment of strict safety regulations.

F I G U R E   III

ORGANIZATION CHART FOR OXYGEN AND ACETYLENE PLANTS

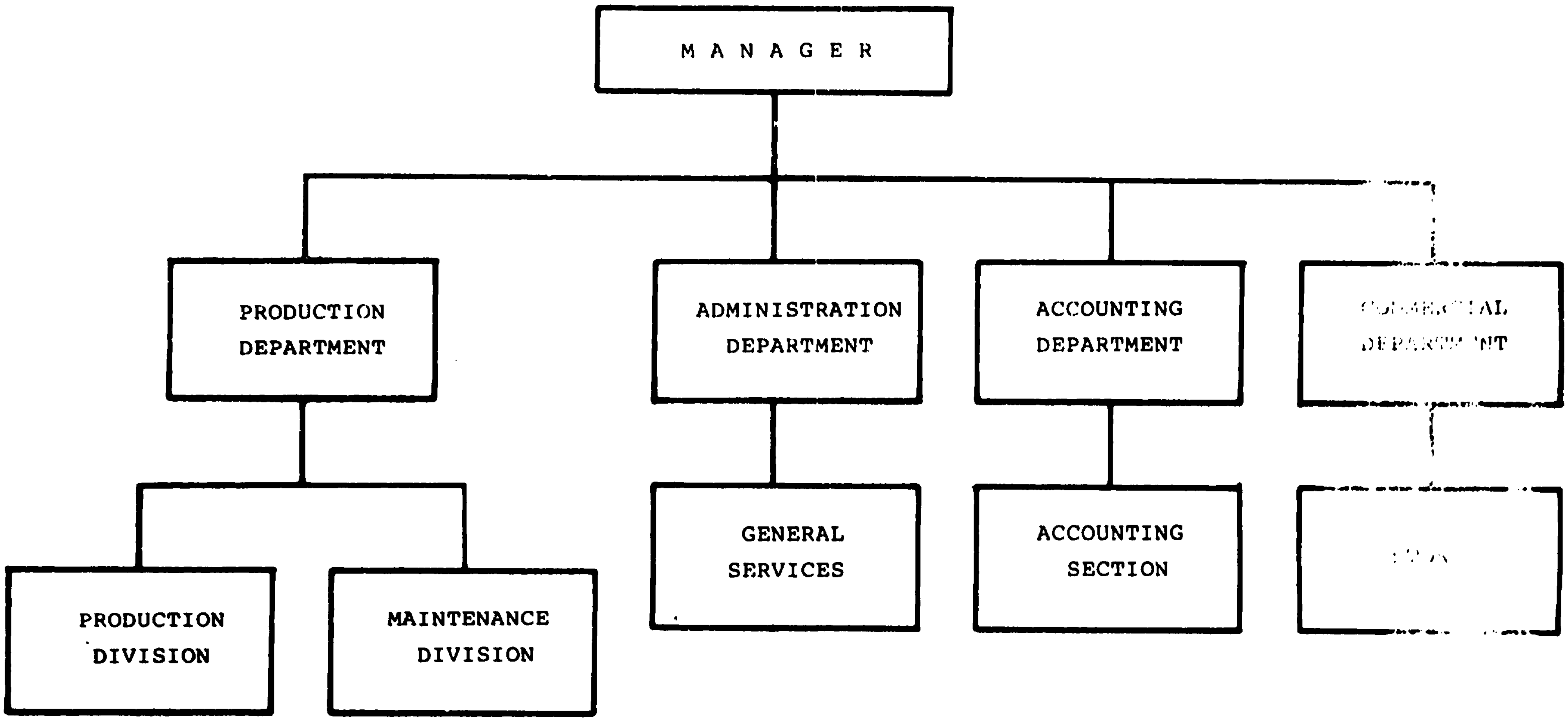


TABLE VII

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. of Shifts	No. Employed	Skill Level	Monthly Salary/ Person (BIRR)	Tota[illegible]
Plant Manager	1	1	Professional/tech.	1200	[illegible]
Secretary	1	1	Skilled	350	[illegible]
Accountant (Chief)	1	1	"	700	[illegible]
Accountant	1	1	"	450	[illegible]
Clerk	1	2	"	250	[illegible]
Administrator	1	1	"	600	[illegible]
General Service	1	3	"	350	[illegible]
Commercial, Head	1	1	"	600	[illegible]
Purchaser	1	1	"	450	[illegible]
Mechanical Fitter	4	4	"	450	[illegible]
Mechanical/Instru- ment Engineer	4	4	Prof./tech.	600	[illegible]
Shift Supervisor	4	4	Skilled	500	[illegible]
Labourer	4	16	Unskilled	90	[illegible]
Cylinder Operator	4	8	Semi-skilled	150	[illegible]
Storekeeper	4	4	Skilled	250	[illegible]

TABLE VII (Cont'd)

Personnel	No. of Shifts	No. Employed	Skill Level	Monthly Salary/ Person (BIRR)	Total Ann[illegible] Salary (BIR[illegible])
Driver, Truck	1	1	"	500	[illegible]
Driver	1	2	"	250	6[illegible]
Guard	2	6	Unskilled	90	[illegible]
Cleaner	1	2	"	70	1,6[illegible]
Messenger	1	2	"	70	1,[illegible]
TOTAL		66			216,[illegible]

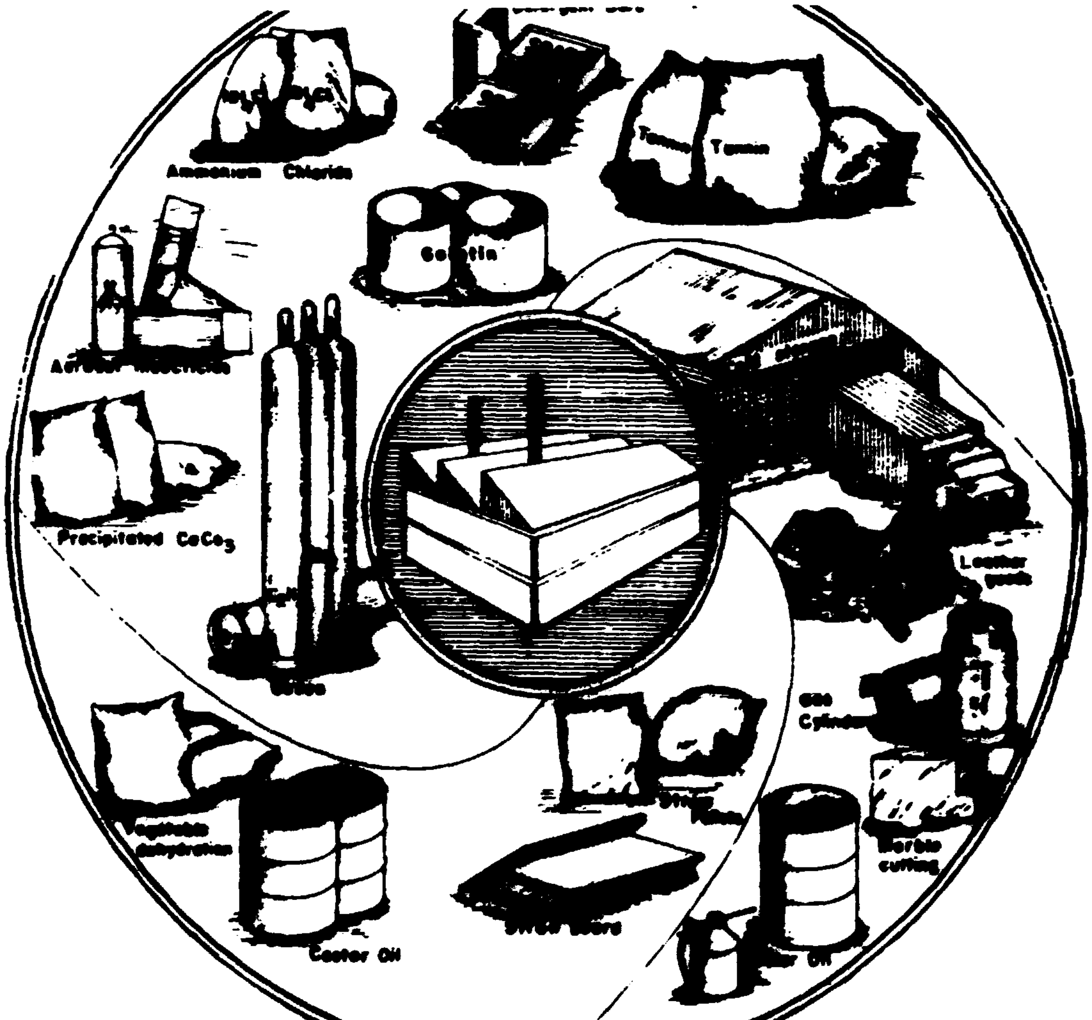
Skill distribution

		%
Professional/tech.	5	7.5
Skilled	27	40.9
Semi-skilled	8	12.2
Unskilled	26	39.4
TOTAL	66	100

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

17160 (3 of 5)



Volume II-B
Final Report

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

VOLUME II - B

AUGUST 1988

INDUSTRIAL PROJECTS SERVICE

PROJECT NUMBER 001/40 - 79

TABLE OF CONTENTS

VOLUME I

- F -

LPG CYLINDERS

TABLE OF CONTENT

II. INTRODUCTION

Liquified Petrolum Gas (LPG) has long been in use in Ethiopia as a domestic fuel in major urban centres like Addis Ababa, Asmara, Dire Dawa, Nazareth, Debre Zeit, Assab and Massawa. It is produced by the Petroleum Refinery at Assab, transported in bulk in special tankers to major distribution centres from where it is further distributed to consumers after being filled into appropriate size cylinders.

In more advanced countries, the distribution of LPG is carried out through a network of gas pipes directly connected to each consumer's residence. For a developing country like Ethiopia, introduction of such a network would be a very expensive venture. Hence, cylinders remain the most practical and less expensive means of distributing LPG.

The demand for LPG cylinders is strongly related to the demand and availability of LPG as a domestic fuel . The traditional method of cooking throughout the country is highly energy intensive, and it is almost entirely dependent on fuel wood as a source of energy. This has significantly contributed to the large scale deforestation process the country is suffering from.

To curtail the continuing pressure on the country's wood resource and at the same time to overcome the household energy crisis faced by the urban population, it is highly essential to promote use of fuel wood substitutes such as electricity, LPG, kerosene, etc. LPG in particular stands best in terms of its low cost and ease of application.

I. SUMMARY

This project profile provides a detailed account on the techno-economic viability of establishing an LPG (Liquified Petroleum Gas) cylinders manufacturing plant in Ethiopia.

The cylinders are meant mainly for the distribution of LPG for use as a domestic fuel in major urban centres throughout the country.

Currently LPG cylinders are all imported from abroad by LPG distributors (Sheel, Agip and Esso) and handed out to customers who deposite a fixed amount of money for temporary ownership.

The demand for LPG cylinders is directly related to the demand for LPG as a domestic fuel. Demand forecast based on household income indicates requirements of 12,600 units in 1989 and 15,300 units by the year 2003. This has limited the annual output of the envisaged plant to 12,000 units per shift. As the demand increases the output can be doubled by introducing a two shift operation.

At the indicated output level, the project is found neither financially nor economically viable. The financial and economic rates of returns are -46.26% and 2%, respectively.

The initial fixed investment cost on plant machinery, equipment, buildings and other civil works is estimated at Birr 3.34 million, out of which Birr 2.34 million (70%) is in foreign currency. The net working capital requirement at full capacity is Birr 360,000. The annual operating cost is estimated at Birr 1.67 million, 28% of which is in foreign currency.

The project is capable of generating employment for 52 people.

Kaliti is considered to be an appropriate location for the plant because of its closeness to Addis - a major market centre for the product, and its ease of access to imported raw materials by rail from Assab.

The Ministry of Mines and Energy has already plans to expand the Petroleum Refinery at Assab and to exploit the natural gas rescurce identified in Oqaden and the Red Sea area. The realization of these plans is expected to provide a promising quantity of LPG for domestic consumption.

Local production of LPG cylinders will have a significant impact in promoting use of LPG as a domestic fuel. It also saves a considerable amount of foreign currency spent on import of LPG cylinders from abroad.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

LPG cylinders are mainly used for packing and distributing LPG for safe household consumption. The major types in circulation for domestic use in Ethiopia are the 12.5 and 15 kg cylinders.

The total liquid petroleum gas cylinder requirement in the country is solely met from external sources. The import data of LPG cylinders were collected from two sources. The first source was the Annual External Trade Statistics and the second source were the gas distributors.

The import data of gas cylinders as reported in the Annual External Trade Statistics apparently comprises of different types and sizes of gas cylinders.

The import of gas cylinders, according to the data collected from the Annual External Trade Statistics, in 1976 was 330 pieces, and in 1980 the cylinder import was reported to be 24,949. (See Table I). The gas distributors, who have monopoly of the cylinder distribution in the country, have no data indicating the import in 1976. On the other hand, the 1980 recorded import data by gas distributors was 2900. This indicates that the classification of gas cylinders of iron and steel in the Annual External Trade Statistics also includes cylinders other than that considered in this study.

Additionally, as shown in Table I and II, there are serious fluctuations in the import of cylinders as reported in the government statistics as well as the gas distributors. For example, according to information from gas distributors, the import of cylinders stood at 4645 in 1974 and this declined to 1000 in 1986. This situation, has thus made the assessment of the demand on the past trend basis rather an impossible task and a different approach had to be devised. The approach used to assess the future demand for gas cylinders was the enduse method.

TABLE I

GAS CYLINDERS IMPORT (OF IRON AND STEEL)

(PCS.)

Year	Quantity
1976	330
1977	6413
1978	1905
1979	4865
1980	24949
1981	8138
1982	5176
1983	6698

SOURCE: Customs and Excise Taxes Administration, External Trade statistics.

TABLE II

IMPORT OF GAS CYLINDERS BY DISTRIBUTORS

(PCS.)

Year	Gas distributors			Total
	Shell	Agip	Esso	
1974	4645	-	-	4645
1975	1998	-	-	1999
1977	3415	-	-	3415
1978	1132	-	-	1132
1980	2600	-	300	2900
1981	1869	3000	350	5219
1982	450	4000	600	5050
1983	2000	-	500	2500
1984	-	2400	-	2400
1985	1197	-	-	1197
1986	1000	-	-	1000

SOURCE: Shell Ethiopia Limited, Agip Ethiopia Limited and Esso Gas Company

2. Past and Future Demand Analysis

The domestic production of LPG between 1972 and 1986 grew from 2600 tons to 5360 tons, at an average rate of 5.44% per year. (See Table III).

TABLE III
DOMESTIC LPG PRODUCTION
(TONS)

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Production	2600	2900	2900	2900	2700	3000	3400	4200	4200	4500	5000	5410	5450	5160	5360

During the last ten years, the demand for LPG has far outstripped the supply, basically because there is an acute shortage of the traditional fuelwood and its price has increased so much that users are compelled to resort to alternative sources of energy. As a result, many households are using LPG as a source of energy. However, as the capacity of the LPG production by the Ethiopian Petroleum Refinery is limited, the supply could not meet the tremendous demand pressure. It is because of the surge in demand for LPG, that cylinders are almost impossible to get and the market price has jumped about five times in the open market.

According to a Natural Gas Utilization Prefeasibility Study carried out by GDC Inc, a U.S. consulting organization, the demand for gas as domestic energy source was estimated to be 100,740 tons and 152,205 tons in 1990 and 2005 respectively. The commercial sector consumption, which is defined as hotels, hospitals and small business, will start at 357 tons in 1990, increasing to 4534 tons in 2005 (See Tables IV and V).

In order to arrive at these demand figures, and the demand for gas by urban households was analyzed by GDC Inc. under the following assumptions.

Firstly, 1982 was taken as a base year and the number of households in the major cities, i.e. Addis Ababa, Asmara and Dire Dawa, were taken to be 300,000, 85,000 and 50,000, respectively. Secondly, 50% of these households are assumed to earn an income of Birr 200 a month and more. Thirdly, the number of households was assumed to grow at the rate of 2.8% a year. Finally, the natural gas consumption was taken to be 43.3 SCF (Standard Cubic Feet) per household per day.

TABLE IV

RESIDENTIAL SECTOR GAS DEMAND

(TONS)

Major Urban Centres	YEAR			
	1990	1995	2000	2005
Addis Ababa	69350	79570	91250	104755
Asmara	19710	22630	25915	29930
Dire Dawa	11680	115706	15330	17520
TOTAL	100740	115706	133225	152205

SOURCE: GDC, Inc., An Energy Sources Organization, Chicago, Illinois, USA, November 1984, Vol. III, P. 11- 54.

TABLE V

COMMERCIAL SECTOR REQUIREMENT

OF NATURAL GAS

(TONS)

Major Urban Centres	YEAR			
	1990	1995	2000	2005
Addis Ababa	267	1445	2578	3112
Asmara	90	446	711	889
Dire Dawa		267	446	533
TOTAL	357	2156	3746	4534

SOURCE: Ibid

The assumption that 50% of the urban households earn a monthly income of Birr 200 and more is on the high side. According to a household survey made by the Central Statistical Office, in 1984, the percentage of households earning Birr 200 per month and more was only 19.06%. Also the number of households in Addis Ababa was estimated to be 267,769[1] in 1984 as against 300,000 in 1982. Therefore, the demand forecast made by GDC, Inc., could not be adopted as it is. In this study, demand is estimated by taking the number of households falling in three income levels, namely those earning per month Birr 101 and above, 201 and above and 401 and above. These income levels represent 38.74%, 19.06% and 7.83% of the total urban households, respectively.

The urban population is expected to grow at an average rate of 4% per year[1]. Average urban household size, on the other hand, grew from 4.1 persons/household in 1978 to 4.6 persons in 1984, showing an average annual growth rate of 1.9%. This rate is assumed to prevail over the forecast period, as housing shortages in the urban centres have the effect of increasing the urban household size. The projected urban population divided by the expected number of persons per household in the years corresponding would give the number of urban households. From the result it was found that the number of urban households could grow annually at an average rate of 2.2%.

The demand estimate shown in Table VI indicates that if the households with an income level of Birr 101 and above are assumed as potential consumers, the demand level will start at about 430,000 in 1988, rising to 595,600 in 2003. On the other hand, if households with an income level of Birr 201 per month and above are assumed as potential users of gas, then the demand for cylinders will amount to about 211,500 and 293,020 in 1988 and 2003, respectively.

---

[1] Population and Housing Census of Ethiopia, 1984: Analytical Report on Results for Addis Ababa, P. 10.

TABLE VI

DEMAND FORECAST FOR LPG CYLINDERS UNDER DIFFERENT HOUSEHOLD INCOME LEVELS

(PCS)

Year	Requirement of Households Earning Monthly Income		
	Birr 101 & Above (38.74)	Birr 201 & Above (19.06)	Birr 401 & Above (7.82)
1988	430,000	211,500	86,900
1989	438,300	215,700	88,600
1990	447,100	220,000	90,400
1991	456,200	224,500	92,200
1992	465,700	229,100	94,100
1993	475,500	233,900	96,100
1994	485,700	239,000	98,200
1995	496,200	244,100	100,300
1996	507,200	249,500	102,500
1997	518,500	255,100	104,800
1998	530,300	260,900	107,200
1999	542,500	266,900	109,600
2000	555,100	273,100	112,200
2001	568,100	279,500	114,800
2002	581,600	286,100	117,500
2003	595,600	293,000	120,400

NOTE: Figures in parenthesis are percentages of households earning the indicated amount of income.

Assuming households with an income level of 401 per month and above, the demand will start at about 86,900 in 1988, and gradually rises to 120,400 in 2003. These demand figures were arrived at assuming that each household uses only one cylinder because of lack of a continuous and adequate supply of gas.

The forecast made using monthly income level of Birr 101 and above was considered to be optimistic, while the demand estimate made assuming households with a monthly income of Birr 401 and above was found out to be conservative. Thus both forecasts were dropped.

In this study, therefore, households with monthly income level of Birr 201 and above was taken to be a likely representative of the demand and this has been adopted.

The other potential users of LPG are hotels and bars, snack bars and restaurants. At present, there are 7,423 hotels and bars, 2918 snack bars and 1982 restaurants[1]. Assuming that each acquires two cylinders over the forecast period, the total potential demand would become 24,646 pieces.

The total number of cylinders in use in the country according to the liquid petroleum gas distributors was estimated at about 87,000. In order to find out the unsatisfied demand, this figure was subtracted from the projected demand figure. Accordingly, the unsatisfied demand will start at about 126,000 in 1988, increasing to about 207,500 in 2003, provided that the availability of traditional fuel remains relatively scarce (See Table VII). The annual increment ranges from 4200 cylinders to 6900 cylinders over the forecast period.

---

[1] Ministry of Domestic Trade.

TABLE VII

DEMAND FORECAST FOR LPG CYLINDERS

TAKING HOUSEHOLDS WITH MONTHLY INCOME OF BIRR 201

AND ABOVE AS POTENTIAL CONSUMERS OF GAS

(PCS.)

Year	Estimated Demand[1]	Existing Stock of Cylinders	Unsatisfied Demand
1988	213,040	87,000	126,040
1989	217,240	87,000	130,240
1990	221,540	87,000	134,540
1991	226,040	87,000	139,040
1992	230,640	87,000	143,640
1993	235,440	87,000	148,440
1994	240,540	87,000	153,540
1995	245,640	87,000	158,640
1996	251,040	87,000	164,040
1997	256,640	87,000	169,640
1998	262,440	87,000	175,440
1999	268,440	87,000	181,440
2000	274,640	87,000	187,640
2001	281,040	87,000	194,040
2002	287,640	87,000	200,640
2003	294,540	87,000	207,540

1 Includes Commercial Enterprises' Demand, such as hotels and bars, restaurants etc.

This corresponds to a new demand generated as a result of the appearance of new households in the indicated income group. The estimated unsatisfied demand in 1988, estimated to be 126,000 cylinders, is assumed to be met over the forecast period; thus corresponding to a yearly allocation of 8400 cylinders during the period 1989 - 2003. Accordingly the total annual demand, that is the new demand together with the unsatisfied demand in 1988 as allocated over the forecast period, is estimated to vary between 12,600 cylinders and 15,300 cylinders in 1989 - 2003 (See Table VIII).

3. Pricing

Different types of cylinders are imported into the country and their prices vary accordingly. Nevertheless, since the primary interest in this study is in cylinders with capacities of 12.5 and 15 kilogram, which are used mainly for domestic cooking purposes, the price analysis was limited to these two sizes.

It should be noted at this juncture that cylidners are not sold, rather users of gas simply deposit money and the legal ownership remains with the gas distributors. Thus, the price discussed concerns the deposit that gas distributors require.

The current deposit charged by gas distributors is composed of cylinders, regulators and hoses. The break-down of the cost for each item is indicated in Table IX.

TABLE VIII

PROJECTED DEMAND FOR LPG CYLINDERS

Year	Current Unsatisfied Demand[1]	New[1] Demand	Total Demand
1988	126,040	-	-
1989	8,400	4,200	12,600
1990	8,400	4,300	12,700
1991	8,400	4,500	12,900
1992	8,400	4,600	13,000
1993	8,400	4,800	13,200
1994	8,400	5,100	13,500
1995	8,400	5,100	13,500
1996	8,400	5,400	13,800
1997	8,400	5,600	14,000
1998	8,400	5,800	14,200
1999	8,400	6,000	14,400
2000	8,400	6,200	14,600
2001	8,400	6,400	14,800
2002	8,400	6,600	15,000
2003	8,400	6,900	15,300

1 The current unsatisfied demand, i.e, indicated in 1988,is assumed to be met over the forecast period.

2 Reflects annual increment (See Table VII , Col. 4)

TABLE IX

DEPOSIT CHARGED BY GAS DISTRIBUTORS FOR CYLINDERS

(BIRR)

Company	Cylinder	Regulator	Hose
Shell	56.00	20	5.75
Agip	53.65	20	5.75

NOTE: Esso and Agip charge the same amount.

B. PLANT CAPACITY

As shown in Table VII, the present unsatisfied demand for LPG cylinder under the assumed household income level, i.e. monthly income of Birr 201 and above together with commercial enterprises' demand was estimated to be 126,000, increasing annually by an amount ranging from 4200 cylinders to 6900 cylinders over the forecast period. Accordingly, the annual demand for cylinders will start at 12,600 in 1988, gradually rising to 15,300 in 2003 (See Table VIII). However, the minimum economic scale of production is understood to be around 500,000 cylinders. Plants with an annual production capacity of more than 2 million LPG cylinders are quite common. Thus, as the estimated demand level is well below the minimum economic level of production, it may be appropriate to consider the assembly of cylinders from boughtin components.

Most LPG cylinder manufacturers believe that a production of less than 500,000 units per annum is not economical. However, plants with annual outputs ranging from 90,000 to 550,000 units are known to exist in India and other developing countries.

The estimated demand in Ethiopia is very small compared with the minimum scales indicated above. A plant with an output of 12,000 units per annum should be quite capable of satisfying the indicated demand. The production can be doubled if necessary by operating the plant in two shifts.

C. PRODUCTION PROGRAMME

The annual output of the LPG cylinder manufacturing plant will be 12,000 units on the basis of an 8-hour single shift and 300 working days.

Assuming that a feasibility study of the project will take one year, and the implementation additionally two years the production can be geared to start in 1991.

The first year of production will start at an output of 70% of the nominal capacity. It will be raised gradually to reach the maximum achievable output of 12,000 units in the fifth year (See Table X).

TABLE X

PRODUCTION PROGRAMME

(NOMINAL CAPACITY 12,000 UNITS/YEAR)

Year	Capacity Utilization (%)	Annual Output (Units)
1991	70	8,400
1992	80	9,600
1993	90	10,800
1994	95	11,400
1995	100	12,000

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

The basic material used in the manufacture of LPG cylinders is low carbon steel made by the acid, open hearth or electric furnace processes. It can be of the mild or high strength type. The specifications of the two types of steel are given in Table XI.

The thickness of the steel mainly depends on the minimum wall stress exerted by the design pressure of about 17 kg/cm^2 ($\pm$ 10%). For mild steel it is 2.6 mms; and for high strength steel just 2.00 mms is sufficient. On the average 20 kgs of mild steel is assumed to be sufficient for the manufacture of one cylinder. The annual steel requirement of the plant is given in Table XII.

The starting material could be in the form of sheet panels or sheet coils that are free from cracks, seams, laminations or any other defects. The former is more applicable to low output plants whereas the latter is more favourable for continuous automated production lines. The plant should be located near the Kalliti Steel Industry (KASI) for an easy access to properly sized and cut steel pieces at a relatively cheaper price. This would also eliminate the need to invest in the decoiler machine and the shearers. The saving is estimated at Birr 414,000 (FOB).

B. UTILITIES AND OTHER INPUTS

The installed power requirement of the plant for the production machinery and equipment was estimated at 360 kw. The annual power demand will be about 432,000 kWh on the basis of a single shift operation. A power transformer with a capacity of 630 KVA will be sufficient to supply enough power for the production as well as for lighting purposes. Its cost is estimated at Birr 25,000 if it is installed by the Ethiopian Electric Light and Power Authority (EELPA).

Water will be mainly required for drinking and preparing chemicals for galvanizing. The annual consumption was estimated at 4,000 m^3.

In addition to electric power and water, other inputs such as welding electrodes, flux, chemicals for galvanizing or paint, and fuel oil for baking the paint will also be required. The bang for holding the valves in place can be manufactured within the plant, whereas the valves have to be imported because of the high precision work involved in their manufacture.
The annual cost of all the inputs required is given on Table XII.

TABLE XI

SPECIFICATION OF STEEL FOR

LPG CYLINDERS MANUFACTURE

Specification	Mild Steel	High Strength Steel
Carbon content (%)	0.15 - 0.25	0.15 - 0.25
Mangansese content (%)	0.5 - 1.0	0.5 - 1.0
Silicon content (%)	Max. 0.3	Max. 0.3
Sulphur cotnent (%)	Max. 0.05	Max. 0.05
Phosphorus content (%)	Max. 0.045	Max. 0.045
Tensile strength (kg/mm^2)	34 - 44	Min. 49
Yield strength (kg/mm^2)	24.5 - 34.5	Min. 33
Elongation (% - for gauge length of 63.5 mms)	20	20

TABLE XII

ANNUAL UTILITIES AND OTHER INPUTS

REQUIREMENT AND COST

(12,000 UNITS/YEAR)

Item Description	Requirement	Birr ('000)
Low carbon steel	240 tons	690.00
Welding rods, flux, etc.	lump sum	45.00
Galvanizing chemicals	lump sum	30.00
Valves	12,000 pcs	45.00
Electric power	432,000 kWh	95.04
Furnace fuel	9,750 lt	5.25
Water	4,000 m^3	2.00
Sub-Total		912.29

V. LOCATION

The most appropriate location for the envisaged LPG cylinders manufacturing plant is Kalliti, about 15 kms south of Addis Ababa. Its proximity to the Kalliti steel Industry (KASI) will provide an easy access to coils or cut to size steel and other inputs. The plant can also obtain tools from the nearby new Spare Parts Factory. Moreover, the main consumption of LPG cylinders is in Addis Ababa, and the small markets in Debre Zeit, Nazareth, Assab, Massawa, Asmara, Dire Dawa and Harrar can be supplied by rail or trucks.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

There are two types of alternative technologies so far in use in LPG cylinder manufacturing. Neither of these alternatives can be utilized in the manufacture of oxygen or acetylene cylinders whose pressure requirement is over 35 and 25 atm ., respectively.

1. Alternative I

This alternative is based on the fabrication of two identical bottom and top ends commonly known as dishes, because of their shapes, and an independent cylinderical body separately. The three pieces are then welded together to form a hollow cylinder closed at both ends.

The two dishes can be hemispherical or elliptical in shape and have cylinderical skirts of 20 mm width, and are fabricated using a deep drawing press.

The cylinderical body is made from a rectangular steel sheet cut to the appropriate and desired size. The sheet is further formed or rolled into a cylinderical shape and longitudinally welded. Double butt, automatic electric arc welding is used to ensure complete penetration of the weld and fusion of the joints.

The two ends or dishes are joined to the extreme ends of the cylinderical body with circumferencial welds using the same welding method previously indicated.

2. Alternative II

The second alternative involves the production of only two pieces of identical shape and dimension that form the cylinder head and bottom. The two pieces are first deep drawn from circular sheet metal blanks, and then joined together at their open ends by an automatic submerged arc welding process.

3. Most Appropriate Alternative

The second alternative is the most appropriate technology recommended for the envisaged plant. Its advantages are that it:

- Saves quite a considerable amount of steel sheet from being wasted through cutting, trimming and blanking;

- Consumes less energy, welding materials and labour since only a single circumferencial weld is required, and

- Is relatively simple and requires less time per unit of cylinder manufactured.

The first alternative still remains the only method applicable for the manufacture of exceptionally large size LPG cylinders, of which the top and bottom units are too long to be produced by deep drawing.

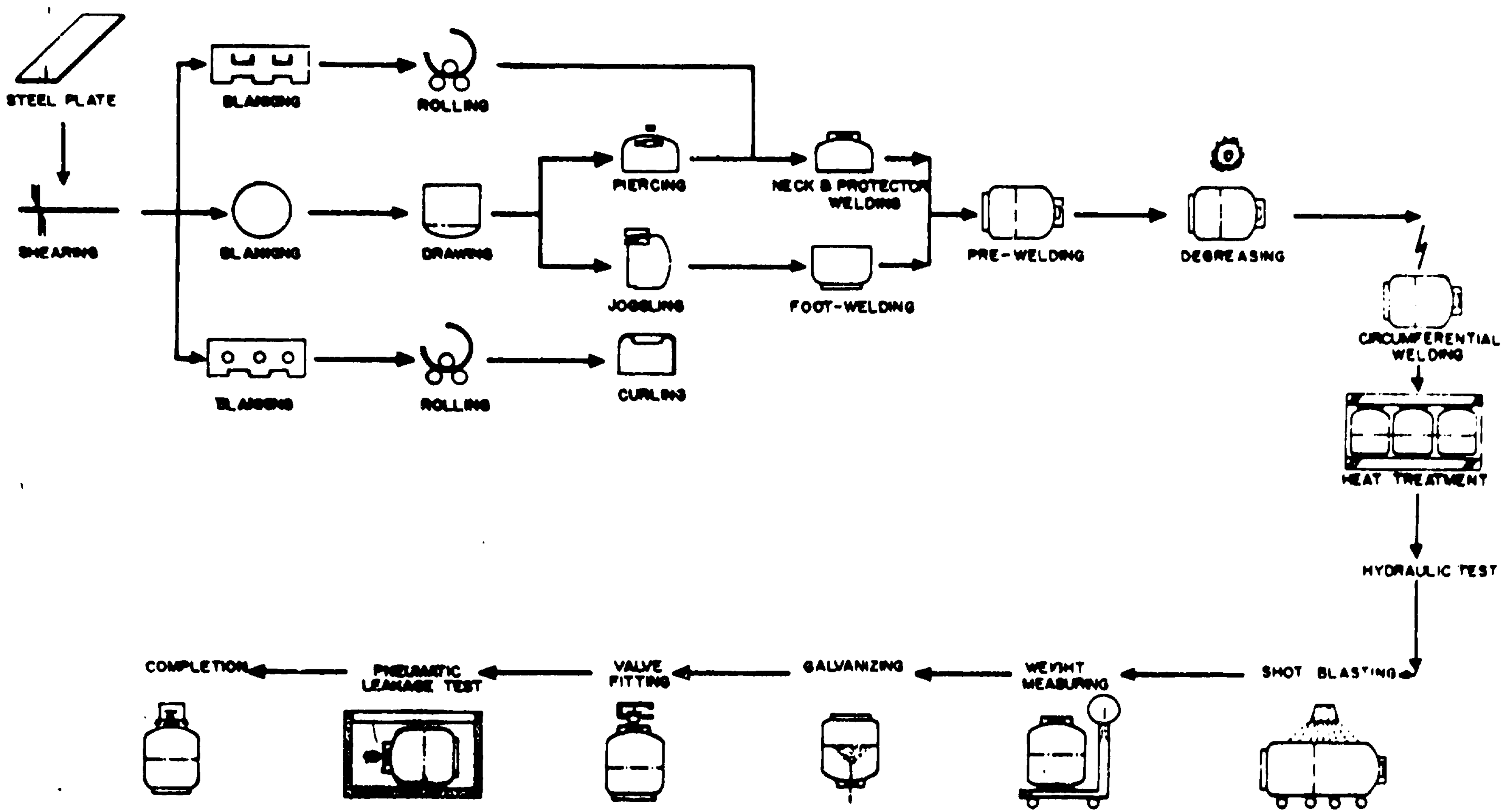
4. Manufacturing Process

The most important steps involved in the manufacture of LPG cylinders are blank production by pressing, deep-drawing, shaping, turning, welding, annealing, testing, sand blasting, surface finishing, valve fitting and air testing. These steps are followed in a consecutive order until the final product is obtained. (See Figure I for the process flow).

The manufacturing process starts with the feeding of cut-to-size flat steel sheets into the stamping press, where round blanks are stamped out after each stroke. The round blanks are further fed manually into a semi-automatic deep drawing press where they are drawn into bucket shapes. After punching a bung hole on the would be top piece and joggling the flange of the bottom piece, the carrying handle and the skirt pieces are welded to each part respectively.

FIGURE I .a

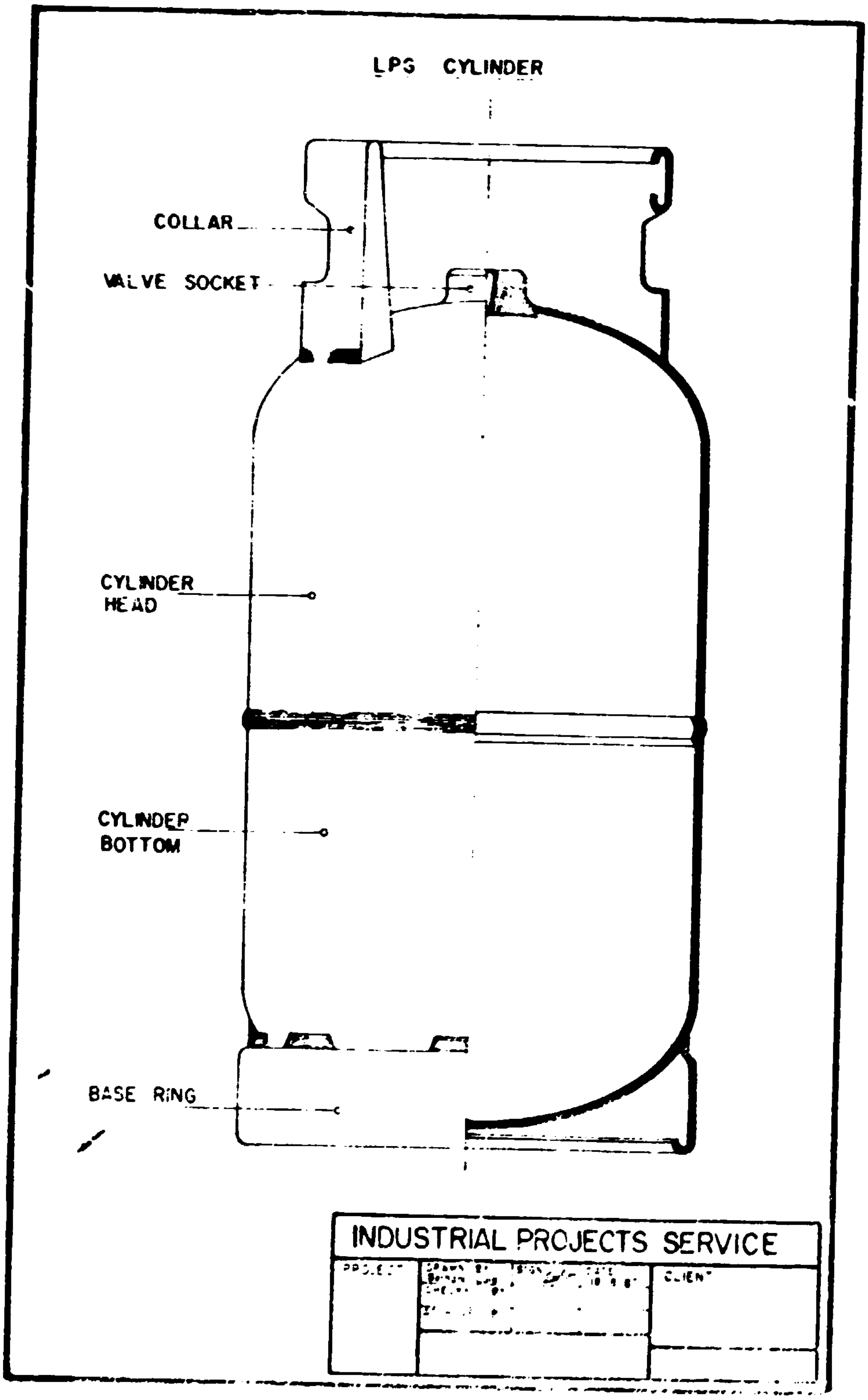
PROCESS FLOW FOR LPG CYLINDERS MANUFACTURING



INUSTRIAL PROJECTS SERVICE

PROJECT			CLIENT

FIGURE I .b


LPG CYLINDER
COLLAR
VALVE SOCKET
CYLINDER HEAD
CYLINDER BOTTOM
BASE RING
INDUSTRIAL PROJECTS SERVICE
PROJECT
CLIENT

The carrying handle and the foot or skirt are blanked, rolled and curled separately. The two dishes are then tack-welded and degreased for the final circumferencial weld to be carried out on a jig by an automatic welding machine. Hand welding is unacceptable because it cannot guarantee full penetration of the weld and perfect fusion of the joint to withstand the high internal pressure the cylinder is subjected to.

Hand or power shears and CO_2 welding equipment can be used in the production and welding of the carrying handles and the skirts to relieve the blanking press and the automatic welding machine.

To relieve the stresses that have been created during welding and other manufacturing operations, the cylinders ar heat treated or annealed in an electric furnace at a temperature of 600°C for about 2 minutes before testing.

After heat treatment, the cylinder is subjected to a hydrostatic test at a pressure of about 20 kg/cm^2 on individual testing stands. Any leaks would be immediately visible. To enable safe and optimal quality cylinders, the hydraulic test is supplemented with burst tests of higher pressures at regular intervals

The tested cylinder is dried with natural air current or with warm air recovered from the furnace. Its surface is then cleaned for painting or galvanizing by shot blasting. Galvanizing is the cheapest and most effective surface treatment method against corrosion and is thus recommended for the envisaged plant.

Finally, the threading of the bang (valve socket) is cleaned and the valve is screwed onto it using a valve fitting machine. After air-testing the valve for leakage, the cylinder is inspected and stored ready for despatch.

It is worth noting that the bangs can be manufactured within the plant using simple industrial lathe machines and thread cutters if their supply cannot be secured from local sources. The valve which is of the self-sealing or gate wheel type is to be imported.

B. ENGINEERING

1. Machinery and Equipment

A list of the major machinery and equipment used in the manufacture of LPG cylinders is given in Table XIII. The total investment cost is estimated at Birr 2,146,753 (CIF Addis)*.

To further reduce the investment cost the decoiling machine and the shearers can be omitted from the list of machinery and equipment given in Table XIII because cut-to-size sheets can be obtained from Kaliti Steel Industry (KASI). The cost reduction will be about Birr 547,738.

---

* Including uncoiler and shearers.

TABLE XIII

MAJOR PLANT MACHINERY AND EQUIPMENT

Item Description	Units
Uncoiler** (Available at KASI)	1
Press and die	1
Shearers** (Available at KASI)	2
Welding equipment	-
Annealing furnace	1
Galvanizing furance	1
Fork-lift truck	1
Accessories	-
Auxillary equipment	-

** Optional Items

2. Plant Layout

The plant will require about 2500 m^2 of land. Out of this, the space to be occupied by the building was estimated at 756 m^2. (See Figure II). For an increased output, and additional shade of about 100 m^2 may be built on the outskirts of the main building. The remaining free space of 1744 m^2 is meant for future expansion, roads, parking, foot path, etc. A detailed break-down of the various sections of the main building is given in Table XIV. The total building cost was estimated at Birr 604,800.

If the plant is amalgamated with the Multi-purpose workshop planned to be set-up by the National Metal Works Corporation at Kalliti, it would eliminate the need for an independent office, tools room, and separate spaces for maintenance workshop, hydraulic testing and inspection. The total investment cost saving on buildings and civil works is thus estimated at Birr 141,120.

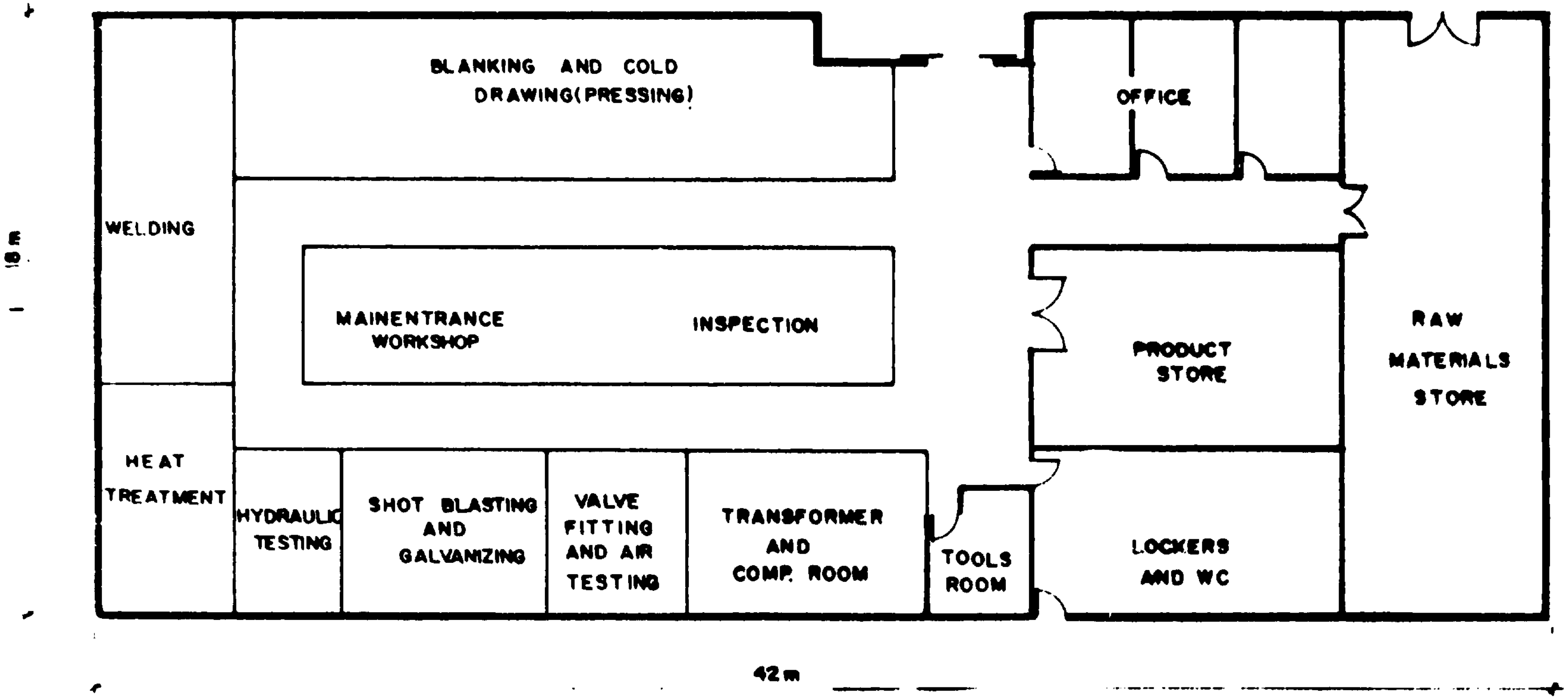
TABLE [illegible]

SPACE REQUIREMENT OF PLANT

Description	Space (M^2)
Office	45
Raw materials store	108
Product store	54
Lockers and W.C.	45
Tools room	12
Blanking and cold drawing	92
Welding	44
Heat treatment	28
Hydraulic testing	15
Shot - blasting and galvanizing	30
Valve fitting and air - testing	20
Transformer and compressor room	35
Maintenance workshop	28
Inspection	40
Isle	160
Sub-total (building space)	756
Free space	1744
Total of site area (50 x 50)	2500

Figure II

PLANT LAYOUT FOR MANUFACTURE OF LPG CYLINDERS



Scale 1:200

VII. ORGANIZATION AND MANPOWER

A. ORGANIZATION

The organizational structure of the plant as shown in Figure III consists of four major sections, namely administration, financial, commercial and technical. The technical section is further divided into the maintenance and production sub-sections. The production sub-section will be mainly responsible for the manufacture of LPG cylinders satisfying market requirements both in quality and quantity.

All four sections will be guided, supervised and controlled by a plant manager who will be in charge of the overall activities of the factory.

B. MANPOWER AND TRAINING

The plant will require a total of 52 employees. The technical section alone will employ 28, out of which 8 will be skilled, 8 semi-skilled and 12 unskilled. A detailed breakdown of the total manpower requirement of the plant is given in Table XV. The annual cost on manpower, including employment benefits, was estimated at Birr 257,625.

All personnel in the Administration, Financial and Commercial Sections including the Plant Manager and his secretary would not be needed if the project is amalgamated with the multi-purpose workshop plant envisaged to be set up at Kalliti by the National Metal Works Corporation. A total annual cost of Birr 126,225 is expected to be saved by doing so.

- F37 -

FIGURE III

ORGANIZATIONAL CHART FOR THE MANUFACTURE OF LPG CYLINDERS

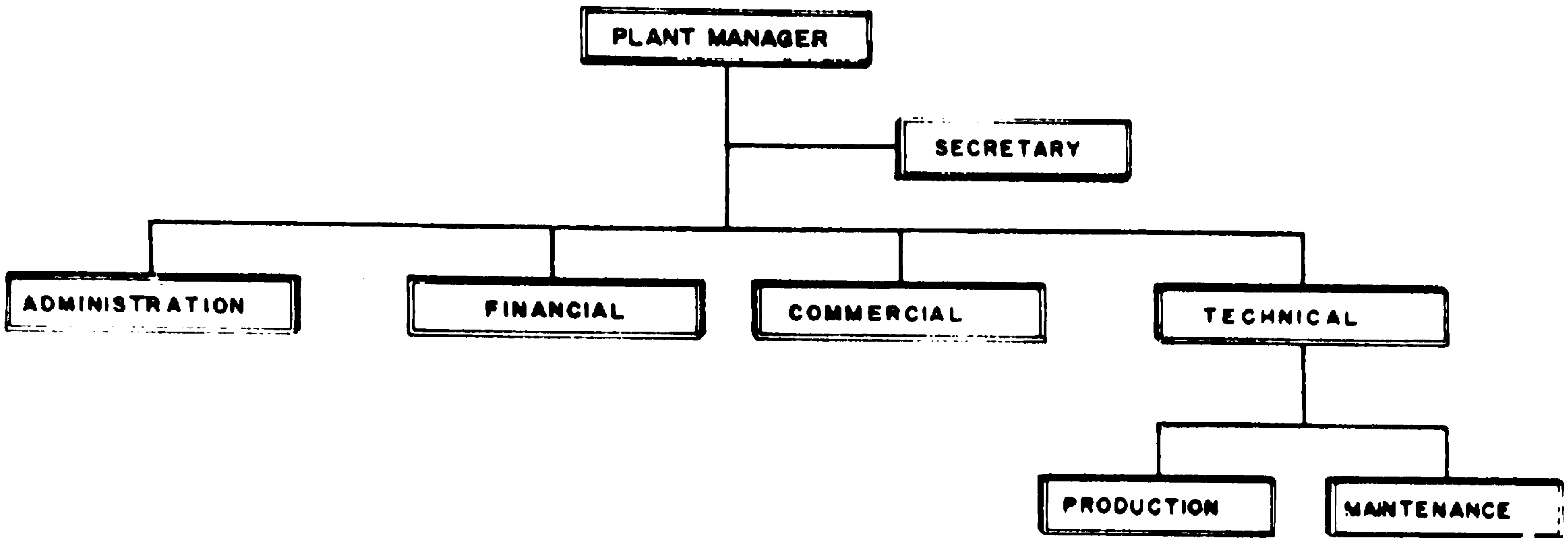


TABLE XV

MANPOWER REQUIREMENT OF LPG CYLINDERS MANUFACTURING PLANT

Description	Qty.	Monthly Salary (Birr)	Annual Salary (Birr)
Plant Manager*	1	1200	14,400
Secretary	1	450	5,400
ADMINISTRATION			
Personnel Officer	1	750	9,000
Typist	1	230	2,760
Drivers	2	400	4,800
Cleaners	2	120	1,440
Messangers	1	120	1,440
Guards	3	225	2,700
FINANCIAL SECTION			
Chief accountant	1	850	10,200
Accountant	1	650	7,800
Clerk	1	300	3,600
COMMERCIAL SECTION			
Procurement and sales head	1	750	9,000
Cashier/payroll	1	500	6,000
Time keeper	1	230	2,760
Stores chief	1	450	5,400
Store keepers	2	600	7,200
Store helpers	2	360	4,320
Typist	1	230	2,760

TABLE XV (Cont'd)

Description	Qty.	Monthly Salary (Birr)	Annual Salary (Birr)
TECHNICAL SECTION			
Technical Section Head*	1	850	10,200
Maintenance*	2	1100	13,200
Skilled workers	5	2,250	27,000
Blanking*			
Welding*			
Heat treatment*			
Galvanizing*			
Testing/quality control*			
Semi-skilled workers	8	2400	28,800
Unskilled workers (helpers)	12	2160	25,920
Sub-total	52	17,175	206,100
Employment benefits (25%)	-		51,525
Total Annual Expense			257,625

* Employees to be sent abroad for training.

The manufacturing process of LPG cylinders is simple. However, the cylinders produced would have to comply with high safety requirements. Hence, a strict follow-up of the major steps in the manufacturing process has to be undertaken. The quality of the weld, wall thickness, straightness and circularity, and possible surface defects and off-sets at the joints are a few of the areas that require utmost attention.

To obtain a first hand theoretical and practical knowledge of the manufacturing process, quality control procedures, maintenance and operation of the manufacturing machinery and equipment, it will be essential to send at least 7 people to a factory of the suppliers for training. The team should consists of the plant manager, maintenance chief the quality control supervisor and four skilled machine operators for blanking, welding, heat treatment and galvanizing. The training cost for two months was estimated at Birr 117,300.

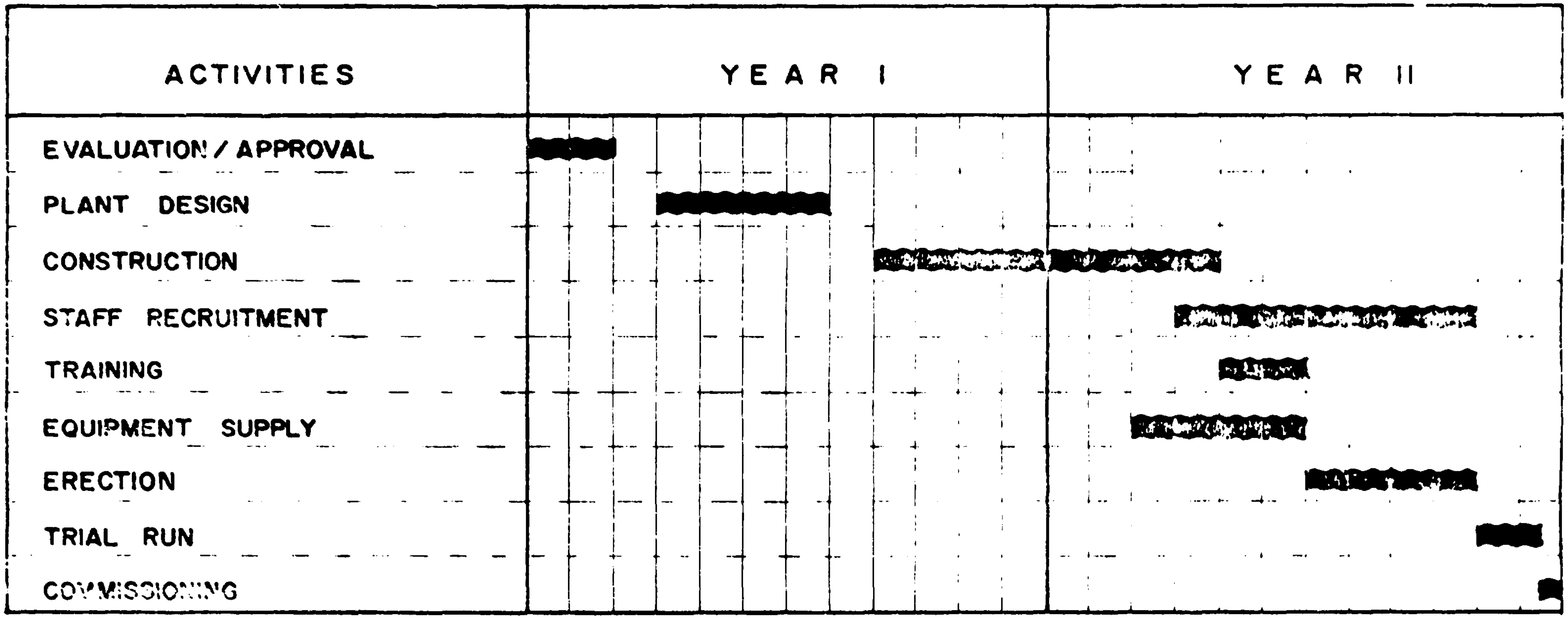
The trainees should be back to take part in the erection, trial-run and commissioning of the plant. They are also expected to train other employees on site during the period of the trial-run.

VIII. IMPLEMENTATION

The implementation of the project is expected to take about 24 months from the time of approval upto commissioning. The civil works should take about 8 months and the erection 4 months. The recruitment and training should start well in advance of the erection to enable the technically skilled employees to participate in the erection. (See Figure IV for further details).

FIGURE IV

IMPLEMENTATION SCHEDULE



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost for the automated plant is shown in Table XVI.

TABLE XVI
SUMMARY OF THE INITIAL INVESTMENT COST
('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Buildings and Civil Works	190.51	571.54	762.05
Plant Machinery and Equipment	1423.14	177.89	1601.03
Office Furniture and Equipment	7.00	28.00	35.00
Vehicles	11.25	14.44	25.69
Preproduction Expenditure	706.89	209.10	915.99
Total	2338.79	1000.97	3339.76

The LPG cylinder plant requires an initial investment cost of Birr 3.34 million. The foreign currency component amounts to Birr 2.3 million which represents 70% of the total initial investment cost. The other 30% is required in local currency. About 61% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the net working capital requirements of the LPG cylinders plant.

	Items	Months of Coverage
1.	Cash in hand	0.5
2.	Accounts receivable	1.0
3.	Raw materials - foreign	6.0
4.	Raw materials - local	3.0
5.	Work in progress	0.5
6.	Finished products	0.5
7.	Accounts payable	1.0

The net working capital requirement at full capacity amounted to Birr 0.36 million.About 22% of the total net working capital required will be in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The total production cost at full capacity amounts to Birr 1.67 million, out of which about 28% is in foreign currency.

4. Internal Rate of Return (IRR)

The LPG cylinders plant will not be financially viable. The internal rate of return calculated was -42.26% and the net present value amounted to Birr -6.03 million calculated at 10% p.a. discount rate.

The selling price assumed for the financial analysis was Birr 75/cylinder. The viability of the proejct was also tested by increasing the selling price to Birr 100/cylidner. Accordingly, the internal rate of return calculated was -19.13% and the net present value amounted to Birr -4.10 million calculated at 10% p.a. discount rate.

If the LPG plant is to be amalgamated with a multi-purpose workshop to be established by National Metal Works Corporation (NMWC) in collaboration with the Government of GDR at Kaliti it is evident that there will be some cost reductions. The fixed investment cost will reduce by Birr 31 million while operating costs at full capacity will decrease by Birr 0.14 million. After taking this fact into consideration the internal rate of return turned out to be -32.65% with a net present value of birr -4.66 million discounted at 10% p.a.

5. Breakeven Analysis

The breakeven point would be reached at a prdocution of 25,363 cylinders assuming a selling price of Birr 100 per cylinder. The unit variable cost and the unit selling price are almost the same.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 2.0%, with a net present value of Birr -1.94 million discounted at 10% p.a.

The project will create employment for about 52 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

LPG Cylinders
Financial Analysis - June 1985
Final Report

2 year(s) of construction, 15 years of production
currency conversion rates
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	3236.26	69.070 % foreign
current assets:	0.00	0.000 % foreign
total assets:	3236.26	69.070 % foreign

Source of funds during construction phase

equity & grants:	3236.26	69.070 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	3236.26	69.070 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	1025.21	1117.48	1209.74
depreciation :	369.34	369.34	369.34
interest :	0.00	0.00	0.00
production costs	1394.56	1486.82	1579.09
thereof foreign	31.23 %	30.10 %	29.10 %
total sales :	630.00	720.00	810.00
gross income :	-764.56	-766.82	-769.09
net income :	-764.56	-766.82	-769.09
cash balance :	-660.02	-428.55	-430.82
net cashflow :	-660.02	-428.55	-430.82

Net Present Value at: 10.00 % = -6028.91
Internal Rate of Return: -42.26 %
Return on equity1: not found
Return on equity2: -42.26 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	457.23	304.82
Auxiliary and service facilities .	25.69	0.00
Incorporated fixed assets	10.00	25.00
Plant machinery and equipment . . .	711.57	889.46
Total fixed investment costs	1204.49	1219.28
Pre-production capital expenditures.	162.56	649.93
Net working capital	0.00	0.00
Total initial investment costs . . .	1367.05	1869.21
Of it foreign, in %	70.85	67.77

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5	6	7	8
% of nom. capacity (single product)	70.00	80.00	90.00	95.00	100.00	100.00
Raw material 1	483.00	552.00	621.00	655.50	690.00	690.00
Other raw materials	84.00	96.00	108.00	114.00	120.00	120.00
Utilities	70.84	79.57	88.31	92.67	97.04	97.04
Energy	3.83	4.31	4.78	5.01	5.25	5.25
Labour, direct	257.63	257.63	257.63	257.63	257.63	257.63
Repair, maintenance	97.77	97.77	97.77	97.77	97.77	97.77
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	12.79	13.73	14.66	15.13	15.60	15.60
Factory costs	1009.86	1101.01	1192.15	1237.72	1283.29	1283.29
Administrative overheads	15.35	16.47	17.60	18.16	18.72	18.72
Indir costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	369.34	369.34	369.34	369.34	369.34	201.71
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	1394.56	1486.82	1579.09	1625.22	1671.35	1503.72
Costs per unit (single product)	0.17	0.15	0.15	0.14	0.14	0.12
Of it foreign, %	31.23	30.10	29.10	28.64	28.21	23.18
Of it variable,%	46.31	49.64	52.59	53.93	55.20	61.36
Total labour	257.63	257.63	257.63	257.63	257.63	257.63

Total Production Costs in '000 Birr

Year	9-12	13-16	17
% of nom. capacity (single product).	100.00	100.00	100.00
Raw material 1	690.00	690.00	690.00
Other raw materials	120.00	120.00	120.00
Utilities	97.04	97.04	97.04
Energy	5.25	5.25	5.25
Labour, direct	257.63	257.63	257.63
Repair, maintenance	97.77	97.77	97.77
Spares	0.00	0.00	0.00
Factory overheads	15.60	15.60	15.60
Factory costs	1283.29	1283.29	1283.29
Administrative overheads	18.72	18.72	18.72
Indir. costs, sales and distribution	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00
Depreciation	206.84	43.24	43.23
Financial costs	0.00	0.00	0.00
Total production costs	1508.85	1345.25	1345.24
Costs per unit (single product)	0.13	0.11	0.11
Of it foreign, %	23.25	15.45	15.44
Of it variable,%	61.15	68.59	68.59
Total labour	257.63	257.63	257.63

F52

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6	7
Coverage	mdc	coto					
Current assets &							
Accounts receivable	30	12.0	85.43	93.12	100.81	104.66	108.50
Inventory and materials	103	3.5	162.75	186.00	209.25	220.88	232.50
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	15	24.0	42.08	45.88	49.67	51.57	53.47
Finished products	15	24.0	42.72	46.56	50.41	52.33	54.25
Cash in hand	15	24.0	15.98	16.07	16.15	16.20	16.24
Total current assets			348.96	387.63	426.29	445.63	464.96
Current liabilities and Accounts payable	30	12.0	84.16	91.75	99.35	103.14	106.94
Net working capital			264.81	295.88	326.95	342.48	358.02
Increase in working capital			264.81	31.07	31.07	15.54	15.54
Net working capital, local			206.31	230.38	254.45	266.48	278.52
Net working capital, foreign			58.50	65.50	72.50	76.00	79.50

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.4 (Cont'd)

Net Working Capital in '000 Birr

	mdc	coto	
Year			8-17
Coverage	mdc	coto	
Current assets è			
Accounts receivable . . .	30	12.0	108.50
Inventory and materials .	103	3.5	232.50
Energy	0	---	0.00
Spares	0	---	0.00
Work in progress . . .	15	24.0	53.47
Finished products . . .	15	24.0	54.25
Cash in hand	15	24.0	16.24
Total current assets			464.96
Current liabilities and			
Accounts payable . . .	30	12.0	106.94
Net working capital			358.02
Increase in working capital			0.00
Net working capital, local			278.52
Net working capital, foreign			79.50

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	1367.05	1869.21
Financial resources	1367.05	1869.21
Sales, net of tax	0.00	0.00
Total cash outflow	1367.05	1869.21
Total assets	1367.05	1869.21
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	398.55	602.42
Outflow, local	398.55	602.42
Surplus (deficit)	0.00	0.00
Inflow, foreign	968.50	1266.79
Outflow, foreign	968.50	1266.79
Surplus (deficit)	0.00	0.00
Net cashflow	-1367.05	-1869.21
Cumulated net cashflow	-1367.05	-3236.26

- F55 -

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	714.16	727.60	817.60	858.80	903.80	900.00
Financial resources	84.16	7.60	7.60	3.80	3.80	0.00
Sales, net of tax	630.00	720.00	810.00	855.00	900.00	900.00
Total cash outflow	1374.17	1156.15	1248.41	1275.21	1321.34	1327.70
Total assets	348.96	38.67	38.67	19.33	19.33	25.69
Operating costs	1025.21	1117.48	1209.74	1255.88	1302.01	1302.01
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-660.02	-428.55	-430.82	416.41	-417.55	-427.70
Cumulated cash balance	-660.02	-1088.57	-1519.39	-1935.80	-2353.34	-2781.04
Inflow, local	700.82	726.60	816.60	858.30	903.30	900.00
Outflow, local	1142.34	976.15	1056.41	1081.21	1121.34	1120.45
Surplus (deficit)	-441.52	-249.55	-239.82	-222.91	-218.05	-220.45
Inflow, foreign	13.33	1.00	1.00	0.50	0.50	0.00
Outflow, foreign	231.83	180.00	192.00	194.00	200.00	207.25
Surplus (deficit)	-218.50	-179.00	-191.00	-193.50	-199.50	-207.25
Net cashflow	-660.02	-428.55	-430.82	-416.41	-417.55	-427.70
Cumulated net cashflow	-3896.28	-4324.83	-4755.65	-5172.06	-5589.60	-6017.30

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	900.00	900.00	900.00	900.00	900.00	900.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	900.00	900.00	900.00	900.00	900.00	900.00
Total cash outflow	1302.01	1302.01	1302.01	1302.01	1327.70	1302.01
Total assets	0.00	0.00	0.00	0.00	25.69	0.00
Operating costs	1302.01	1302.01	1302.01	1302.01	1302.01	1302.01
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-402.01	-402.01	-402.01	-402.01	-427.70	-402.01
Cumulated cash balance	-3183.05	-3585.06	-3987.07	-4389.08	-4816.78	-5218.79
Inflow, local	900.00	900.00	900.00	900.00	900.00	900.00
Outflow, local	1106.01	1106.01	1106.01	1106.01	1120.45	1106.01
Surplus (deficit)	-206.01	-206.01	-206.01	-206.01	-220.45	-206.01
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	196.00	196.00	196.00	196.00	207.25	196.00
Surplus (deficit)	-196.00	-196.00	-196.00	-196.00	-207.25	-196.00
Net cashflow	-402.01	-402.01	-402.01	-402.01	-427.70	-402.01
Cumulated net cashflow	-6419.31	-6821.32	-7223.33	-7625.34	-8053.04	-8455.05

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	900.00	900.00	900.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	900.00	900.00	900.00
Total cash outflow	1302.01	1302.01	1302.01
Total assets	0.00	0.00	0.00
Operating costs	1302.01	1302.01	1302.01
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	-402.01	-402.01	-402.01
Cumulated cash balance	-5620.80	-6022.81	-6424.82
Inflow, local	900.00	900.00	900.00
Outflow, local	1106.01	1106.01	1106.01
Surplus (deficit)	-206.01	-206.01	-206.01
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	196.00	196.00	196.00
Surplus (deficit)	-196.00	-196.00	-196.00
Net cashflow	-402.01	-402.01	-402.01
Cumulated net cashflow	-8857.06	-9259.07	-9661.08

- F58 -

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value .... -7605.04 at 10.00 %

Internal Rate of Return (IRRE1) .. not found

b) Net Worth versus Net cash return:

Net present value .... -6028.91 at 10.00 %

Internal Rate of Return (IRRE2) .. -42.26 %

c) Internal Rate of Return on total investment:

Net present value .... -6028.91 at 10.00 %

Internal Rate of Return (IRR) .. -42.26 %

Net Worth = Equity paid plus reserves

TABLE A.6

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	630.00	720.00	810.00	855.00	900.00
Less: variable costs, incl. sales tax.	645.86	738.12	830.39	876.52	922.65
Variable margin	-15.86	-18.12	-20.39	-21.52	-22.65
As % of total sales	-2.52	-2.52	-2.52	-2.52	-2.52
Non-variable costs, incl. depreciation	748.70	748.70	748.70	748.70	748.70
Operational margin	-764.56	-766.82	-769.09	-770.22	-771.35
As % of total sales	-121.36	-106.50	-94.95	-90.08	-85.71
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-764.56	-766.82	-769.09	-770.22	-771.35
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-764.56	-766.82	-769.09	-770.22	-771.35
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-764.56	-766.82	-769.09	-770.22	-771.35
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-764.56	-766.82	-769.09	-770.22	-771.35
Accumulated undistributed profit	764.56	-1531.38	-2300.46	-3070.68	-3842.04
Gross profit, % of total sales	-121.36	-106.50	-94.95	-90.08	-85.71
Net profit, % of total sales	-121.36	-106.50	-94.95	-90.08	-85.71
ROE, Net profit, % of equity	-23.62	-23.69	-23.76	-23.80	-23.83
ROI, Net profit+interest, % of invest.	-21.84	-21.71	-21.58	-21.52	-21.45

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	900.00	900.00	900.00	900.00	900.00
Less: variable costs, incl. sales tax.	922.65	922.65	922.65	922.65	922.65
Variable margin	-22.65	-22.65	-22.65	-22.65	-22.65
As % of total sales	-2.52	-2.52	-2.52	-2.52	-2.52
Non variable costs, incl. depreciation	581.06	586.20	586.20	586.20	586.20
Operational margin	-603.72	-608.85	-608.85	-608.85	-608.85
As % of total sales	-67.08	-67.65	-67.65	-67.65	-67.65
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-603.72	-608.85	-608.85	-608.85	-608.85
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-603.72	-608.85	-608.85	-608.85	-608.85
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-603.72	-608.85	-608.85	-608.85	-608.85
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-603.72	-608.85	-608.85	-608.85	-608.85
Accumulated undistributed profit	-4445.75	-5054.61	-5663.46	-6272.31	-6881.17
Gross profit, % of total sales	-67.08	-67.65	-67.65	-67.65	-67.65
Net profit, % of total sales	57.08	-67.65	-67.65	-67.65	-67.65
ROE, Net profit, % of equity	-18.65	-18.81	-18.81	-18.81	-18.81
ROI, Net profit+interest, % of invest.	-16.68	-16.82	-16.82	-16.82	-16.82

TABLE A.6 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	900.00	900.00	900.00	900.00	900.00
Less: variable costs, incl. sales tax.	922.65	922.65	922.65	922.65	922.65
Variable margin	-22.65	-22.65	-22.65	-22.65	-22.65
As % of total sales	-2.52	-2.52	-2.52	-2.52	-2.52
Non-variable costs, incl. depreciation	422.60	422.60	422.60	422.60	422.59
Operational margin	-445.25	-445.25	-445.25	-445.25	-445.24
As % of total sales	-49.47	-49.47	-49.47	-49.47	-49.47
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-445.25	-445.25	-445.25	-445.25	-445.24
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-445.25	-445.25	-445.25	-445.25	-445.24
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-445.25	-445.25	-445.25	-445.25	-445.24
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-445.25	-445.25	-445.25	-445.25	-445.24
Accumulated undistributed profit	-7326.42	-7771.67	-8216.92	-8662.17	-9107.42
Gross profit, % of total sales	-49.47	-49.47	-49.47	-49.47	-49.47
Net profit, % of total sales	-49.47	-49.47	-49.47	-49.47	-49.47
ROE, Net profit, % of equity	-13.76	-13.76	-13.76	-13.76	-13.76
ROI, Net profit+interest, % of invest.	-12.21	-12.21	-12.21	-12.21	-12.21

COMFAR

TABLE A.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	1367.05	3236.26
Fixed assets, net of depreciation	0.00	1367.05
Construction in progress	1367.05	1869.21
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	1367.05	3236.26
Equity capital	1367.05	3236.26
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	3980.43	4416.58	4854.99	5275.20	5696.55	6124.25
Fixed assets, net of depreciation	2866.92	2497.58	2128.23	1758.89	1389.55	1187.84
Construction in progress	0.00	0.00	0.00	0.00	0.00	25.69
Current assets	332.98	371.56	410.14	429.43	448.72	448.72
Cash, bank	15.98	16.07	16.15	16.20	16.24	16.24
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	0.00	764.56	1531.38	2300.46	3070.68	3842.04
Loss	764.56	766.82	769.09	770.22	771.35	603.72
Total liabilities	3980.43	4416.58	4854.99	5275.20	5696.55	6124.25
Equity capital	3236.26	3236.26	3236.26	3236.26	3236.26	3236.26
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	84.16	91.75	99.35	103.14	106.94	106.94
Bank overdraft, finance required	660.02	1088.57	1519.39	1935.80	2353.34	2781.04
Total debt	744.17	1180.32	1618.73	2038.94	2460.29	2887.99
Equity, % of liabilities	81.30	73.28	66.66	61.35	56.81	52.84

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	6526.26	6928.27	7330.28	7732.29	8159.99	8562.00
Fixed assets, net of depreciation	1006.69	799.85	593.00	386.16	342.92	325.37
Construction in progress	0.00	0.00	0.00	0.00	25.69	0.00
Current assets	448.72	448.72	448.72	448.72	448.72	448.72
Cash, bank	16.24	16.24	16.24	16.24	16.24	16.24
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	4445.75	5054.61	5663.46	6272.31	6881.17	7326.42
Loss	608.85	608.85	608.85	608.85	445.25	445.25
Total liabilities	6526.26	6928.27	7330.28	7732.29	8159.99	8562.00
Equity capital	3236.26	3236.26	3236.26	3236.26	3236.26	3236.26
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	106.94	106.94	106.94	106.94	106.94	106.94
Bank overdraft, finance required.	3183.05	3585.06	3987.07	4389.08	4816.79	5218.79
Total debt	3290.00	3692.01	4094.02	4496.03	4923.73	5325.73
Equity, % of liabilities	49.59	46.71	44.15	41.85	39.66	37.80

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	8964.01	9366.02	9768.03
Fixed assets, net of depreciation	282.12	238.88	195.65
Construction in progress	0.00	0.00	0.00
Current assets	448.72	448.72	448.72
Cash, bank	16.24	16.24	16.24
Cash surplus, finance available	0.00	0.00	0.00
Loss carried forward	7771.67	8216.92	8662.17
Loss	445.25	445.25	445.24
Total liabilities	8964.01	9366.02	9768.03
Equity capital	3236.26	3236.26	3236.26
Reserves, retained profit	0.00	0.00	0.00
Profit	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00
Current liabilities	106.94	106.94	106.94
Bank overdraft, finance required	5620.80	6022.81	6424.82
Total debt	5727.75	6129.76	6531.77
Equity, % of liabilities	36.10	34.55	33.13

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	1256.59	1725.11
Financial resources .	1256.59	1725.11
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	1256.59	1725.11
Total assets	1256.59	1725.11
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	288.09	458.32
Outflow, local	288.09	458.32
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	968.50	1266.79
Outflow, foreign . . .	968.50	1266.79
Surplus (deficit) .	0.00	0.00
Net cashflow	-1256.59	-1725.11
Cumulated net cashflow	-1256.59	-2981.70

COMFAR

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	628.99	686.08	748.88	788.44	829.84	828.00
Financial resources .	49.39	3.68	3.68	1.84	1.84	0.00
Sales, net of tax . .	579.60	662.40	745.20	786.60	828.00	828.00
Total cash outflow . .	807.07	669.59	714.55	726.81	749.29	756.83
Total assets	202.86	20.42	20.42	10.21	10.21	17.75
Operating costs . . .	604.21	649.17	694.12	716.60	739.08	739.08
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-178.08	-3.51	34.33	61.63	80.55	71.17
Cumulated cash balance	-178.08	-181.59	-147.26	-85.64	-5.09	66.08
Inflow, local	615.66	685.08	747.88	787.94	829.34	828.00
Outflow, local	575.24	489.59	522.55	532.81	549.29	549.58
Surplus (deficit) .	40.42	175.49	225.33	255.13	280.05	278.42
Inflow, foreign . . .	13.33	1.00	1.00	0.50	0.50	0.00
Outflow, foreign . . .	231.83	180.00	192.00	194.00	200.00	207.25
Surplus (deficit) .	-218.50	-179.00	-191.00	-193.50	-199.50	-207.25
Net cashflow	-178.08	-3.51	34.33	61.63	80.55	71.17
Cumulated net cashflow	-3159.78	-3163.29	-3128.96	-3067.34	-2986.79	-2915.62

TABLE A.8 (Cont'd) .... COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	828.00	828.00	828.00	828.00	828.00	828.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	828.00	828.00	828.00	828.00	828.00	828.00
Total cash outflow	739.08	739.08	739.08	739.08	756.83	739.08
Total assets	0.00	0.00	0.00	0.00	17.75	0.00
Operating costs	739.08	739.08	739.08	739.08	739.08	739.08
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	88.92	88.92	88.92	88.92	71.17	88.92
Cumulated cash balance	155.00	243.92	332.84	421.76	492.93	581.85
Inflow, local	828.00	828.00	828.00	828.00	828.00	828.00
Outflow, local	543.08	543.08	543.08	543.08	549.58	543.08
Surplus (deficit)	284.92	284.92	284.92	284.92	278.42	284.92
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	196.00	196.00	196.00	196.00	207.25	196.00
Surplus (deficit)	-196.00	-196.00	-196.00	-196.00	-207.25	-196.00
Net cashflow	88.92	88.92	88.92	88.92	71.17	88.92
Cumulated net cashflow	-2826.70	-2737.78	-2648.86	-2559.94	-2488.77	-2399.85

TABLE A.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	828.00	828.00	828.00
Financial resources	0.[illegible]	0.00	0.00
Sales, net of tax	828.00	828.00	828.00
Total cash outflow	739.08	739.08	739.08
Total assets	0.00	0.00	0.00
Operating costs	739.08	739.08	739.08
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	88.92	88.92	88.92
Cumulated cash balance	670.77	759.69	848.61
Inflow, local	828.00	828.00	828.00
Outflow, local	543.08	543.08	543.08
Surplus (deficit)	284.92	284.92	284.92
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	196.00	196.00	196.00
Surplus (deficit)	-196.00	-196.00	-196.00
Net cashflow	88.92	88.92	88.92
Cumulated net cashflow	-2310.93	-2222.01	-2133.09

COMFAR 2.1

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-2398.32	at	10.00 %
Internal Rate of Return (IRRE1) ..	-9.25 %		

b) Net Worth versus Net cash return:

Net present value	-1941.07	at	10.00 %
Internal Rate of Return (IRRE2) ..	2.00 %		

c) Intern. Rate of Return on total investment:

Net present value	-1941.07	at	10.00 %
Internal Rate of Return (IRR) ..	2.00 %		

Net Worth = Equity paid plus reserves

- G -

S T R A W B O A R D

TABLE OF CONTENTS

I. SUMMARY

The plant is envisaged to produce strawboard from wheat straw and waste paper.

The present domestic demand for the product is estimated to be 750 tons in 1987 and is expected to reach 2569 tons in year 2003, at an annual growth rate of 8%. This is an import substituting project.

A plant capacity of 10 tons per 24 hours has been proposed for this is the minimum economic size.

Asella town has been recommended as the location of the project mainly due to its proximity to the source of straw supply, which is a bulky material to transport.

The total initial investment cost is estimated to be about Birr 7.8 million, out of which Birr 3.6 million will be for machinery and equipment. The foreign currency component amounted to be 85% of the total initial investment. The building requirement is approximately 3500 m^2.

The project can provide employment for 45 persons.

Both financially and economically the project is not viable. The internal rate of return and the economic rate of return turned out to be -1.92% and 5.74%, respectively. This is understandable considering the low capacity utilization resulting from the low demand.

II. INTRODUCTION

The project considers the establishment of a plant to produce strawboard for the domestic market. The idea is to utilise straw, an abundantly available agricultural waste, as the main raw material.

There are two different types of strawboards: strawboard paper made from straw pulp and strawboard panel made from un-pulped straw. The former is mainly used by the paper converting industry to produce predominantly book and document bindings and packaging materials while the latter is primarily used in the construction sector as wall panels, ceilings, roofings, doors, prefabricated housings, furniture, display boards, packing boards, etc. The processes and the machinery of these two types of products are also completely different. This project considers the productions of strawboard paper.

Currently no strawboard is produced in the country. The product of this project is to substitute all "leatherboard" and 50% of duplexboard imports.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Straw which is often a waste product of wheat, rice, barley, oats and rye production have been predominantly used as animal feed in the majority of countries. Recently, however new applications of these agricultural residues have been developed mostly for use in the printing and construction sectors.

According to the information gathered from the Ethiopian Printing Corporation, the import of leather and duplex-boards into the country amounts to 70 tons and 1300 tons annually, respectivley. These products are used to produce agendas, flat box files, register making, cake tray, box hosieries and other packaging materials for industrial goods. As strawboard could be used for similar activities, the demand for strawboard was thus investigated by taking the anticipated growth in board requirement resulting from the growth in the economy.

2. Past and Future Demand Analysis

As such the demand for strawboard cannot be analyzed directly. Due to this fact, its demand analysis was approached through an indirect way, that is by analyzing the demand for leatherboard and duplexboard in the country, for the two products are thought to substitute strawboard.

As mentioned earlier in the study, the Ethiopian Printing Corporation currently imports 70 tons of leatherboard and 1300 tons of duplexboard annually. Although these two products have quite different applications, there is a very good chance that strawboard could easily substitute leatherboard completely.

With regard to duplexboard, however, because of its wide applications, strawboard can substitute not more than 50 per cent of this product. This information was obtained from knowledgable people in the Printing Corporation. Therefore the future demand for strawboard was assessed taking into account this considerations.

The principal users of paperboard, mainly for packaging, include the food industries, the beverage industries, the printing industries and shoe factories. Some of them, however, have partially switched to plastic containers. These industries are anticipated to grow at an average annual growth rate of 7.7% in the aggregate during the period 1986 - 1994.[1]

Consequently the future demand for paperboard is expected to show more or less a similar growth pattern. Thus, for the purpose of this study, an average growth rate of 8% per year is applied to the Ethiopian Printing Corporation current import figure of leatherboard and 50% of the duplexboard import which amounted to 750 tons. Accordingly, the future demand is expected to grow to about 2600 tons by the year 2003. (See Table I).

3. Pricing

Since strawboard is not imported into the country, its price was investigated by taking the current import prices of both leatherboard and duplexboard, the two products straw board is assumed to substitute. The F.O.B. prices of the two products are shown in Table II below.

1 Ten Year Perspective Plan, ONCCP.

TABLE I

DEMAND FORECAST FOR STRAWBOARD

BASED ON AN AVERAGE ANNUAL GROWTH RATE OF 8%

(TONNS)

Year	Estimated Future Demand
Base Figure	750
1988	810
1989	875
1990	945
1991	1020
1992	1102
1993	1190
1994	1285
1995	1388
1996	1499
1997	1619
1998	1749
1999	1887
2000	2040
2001	2203
2002	2379
2003	2569

TABLE II

F.O.B. PRICES OF LEATHER AND DUPLEXBOARDS

BIRR/TON

Item	Price
Leatherboard	1400
Duplexboard	970

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

This is an import subsituting project. The minimum economic scale of pulpborad making plant is 5 tonnes per 24 hours a day. If one considers 300 working days, the annual production volume will amount to 1500 tons. However, according to the forecast in this study, the local demand approximates this level some where in 1996. In other words, the plant will operate below 50% capacity utilization for the coming 7 to 8 years. After this period, however, there is a good chance for the plant to operate close to full capacity utilization.

The plant for which a price offer has been obtained has a 10 tonnes/24 hrs. capacity and there is no price difference between the 5 tonnes and 10 tonnes per 24 hours capacity. The plant capacity is, therefore, by far bigger than the market estimate envisaged.

2. Production Programme

The production programme and the capacity utilization are shown in Table III. Assuming that the plant would start producing at 27% of full capacity, it will utilize at the maximum 86% of the full capacity of the plant at the end of its life.

TABLE III

PRODUCTION PROGRAMME AND CAPACITY UTILIZATION

Year	Demand (Tons)	Production Programme (Tons)	Capacity Utilization %
1988	810	810	27
1989	875	875	29
1990	945	945	32
1991	1020	1020	34
1992	1102	1102	37
1993	1190	1190	40
1994	1285	1285	43
1995	1388	1388	46
1996	1499	1499	50
1997	1619	1619	54
1998	1749	1749	58
1999	1887	1887	63
2000	2040	2040	68
2001	2203	2203	73
2002	2379	2379	79
2003	2569	2569	86

IV. RAW MTERIALS AND INPUTS

A. STRAW AVAILABILITY

The project is planned to process straw from wheat and barley, which are grown in the country abundantly.

The peasant farming sector; which is the dominant source of the country's agricultural produces, uses on the average about 1.23 million hectars of land annually for growing wheat and barley only (See Table IV). It will be difficult to collect straw commercially from the peasant sector since the farms are splittered and scattered and the farmers use the straw, among others, to feed their cattle. An exception is the mechanised peasant coopertive farms, which are increasing in number as to be seen in Arsi and Gojjam Administrative Regions.

With respect to the state farms, the Southern Agricultural Development Corporation is the main, if not the only, producer of wheat and barley. The concerned state farm enterprises under the Corporation and their respective wheat and barley farm land and production are given in Table V.

The actual quantity of straw depends on several factors, including plant variety, soil conditions,fertilisers, metrological conditions, harvesting techniques, etc. With the exception of about 1600 tons of straw per year presently collected by the Animal Feed Corporation from Dixis State Farm for animal feed preparation, the state farms burn their straw at cost for clearinq the farm for the next plantation and only a negligible amount is grazed by roaming herd.

TABLE IV

PEASANT SECTOR PRODUCTION OF WHEAT AND BARLEY BY ADMINISTRATIVE REGIONS: 1982/83 and 1983/84 - MAIN SEASONS

Region	MAIN SEASON 1982/83				MAIN SEASON 1983/84			
	Barley		Wheat		Barley		Wheat	
	Area Ha	Production Qt	Area Ha	Production Qt	Area Ha	Production Qt	Area Ha	Production Qt
Total	693210	6014127	486580	4821120	748773	5067996	533267	4208555
Arssi	123073	1297816	129720	1728932	110654	1156110	134145	1568957
Bale	24005	220840	11565	105311	26854	179650	11176	93371
Gamogofa	15836	106022	3939	31604	22352	126168	4182	35276
Gojam	127197	919697	42448	415082	125704	673174	48379	352104
Gonder	95532	1300753	45382	491835	106642	915423	48608	386614
Hararghe	6630	52728	3149	26108	9071	59025	4274	29765
Illubabor	3388	26154	774	7529	3518	24810	1151	12021
Kofa	8524	65168	3841	31284	6251	40967	4437	34501
Shoa	174072	1310769	184042	1563138	210671	1254647	187245	1221664
Sidamo	39842	27821[illegible]	4341	43921	42742	225611	7987	58940
Wollaga	21109	150367	6707	57937	21343	130724	7105	57188
Wollo	55002	285599	50672	318439	62971	281687	73988	358154

SOURCE: General Agricultural Survey, Preliminary Report 1983/84, Vol. I, Planning and Programme Dept., Ministry of Agriculture.

It is generally believed that an average of 1.25 tons of straw per hectare can be mechanically recovered from the state farms, the unrecoverable part serving the purpose of enriching the soil for next season. Recorded data from the Dixis State Farm put its average net recovery as high as 2.1 tons/hectare. It must be noted, however, that the grain yield rate of Dixis State Farm is also higher than average; third among the state farms, exceeded by the Lole State Farm which has the highest yield rate and the Serufta State Farm standing second.

To be conservative, an average recoverable straw rate of 1.2 tons/hectare have been flatly used in this study for all state farms. This gives a total of about 93,000 tons of mechanically recoverable wheat and barley straw from the state farms in the Arsi and Bale Administrative Regions only; by region 37,650 and 55,380 tons, respectively. Details for each farm are given in Table V.

The Ministry of State Farms Development in conjunction with the Southern Agricultural Development Corporation are presently entertaining a project idea to producing about 5000 tons per year of straw briquets at the Dixis State Farm. This still leaves about 88,000 tons of straw per year for the strawboard projects and the straw pelletising project being parallely studied. The amount being collected by the Animal Feed Corporation is negligible compared to the supply and demand, and is covered by the projections of the straw pelletising project under study.

The above potential straw supply figures can further be supplemented by the possible straw supply from the increasing number of mechanised peasant cooperative farms which have high concentration in Arsi Region. If necesssary, these can further be investigated at feasibility study stage.

- G11 -

TABLE V

SOUTHERN AGRICULTURAL DEVELOPMENT CORPORATION

PRODUCTION OF WHEAT AND BARLEY

1984/85 - 1986/87

State Farm Enterprise	Crop Type	1984/85		1985/86		1986/87		Annual Average		Total Average Hectar Per Enterprise	Expected Straw in Tons	Distance From	Remarks
		Area in Hectar	Prod. in Quintals	Area in Hectar	Prod. in Quintals	Area in Hectar	Prod. in Quintals	Area in Hectar	Prod. in Quintals				
ARSI													
Dixis	Wheat	8002	159282	7947	139198	7162	176048	7704	158176	7704	9245	Asella 92 km	
Lole	Wheat	747	23277	1425	46319	1186	36168	1119	35255	2680	3216	Asella 40 km	
	Barley	1581	38150	1480	30714	1623	35017	1561	34627				
Adelle	Wheat	5721	98007	5563	114864	5490	102088	5491	104986	5491	6589	Asella 139 km	
Garadella &	Wheat	8637	121872	8464	130832	8338	157861	8480	136855	11042	13250	Asella 132 km	
Temella (1)	Barley	2409	12716	2574	36637	2704	44469	2562	31274			(near Asasa)	
Goffer	Wheat	2927	30353	2367	38503	3114	71284	2803	46713	4460	15352	Asella 142 km	
	Barley	1733	21857	2044	24557	1195	10515	1657	18974			(Shashemene 25 km)	
Sub-Total	Both	31757		31864		30512		31377		31377	37652		
BALE													
Harero & Hunte (2)	Wheat	6956	10555	8748	154567	8154	190643	7953	118588	9869	11843	Shashemene 80 km	
	Barley	2371	22852	1484	22754	1892	36266	1916	27291				
Sinanna	Wheat	8614	107453	9498	144306	9292	149587	9135	133782	10361	12433	Robe/Bale 14-40 km	
	Barley			1144	18540	1307	32449	1226	25495				
Shenika	Wheat	3065 (3)	13690 (3)	6199	45561	6132	53110	6166	49336	6166	17399	Robe/Bale 78 km	
Dinkiti	Wheat	6907	106386	6535	109505	7000	105404	6814	107098	6814	8177	Robe/Bale 90 km	
Scrufta	Wheat	4048	93588	4865	122661	4295	111795	4403	109348	6803	8163	Robe/Bale 135 km	
	Barley	2268	43396	2229	44334	2704	40640	2400	42790				
Gololcha	Wheat			4902 (3)	7754 (3)	6138	127439	6138	127439	6139	7366	Robe/Bale 130 km	
Sub-Total	Both	34229		45604		46914		46151		46151	55381		
GRAND TOTAL	Both	65986		77468		77426		77528		77528	93033		

NOTE: (1) Garadella and Temella have been separated as two independent enterprises since 1985/86.
(2) Harero and Hunte have been separated as two independent enterprises since 1986/87.
(3) Figures excluded from the averages since they are unrepresentative.

SOURCE: Southern Agricultural Development Corporation, Addis Ababa.

2. Straw Collection and storage

The straw collection for delivery to this project can be carried out in a similar manner as is presently being done at Dixis State Farm. At present all harvesting is carried out by combine harvesters. The recoverable straw is picked-up and baled by means of mechanised square balers (John Deere 342A) producing bales of about 15 kg with dimension of 1.00 x 0.46 x 0.36 meters (0.166 m^3/bale). The bales are ejected from the baler as it moves and manually collected and placed in piles at the perimeter of the field. The bales are then manually loaded on trailers for delivery.

It will be necessary to replace the manual field collection of bales with wheel tractor driven trailers as the consignment is going to be much higher than the present one.

It must be noted that harvesting starts at the end of October or early November and generally completed by early January. The straw collection has to take place simultaneously for technical reasons and for the fields have to be cleared for prepration for the next plantation which starts shortly then after. This leaves a net collection period of about three months and the capacity of the collecting facilities (balers, trailers, wheel tractors, labour, etc) has to take this fact into account.

The storage facility at the project site should also consider the seasonal supply of straw. Considering the high volume of storage requirement, it will be preferable to use open storage, where the straw is covered with light weight tarpaulins only. Enough space should be left between bale piles (about 5m) to create fire break. Taking this into account, a straw volume (in tons) to storage space area (in m^2) ratio of about 1:2 can be used to roughly estimate the open space requirement.

B. OTHER INPUTS AND UTILITIES

Other than straw, the plant requires a substantial amount of corrugated kraftliner and kraft paper wastes which make about 50% of the strawboard. These are pulped in a hydrapulper type unit and cleaned by a high density cleaner.

Caustic soda, rosin and alum are added for cooking straw and to effect inter fibre bonding.

Power requirement is about 300 KW and boiler capacity is 3-5 TPH at 10 kg/am^2. Water required is 3800 m^3/24hrs. Effluent goes to drain without treatment. However, it has to be checked at the stage of the feasibility study if the disposed water contains tolerably low pollution.

C. RAW MATERIALS AND INPUTS CONSUMPTION AND COSTS

The consumption rates and estimated prices of all raw materials and inputs are given in Table VI.

It is assumed that the concerned farms take over the straw collection activity, as this is closely interlinked with their normal farm operations and supply the project. The farms can either buy the required trailers balers, trucks etc. by themselves or lease them from the project. At present, Dixis farm charges 0.10 Birr/Bale (6.70 Birr/ton) for straw only. Rough estimations under normal conditions indicate a price of about 20 Birr/ton of baled and collected straw at farm site (including collection and over head costs and some margin). Transportation to project site will be a considerable additional cost depending on the distance.

In this study an international price of 50 Birr/ton delivered at project site, as practiced in the UK, has been taken.

The straw requirement given in Table VI assumes a maximum of 16% moisture content of the delivery and 5% loss in process.

TABLE VI
RAW MATERIALS AND INPUTS CONSUMPTION AND COSTS

Item	Consumption Per Tonne Of Board	Unit Price	Annual Cost For 2569 Tonnes of Board (Birr)	
			F.C.	L.C
1. Straw	500 kg	50 Birr/tonne	-	64,225
2. Corrugated Board/Liner	500 kg	200 Birr/tonne	-	256,900
3. Other inputs	150 kg	1000 Birr/tonne	1,027,600	1,541,400
4. Electric Power	200 KWh	0.22	-	113,036
5. Fuel	100 kg	550 Birr/tonne	-	141,295
		Total	1,027,600	2,116,856

VI. TECHNOLOGY AND ENGIENERING

This profile describes the production of strawboard for the printing industry using corrugated board and kraft-liner and straw. The board is produced on a cylinder mould type of paper machine and the basis weight varies from 115 g/m² - 160g/m². Higher basis weight can also be obtained.

A. PROCESS AND TECHNOLOGY

1. Straw Pulp Line

Wheat straw is conveyed to crusher and vibrating screen before cutter for further treatment at cyclone and exhaust fan. Dirt, sand and foreign heavy impurities are separated.

Through belt conveyor and hopper, straw is fed to digester for mild cooking with chemicals. After mild cooking the fibre stock is beaten at beater and screening is done. At cylinder washer the pulp is washed and cleaned. Heavy impurities can be separated again at super cyclone. Through valveless filter, the fiber is thickened before further proportioning.

Caustic soda consumption is 8% on straw supplied.

2. Corrugated Line

Waste paper such as old corrugated carton, kraft paper, etc..... is dissolved at pulper together with water and white water.

V. LOCATION

As straw, the principal raw material, is very bulky to transport, the factory should normally be located such that the source of straw supply should be within a 50 km radius of the factory.

The location should provide enough infrastructural and social facilities to reasonably attract the skilled labour force required for the plant. The required electric power should also be available.

Taking the above into consideration, it is proposed that the project be location at Asella town which is only 175 km from Addis Ababa, a major market centre. Asella is the capital of Arsi Administrative Region and provides the required infrastructural and social facilities.

If located at Asella, the project can be easily supplied with straw from Lole State Farm, 40 km from Asella. If the project expands its production considerably in the future, the mechanised peasant co-operative farms at Lole and Eteya (23 km from Asella) can easily supply the additional requirement, as these cooperative farms at each site are much bigger than the Lole State Farm.

After pulping, the heavy impurities, such as sand, clip, etc.... are separated at high density cleaner.

Through screen, the light weight impurities, such as vinyl, plastic, styorfoam etc.... can be separated. At valveless filter, fiber is thickened and washed for further processing.

Double disc refiner will treat the stock to give proper strength and fiber fibrillation.

3. Cylinder Mould Type Paper Machine

Prepared pulp and chemicals are fed into each vat to form fiber mat for further web formation.

The formed wet web is pressed to take out water from the web by press rolls, such as baby press and main press. The felt should be kept clean by shower.

Also the felt should be controlled for proper tension and guide by stretcher and automatic guide.

At Yankee dryer, the pressed web is dryed to 90% - 95% dryness.

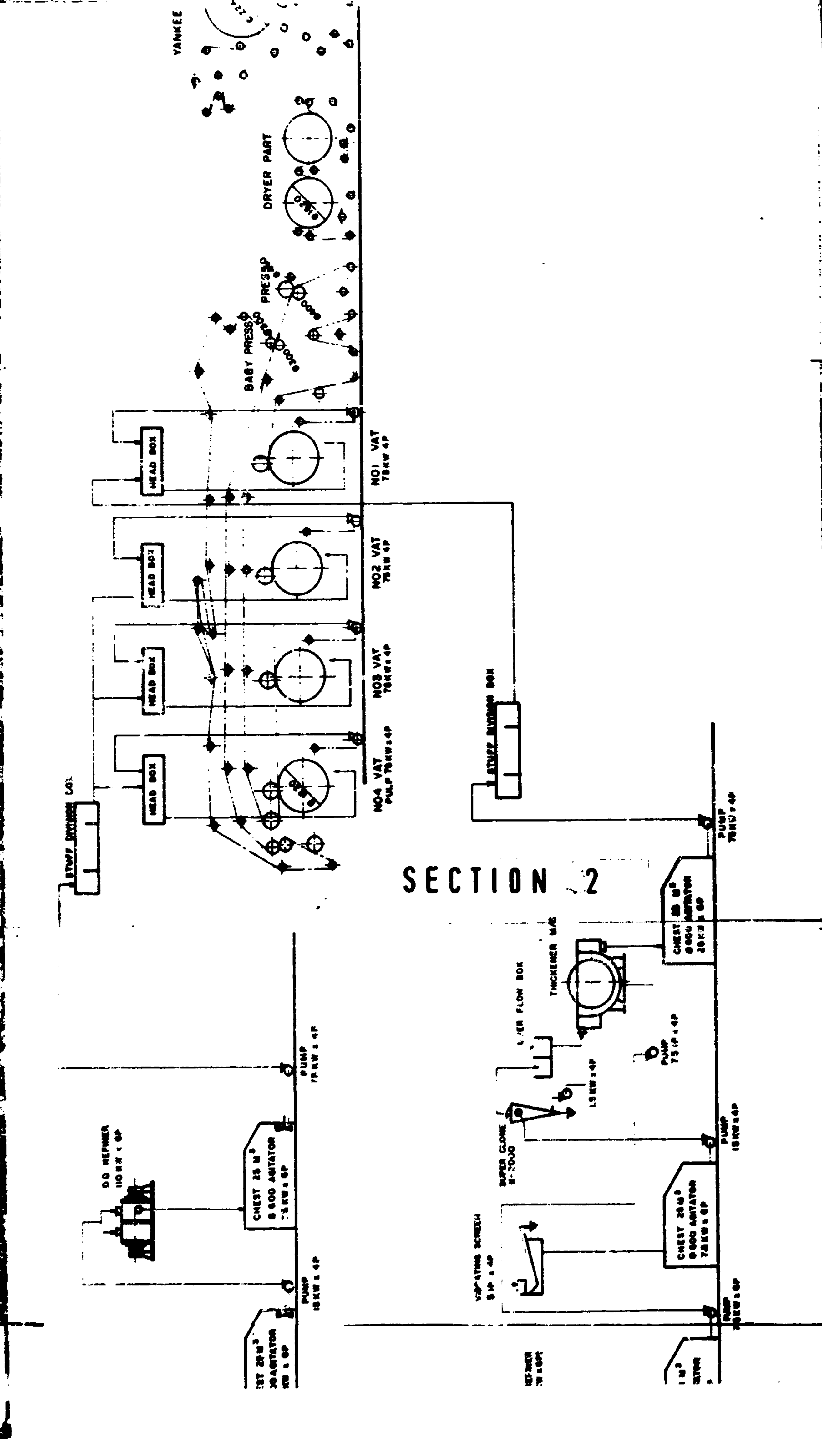
The evaporated vapour is vented through ventillation hood. After dryer pat, paper is wound at pope reel part. As auxiliary equipment, vacuum system, paper machine drive system, drainage system, air compressor, lubrication system etc.... will be used to operate paper machinery.

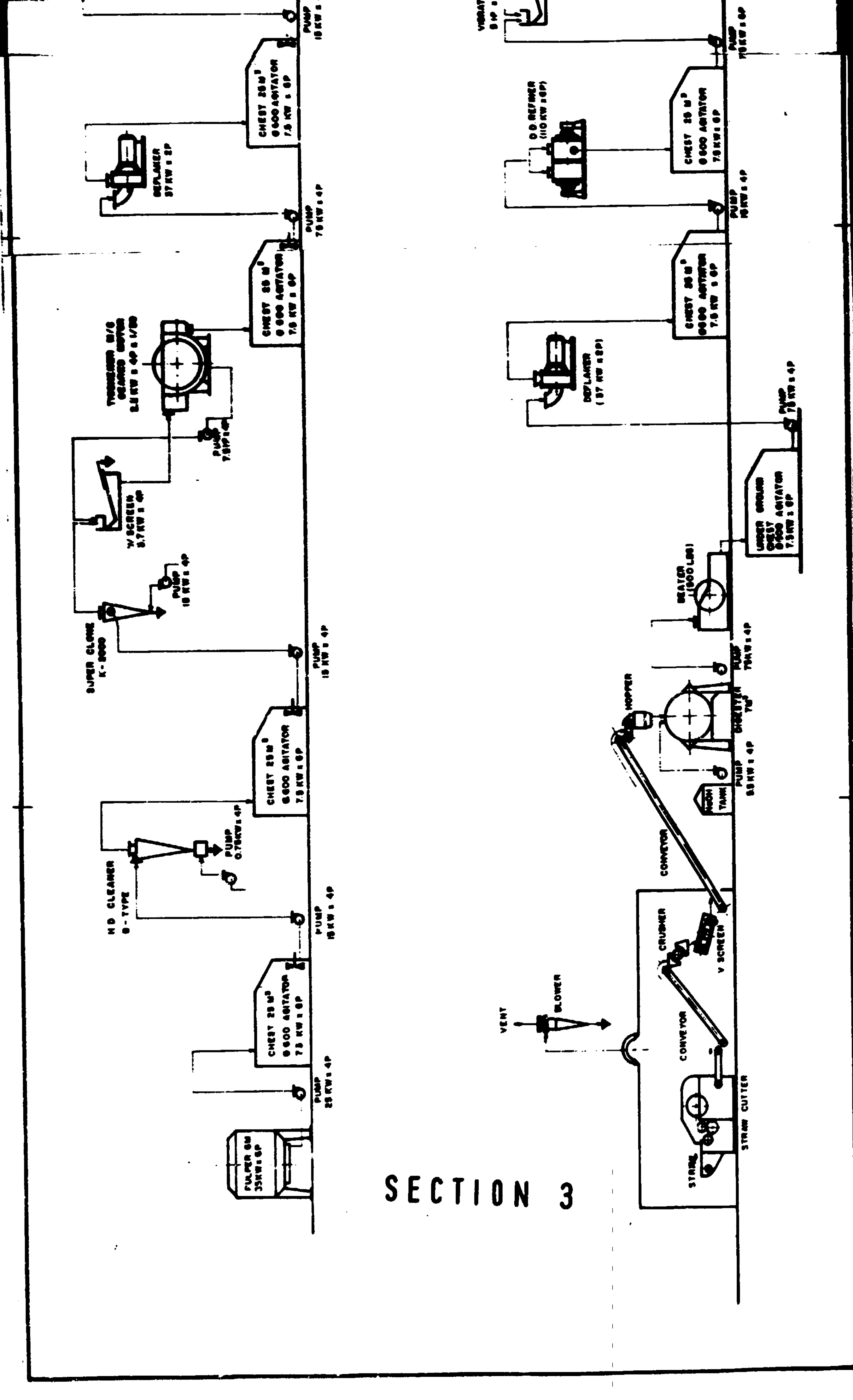
Paper flow is shown in Figure I.

SECTION 1

FIGURE 1

INDUSTRIAL PROJECTS SERVICE				
PROJECT INDUSTRIAL OPPORTUNITY STUDY	Drawn by BEKELE GORBA	Sign	Date NOV 28 1987	CLIENT
	Checked			
	Approved			
	STRAW BOARD PAPER FLOW SHEET			Scale
				Dr. No.


SECTION 2
YANKEE
DRYER PART
PRESS
BABY PRESS
HEAD BOX
HEAD BOX
HEAD BOX
HEAD BOX
NO1 VAT
NO2 VAT
NO3 VAT
NO4 VAT
STUFF DIVISION BOX
STUFF DIVISION BOX
PUMP
THICKENER
OVER FLOW BOX
SUPER CLONE
VIBRATING SCREEN
D.D REFINER
PUMP
PUMP


STRAW CUTTER
CONVEYOR
CRUSHER
V SCREEN
BLOWER
VENT
HOPPER
CONVEYOR
BEATER
DEFLAKER
D.D REFINER
H D CLEANER
SUPER CLONE
PUMP

SECTION 3

3. Technology Source

The equipment, technical know-how and training can be obtained from:

MES Coproration
C.P.O. Box 7180
Seoul, Korea
Telex: MESCO K24774
Phone: 765 - 2431/4

B ENGINEERING

1. Machinery and Equipment

The machinery as described above is available as a turnkey project for around U.S$1,518,500, C & F Assab; which includes engineering and equipment supply.

The supply also includes the following items:

- Boiler, water tube type, 10 ton/hr, 10 kg/cm^2,
- Air compressor, 2750 l/min, 7 kg/cm.,
- Overhead crane, 5 ton capacity,
- Electrical works including M.C.C. panel substation system, power panel, lighting panel, wiring, etc...,
- Consummable materials for wire, canvas, felt, etc.... for initial operation.

Estimated cost of machinery and equipment and technology fee and training are shown in Table VII .

TABLE VII

MACHINERY AND EQUIPMENT COST, TECHNOLOGY AND TRAINING FEE

Items	Cost		
	F.C.(Birr)	L.C.(Birr)	Total Birr
Machinery and equipment	2,261,400	-	2,261,400
Sub Total (FOB)	2,261,400	-	2,261,400
Sea Freight (8%)	-	181,000	181,000
Inland transport, handling and service charges (12.5%)	-	282,700	282,700
Technology fee and training	400,000	-	400,000
Two pick-up vehicles	54,000	36,000	90,000
Fork-lift	103,500	-	103,500
Spares	113,100	13,400	126,500
Total	2,932,000	513,100	3,445,100
Contingencies (10%)	293,200	51,310	344,510
Grand Total	3,225,200	564,410	3,789,610

2. Layout and Building

The layout for the straw board plant is shown in Figure II. The site area is about 11,000 m^2. The building required is approximately 3500 m^2.

Investment cost on building and civil works is estimated as follows:

Building, 3500 m^2	Birr	3,150,000
Land & Site Preparation (2%)	"	63,000
Outdoor works (10%)		315,000
Sub Total		3,528,000
Contingencies (10%)		352,800
Total Birr		3,880,800

Building elevation is shown in Figure III.

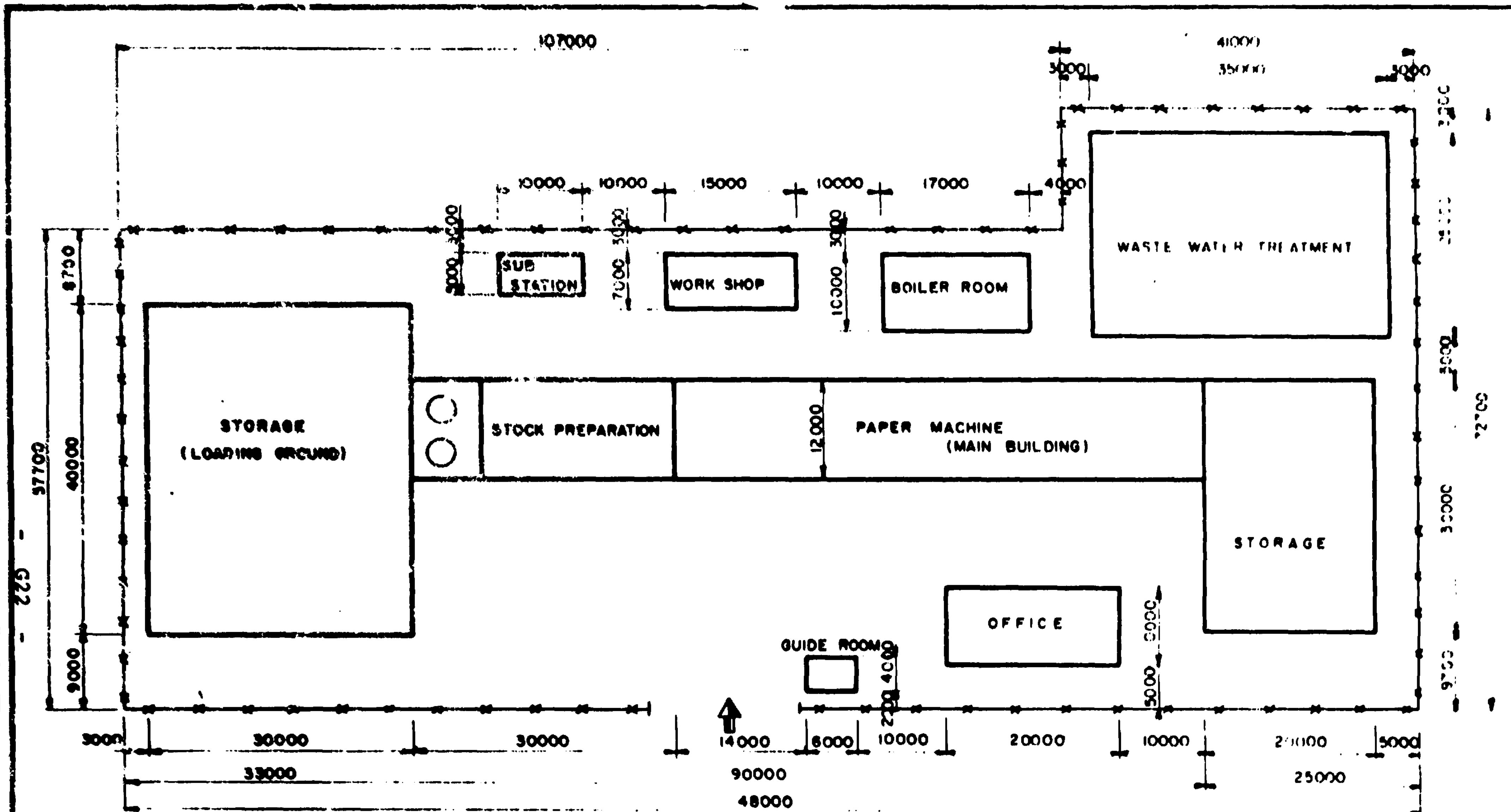


FIGURE 2

INDUSTRIAL PROJECTS SERVICE

PROJECT INDUSTRIAL OPPORTUNITY STUDY	LAND AREA LAY OUT	CLIENT
		SCALE 1:600

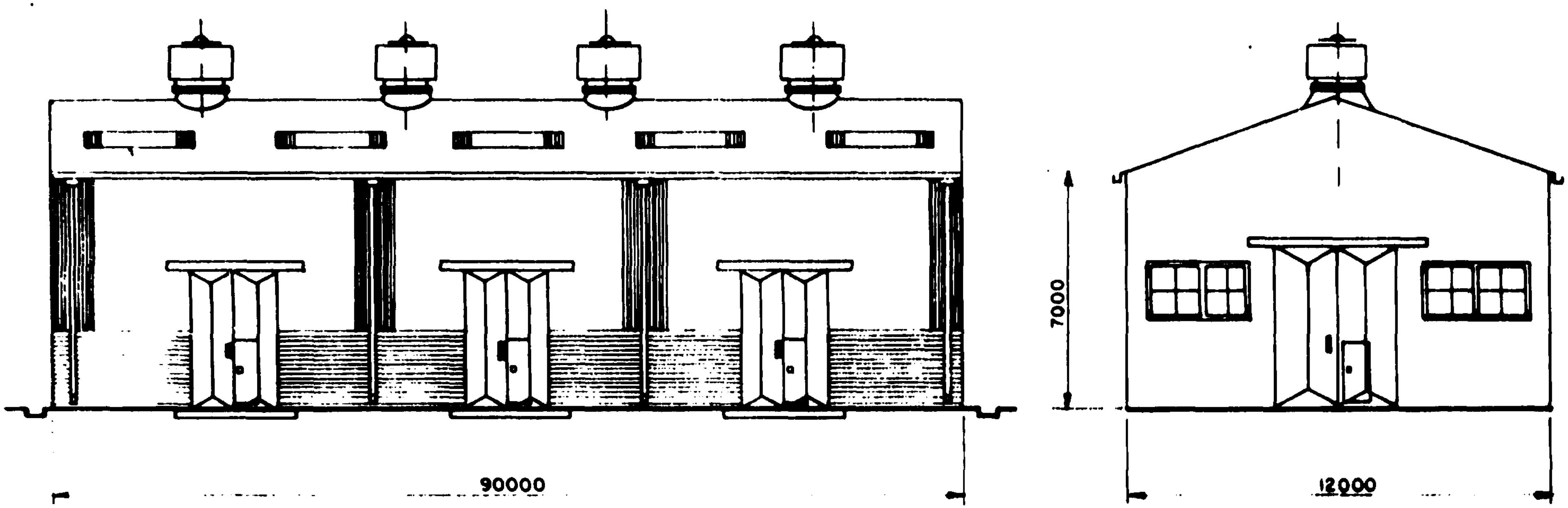


FIGURE 3

INDUSTRIAL PROJECTS SERVICE				
PROJECT INDUSTRIAL OPPORTUNITY STUDY	Drawn by Baikonur Lake		Date … 20/87	CLIENT
	Checked by			
	Approved by			
	BUILDING ELEVATION			SCALE 1 600

VII. ORGANIZATION AND MANPOWER

A. ORGANIZATION

Considering its unique manufacturing process and size, the project is to have its own management to run its operation under the supervision of a state organization. The proposed organization chart is shown in Figure IV.

B. MANPOWER AND TRAINING

The total number of employees required to start one shift operation is 45. The break-down as well as monthly salaries/ wages and qualifications are shown in Table VIII.

For additional shift operations, the extra manpower requirement is given in Table IX. It must be noted that on account of a second shift, the post of shift supervisor has to be newly created.

The training of staff will be undertaken by the Company which will supply plant equipment and machinery. Eventhough the technology is different, some orientation on board making can be given at the Wonji Paper Mill.

Training facilities will be provided by the contraction for about 6 key personnel, including the production/technical head.

FIGURE IV

ORGANIZATION CHART

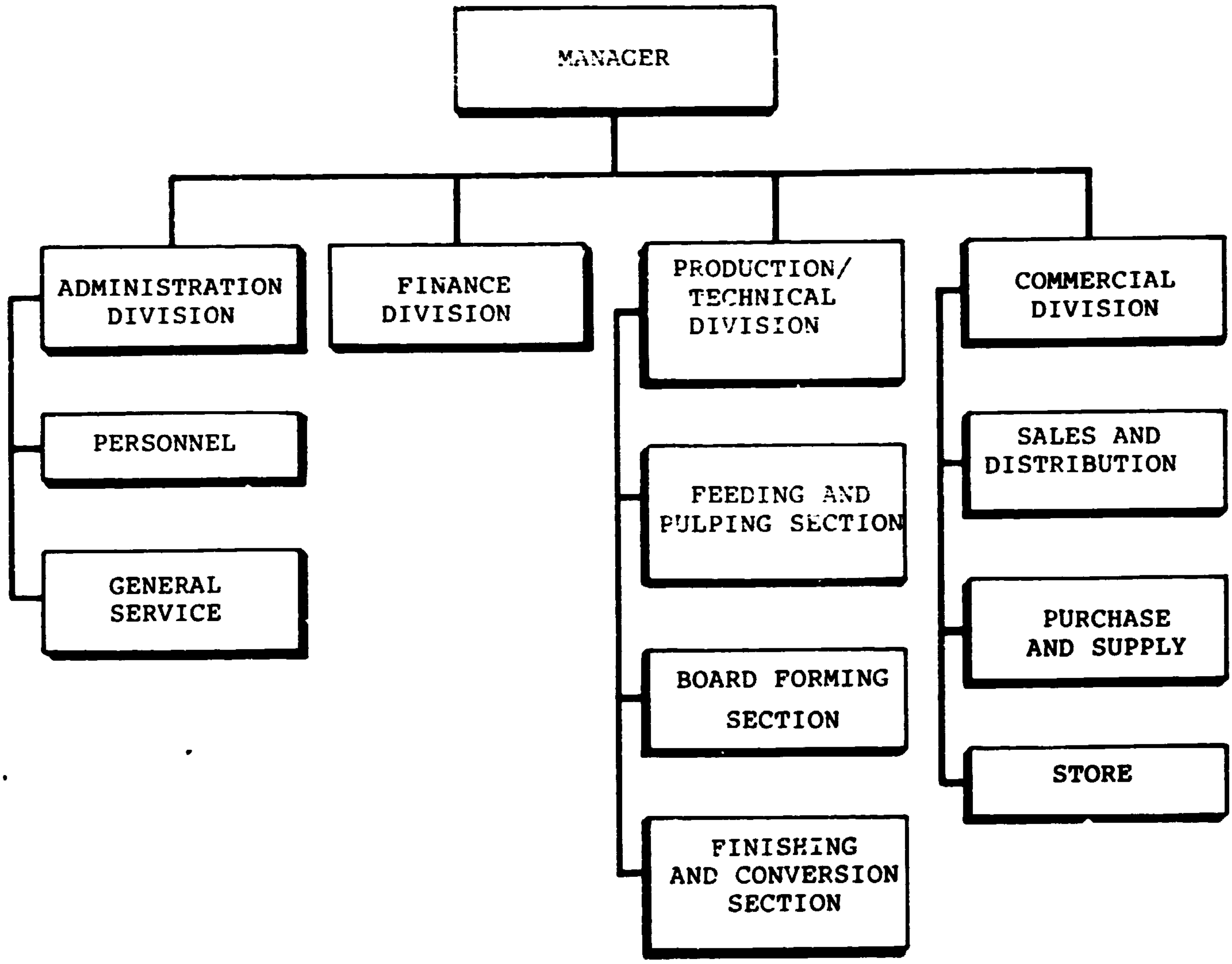


TABLE VIII

MANPOWER REQUIREMENT FOR ONE SHIFT OPERATION

	Post	No. of Persons	Monthly Salary Per Person	Total Monthly Salary	Qualification (Skill)
1	Plant Manager	1	1200	1200	
2	Secretary	1	450	450	Secretarial diploma
3	Production/Technical Head	1	900	900	BSc. in engineering plus specialised training
4	Chief Mechanic	1	600	600	Poly graduate and experienc
5	Mechanic	1	400	400	Technical school graduate
6	Electrician	1	400	400	" " "
7	Production Clerk	1	300	300	Commercial school graduate
8	Forman	3	350	1050	Technical School graduate
9	Operators	6	200	1200	Skilled
10	Conversion Shop	4	200	800	Skilled
11	Fork lift opertor	1	200	200	Skilled
12	Labourers	6	60	360	Unskilled
13	Administration Head	1	600	600	Diploma with Experience or B.A. in Administration
14	Personnel Clerk	1	300	300	Commercial school graduate
15	General Service Asst.	1	350	350	Technical school graduate
16	Drivers	2	200	400	3rd driving licence
17	Guards	4	60	240	Unskilled
18	Cleaner & Messenger	2	60	120	Unskilled
19	Financial Head	1	600	600	Accounting diploma with experience or degree in accounting
20	Accounting clerks	2	300	300	Commercial school graduate

TABLE VIII (Cont'd)

	Post	No. of Persons	Monthly Salary Per Person	Total Monthly Salary	Qualification (Skill)
21	Commercial Head	1	600	600	Diploma in mgt. with experience or MBA.
22	Sales and Distribution Officer	1	400	400	Commercial school graduate with experience
23	Purchase and Supply Officer	1	400	400	ditto
24	Store Keeper	1	300	300	Commercial school graduate
	TOTAL	45	—	12470	

TABLE IX

EXTRA MANPOWER REQUIREMENT

FOR EACH ADDITIONAL SHIFT

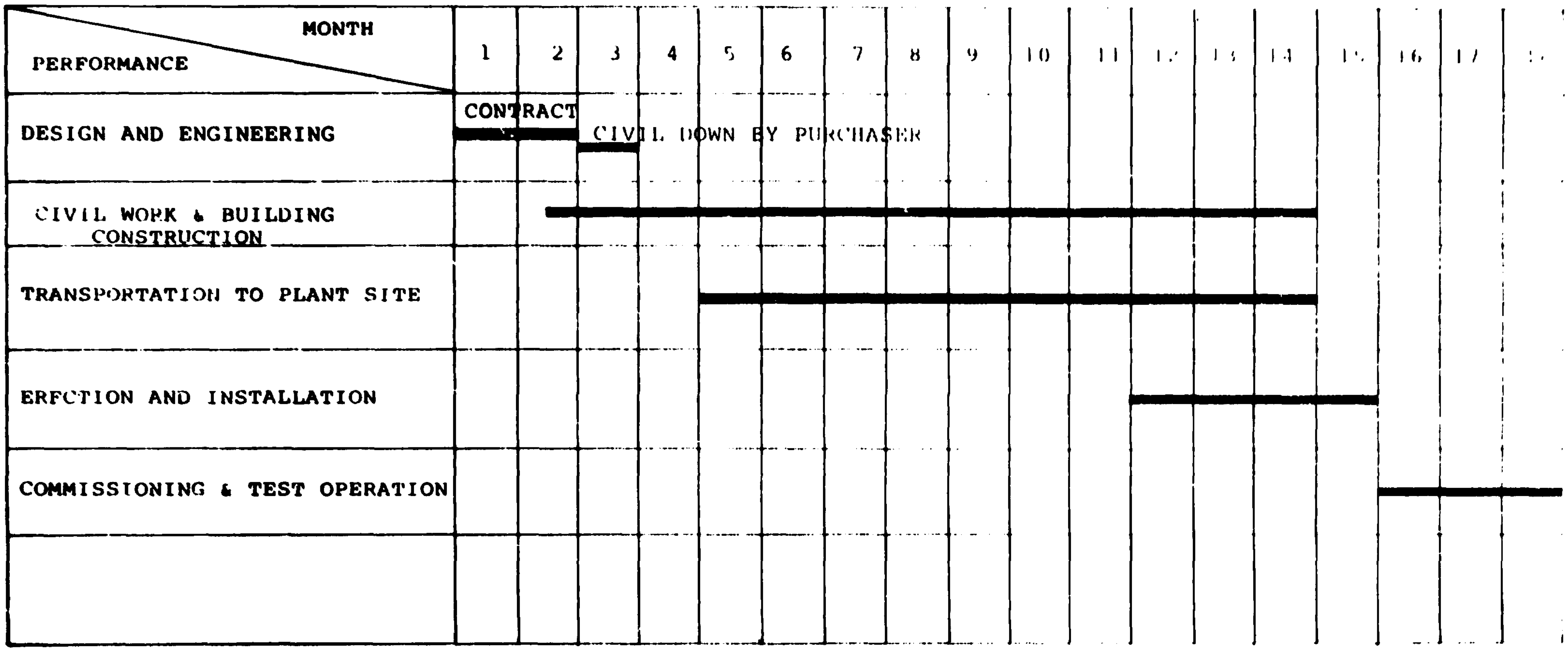
	Post*	No. of Persons	Remarks
1	Shift Supervisor	1	Plus one for the day shift. (Technical school graduate with experience, monthly salary 400 Birr)
2	Mechanic/electrician	1	
3	Formen	3	For qualification and monthly salary see Table VIII.
4	Operators	6	
5	Conversion shop	4	
6	Fork lift operator	1	
7	Labourers	6	
	TOTAL	22	

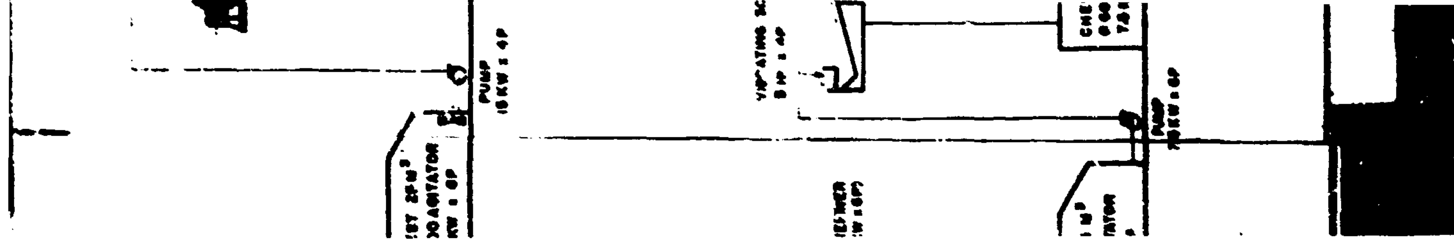
VIII. IMPLEMENTATION SCHEDULE

Duration of the implementation after financial arrangements and contractual committment is estimated to be 18 months. This is with the assumption that the civil work and cosntruction will be completed in 14 months. Rough indication of project time schedule is shown in Figure V.

FIGURE V

PROJECT TIME SCHEDULE





IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table X.

TABLE X

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Cost Items	Cost		
	Foreign	Local	Total
Buildings and civil works	2716.56	1164.24	3880.80
Plant machinery and equipment	3051.95	524.81	3576.76
Office furniture and equipment	12.38	37.12	49.50
Vehicles	173.25	39.60	212.85
Pre-production expenditure	7.17	64.46	71.63
Total	5961.31	1830.23	7791.54

The strawboard plant requires an initial investment cost of Birr 7.79 million. The foreign currency component amounts to Birr 5.96 million which represents 77% of the total initial investment cost. The other 23% is required in local currency. About 51% of the total foreign currency requirement will be for machinery and equipment.

2. Wrking Capital Requirements

The following parameters were used to estimate the net working capital requirements of the strawboard plant.

	Items	Months of Coverage
1.	Cash in hand	0.5
2.	Accounts receivable	0.5
3.	Raw materials - straw	9.0
4.	Work in progress	0.07
5.	Finished products	1.0
6.	Accounts payable	1.0

The net working capital requirement on the fifth year of production amounted to Birr 0.78 million which increases to Birr 1.14 million by the tenth year of production. About 11% of the total net working capital required will be in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The total production cost on the fifth year of production amounts to Birr 2.39 million, out of which about 50% is in foreign currency.

4. Internal Rate of Return (IRR)

The strawboard plant will not be financially viable. The internal rate of return calculated was -1.92% with a net present value of Birr -5.83 million discounted at 10% p.a.

The selling price assumed for the financial analysis was Birr 1710/tonne of board. This was arrived at by taking the average F.O.B. price of leatherboard and duplexboard and thereby adding freight charges, insurance, port handling, bank charge, local transport and other costs.

5. Breakeven Analysis

The breakeven point would be reached at a production of about 1930 tonnes of board or a sales revenue of Birr 3.3 million.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 5.74% with a net present value of Birr -2.79 million discounted at 10% p.a.

The project will create employment for about 45 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

Straw Board Plant
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	7791.54	76.510 % foreign
current assets:	0.00	0.000 % foreign
total assets:	7791.54	76.510 % foreign

Source of funds during construction phase

equity & grants:	7791.54	76.510 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	7791.54	76.510 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	1394.95	1480.60	1572.36
depreciation :	613.56	613.56	613.56
interest :	0.00	0.00	0.00
production costs	2008.51	2094.16	2185.92
thereof foreign	53.19 %	52.42 %	51.65 %
total sales :	1496.25	1615.95	1744.20
gross income :	-512.26	-478.21	-441.72
net income :	-512.26	-478.21	-441.72
cash balance :	-403.26	90.06	124.16
net cashflow :	-403.26	90.06	124.16

Net Present Value at: 10.00 % = -5831.99
Internal Rate of Return: -1.92 %
Return on equity1: -16.41 %
Return on equity2: -1.92 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2 .... COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	1552.32	2328.48
Auxiliary and service facilities	85.14	127.71
Incorporated fixed assets	19.80	29.70
Plant machinery and equipment	1430.70	2146.06
Total fixed investment costs	3087.96	4631.95
Pre-production capital expenditures.	28.66	42.97
Net working capital	0.00	0.00
Total initial investment costs	3116.62	4674.92
Of it foreign, in %	76.51	76.51

Straw Board Plant --- Financial Analysis - July 1988

COMFAR

TABLE A.3 -- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Total Production Costs in '000 Birr

Year	3	4	5	6	7	8
% of nom. capacity (single product).	34.06	36.78	39.70	42.90	46.32	50.02
Raw material 1	109.38	118.13	127.50	137.75	148.75	160.63
Other raw materials	875.00	945.00	1020.00	1102.00	1190.00	1285.00
Utilities	45.96	48.73	51.70	54.94	58.43	62.19
Energy	60.29	63.93	67.82	72.08	76.66	81.59
Labour, direct	15.59	15.59	15.59	15.59	15.59	15.59
Repair, maintenance	270.79	270.79	270.79	270.79	270.79	270.79
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	8.16	8.38	8.62	8.87	9.15	9.45
Factory costs	1385.16	1470.54	1562.02	1662.03	1769.37	1885.24
Administrative overheads	9.79	10.06	10.34	10.65	10.98	11.34
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	613.56	613.56	613.56	613.56	613.56	556.67
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	2008.51	2094.16	2185.92	2286.25	2393.91	2453.25
Costs per unit (single product)	2.30	2.22	2.14	2.07	2.01	1.91
Of it foreign, %	53.19	52.42	51.65	50.89	50.14	49.08
Of it variable,%	53.30	55.21	57.09	58.97	60.82	64.09
Total labour	15.59	15.59	15.59	15.59	15.59	15.59

Straw Board Plant --- Financial Analysis - July 1988

COMFAR

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	9	10	11	12	13	14
% of nom. capacity (single product).	54.03	58.35	63.02	68.08	73.45	79.41
Raw material 1	173.50	187.38	202.38	218.63	235.88	255.00
Other raw materials	1388.00	1499.00	1619.00	1749.00	1887.00	2040.00
Utilities	66.27	70.67	75.42	80.57	86.03	92.09
Energy	86.94	92.71	98.94	105.70	112.87	120.82
Labour, direct	15.59	15.59	15.59	15.59	15.59	15.59
Repair, maintenance	270.79	270.79	270.79	270.79	270.79	270.79
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	9.78	10.13	10.50	10.91	11.35	11.83
Factory costs	2010.87	2146.26	2292.63	2451.19	2619.51	2806.12
Administrative overheads	11.73	12.15	12.61	13.10	13.62	14.20
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	573.69	599.24	599.24	599.24	236.61	236.61
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	2596.30	2757.65	2904.47	3063.52	2869.74	3056.93
Costs per unit (single product)	1.37	1.84	1.79	1.75	1.52	1.50
Of it foreign, %	48.57	48.17	47.47	46.78	41.27	40.84
Of it variable,%	65.41	66.51	68.20	69.85	80.45	81.65
Total labour	15.59	15.59	15.59	15.59	15.59	15.59

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	15	16	17
% of nom. capacity (single product).	85.75	92.60	100.00
Raw material 1	275.38	297.38	321.13
Other raw materials	2203.00	2379.00	2569.00
Utilities	98.55	105.52	113.04
Energy	129.28	138.43	148.30
Labour, direct	15.59	15.59	15.59
Repair, maintenance	270.79	270.79	270.79
Spares	0.00	0.00	0.00
Factory overheads	12.35	12.90	13.50
Factory costs	3004.94	3219.60	3451.35
Administrative overheads	14.82	15.48	16.20
Indir. costs, sales and distribution	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00
Depreciation	236.61	236.61	236.61
Financial costs	0.00	0.00	0.00
Total production costs	3258.36	3471.70	3704.16
Costs per unit (single product)	1.48	1.46	1.44
Of it foreign, %	40.44	40.05	39.69
Of it variable,%	82.77	83.84	84.85
Total labour	15.59	15.59	15.59

TABLE A.4

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6	7
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	58.12	61.69	65.51	69.70	74.18
Inventory and materials	177	2.0	505.08	545.48	588.77	636.10	686.89
Energy	1	360.0	0.17	0.18	0.19	0.20	0.21
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	7.70	8.17	8.68	9.23	9.83
Finished products	30	12.0	116.25	123.38	131.03	139.39	148.36
Cash in hand	15	24.0	12.68	12.70	12.72	12.75	12.77
Total current assets			699.99	751.60	806.90	867.37	932.25
Current liabilities and							
Accounts payable	30	12.0	115.43	122.55	130.17	138.50	147.45
Net working capital			584.56	629.06	676.74	728.86	784.80
Increase in working capital			584.56	44.50	47.68	52.13	55.94
Net working capital, local			518.38	559.16	602.85	650.62	701.88
Net working capital, foreign			66.17	69.90	73.88	78.24	82.92

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.4 (Cont'd)

Net Working Capital in '000 Birr

Year	mdc	coto	8	9	10	11	12
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	79.02	84.28	89.93	96.05	102 68
Inventory and materials	177	2.0	741.73	801.18	865.25	934.51	1009.55
Energy	1	360.0	0.23	0.24	0.26	0.27	0 29
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	10.47	11.17	11.92	12.74	13.62
Finished products	30	12.0	158.05	168.55	179.87	192.10	205.36
Cash in hand	15	24.0	12.80	12.83	12.86	12.90	12.93
Total current assets			1002.30	1078.24	1160.09	1248 57	1344.42
Current liabilities and							
Accounts payable	30	12.0	157.10	167.57	178.85	191.05	204.27
Net working capital			845.20	910.67	981.23	1057.52	1140.16
Increase in working capital			60.39	65.48	70.56	76.28	82.64
Net working capital, local			757.22	817.22	881.88	951.79	1027.52
Net working capital, foreign			87.97	93.45	99.35	105.73	112.64

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.4 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year	mdc	coto	13	14	15	16	17
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	109.71	117.51	125.82	134.80	144.48
Inventory and materials	177	2.0	1089.20	1177.51	1271.59	1373.18	1482.84
Energy	1	360.0	0.31	0.34	0.36	0.38	0.41
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	2	180.0	14.55	15.59	16.69	17.89	19.17
Finished products	30	12.0	219.43	235.03	251.65	269.59	288.96
Cash in hand	15	24.0	12.97	13.02	13.06	13.12	13.17
Total current assets			1446.18	1558.99	1679.18	1808.95	1949.04
Current liabilities and							
Accounts payable	30	12.0	218.29	233.84	250.41	268.30	287.61
Net working capital			1227.89	1325.15	1428.77	1540.65	1661.43
Increase in working capital			87.73	97.26	103.62	111.88	120.78
Net working capital, local			1107.90	1197.03	1291.98	1394.51	1505.19
Net working capital, foreign			119.98	128.12	136.78	146.14	156.24

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

- G43 -

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	3116.62	4674.92
Financial resources	3116.62	4674.92
Sales, net of tax	0.00	0.00
Total cash outflow	3116.62	4674.92
Total assets	3116.62	4674.92
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	732.10	1098.13
Outflow, local	732.10	1098.13
Surplus (deficit)	0.00	0.00
Inflow, foreign	2384.52	3576.79
Outflow, foreign	2384.52	3576.79
Surplus (deficit)	0.00	0.00
Net cashflow	-3116.62	-4674.92
Cumulated net cashflow	-3116.62	-7791.54

COMFAR

TABLE A.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1611.68	1623.07	1751.82	1892.75	2043.84	2207.01
Financial resources	115.43	7.11	7.62	8.33	8.94	9.66
Sales, net of tax	1496.25	1615.95	1744.20	1884.42	2034.90	2197.35
Total cash outflow	2094.94	1532.21	1627.66	1733.15	1845.24	2051.77
Total assets	699.99	51.61	55.30	60.46	84.89	155.19
Operating costs	1394.95	1480.60	1572.36	1672.68	1760.35	1896.58
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-483.26	90.86	124.17	159.61	198.61	155.24
Cumulated cash balance	-483.26	-392.40	-268.24	-108.63	89.98	245.21
Inflow, local	1562.51	1620.62	1749.20	1889.89	2040.77	2203.69
Outflow, local	1389.59	906.71	970.30	1040.82	1115.51	1212.33
Surplus (deficit)	172.92	713.91	778.91	849.08	925.26	991.36
Inflow, foreign	49.17	2.44	2.62	2.86	3.07	3.32
Outflow, foreign	705.35	625.50	657.36	692.33	729.72	839.44
Surplus (deficit)	-656.18	-623.06	-654.74	-689.47	-726.65	-836.12
Net cashflow	-483.26	90.86	124.17	159.61	198.61	155.24
Cumulated net cashflow	-8274.80	-8183.94	-8059.78	-7900.17	-7701.56	-7546.33

Straw Board Plant --- Financial Analysis - July 1988

COMFAR

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	2383.95	2574.57	2780.69	3004.00	3240.80	3503.95
Financial resources	10.47	11.28	12.20	13.21	14.03	15.55
Sales, net of tax	2373.48	2563.29	2768.49	2990.79	3226.77	3488.40
Total cash outflow	2226.26	2240.26	2393.71	2560.14	2998.54	3276.58
Total assets	203.66	81.84	88.48	95.85	186.89	240.52
Operating costs	2022.60	2158.41	2305.23	2464.29	2633.13	2820.32
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	178.52	215.73
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	157.69	334.32	386.98	443.86	242.26	227.37
Cumulated cash balance	402.90	737.22	1124.19	1568.06	1810.32	2037.69
Inflow, local	2380.35	2570.70	2776.50	2999.47	3235.98	3498.61
Outflow, local	1308.32	1379.06	1481.45	1592.53	1903.11	2081.09
Surplus (deficit)	1072.04	1191.64	1295.05	1406.93	1332.87	1417.52
Inflow, foreign	3.60	3.88	4.19	4.54	4.82	5.34
Outflow, foreign	917.94	861.20	912.26	967.61	1095.42	1195.49
Surplus (deficit)	-914.35	-857.32	-908.07	-963.07	-1090.61	-1190.15
Net cashflow	157.69	334.32	386.98	443.86	242.26	227.37
Cumulated net cashflow	-7388.64	-7054.32	-6667.35	-6223.48	-5981.23	-5753.85

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	3783.70	4085.98	4412.30
Financial resources .	16.57	17.89	19.31
Sales, net of tax . .	3[illegible]7.13	4068.09	4392.99
Total cash outflow . .	[illegible]95.32	3663.06	3952.06
Total assets	120.19	129.77	140.09
Operating costs . . .	3019.75	3235.09	3467.55
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	255.38	298.20	344.42
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	388.38	422.92	460.24
Cumulated cash balance	2426.06	2848.99	3309.23
Inflow, local	3778.01	4079.83	4405.67
Outflow, local	2234.61	2427.47	2635.64
Surplus (deficit) .	1543.39	1652.36	1770.02
Inflow, foreign . . .	5.69	6.14	6.63
Outflow, foreign . . .	1160.71	1235.59	1316.42
Surplus (deficit) .	-1155.02	-1229.44	-1309.78
Net cashflow	388.38	422.92	460.24
Cumulated net cashflow	-5365.48	-4942.55	-4482.31

TABLE A.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-8965.69	at	10.00 %
Internal Rate of Return (IRRE1) ..	-16.41 %		

b) Net Worth versus Net cash return:

Net present value	-5831.99	at	10.00 %
Internal Rate of Return (IRRE2) ..	-1.92 %		

c) Internal Rate of Return on total investment:

Net present value	-5831.99	at	10.00 %
Internal Rate of Return (IRR) ..	-1.92 %		

Net Worth = Equity paid plus reserves

TABLE A.6

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	1496.25	1615.95	1744.20	1884.42	2034.90
Less: variable costs, incl. sales tax.	1070.56	1156.20	1247.96	1348.29	1455.96
Variable margin	425.69	459.75	496.24	536.13	578.94
As % of total sales	28.45	28.45	28.45	28.45	28.45
Non-variable costs, incl. depreciation	937.96	937.96	937.96	937.96	937.96
Operational margin	-512.26	-478.21	-441.72	-401.83	-359.01
As % of total sales	-34.24	-29.59	-25.33	-21.32	-17.64
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	512.26	-478.21	-441.72	-401.83	-359.01
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-512.26	-478.21	-441.72	-401.83	-359.01
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-512.26	-478.21	-441.72	-401.83	-359.01
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-512.26	-478.21	-441.72	-401.83	-359.01
Accumulated undistributed profit	-512.26	-990.47	-1432.19	-1834.02	-2193.03
Gross profit, % of total sales	-34.24	-29.59	-25.33	-21.32	-17.64
Net profit, % of total sales	-34.24	-29.59	-25.33	-21.32	-17.64
ROE, Net profit, % of equity	-6.57	-6.14	-5.67	-5.16	-4.61
ROI, Net profit+interest, % of invest.	-6.12	-5.68	-5.22	-4.72	-4.19

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	2197.35	2373.48	2563.29	2768.49	2990.79
Less: variable costs, incl. sales tax.	1572.19	1698.21	1834.02	1980.84	2139.89
Variable margin	625.16	675.27	729.27	787.65	850.90
As % of total sales	28.45	28.45	28.45	28.45	28.45
Non-variable costs, incl. depreciation	881.06	898.09	923.63	923.63	923.63
Operational margin	-255.90	-222.82	-194.36	-135.98	-72.73
As % of total sales	-11.65	-9.39	-7.58	-4.91	-2.43
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-255.90	-222.82	-194.36	-135.98	-72.73
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-255.90	-222.82	-194.36	-135.98	-72.73
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-255.90	-222.82	-194.36	-135.98	-72.73
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-255.90	-222.82	-194.36	-135.98	-72.73
Accumulated undistributed profit	-2448.93	-2671.75	-2866.10	-3002.08	-3074.81
Gross profit, % of total sales	-11.65	-9.39	-7.58	-4.91	-2.43
Net profit, % of total sales	-11.65	-9.39	-7.58	-4.91	-2.43
ROE, Net profit, % of equity	-3.28	-2.86	-2.49	-1.75	-0.93
ROI, Net profit+interest, % of invest.	-2.93	-2.50	-2.16	-1.50	-0.80

COMFAR 2.1 UNIDO

TABLE A.6 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	3226 77	3488.40	3767.13	4068.09	4392.99
Less: variable costs, incl. sales tax.	2308.73	2495.93	2695.36	2910.69	3143.16
Variable margin	918.04	992.47	1071.77	1157.40	1249.83
As % of total sales	28.45	28.45	28.45	28.45	28.45
Non-variable costs, incl. depreciation	561.00	561.00	561.00	561.00	561.00
Operational margin	357.03	431.47	510.77	596.39	688.83
As % of total sales	11.06	12.37	13.56	14.66	15.68
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	357.03	431.47	510.77	596.39	688.83
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	357.03	431.47	510.77	596.39	688.83
Tax	178.52	215.73	255.38	298.20	344.42
Net profit	178.52	215.73	255.38	298.20	344.42
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	178.52	215.73	255.38	298.20	344.42
Accumulated undistributed profit	-2896.30	-2680.56	-2425.18	-2126.98	-1782.56
Gross profit, % of total sales	11.06	12.37	13.56	14.66	15.68
Net profit, % of total sales	5.53	6.18	6.78	7.33	7.84
ROE, Net profit, % of equity	2.29	2.77	3.28	3.83	4.44
ROI, Net profit+interest, % of invest.	1.92	2.26	2.65	3.06	3.49

TABLE A.7 (Cont'd)

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	3116.62	7791.54
Fixed assets, net of depreciation	0.00	3116.62
Construction in progress	3116.62	4674.92
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	3116.62	7791.54
Equity capital	3116.62	7791.54
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

COMFAR

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	8390.23	8306.49	8189.95	8038.67	7938.99	7948.64
Fixed assets, net of depreciation	7177.98	6564.42	5950.85	5337.29	4723.73	4167.06
Construction in progress	0.00	0.00	0.00	0.00	0.00	85.14
Current assets	687.31	738.90	794.18	854.62	919.48	989.50
Cash, bank	12.68	12.70	12.72	12.75	12.77	12.80
Cash surplus, finance available .	0.00	0.00	0.00	0.00	89.98	245.21
Loss carried forward	0.00	512.26	990.47	1432.19	1834.02	2193.03
Loss	512.26	478.21	441.72	401.83	359.01	255.90
Total liabilities	8390.23	8306.49	8189.95	8038.67	7938.99	7948.64
Equity capital	7791.54	7791.54	7791.54	7791.54	7791.54	7791.54
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	115.43	122.55	130.17	138.50	147.45	157.10
Bank overdraft, finance required.	483.26	392.40	268.24	108.63	0.00	0.00
Total debt	598.69	514.95	398.41	247.13	147.45	157.10
Equity, % of liabilities	92.86	93.80	95.14	96.93	98.14	98.02

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	7959.11	7970.39	7982.59	7995.81	8188.35	8241.12
Fixed assets, net of depreciation	3678.51	3206.98	2607.75	2008.51	1771.90	1620.43
Construction in progress	127.71	0.00	0.00	0.00	85.14	127.71
Current assets	1065.42	1147.23	1235.68	1331.49	1433.21	1545.97
Cash, bank	12.83	12.86	12.90	12.93	12.97	13.02
Cash surplus, finance available	402.90	737.22	1124.19	1568.06	1810.32	2037.69
Loss carried forward	2448.93	2671.75	2866.10	3002.08	3074.81	2896.30
Loss	222.82	194.36	135.98	72.73	0.00	0.00
Total liabilities	7959.11	7970.39	7982.59	7995.81	8188.35	8241.12
Equity capital	7791.54	7791.54	7791.54	7791.54	7791.54	7791.54
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	178.52	215.73
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	167.57	178.85	191.05	204.27	218.29	233.84
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	167.57	178.85	191.05	204.27	218.29	233.84
Equity, % of liabilities	97.89	97.76	97.61	97.45	95.15	94.54

TABLE A.' (Cont'd)

COMFAR

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	8297.34	8358.04	8423.57
Fixed assets, net of depreciation	1511.53	1274.92	1038.31
Construction in progress	0.00	0.00	0.00
Current assets	1666.11	1795.83	1935.87
Cash, bank	13.06	13.12	13.17
Cash surplus, finance available	2426.07	2848.99	3309.23
Loss carried forward	2680.56	2425.18	2126.98
Loss	0.00	0.00	0.00
Total liabilities	8297.34	8358.04	8423.57
Equity capital	7791.54	7791.54	7791.54
Reserves, retained profit	0.00	0.00	0.00
Profit	255.38	298.20	344.42
Long and medium term debt	0.00	0.00	0.00
Current liabilities	250.41	268.30	287.61
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	250.41	268.30	287.61
Equity, % of liabilities	93.90	93.22	92.50

TABLE A. - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	2928.85	4393.27
Financial resources	2928.85	4393.27
Sales, net of tax	0.00	0.00
Total cash outflow	2928.85	4393.27
Total assets	2928.85	4393.27
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	544.33	816.48
Outflow, local	544.33	816.48
Surplus (deficit)	0.00	0.00
Inflow, foreign	2384.52	3576.79
Outflow, foreign	2384.52	3576.79
Surplus (deficit)	0.00	0.00
Net cashflow	-2928.85	-4393.27
Cumulated net cashflow	-2928.85	-7322.12

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1481.30	1499.05	1617.97	1748.13	1887.68	2038.37
Financial resources	98.80	5.95	6.37	6.97	7.48	8.07
Sales, net of tax	1382.50	1493.10	1611.60	1741.16	1880.20	2030.30
Total cash outflow	1746.65	1304.77	1384.33	1472.18	1565.60	1743.18
Total assets	553.70	40.25	43.13	47.15	50.60	131.06
Operating costs	1192.96	1264.52	1341.20	1425.03	1515.00	1612.12
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-265.35	194.27	233.65	275.94	322.07	295.19
Cumulated cash balance	-265.35	-71.08	162.57	438.51	760.58	1055.78
Inflow, local	1432.13	1496.60	1615.35	1745.26	1884.60	2035.05
Outflow, local	1041.30	679.27	726.97	779.85	835.88	903.74
Surplus (deficit)	390.83	817.33	888.39	965.41	1048.73	1131.31
Inflow, foreign	49.17	2.44	2.62	2.86	3.07	3.32
Outflow, foreign	705.35	625.50	657.36	692.33	729.72	839.44
Surplus (deficit)	-656.18	-623.06	-654.74	-689.47	-726.65	-836.12
Net cashflow	-265.35	194.27	233.65	275.94	322.07	295.19
Cumulated net cashflow	-7587.47	-7393.20	-7159.55	-6883.61	-6561.53	-6266.34

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	2201.79	2377.85	2568.22	2774.46	2993.18	3236.20
Financial resources .	8.75	9.43	10.20	11.04	11.72	13.00
Sales, net of tax . .	2193.04	2368.42	2558.02	2763.42	2981.46	3223.20
Total cash outflow . .	1891.29	1894.74	2022.59	2161.25	2383.37	2586.62
Total assets	173.87	63.83	69.00	74.75	155.78	202.62
Operating costs . . .	1717.43	1830.91	1953.59	2086.50	2227.59	2384.00
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	310.50	483.11	545.62	613.21	609.82	649.58
Cumulated cash balance	1366.27	1849.39	2395.01	3008.22	3618.04	4267.62
Inflow, local	2198.19	2373.98	2564.03	2769.93	2988.37	3230.86
Outflow, local	973.35	1033.54	1110.33	1193.64	1287.94	1391.13
Surplus (deficit) .	1224.84	1340.44	1453.70	1576.28	1700.42	1839.73
Inflow, foreign . . .	3.60	3.88	4.19	4.54	4.82	5.34
Outflow, foreign . . .	917.94	861.20	912.26	967.61	1095.42	1195.49
Surplus (deficit) .	-914.35	-857.32	-908.07	-963.07	-1090.61	-1190.15
Net cashflow	310.50	483.11	545.62	613.21	609.82	649.58
Cumulated net cashflow	-5955.85	-5472.73	-4927.11	-4313.90	-3704.08	-3054.50

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	3494.59	3773.77	4075.16
Financial resources	13.85	14.95	16.14
Sales, net of tax	3480.74	3758.82	4059.02
Total cash outflow	2644.38	2831.79	3034.09
Total assets	93.73	101.20	109.26
Operating costs	2550.65	2730.58	2924.83
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	850.21	941.99	1041.08
Cumulated cash balance	5117.83	6059.81	7100.89
Inflow, local	3488.90	3767.63	4068.53
Outflow, local	1483.67	1596.20	1717.67
Surplus (deficit)	2005.23	2171.43	2350.86
Inflow, foreign	5.69	6.14	6.63
Outflow, foreign	1160.71	1235.59	1316.42
Surplus (deficit)	-1155.02	-1229.44	-1309.78
Net cashflow	850.21	941.99	1041.08
Cumulated net cashflow	-2204.29	-1262.30	-221.23

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-3651.31	at	10.00 %
Internal Rate of Return (IRRE1) ..	1.75 %		

b) Net Worth versus Net cash return:

Net present value	-2788.48	at	10.00 %
Internal Rate of Return (IRRE2) ..	5.74 %		

c) Internal Rate of Return on total investment:

Net present value	-2788.48	at	10.00 %
Internal Rate of Return (IRR) ..	5.74 %		

Net Worth = Equity paid plus reserves

- H -

STRAW TREATMENT AND PELLETISING

TABLE OF CONTENT

I. SUMMARY

Treated and pelleted straw is more palatable and nutritive than in its natural condition. Pelleted straw is comparable to good quality hay which is currently in a very short supply. Furthermore storage and transport considerations support the processing of straw to pellets.

The animal feed situation in Ethiopa is characterized by supply scarcity and deficiency in quality. Rough and conservative estimate of the market size for pelleted straw is in the range of 80,000 and 200,000 tons between now and 15 years hence.

In view of the different locations of the sources of supply of straw, a series of 30,000 tpa plants have been recommended.

The straw, mainly that of wheat and barley, is expected to be obtained from state farms such as those found in the Arsi and Bale Administrative Regions.

The manufacturing process of nutritionally improved straw consists of straw intaking, grinding, mixing, extruding and finishing and packaging.

The initial investment cost of the recommended size of plant is estimated at about Birr 6.3 million. Of this amount the share of the foreign component is about 71%.

The financial and economic evaluations indicate the project to be highly viable with rates of return of 30.10% and 42.48%, respectivley.

The project is expected to create employment for not less than 60 people. per plant.

II. INTRODUCTION

Ethiopia has one of the highest livestock population in the world. With its 27 million cattle and 41 million sheep and goats, Ethiopia ranks 10th in the world and first in Africa in terms of livestock population. The sector, however, still remains to be exploited.

Processed animal feed, including treated and pelleted straw, could play a major role in the development and exploitation of the livestock sector. Presently virtually all the forage supply in Ethiopia has been reported to come from unimproved grazing land and crop residue; the share of processed feed being negligible.

The responsibility of establishing animal feed processing plants falls on the Ministry of State Farms which has been entrusted with the development and exploitation of the public sector of the livestock industry. Some efforts have been made by the Ministry to investigate the possibility of manufacturing pelleted straw from crop residue and other agricultural by-products obtainable from state farms. Nevertheless a systematic project study still remains to be carried out.

The project is domestic resource based; its major imput being wheat and barley straw. In the absence of such a project the substantial portion of the agricultural residue from the state farms is rendered waste causing disposal problems for the farms.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Generally, animal feeds are categorized into two groups - - concentrates and roughages. Concentrates are feeds that are low in fibre and high in total digestable nutrients. Concentrates mainly consists of various grains, grain reject and screenings, flour milling by-products, oil seed meals, discarded human food and abattoir by-products. Most concentrates are rich in protein contents.

Roughages, on the other hand, are feeds such as hay, straw, sown fodder, native or cultivated pastures, and agro-industrial by-products (cane top, sisal waste, rice husk, etc). Roughages are high in fibre but low in total digestable nutrients. Roughages such as straw can be treated and pelleted to increase their food value and utility.

The nutritional requirement for any type of livestock can not be met by a single feed element. A mixture of concentrates and roughages at varying proportions are recommended for most types of livestock. Nowadays there are a number of plants, particularly in developed countries, which produce balanced animal feeds which are normally referred to as compound feeds.

The proportion of the concentrate and roughage requirement varies by type of farm, dairy, poultry, swine, beef cattle, etc. farms. Protein rich fodder are very essential in obtaining satisfactory production from dairy cattle, swine and poultry. Accordingly, such farms require a greater proportion of concentrates than roughages. Roughages, on the other hand, can be efficiently used by farms engaged in raising beef cattle.

2. Present Demand and Supply Situation of Animal Feeds

According to 1985 report by the Ministry of Agriculture[1], the forage supply in Ethiopia has been estimated to come mainly from unimproved grazing land (90%), crop residues (7%) and other sources (3%). Processed animal feed is presumably included in the other sources. This indicates that the animal feed processing industry in the country currently plays a very negligible role in the livestock sector. A comparison with the production data of other developed countries shows the sector's rudimentary stage of development (See Table I).Ethiopia's livestock resource in terms of number, on the other hand, is estimated to be far greater than most of the countries shown in the table.

The need to increase the share of the processed animal feeds, including treated and pelleted straw, becomes clear when the country's current agricultural situation in general and the livestock sector in particular are considered. Regarding the livestock and animal feed situation in the country, the following bleak conditions have been noted by various reports dealing on various aspects of the sector:

- It has been estimated that more than 70% of the cattle population in the country are found in the highlands which are overgrazed and exposed to soil erosion;

- The livestock productivity in terms of surplus output is low; the off-take rate being only 7% for cattle while the rates attained by other developing African countries range from 13% to 45%.

---

[1] Project Preparation Report, "Feed & Forage Product", Ministry of Agriculture.

TABLE I

CONSUMPTION OF PREPARED ANIMAL FEEDS

OF SELECTED DEVELOPING COUNTRIES

1979 - 1981

('000 TONS)

Country	Production
Dominican Republic	107.5
Ivory Coast	32.9
Jamaica	189.1
Malaysia	536.3
Nigeria	90.9
Republic of Korea	3666.5
Tunisia	335.3
Turkey	762.3
Egypt	1358.2
Kenya	129.4
Ethiopia (1981/82)*	15.5

SOURCE: Handbook of Industrial Statistics (1984)

* Statistical Abstract (1984)

- The low productivity of the livestock sector is partly attributed to the scarcity of forage supplies. It is estimated that 85% of forage intake is used to meet animal maintenance requirements, leaving only 15% for production.

The above and other related facts strongly suggest the need for accelerating the development of the animal feed processing industry of the country. The establishment of a straw treating and pelleting plant is particularly recommended for the following reasons:

- Straw is now fed to animals in its natural form which, besides its low nutritive value, is low in digestability and palatability due to its high lignin content. If treated with the necessary chemicals, its nutritive value and palatability can be greatly improved. In fact, it can be made comparable to good quality hay;

- Straw in its natural form is very bulky, making its storage and transportation cost very expensive. In the case of treated and pelleted straw, these costs can be substantially reduced, rendering its supply economical in areas other than where it is collected.

- In some areas, straw is produced in quantities more than it can be put to useful application and causes disposal problems. The establishment of a straw treating and pelleting plant will reduce, the disposal cost of farms in such cases.

Quantifying the demand for animal feeds in general, and for pelleted straw in particular, is difficult for a number of reasons:

- A complete data on the modern livestock sector (state farms, cooperatives, private commercial dairy and poultry farms), which is the potential consumer of processed animal feeds (including treated and pelleted straw), and the supply situation of animal feeds (processed and natural) is not available or easily obtainable;

- There is no fixed feeding formula applicable to a specific category of animal feeds (roughages or concentrates). Availability and cost of production or procurement determines the proportion to be recommended for consumption by a specific type of livestock. If roughage of very high quality is available in adequate quantity, and if concentrates are scarce, a higher proportion of roughages will be recommended. On the other hand, if a substantial quantity of concentrates are available, consumption of roughages will be reduced to the minimum level of requirement.

- The rate of consumption is also determined not only by the type of animal but also by the energy requirement, sex, age, weight and stage of lactation or gestation of each particular type of animal. These aspects are not available in quantified form nor standards have been established for them.

Notwithstanding the above facts, it does not require any effort to recognize the existence of a serious shortage in the supply of animal feeds of whatever form -- processed or natural. For instance, the existence of a black market for animal feeds, especially for flour mill by-products, indicates that the product is in short supply. Moreover, the difference in the selling prices between the producers (flour mills) and the black market shown below indicates the acuteness of the shortage. The price differences range from three fold for corn to thirteen fold for wheat brans.

	Factory Selling Price (Birr)	Black Market Selling Price[1] (Birr)
Wheat brans	6.12	85.00
Wheat middlings	7.14	90.00
Corn	30.00	100.00

Another report on animal feed supply and demand by the Ministry of State Farms Development[1] indicates a shortage in the supply of both concentrates and roughages. The supply situation in 76/77 of these two categories of animal feeds, with respect to dairy and poultry farms, was as follows:

---

[1] Investigative Report by the Central Zone Office of the Ministry of Agriculture (1977).

	Concentrates (Quintals)	Roughages (Hay) (Quintals)
Requirement	157,390	204,890
Actual	106,239	108,026
Shortage	51,151	96,864

A more pronounced shortage would have been revealed if the feed requirements of the following farms, which are not included in the above computation, is known:

- Private dairy and poultry farms,
- Farms owned by cooperatives,
- Fattening or beef cattle breeding state farms,
- Dairy and other farms owned by organizations such as the Relief and Rehabilitation Commission, the children's Commission, universities, charity organizations, etc.

It is difficult to give a quantified estimate of the present demand for treated and pelleted straw. However the above and other facts suggest that animal feeds of any type, including treated and pelleted straw, would command a substantial volume of the demand.

3. Demand Projection

Treated and pelleted straw is expected to have a substantial volume of demand to cover the current observed shortage in the supply of good quality roughages, and to meet additional requirements resulting from the future expansion of the livestock sector, particularly that of state and cooperative farms.

The 1987-89 three year plan envisages a substantial growth of the sector (See Table II). By 1989 State Farms and Cooperatives are expected to hold 210,000 sheep and goats and 54,400 cattle in their breeding and fattening ranches. The Ten-Year Perspective Plan also envisages that cattle under State Farms and Cooperatives would number over 90,000 by the end of the plan period (1994).

The projected demand for treated and pelleted straw was made with due consideration of the provisions in the above mentioned plans. The following were the major underlying considerations and assumptions in making the demand for treated and pelleted straw:

- The main market segment for treated and pelleted straw consists of farms engaged in beef cattle breeding and raising. Feeds of pelleted straw are required at a rate of 3.5 kgs per day per cattle. This is based on a standard recommendation in a report by the Ministry of State Farms Development.

- 50% of the feeds required for beef cattle have been allowed for animals in other types of farms (dairy, sheep and goats, poultry, etc.) under state, cooperative, or private ownership.

- It has been assumed that 75% of the 1987 - 89 plan and 60% of the Ten Year Perspective Plan will be realized with respect to the livestock sector. For the first two years (1981/82 and 1982/83) of the Ten Year Plan period the achievement rate was about 59%, on the average.

TABLE II

NUMBER OF BEEF CATTLE, SHEEP AND GOATS

UNDER STATE FARMS AND COOPERATIVES

1987 - 89 PLAN

('000 HEADS)

Year	State Farms		Cooperatives		Total	
	Sheep & Goats	Beef Cattles	Sheep & Goats	Beef Cattle	Sheep & Goats	Beef Cattle
1984/85 (Actual)	-	8.2	-	-	-	8.2
1985/86 (Estimate)	-	13.2	4.2.	6.2	4.2	19.4
1986/87	4.0	30.4	6.7	5.5	10.7	35.9
1987/88	7.0	43.4	9.8	6.9	16.8	50.3
1988/89	196.0	46.4	13.5	8.0	209.5	54.4

SOURCE: Three Year Plan (1987 - 89) For the Agricultural Sector

- For the years subsequent to 1994 (the last year of The Ten Year Perspective Plan) the livestock sector is assumed to grow annually by about 6%. The growth rate envisaged for the sector in the Ten Year Perspective Plan was 10.7%. Given the livestock resource base of the country and the sector's present low development level, the growth rate assumed is modest.

The projected demand for treated and pelleted straw is given in Table III. The demand for the product has been forecast to be 78,000 tons in 1989, and it is expected to grow to 175,000 tons by 2003. It should be noted, however, that because of the limitations of the data on which the projection is based, the demand projection should only be taken as indicative rather than conclusive.

TABLE III

DEMAND PROJECTION OF TREATED AND PELLETED STRAW

('000 TONS)

Year	Demand
1989	78.2
1994	103.5
1995	109.7
1996	116.3
1997	123.3
1998	130.7
1999	138.5
2000	146.8
2001	155.6
2002	165.0
2003	174.9

3. Pricing and Distribution

The average ex-factory selling price of straw pellet in Europe is reported to be about US $100 (Birr 207.00) per ton. Since the product is new to the Ethiopian market, no prices are available. The price of the close substitute product, loose hay, was reported to be Birr 1.80 per 17.5 kgs at the source of supply in 1984. This comes to about Birr 103.00 per ton. But pelleted straw has other cost related advantages justifying a higher price than for loose hay. Transportation and storage costs will be substantially lower in the case of pelleted straw. For instance, the Poultry Development and Feed Processing Enterprise was reported to have spent Birr 2.87 per bale, on the average during 1982-1984. A saving in the transportation cost of about 50%, which is a very conservative estimate, would result in a cost saving of about Birr 82.00 per ton. The saving in the storage cost will also be considerable. Thus pricing the pelleted straw (ex-factory) at about Birr 200.00 per ton appears reasonable.

Pelleted straw can be supplied either in bulk or in bags. In the latter case, the selling prices of the product should be adjusted upward to recover the cost of the bag and the bagging operation.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

Taking into consideration the indicative demand for nutritionally improved straw (NIS), the logistics of straw collection and the consumption centre of the finished products, the minimum economic and technical size processing plant and other relevant factors it is recommended that instead of one or two large plants, a series of 30,000 tpa units should be built. Because of raw material constraint, only three plants with a yearly capacity of 30,000 tons each have been recommended for the time being. For detailes of raw material availability see the chapter on Materials and Inputs.

2. Production Programme

Assuming that the proposed straw treatment plants would start production in 1991, the capacity utilization of the plant would be 80% in the first year. The capacity utilization is expected to reach 90% during the second year and 100% after the third year. The production programme, the capacity utilization and the demand gap are given in Table IV.

As the demand gap will keep on widening every year, it is proposed in this profile that the establishment of similar units should be considered after 1998.

TABLE IV
PRODUCTION PROGRAMME AND CAPACITY UTILIZATION

Year	Demand ('000 Tons)	Production Programme[1] ('000 Tons)	Demand Coverage[2] (%)	Capacity Utilization (%)
1991	88	24	82	80
1992	93	27	87	90
1993	95	30	95	100
1994	103.5	30	87	100
1995	109.7	30	82	100
1996	116.3	30	77	100
1997	123.3	30	73	100
1998	130.7	30	69	100
1999	138.5	30	65	100
2000	146.8	30	61	100
2001	155.6	30	58	100
2002	165.0	30	55	100
2003	174.9	30	51	100

1 The same production programme is adopted for the remaining two plants.

2 The output of all the three plants is compared with the projected demand.

IV. MATERIALS AND INPUTS

A. RAW MATERIALS

1. Straw Availability

The project is planned to process straw from wheat and barley, which are abundantly grown in the country .

The peasant farming sector, the dominant source of the country's agricultural produces, uses an average of 1.23 million hectares of land annually for growing wheat and barley only (See Table V). It will be difficult to collect straw commercially from the peasant sector, since the farms are scattered and the farmers use the straw, among others, to feed their cattle. An exception is the mechanized peasant cooperative farms, whose number is increasing, for example in the Arsi and Gojjam Administrative Regions.

With respect to the State Farms, the Southern Agricultural Development Corporation is the main, if not the only, producer of wheat and barley. The State Farm Enterprises under the Corporation, the wheat and barley farmlands and production are given in Table VI.

TABLE V

PEASANT SECTOR PRODUCTION OF WHEAT AND BARLEY
BY ADMINISTRATIVE REGIONS: 1982/83 and 1983/84 - MAIN SEASONS

Region	MAIN SEASON 1982/83				MAIN SEASON 1983/84			
	Barley		Wheat		Barley		Wheat	
	Area (Ha)	Production (Qt)	Area (Ha)	Production (Qt)	Area (Ha)	Production (Qt)	Area (Ha)	Production (Qt)
Total	693210	6014127	486580	4821120	748773	5067996	532677	420855
Arsi	123073	1297816	129720	1728932	116054	1156110	134145	1568957
Bale	24005	220840	11565	105311	26854	129650	11176	93371
Gamo Gofa	15836	106022	3939	31604	22352	126168	4182	35276
Gojjam	127197	919697	42448	415082	125704	673174	48379	352104
Gonder	95532	1300753	45382	491835	106642	915423	48608	386614
Hararghe	6630	52728	3149	26108	9071	59025	4274	29765
Illubabor	3388	26154	774	7529	3518	24810	1151	12021
Kaffa	8524	65168	3841	31284	6251	40967	4437	34501
Shewa	174072	13107[illegible]	184042	1563138	210671	1254647	187245	1221664
Sidamo	39842	278214	4341	43921	42742	225611	7987	58940
Wellega	21109	150367	6707	57937	21343	130724	7105	57188
Wello	54002	285599	50672	318439	62971	281687	73988	358154

SOURCE: General Agricultural Survey, Preliminary Report 1983/84, Vol.1.
Planning and Programme Dept, Ministry of Agriculture.

TABLE VI

SOUTHERN AGRICULTURAL DEVELOPMENT CORPORATION

PRODUCTION OF WHEAT AND BARLEY

1984/85 - 1986/87

State Farm Enterprise	Crop Type	1984/85		1985/86		1986/87		Annual Average		Total Average Hectar Per Enterprise	Expected Straw In Tons	Distance From	Remarks
		Area in Hectar	Prod. in Quintals	Area in Hectar	Prod. in Quintals	Area in Hectar	Prod. in Quintals	Area in Hectar	Prod. in Quintals				
ARSI													
Dixis	Wheat	8002	159282	7947	139198	7162	176048	7704	158176	7704	9245	Asella 92 km	
Lole	Wheat	747	23277	1425	46319	1186	36168	1119	35255	2680	3216	Asella 40 km	
	Barley	1581	38150	1480	30714	1623	35017	1561	34627				
Adelle	Wheat	5721	98007	5563	114864	5490	102088	5491	104986	5491	6589	Asella 139 km	
Garadella &	Wheat	8637	121872	8464	130832	8338	157861	8480	136855	11042	13250	Asella 132 km	
Temella (1)	Barley	2409	12716	2574	36637	2704	44469	2562	31274			(near Asasa)	
Goffer	Wheat	2927	30353	2367	38503	3114	71284	2803	46713	4460	15352	Asella 142 km	
	Barley	1733	21857	2044	24557	1195	10515	1657	18974			(Shashemene 25 km)	
Sub-Total	Both	31757		31864		30512		31377		31377	37652		
BALE													
Herero & Hunte (2)	Wheat	6956	10555	8748	154567	8154	190643	7953	118588	9869	11843	Shashemene 80 km	
	Barley	2371	22852	1484	22754	1892	36266	1916	27291				
Sinanna	Wheat	8614	107453	9498	144306	9292	149587	9135	133782	10361	12433	Robe/Bale 14-40 km	
	Barley			1144	18540	1307	32449	1226	25495				
Shenika	Wheat	3065(3)	13690(3)	6199	45561	6132	53110	6166	49336	6166	17399	Robe/Bale 78 km	
Dinkiti	Wheat	6907	106386	6535	109505	7000	105404	6814	107098	6814	8177	Robe/Bale 90 km	
Scrufta	Wheat	4048	93588	4865	122661	4295	111795	4403	109348	6803	8163	Robe/Bale 135 km	
	Barley	2268	43396	2229	44334	2704	40640	2400	42790				
Gololcha	Wheat			4902(3)	7754(3)	6138	127439	6138	127439	6139	7366	Robe/Bale 130 km	
Sub-Total	Both	34229		45604		46914		46151		46151	55381		
GRAND TOTAL	Both	65986		77468		77426		77528		77528	93033		

NOTE:
(1) Garadella and Temella have been separated as two independent enterprises since 1985/86.
(2) Herero and Hunte have been separated as two independent enterprises since 1986/87.
(3) Figures excluded from the averages since they are unrepresentative.

SOURCE: Southern Agricultural Development Corporation, Addis Ababa.

The actual quantity of the available straw depends on several factors, including plant variety, soil conditions, fertilisers, meteorological conditions, harvesting techniques, etc. With the exception of about 1600 tons of straw per year presently collected by the Animal Feed Corporation from the Dixis State Farm for animal feed preparation, the state farms burn their straw at a cost to clear the farm for the next plantation and only a negligible amount is grazed by roaming herd.

It is generally believed that an average of 1.25 tons of straw per hectare can be mechanically recovered from the state farms, the unrecoverable part serves the purpose of enriching the soil for the next season. The recorded data from the Dixis State Farm puts the average net recovery as high as 2.1 tons/hectare. It must be noted, however, that the grain yield rate of the Dixis State Farm is also higher than the average; third among the state farms, exceeded by the Lole State Farm which has the highest yield rate and the Serufta State Farm standing second.

To be on the conservative side, an average recoverable straw rate of 1.2 tons/hectare has been used in this study for all state farms. This gives a total of about 93,000 tons of mechanically recoverable wheat and barley straw from the state farms in the Arsi and Bale Administrative Regions only, 37,650 and 55,380 tons, respectively. Details for each farm are given in Table VI.

The Ministry of State Farms Development in conjunction with the Southern Agricultural Development Corporation are presently entertaining a project idea to produce about 5000 tons per year of straw briquets at the Dixis State Farm. This still leaves about 88,000 tons of straw per year available in the state farms for the project and the Straw Board Project being studied parallely.

The peasant co-operatives in Arsi Region put estimated area ranging from 6940 hectares in 1982/83 to 23580 hectares in 1985/86 under wheat and barley. The corresponding recoverable quantity of straw was thus estimated to vary between 8328 tons and 28,296 tons. Similarly the co-operatives in Bale Region used an area ranging from 2510 hecatres to 7880 hectares for wheat and barley during the same period. This gives about 3000 tons and 9500 tons of recoverable straw. The maximum combined recoverable quantity was about 38,000 tons, indicating that the peasant co-operatives farms are potentially useful raw material sources as well (See Table VII).

The above potential straw supply will gradually tend to increase as a result of the increasing number of mechanised peasant cooperative farms which are mainly concentrated in the Arsi Region and the expansion programme envisaged in the state farm enterprises.

2. Straw Collection and Storage

The straw collection for delivery to this project can be carried out in a similar manner as is presently being done at Dixis State Farm. At present, all harvesting is carried out by combine harvesters. The recoverable straw is picked up and baled by mechanised square balers (John Deere 342 A) producing bales of about 15 kg with a dimension of 1.00 x 0.46 x 0.36 meters (0.166 m^3/bale). The bales are ejected from the baler as it moves and manually collected and placed in piles at the perimeter of the field. The bales are then manually loaded on trailers for delivery.

It will be necessary to replace the manual field collection of bales with wheel tractor driven trailers as the consignment is going to be much higher than the present one.

TABLE VII

ESTIMATED AREA UNDER CROPS AND QUANTITY OF RECOVERABLE STRAW IN PEAST CO-OPERATIVE FARMS, 1982/83 - 1985/86

Region	Crop Type	Area Under Crop in Hectares				Recoverable Quantity[1]	
		1982/83	1983/84	1984/85	1985/86	Minimum (tons)	Maximum (tons)
Arsi	Barly	3870	3240	4460	8260		
	Wheat	3070	5600	7730	15320		
	Sub-Total	6940	8840	12190	23580	8328	28296
Bale	Barley	1740	1220	3120	3470		
	Wheat	2510	1290	4620	4410		
	Sub-Total	4250	2510	7740	7880	3012	9456
Grand Total (Arsi + Bale)		11190	11350	19930	31460	13428	37752

Source : Time Series Data on Area, Production and Yield of Major Crops, Central Statistical Authority, Oct. 1987.

[1] Estimated using a recoverable rate of 1.2 tons/hectare.

It must be noted that harvesting starts at the end of October or early November and is generally completed by early January. The straw collection has to be carried out simultaneously for the fields have to be cleared for preparation for the next plantation which starts shortly thereafter. This leaves a net collection period of about three months and the capacity of the collecting facilities (balers, trailers, wheel tractors, labour, etc.) has to take these factors into account.

The storage facility at the project site should also consider the seasonal supply of straw. Considering the high volume of the storage requirement, it will be preferable to use open storage, where the straw is covered with light weight tarpaulins only. Enough space should be left between the bale piles (about 5m) to create a fire break. Taking this into account, a ratio of the straw volume (in tons) to the storage space area (in m^2) of about 1:2 can be used to estimate the open space requirement.

B. UTILITIES

The utility requirements of the 30,000 tpa plant are as follows:

Electricity	60,000 kWh/year
Water	1,000 m^3/year

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

The main raw materials required are straw and a small quantity of sodium hydroxide, unless other nutritional additives are required. This will depend on the individual circumstances such as the type of animals to be fed and their overall diet. The straw should contain less than 19.5% of moisture on delivery into the plant. The pellet has a moisture content of 12% and on average there is a 2% straw loss in the process. Therefore total intake of straw to make one ton of pellets is upto 1.1 tons. Thus, based on the planned production programme, the annual supply programme of straw will be 26,400, 29,700 and 33,000 tons in the first, second and third years, respectively.

D. MATERIAL AND INPUT COSTS

1. Cost of Raw Material

The total annual cost of straw and sodium hydroxide (about 150 tons) will be Birr 1.82 million. It is assumed that the straw will be supplied at the factory gate at a cost of Birr 50/ton.

2. Cost of Utilities

Electricity

The cost of electricity will be Birr 0.22/kWh.

Water

Water for process (if required) and potable uses will cost Birr 0.5/m^3.

3. Other Costs

Fuel for Vehicles

The total annual fuel cost for vehicles is estimated to be Birr 20,000.

Packing Materials

The NIS pellets (1 cm in diameter and 3 cm long) are to be packed in 50 kg sacks and the product should be kept dry. The cost for packing will be about Birr 420,000/year. Bulk packing (1 ton) could also be considered.

V. LOCATION

The determination of a proper location of the proposed straw treatment plant requires a detailed study of the agricultural area with regard to arable crop density, straw yields per hectare, methods of harvesting and handling and the relative locations of livestock centres vis-a-vis the production units.

The identification of locations for the straw treatment plant in this study was based on the following major factors:

- Potential availability of straw,
- Transportation costs of raw material vis-a-vis the end-product,
- Relative locations of livestock centres vis-a-vis the production units, and
- The availability of suitable infrastructure.

As mentioned earlier under Raw Materials and Inputs, the Arsi and Bale Administrative Regions are the two potential straw supply sources. On the other hand, the consumption centres (farms) of the finished products are scattered in various parts of the country. In addition, according to the Ten Year Perspective Plan, six new farms with the following capacities are planned:

Kombolcha - 29,930 beef cattle/year, comprising 14,930 for live export and 15,000 for processing.

Dire Dawa - 79,205 beef cattle/year, comprising 19,205 for live export and 60,000 for processing.

Malge Wondo - 99,006 beef cattle/year, comprising 19,006 for live export and 80,000 for processing.

Debre Zeit - 143,587 highland sheep from farms around Sheneka and Dinkiti.

Jijiga - 17,255 beef cattle for processing in a new slaughterhouse.[1]

It is clear from the above that the planned farms in Kombolcha, Dire Dawa and Jijiga are relatively far from the raw material sources, while the farms in Malge Wondo and Debre Zeit would be at a reasonable distance from the raw material sources. Moreover, the combined capacities of these two farms is by far greater than the other three.

One major advantage of straw pelletising is that it increases the bulk density of the straw by at least five times. As a result, it is preferable to transport the end-product to the consumption centres rather than the raw material to the production unit near the consumption centre.

In view of the above major factors, it is recommended that the proposed plants should be located at the source of the raw material. (See Table VI). The annual yield of straw in any one of the state farms is below 33,000 tons which is required for one processing plant. Therefore the plants has to be supplied from more than one farm. Garadella and Temella, Goffer and Herero and Hunte have been identified as the source of the straw supply (about 30,500 tons), since they are located close to each other and within a radius of 40 km from Asosa. Therefore one straw treatment plant could be located at Asasa, 132 km from Asella near the Garadella and Temella State Farms. One more plant could be established in Arsi region, particularly in the proximity of the peasant co-operative farms and a third one in Bale Region.

---

1 Slaughterhouse By-Products Utilization in Ethiopia, Agroconsult Dresden, December 1986. Hides Tannery Feasibility Study, April 1986.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Alternative Technologies of Straw Treatment

The production of nutritionally improved straw (NIS) may be carried out either by on-farm processing or by factory controlled processing methods.

a. On-Farm Processing

On farm processing of straw is carried out, as the name implies at the site where there is an abundant amount of straw, using heavy mobile truck and the accessories required for the chemical treatment, mechanical working and extrusion. The treated straw can be fed directly to animals on farms. Although the on-farming process entails cost savings in transporting the straw as well as the finished product, it has the following major drawbacks:

- The process is not continuous and fast, and
- The location of livestock centres in distant farms from the production units might not always warrant the use of on-farm processing.

b. Factory Controlled Processing

The factory controlled processing by chemical treatment (sodium hydroxide) mechanical working (grinding) and cooking (extrusion) is continuous and fast. It also yields a finished product which is of consistent and high quality.

There would also be economies of scale, if multiple units are built instead of one large processing plant. Hence it is possible to locate a series of plants at sites close to the consumption centres.

2. Manufacturing Process

The manufacturing process of nutritionally improved straw consists of three main parts:

- Straw intake,
- Grinding, mixing and extrusion, and
- Finishing.

a. Straw Intake

The straw bales will be delivered to the plant and stored in an area adjacent to the two intake points of the tub grinders. Initial particle size reduction is required to convert the baled straw to a form which can be conveyed mechanically in the plant. All metal ties must be removed before the tub grinder, which is designed to handle bales of different dimensions and densities, is loaded with bales by a fork lift truck. The bales are broken down and ground via suitable rotary beaters through screen baskets. The hole sizes of the baskets determine the coarseness of the grind. From the underside of the tub grinder, the coarsely ground material passes to the storage conveyor. This conveyor regulates the flow of straw to the second girnding process with the flow controlled by the process requirements.

b. Grinding

From the storage conveyor, the material is moved to a point in front of the furnace where it drops into a duct and is conveyed into the grinder pneumatically. During the time the material is in the duct it is dried by hot gases, stones are removed in a stone trap and ferrous materials by a bank of magnets. The drying acts to partially condition the straw and reduce the future power requirement in the grinder, which is a rotor beater type with a large screen area, located in a pit. The action of the mill effectively increases the surface area of the straw mass and can be used to control the particle size or fibre length in the final extruded product. After grinding the material is pneumatically conveyed to the grinder cyclone and enters the mixer via a suitable rotary seal. The air is returned to the atmosphere outside the building.

The mixer unit is designed to mix the ground straw with the sodium hydroxide which is added in the required amount by an automatic addition system linked to the band weigher. The band weigher reads the exact weight of ground straw to be processed and hence fixes the corresponding amount of sodium hydroxide to be added. Water can be added in the same way, if required.

From the mixer the material is conveyed to the press feeders which control the amount of material required by each press. Any material which is not required goes to the overflow bin which is emptied when necessary and recycled by the pneumatic system into the conveyor feeding the presses.

From the extrusion presses the hot pellets are conveyed to the band weigher at which stage certain acids can be added for nutritional reasons, if required. The hot pellets enter the horizontal cooler and pass through the length of the cooling chamber. Air is pulled through the product bed and is extracted via the fan and cyclone, with any dust returning to the process via a suitable rotary seal. The air is returned to the atmosphere outside the building.

c. Finishing

From the end of the cooler the finished product is conveyed to the elevator and molasses can be added at this stage, if required for nutritional reasons. From the head of the elevator the material is conveyed to either a storage bay outside the building or a packing system.

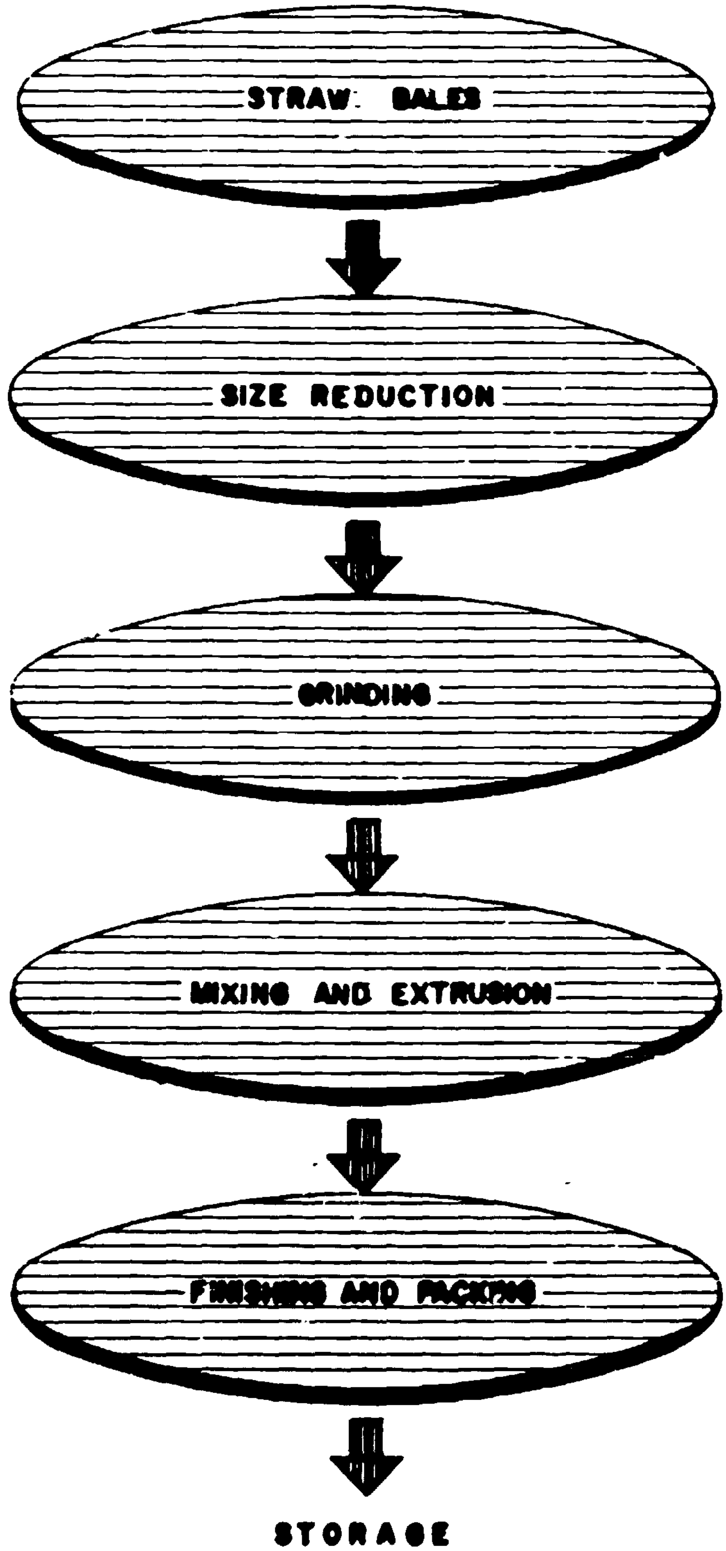
The packing system consists of a small holding bin which is connected to a 50 kg weigher. The weighed material is dropped into a suitable sack or bag and is conveyed to a stitching unit which is located along the length of the bag conveyor. A simplified process flow chart is given in Figure I.

The main advantages of the NIS process are as follows:

- It handles bales of any size,
- It increases the bulk density of the straw at least five times,
- The process is continuous and fast,
- Atmospheric and water pollution are neglible,
- The finished product is of a consistent and high quality, and
- NIS pellets have good handling and storage characteristics.

FIGURE I

PROCESS FLOW CHART OF STRAW PELLETISING



3. Source of Technology

The equipment, installation and transfer of technology is available from:

BOCM Silicock Ltd,
Basing View,
Basingstoke,
Hampshire RG21 2EQ,
UK.
Telephone 0256 29211
Telex 858429

B. ENGINEERING

1. Machinery and Equipment

The machinery required to process 30,000 tons of straw per year and the cost estimates are given in Table VIII.

2. Plant Layout

The layout of the proposed plant is shown in Figure II. The area requirement for production and offices is estimated to be 650 m^2 with the following breakdown:

- factory - 40 m x 15 m = 600 m^2
- silos - 4 x 125 tonne capacity each
- weighbridge/office - 5 m x 10 m = 50 m^2
- plant site 1800 m^2 (large enough to store a day's production)

TABLE VIII
TOTAL FIXED INVESTMENT COST

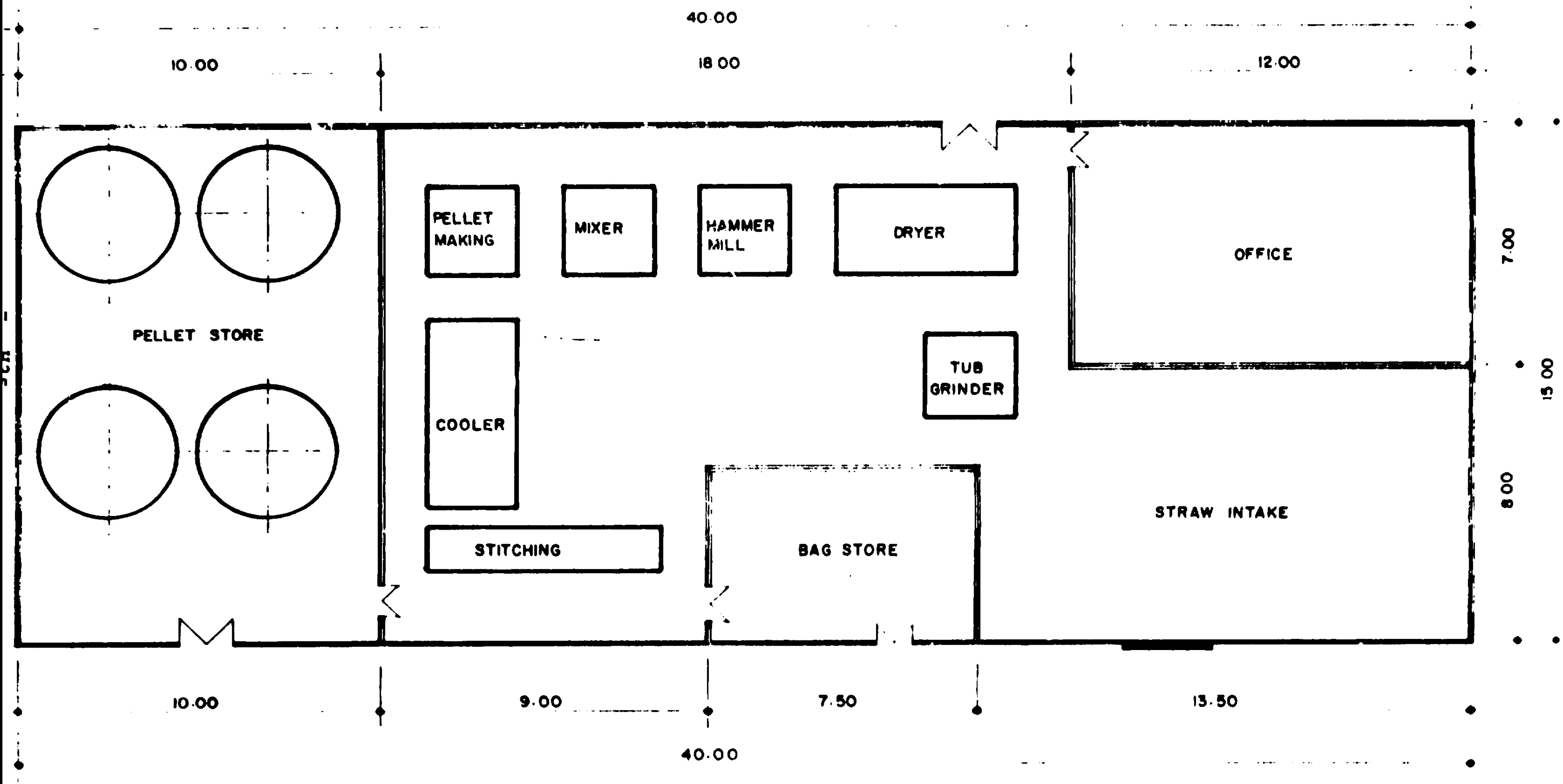
Description	COST ('000 Birr)		
	F.C	L.C.	TOTAL
A. MACHINERY AND EQUIPMENT			
1. Plant and Spares(turnkey)	2898	-	2898
2. Fork lift truck	52	-	52
3. Silos (4x125 tonnes) with feeder system	248	-	248
Total plant cost	3,198	-	3,198
Freight	-	320	320
Total Machinery Cost (C & F)	3,198	320	3,518
Local Cost (12.5% of C & F)	-	440	440
Total Cost of Machinery and Equipment (Incl. 10% Contingency)	3,518	836	4,354
B. BUILDING AND CIVIL WORKS			
1. Building Cost	175.5	409.5	585
2. Site Development (2% of Building Cost)	-	11.7	11.7
3. Outdoor Works (Sewage, drainage piping, etc. 10% of building cost)	-	58.5	58.5
Total Building and Civil Works Cost (Incl. 10% Contingency)	193	527	720

TABLE VIII (Cont'd)

Description	COST ('000 BIRR)		
	F.C.	L.C.	TOTAL
C. SERVICE EQUIPMENT			
Office Furniture and Equipment	13	22	37
D. VEHICLES			
Pick-up (one)	28	12	40
Service car (one)	17	8	25
10% contingency	4.5	2	6.5
Sub-Total	50	22	72

FIGURE II

PLANT LAYOUT FOR STRAW PELLET PRODUCTION



Scale 1:150

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of the proposed straw treatment plant is given in Figure III It consists of five divisions, namely Production, Maintenance, Commercial, Accounts and Administration. The heads of all divisions will directly report to the plant manager.

B. MANPOWER

The manpower requirements for three shifts is shown in Table IX. It is estimated that the plant would employ 65 people. On-the-job training is assumed to be as part of the turnkey project.

FIGURE III

ORGANIZATION CHART OF STRAW TREATMENT PLANT

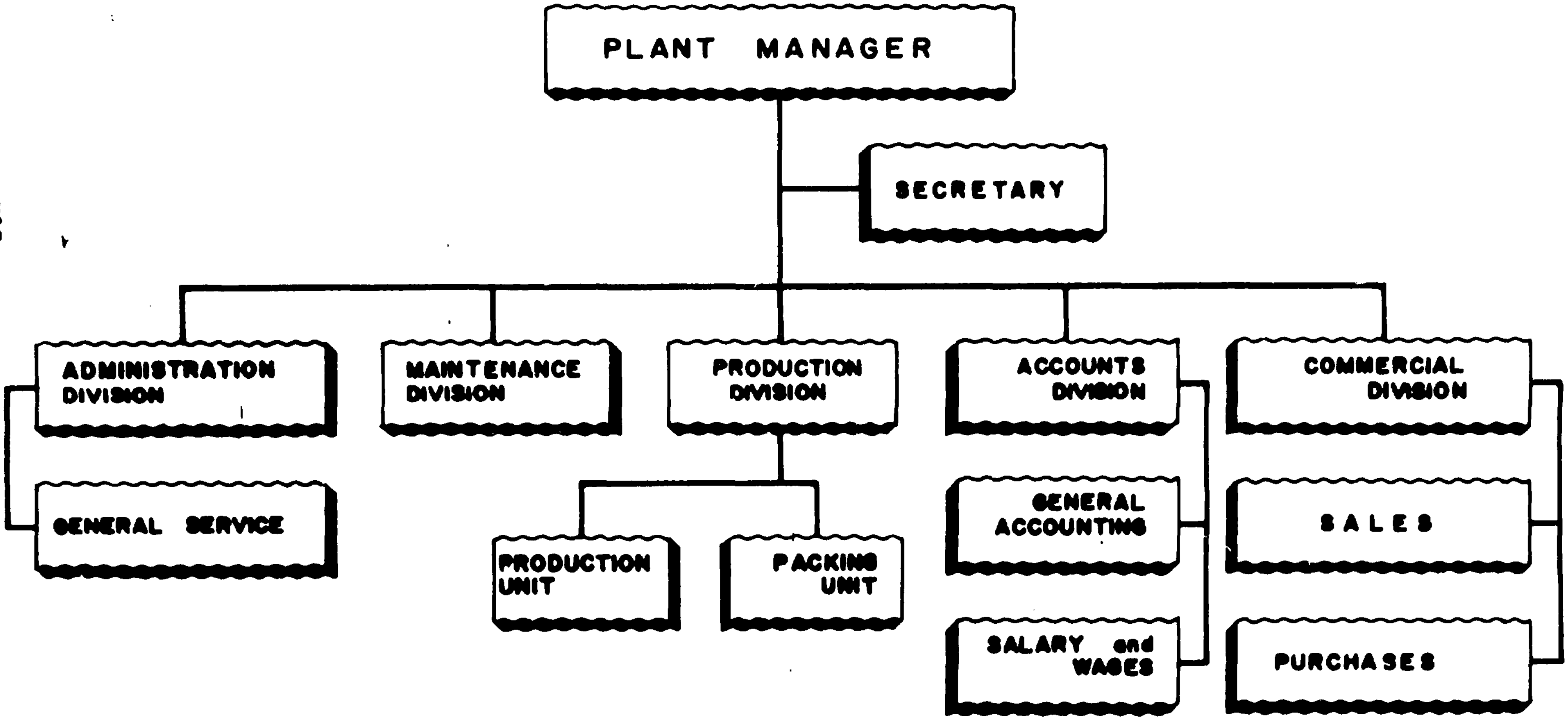


TABLE IX

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. of Shifts	No. Employed	Skill Level	Monthly Salary/ Person (Birr)	Total Annual Salary (Birr)
Plant Manager	1	1	Professional/tech	1200	14,400
Secretary	1	1	Skilled	350	4,200
Accountant (Chief)	1	1	"	700	8,400
Accountant	1	1	"	450	5,400
Clerk	1	2	"	250	6,000
Administrator	1	1	"	600	7,200
General Service	1	2	"	350	8,400
Commerical, Head	1	1	"	600	7,200
Sales	1	1	"	450	5,400
Collection/Distribution Controller	1	1	"	450	5,400
Store Keeper	3	3	"	250	9,000
Production Supervisor	3	3	"	500	1,800
Maintenance, Head	3	3	"	700	25,200
Electrician/Mechanic	3	6	"	450	32,400
Fork Lift Truck Driver	3	6	"	250	18,000
Process Operator	3	12	Semi-skilled	150	21,600
Labourer	3	9	Unskilled	90	9,720
Driver	1	2	Skilled	250	6,200
Guard	3	6	Unskilled	90	6,480
Messenger	1	1	"	70	840
Cleaner	1	2	"	70	1,680
Total (Includes 25% Employment Benefit)		65			276,150

Skill Distribution

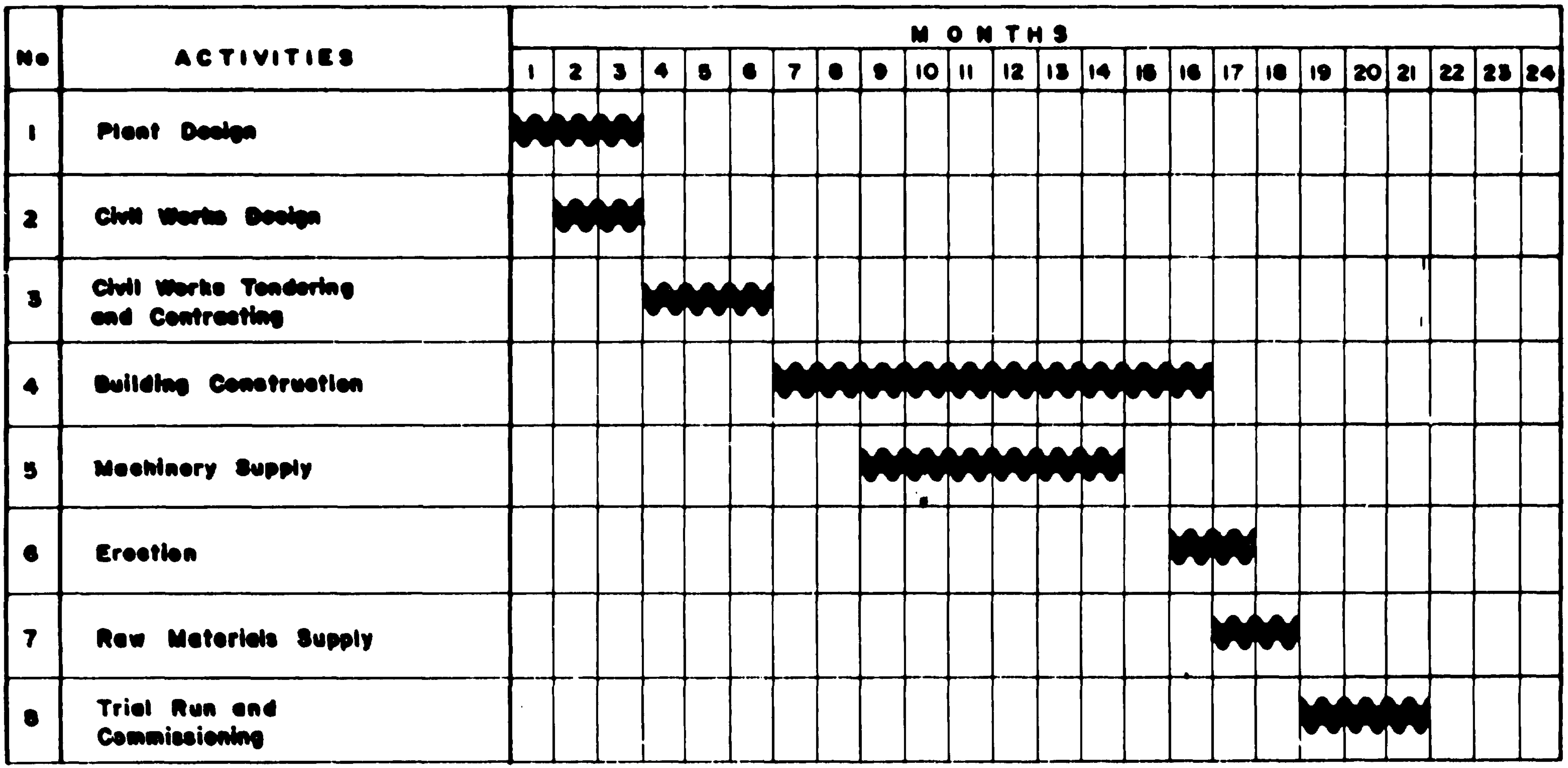
		%
Professional/technical	1	1.5
Skilled	34	52
Semi-skilled	12	18
Unskilled	18	28
Total	65	100

VIII. IMPLEMENTATION SCHEDULE

A general schedule for the project implementation has been worked out and is given in Figure IV. It is estimated that about 21 months will be required for the plant construction and startup.

FIGURE IV

IMPLEMENTATION SCHEDULE OF STRAW TREATMENT PLANT



IX. FINANCIAL AND ECONOMIC EVAUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table X.

TABLE X

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Buildings and Civil Works	193.00	527.00	720.00
Plant Machinery and Equipment	3518.00	836.00	4354.00
Office Furniture and Equipment	13.00	22.00	35.00
Vehicles	50.00	22.00	72.00
Preproduction Expenditure	640.06	425.44	1065.50
Total	4414.06	1832.44	6246.50

The straw treatment and pelletising plant requires an initial investment cost of Birr 6.25 million. The foreign currency component amounts to Birr 4.41 million which represents 71% of the total initial investment cost. The other 29% is required in local currency. About 80% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the net working capital requirements of the straw pelletising plant.

Item	Months of Coverage
1. Cash in hand	0.5
2. Accounts Receivable	1.0
3. Raw Materials - straw	9.0
4. Work in progress	0.5
5. Finished products	1.0
6. Accounts payable	1.0

The net working capital requirement at full capacity amounted to Birr 1.74 million. About 2% of the total net working capital required will be in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The total production cost at full capacity amounts to Birr 3.52 million, out of which about 20% is in foreign currency.

4. Internal Rate of Return (IRR)

The straw pelletising plant will be financially viable with an internal rate of return of 30.10% and a net present value of Birr 11.25 million calculated at 10% p a. discount rate.

The selling price assumed for the financial analysis was Birr 260 per ton.

5. Breakeven Analysis

The breakeven point would be reached at a production of 6108 tons of nutritionally valuable pellets. The total revenue generated at the breakeven point would be Birr 1.59 million. This means the plant would breakeven if it uses 20% of its capacity.

B. ECONOMIC ANALYSIS

The straw treatment and pelletising plant will be economically viable with an economic rate of return of 42.48% and a net present value of Birr 18.65 million discounted at 10% p.a.

The project will create employment for about 65 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

COMFAR © 2.1 UNIDO

Straw Treatment and Pelletizing
Financial Analysis - July 1988
Opportunity Study _ Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	6245.20	70.658 % foreign
current assets:	0.00	0.000 % foreign
total assets:	6245.20	70.658 % foreign

Source of funds during construction phase

equity & grants:	6245.20	70.658 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	6245.20	70.658 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	2334.52	2577.45	2820.39
depreciation :	702.27	702.27	702.27
interest :	0.00	0.00	0.00
production costs	3036.79	3279.72	3522.66
thereof foreign	21.02 %	20.45 %	19.44 %
total sales :	6240.00	7020.00	7800.00
gross income :	3203.21	3740.28	4277.34
net income :	1601.61	1870.14	2138.67
cash balance :	897.88	2404.83	2873.36
net cashflow :	897.88	2404.83	2873.36

Net Present Value at: 10.00 % : 11254.08
Internal Rate of Return: 30.10 %
Return on equity1: 27.24 %
Return on equity2: 30.10 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	360.00	360.00
Auxiliary and service facilities	25.00	47.00
Incorporated fixed assets	13.90	19.80
Plant machinery and equipment	2612.00	1742.00
Total fixed investment costs	3010.90	2168.80
Pre-production capital expenditures.	532.75	532.75
Net working capital	0.00	0.00
Total initial investment costs	3543.65	2701.55
Of it foreign, in %	72.11	68.76

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9	10-12
% of nom. capacity (single product)	80.00	90.00	100.00	100.00	100.00	100.00
Raw material 1	1456.00	1638.00	1820.00	1820.00	1820.00	1820.00
Other raw materials	336.00	378.00	420.00	420.00	420.00	420.00
Utilities	11.23	12.47	13.70	13.70	13.70	13.70
Energy	16.40	18.20	20.00	20.00	20.00	20.00
Labour, direct	276.15	276.15	276.15	276.15	276.15	276.15
Repair, maintenance	210.57	224.56	238.54	238.54	238.54	238.54
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	10.56	11.28	12.00	12.00	12.00	12.00
Factory costs	2316.92	2558.65	2800.39	2800.39	2800.39	2800.39
Administrative overheads	17.60	18.80	20.00	20.00	20.00	20.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	702.27	702.27	702.27	474.77	479.77	489.17
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	3036.79	3279.72	3522.66	3295.16	3300.16	3309.56
Costs per unit (single product)	0.13	0.12	0.12	0.11	0.11	0.11
Of it foreign, %	21.62	20.45	19.44	16.59	16.67	16.82
Of it variable,%	64.00	66.67	68.96	73.73	73.61	73.40
Total labour	276.15	276.15	276.15	276.15	276.15	276.15

Straw Treatment and Pelletising --- Financial Analysis - July 1988

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	13-17
% of nom. capacity (single product)	100.00
Raw material 1	1820.00
Other raw materials	420.00
Utilities	13.70
Energy	20.00
Labour, direct	276.15
Repair, maintenance	238.54
Spares	0.00
Factory overheads	12.00
Factory costs	2800.39
Administrative overheads	20.00
Indir. costs, sales and distribution	0.00
Direct costs, sales and distribution	0.00
Depreciation	50.40
Financial costs	0.00
Total production costs	2870.79
Costs per unit (single product)	0.10
Of it foreign, %	7.09
Of it variable,%	84.62
Total labour	276.15

TABLE A.4

COMFAR

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	194.54	214.79	235.03	235.03
Inventory and materials	270	1.3	1092.00	1228.50	1365.00	1365.00
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	15	24.0	96.54	106.61	116.68	116.68
Finished products	30	12.0	194.54	214.79	235.03	235.03
Cash in hand	15	24.0	21.45	22.12	22.78	22.78
Total current assets			1599.08	1786.80	1974.53	1974.53
Current liabilities and						
Accounts payable	30	12.0	193.08	213.22	233.37	233.37
Net working capital			1406.00	1573.58	1741.16	1741.16
Increase in working capital			1406.00	167.58	167.58	0.00
Net working capital, local			1380.00	1545.24	1710.49	1710.49
Net working capital, foreign			26.01	28.34	30.67	30.67

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	3543.65	2701.55
Financial resources	3543.65	2701.55
Sales, net of tax	0.00	0.00
Total cash outflow	3543.65	2701.55
Total assets	3543.65	2701.55
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surpus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	988.42	844.02
Outflow, local	988.42	844.02
Surplus (deficit)	0.00	0.00
Inflow, foreign	2555.23	1857.53
Outflow, foreign	2555.23	1857.53
Surplus (deficit)	0.00	0.00
Net cashflow	-3543.65	-2701.55
Cumulated net cashflow	-3543.65	-6245.20

TABLE A.5 (Cont'd)

COMFAR

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	6433.08	7040.14	7820.14	7800.00	7800.00	7800.00
Financial resources	193.08	20.14	20.14	0.00	0.00	0.00
Sales, net of tax	6240.00	7020.00	7800.00	7800.00	7800.00	7800.00
Total cash outflow	5535.20	4635.32	5146.78	4959.06	4959.06	5097.81
Total assets	1599.08	187.72	187.72	0.00	0.00	25.00
Operating costs	2334.52	2577.45	2820.39	2820.39	2820.39	2820.39
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	1601.61	1870.14	2138.67	2138.67	2138.67	2252.42
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	897.88	2404.83	2673.36	2840.94	2840.94	2702.19
Cumulated cash balance	897.88	3302.70	5976.06	8817.00	11657.94	14360.13
Inflow, local	6420.07	7038.98	7818.98	7800.00	7800.00	7800.00
Outflow, local	5340.16	4461.80	4959.29	4775.06	4775.06	4896.81
Surplus (deficit)	1079.91	2577.17	2859.69	3024.94	3024.94	2903.19
Inflow, foreign	13.00	1.17	1.17	0.00	0.00	0.00
Outflow, foreign	195.04	173.51	187.50	184.00	184.00	201.00
Surplus (deficit)	-182.04	-172.35	-186.33	-184.00	-184.00	-201.00
Net cashflow	897.88	2404.83	2673.36	2840.94	2840.94	2702.19
Cumulated net cashflow	-5347.32	-2942.50	-269.14	2571.80	5412.74	8114.93

Straw Treatment and Pelletizing --- Financial Analysis - July 1988

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	7800.00	7800.00	7800.00	7800.00	7800.00	7800.00
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	7800.00	7800.00	7800.00	7800.00	7800.00	7800.00
Total cash outflow . .	5117.31	5065.61	5065.61	5065.61	5310.00	5332.00
Total assets	47.00	0.00	0.00	0.00	25.00	47.00
Operating costs . . .	2820.39	2820.39	2820.39	2820.39	2820.39	2820.39
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	2249.92	2245.22	2245.22	2245.22	2464.60	2464.60
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	2682.69	2734.39	2734.39	2734.39	2490.00	2468.00
Cumulated cash balance	17042.82	19777.21	22511.60	25245.99	27736.00	30204.00
Inflow, local	7800.00	7800.00	7800.00	7800.00	7800.00	7800.00
Outflow, local	4900.31	4881.61	4881.61	4881.61	5109.00	5115.00
Surplus (deficit) .	2899.69	2918.39	2918.39	2918.39	2691.00	2685.00
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	217.00	184.00	184.00	184.00	201.00	217.00
Surplus (deficit) .	-217.00	-184.00	-184.00	-184.00	-201.00	-217.00
Net cashflow	2682.69	2734.39	2734.39	2734.39	2490.00	2468.00
Cumulated net cashflow	10797.62	13532.01	16266.40	19000.79	21490.79	23958.80

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	7800.00	7800.00	7800.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	7800.00	7800.00	7800.00
Total cash outflow	5285.00	5285.00	5285.00
Total assets	0.00	0.00	0.00
Operating costs	2820.39	2820.39	2820.39
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	2464.60	2464.60	2464.60
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	2515.00	2515.00	2515.00
Cumulated cash balance	32719.00	35234.01	37749.01
Inflow, local	7800.00	7800.00	7800.00
Outflow, local	5101.00	5101.00	5101.00
Surplus (deficit)	2699.00	2699.00	2699.00
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	184.00	184.00	184.00
Surplus (deficit)	-184.00	-184.00	-184.00
Net cashflow	2515.00	2515.00	2515.00
Cumulated net cashflow	26473.80	28988.80	31503.81

TABLE A.5 (Cont'd)

COMFAR (c)

---------------------------------- -- ------------------------------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Cashflow Discounting.

a) Equity paid versus Net income flow:

Net present value	8809.81	at	10.00 %
Internal Rate of Return (IRRE1) .	27.24 %		

b) Net Worth versus Net cash return:

Net present value	11254.69	at	10.00 %
Internal Rate of Return (IRRE2)	30.10 %		

c) Internal Rate of Return on total investment.

Net present value	11254.69	at	10.00 %
Internal Rate of Return (IRR) ..	30.10 %		

Net Worth : Equity paid plus reserves

-------------------------------------- ---

TABLE A.6

COMFAR

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	6240.00	7020.00	7800.00	7800.00	7800.00
Less: variable costs, incl. sales tax	1943.50	2186.43	2429.37	2429.37	2429.37
Variable margin	4296.50	4833.57	5370.63	5370.63	5370.63
As % of total sales	68.85	68.85	68.85	68.85	68.85
Non-variable costs, incl. depreciation	1093.29	1093.29	1093.29	1093.29	1093.29
Operational margin	3203.21	3740.28	4277.34	4277.34	4277.34
As % of total sales	51.33	53.28	54.84	54.84	54.84
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	3203.21	3740.28	4277.34	4277.34	4277.34
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	3203.21	3740.28	4277.34	4277.34	4277.34
Tax	1601.61	1870.14	2138.67	2138.67	2138.67
Net profit	1601.61	1870.14	2138.67	2138.67	2138.67
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1601.61	1870.14	2138.67	2138.67	2138.67
Accumulated undistributed profit	1601.61	3471.75	5610.42	7749.08	9887.75
Gross profit, % of total sales	51.33	53.28	54.84	54.84	54.84
Net profit, % of total sales	25.67	26.64	27.42	27.42	27.42
ROE, Net profit, % of equity	25.65	29.95	34.25	34.25	34.25
ROI, Net profit+interest, % of invest.	20.93	23.92	26.78	26.78	26.78

TABLE A.6 (Cont'd)

COMFAR

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	7800.00	7800.00	7800.00	7800.00	7800.00
Less: variable costs, incl. sales tax.	2429.37	2429.37	2429.37	2429.37	2429.37
Variable margin	5370.63	5370.63	5370.63	5370.63	5370.63
As % of total sales	68.85	68.85	68.85	68.85	68.85
Non-variable costs, incl. depreciation	865.79	870.79	880.19	880.19	880.19
Operational margin	4504.84	4499.84	4490.44	4490.44	4490.44
As % of total sales	57.75	57.69	57.57	57.57	57.57
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	4504.84	4499.84	4490.44	4490.44	4490.44
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	4504.84	4499.84	4490.44	4490.44	4490.44
Tax	2252.42	2249.92	2245.22	2245.22	2245.22
Net profit	2252.42	2249.92	2245.22	2245.22	2245.22
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	2252.42	2249.92	2245.22	2245.22	2245.22
Accumulated undistributed profit	12140.17	14390.09	16635.31	18880.54	21125.75
Gross profit, % of total sales	57.75	57.69	57.57	57.57	57.57
Net profit, % of total sales	28.88	28.85	28.78	28.78	28.78
ROE, Net profit, % of equity	36.07	36.03	35.95	35.95	35.95
ROI, Net profit+interest, % of invest.	28.12	27.92	27.86	27.86	27.86

TABLE A.6 (Cont'd)

COMFAR

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	7800.00	7800.00	7800.00	7800.00	7800.00
Less: variable costs, incl. sales tax.	2429.37	2429.37	2429.37	2429.37	2429.37
Variable margin	5370.63	5370.63	5370.63	5370.63	5370.63
As % of total sales	68.85	68.85	68.85	68.85	68.85
Non-variable costs, incl. depreciation	441.42	441.42	441.42	441.42	441.42
Operational margin	4929.21	4929.21	4929.21	4929.21	4929.21
As % of total sales	63.20	63.20	63.20	63.20	63.20
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	4929.21	4929.21	4929.21	4929.21	4929.21
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	4929.21	4929.21	4929.21	4929.21	4929.21
Tax	2464.60	2464.60	2464.60	2464.60	2464.60
Net profit	2464.60	2464.60	2464.60	2464.60	2464.60
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	2464.60	2464.60	2464.60	2464.60	2464.60
Accumulated undistributed profit	23590.36	26054.96	28519.57	30984.18	33448.78
Gross profit, % of total sales	63.20	63.20	63.20	63.20	63.20
Net profit, % of total sales	31.60	31.60	31.60	31.60	31.60
ROE, Net profit, % of equity	39.46	39.46	39.46	39.46	39.46
ROI, Net profit+interest, % of invest.	30 49	30.31	30.31	30.31	30.31

TABLE A.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	3543.65	6245.20
Fixed assets, net of depreciation	0.00	3543.65
Construction in progress	3543.65	2701.55
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	3543.65	6245.20
Equity capital	3543.65	6245.20
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	8039.88	9930.17	12088.98	14227.65	16366.32	18618.74
Fixed assets, net of depreciation	5542.93	4840.66	4138.39	3436.12	2733.85	2259.08
Construction in progress	0.00	0.00	0.00	0.00	0.00	25.00
Current assets	1577.62	1764.69	1951.75	1951.75	1951.75	1951.75
Cash, bank	21.45	22.12	22.78	22.78	22.78	22.78
Cash surplus, finance available	897.88	3302.70	5976.06	8817.00	11657.95	14360.13
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	8039.88	9930.17	12088.98	14227.65	16366.32	18618.74
Equity capital	6245.20	6245.20	6245.20	6245.20	6245.20	6245.20
Reserves, retained profit	0.00	1601.61	3471.75	5610.42	7749.08	9887.75
Profit	1601.61	1870.14	2138.67	2138.67	2138.67	2252.42
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	193.08	213.22	233.37	233.37	233.37	233.37
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	193.08	213.22	233.37	233.37	233.37	233.37
Equity, % of liabilities	77.68	62.89	51.66	43.89	38.16	33.54

Straw Treatment and Pelletizing --- Financial Analysis - July 1988

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

- H60 -

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	20868.66	23113.88	25359.10	27604.32	30068.92	32533.53
Fixed assets, net of depreciation	1804.31	1362.14	872.97	383.80	333.40	308.00
Construction in progress	47.00	0.00	0.00	0.00	25.00	47.00
Current assets	1951.75	1951.75	1951.75	1951.75	1951.75	1951.75
Cash, bank	22.78	22.78	22.78	22.78	22.78	22.78
Cash surplus, finance available	17042.82	19777.21	22511.60	25245.99	27736.00	30204.00
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	20868.66	23113.88	25359.10	27604.32	30068.92	32533.53
Equity capital	6245.20	6245.20	6245.20	6245.20	6245.20	6245.20
Reserves, retained profit	12140.17	14390.09	16635.31	18880.54	21125.75	23590.36
Profit	2249.92	2245.22	2245.22	2245.22	2464.60	2464.60
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	233.37	233.37	233.37	233.37	233.37	233.37
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	233.37	233.37	233.37	233.37	233.37	233.37
Equity, % of liabilities	29.93	27.02	24.63	22.62	20.77	19.20

TABLE A.7 (Cont'd)

COMFAR

- H61 -

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	34998.14	37462.74	39927.35
Fixed assets, net of depreciation	304.60	254.20	203.80
Construction in progress	0.00	0.00	0.00
Current assets	1951.75	1951.75	1951.75
Cash, bank	22.78	22.78	22.78
Cash surplus, finance available	32719.01	35234.02	37749.02
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	34998.14	37462.74	39927.35
Equity capital	6245.20	6245.20	6245.20
Reserves, retained profit	26054.96	28519.57	30984.18
Profit	2464.60	2464.60	2464.60
Long and medium term debt	0.00	0.00	0.00
Current liabilities	233.37	233.37	233.37
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	233.37	233.37	233.37
Equity, % of liabilities	17.84	16.67	15.64

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	3294.15	2486.35
Financial resources	3294.15	2486.35
Sales, net of tax	0.00	0.00
Total cash outflow	3294.15	2486.35
Total assets	3294.15	2486.35
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	738.92	628.82
Outflow, local	738.92	628.82
Surplus (deficit)	0.00	0.00
Inflow, foreign	2555.23	1857.53
Outflow, foreign	2555.23	1857.53
Surplus (deficit)	0.00	0.00
Net cashflow	-3294.15	-2486.35
Cumulated net cashflow	-3294.15	-5780.50

TABLE A.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	4953.19	5416.09	6016.09	6000.00	6000.00	6000.00
Financial resources	153.19	16.09	16.09	0.00	0.00	0.00
Sales, net of tax	4800.00	5400.00	6000.00	6000.00	6000.00	6000.00
Total cash outflow	3072.85	2188.89	2382.87	2239.48	2239.48	2260.08
Total assets	1221.32	143.39	143.39	0.00	0.00	20.60
Operating costs	1851.52	2045.50	2239.48	2239.48	2239.48	2239.48
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1880.35	3227.20	3633.22	3760.52	3760.52	3739.92
Cumulated cash balance	1880.35	5107.54	8740.76	12501.28	16261.80	20001.72
Inflow, local	4940.19	5414.92	6014.92	6000.00	6000.00	6000.00
Outflow, local	2877.81	2015.38	2195.38	2055.48	2055.48	2059.08
Surplus (deficit)	2062.39	3399.54	3819.55	3944.52	3944.52	3940.92
Inflow, foreign	13.00	1.17	1.17	0.00	0.00	0.00
Outflow, foreign	195.04	173.51	187.50	184.00	184.00	201.00
Surplus (deficit)	-182.04	-172.35	-186.33	-184.00	-184.00	-201.00
Net cashflow	1880.35	3227.20	3633.22	3760.52	3760.52	3739.92
Cumulated net cashflow	-3900.15	-672.96	2960.26	6720.78	10481.30	14221.22

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Total cash outflow	2278.78	2239.48	2239.48	2239.48	2260.08	2278.78
Total assets	39.30	0.00	0.00	0.00	20.60	39.30
Operating costs	2239.48	2239.48	2239.48	2239.48	2239.48	2239.48
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	3721.22	3760.52	3760.52	3760.52	3739.92	3721.22
Cumulated cash balance	23722.94	27483.46	31243.98	35004.50	38744.41	42465.63
Inflow, local	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Outflow, local	2061.78	2055.48	2055.48	2055.48	2059.08	2061.78
Surplus (deficit)	3938.22	3944.52	3944.52	3944.52	3940.92	3938.22
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	217.00	184.00	184.00	184.00	201.00	217.00
Surplus (deficit)	-217.00	-184.00	-184.00	-184.00	-201.00	-217.00
Net cashflow	3721.22	3760.52	3760.52	3760.52	3739.92	3721.22
Cumulated net cashflow	17942.44	21702.96	25463.48	29224.00	32963.91	36685.13

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	6000.00	6000.00	6000.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	6000.00	6000.00	6000.00
Total cash outflow	2239.48	2239.48	2239.48
Total assets	0.00	0.00	0.00
Operating costs	2239.48	2239.48	2239.48
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	3760.52	3760.52	3760.52
Cumulated cash balance	46226.15	49986.67	53747.19
Inflow, local	6000.00	6000.00	6000.00
Outflow, local	2055.48	2055.48	2055.48
Surplus (deficit)	3944.52	3944.52	3944.52
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	184.00	184.00	184.00
Surplus (deficit)	-184.00	-184.00	-184.00
Net cashflow	3760.52	3760.52	3760.52
Cumulated net cashflow	40445.65	44206.17	47966.69

TABLE A.8 (Cont'd)

- H66 -

Cashflow Discounting:

a) Equity paid versus Net income flow:
    Net present value .... 16203.31 at 10.00 %
    Internal Rate of Return (IRRE1) .. 39.81 %
b) Net Worth versus Net cash return:
    Net present value .... 18651.16 at 10.00 %
    Internal Rate of Return (IRRE2) .. 42.48 %
c) Internal Rate of Return on total investment:
    Net present value .... 18651.16 at 10.00 %
    Internal Rate of Return (IRR) .. 42.48 %

Net Worth - Equity paid plus reserves

- I -

GELATIN

TABLE OF CONTENTS

I. SUMMARY

This plant is envisaged to produce different types of gelatin which have uses in the pharmaceutical, textile and paper industries as well as in the confectionary and dairy fields as edible gelatin. This product is intended for local consumption as well as export.

The minimum economic scale is 1000 tons per annum. Demand estimate is below this figure.

Gelatin can be produced from pig skin, beef bone, hide and untanned tannery wastes. The choice of raw material is more in favour of bones as these are abundantly found and as the highest quality of gelatin is usually obtained from them.

The plant is substantially capital intensive and has high initial investment amounting to 16.75 million Birr, of which 69% is in foreign currency.

It can generate employment for 80 people.

The plant requires a building area of 4000 m² and the site has to be at least twice its size.

The project has a low internal rate of retun and will not be financially viable. However, it is economically viable with an economic rate of return of 12.59% with a net present value of Birr 3.12 million discounted at 10% p.a.

II. INTRODUCTION

This profile analyses the potential for the export of gelatin. The international market has been in the range of 64,000 tons and 75,000 tons per annum between 1981 and 1985. Of this total, about 4% is from developing countries like Colombia, Pakistan, Singapore, etc. Ethiopia also imports a small quantity of gelatin for the pharmaceutical industry.

Developed countries have various specifications of pharmaceutical gelatins, photographic gelatins and edible gelatins. The largest consumption is in the food industry, followed by the pharmaceutical and technical industries. Photographic gelatin is the most expensive type and to produce it requires well developed testing and a high level of production skill. The plant has, therefore, to start first with the production of edible, pharmaceutical and technical gelatins before going to the complex product.

This is a project which is raw material oriented. Even though it is capital-intensive it can be made viable by exploring the export market potential.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Ethiopia, with an estimated livestock population of more than 25 million cattle, and 40 million sheep and goats, ranks first in Africa. The country earns a substantial foreign exchange through the export of live animals, raw hide and skin, semi-processed hide and finished leather products. The tanning industry is reported to be a major source of enviornmental problem as a result of a high quantity of waste generated both solid and water borne. Although the solid waste is characterised as "waste" in the leather sector, a significant amount of this can be further processed as glue, gelatin, fertilizer, feedstuff, polypeptides and amino acid. In most developing countries, valuable protein is derived from animal by-products. Some countries, with large livestock populations export bones and tannery waste products as gelatin raw materials and thus lose the high added value that could be gained from the final commodity. Others, like Ethiopia, discard their animal by-products completely.

The purpose of this study is to investigate the domestic as well as international market potential for gelatin export from Ethiopia.

Gelatin is a mixture of protein obtained by hydrolysis of collagen by boiling skin, ligaments, tendons and bones. The principal end-users of gelatin are the food, pharmaceutical and photographic industries.

The largest market for gelatin, at the international level, is the food industry, which uses it in the production of dessert, marshmallows, confectionery, etc. The food industry is estimated to use some 55% of the gelatin production in the world. The remaining 45% percent is divided between the pharmaceutical and photographic industries.

An important geographical market for gelatin is North America, where the total demand stands at about 45,000 tons. The second is Western Europe with a demand volume estimated at 30,000 tons.[1]

The market for pharmaceutical and photographic gelatin, which represent about 40% of the total international market, is dominated by multinational corporations, and usually, it is extremely difficult for new manufacturers to penetrate this market. Strict specifications and criteria imposed by these multinationals create conditions that make the market out of bound for many developing nations.

As a result, the gelatin market for most developing countries is limited to edible gelatin. The market for this commodity is much larger and widespread, about 55% of international market. The diversity of uses of edible gelatin in a broad range of foodstuffs requires that wide range of grades be available, creating an ample opportunity for developing countries to participate in the international market for edible gelatin.

The import of gelatin into Ethiopia between 1977 and 1984 is shown in Table I. As shown in the table, the import was very low. Since the production of gelatin is directly related to the food, photographic and pharmaceutical industries and

---

1. International Trade Centre: Gelatin: An Overview of the World Market, Geneva, 1984

since these industries are either at an infant stage or do not exist, the domestic consumption of gelatin is no wonder insignificant. Thus the future demand for this product will greatly depend on the growth of the set industries.

Presently, the single most important user of gelatin in Ethiopia is the Ethiopian Pharmaceutical Manufacturing Factory. Gelatin is used by the factory as capsule and in tablets. In 1986, the gelatin consumption by the factory was about 25 tons.

TABLE I

GELATIN AND OTHER DERIVATIVES IMPORT

Year	Quantity (tons)	Value (Birr)
1977	14.3	34825
1978	70.9	103783
1979	19.6	33747
1980	14.3	55572
1981	36.8	138458
1982	41.6	133488
1983	10.1	34250
1984	20.8	109759

SOURCE: Customs and Excise Taxes Administration, External Trade Statistics.

2. Past and Future Demand Analysis

The demand for gelatin was considered by taking into account local prospects as well as export market potentials.

a. Domestic Market Prospects

As indicated earlier, the application of gelatin in Ethiopia is mainly limited to the pharmaceutical industry, which has yet to be developed. Its usage in the food industry, which is an important user of edible gelatin in other countries, barely exists. In many countries, especially in the developed countries, the food industry uses gelatin in the production of dessert, marshmallows, confectionery, etc. Thus, according to the available information, the food industry consumes about 55% of the gelatin production in the world.

Since gelatin is now mainly used in medicine preparation, in the country, its future demand in the domestic market was analyzed on the basis of the production plan of the Ethiopian Pharmaceuticals Manufacturing Factory (EPHARM).

As shown in Table I, the import of gelatin between 1977 and 1984 shows wide fluctuations. The highest import figure was 70.9 tons in 1978. There were sharp declines in the subsequent two years, but this was followed by an increase in the import. In 1983 and 1984, the import again fell drastically. A close examination of the import figures shows that they are related to the production of capsules and tablets by the Ethiopian Pharmaceuticals Manufacturing Factory.

According to information from EPHARM, gelatin is imported in two forms, as capsules and powder. The capsules are used as packing material, while the powder is used as an integeral part of tablets. The consumption of gelatin capsules and gelatin powder by EPHARM during the last three years is shown in Table II.

TABLE II

GELATIN CAPSULES AND POWDER CONSUMPTION BY EPHARM

(TONS)

Year	Capsules Production	Gelatin Content	Gelatin Powder
1984-85	150,000,000	6.9	5
1985-86	280,000,000	12.88	5
1986-87	455,000,000	20.93	5

SOURCE: Ethiopian Pharmaceuticals Manufacturing Factory

There are two types of capsules. These are capsule No. 0 and capsule No.2. The share of gelatin in capsules No. 0 and No. 2 is estimated at 70 and 40 milligram per capsule, respectively.

Of the total capsule production, capsule No. 2 represents 80% while the remaining 20% is made up of capsule No. 0. It was on the basis of this share that the future capsule production was apportioned and the total gelatin requirement for capsules and gelatin powder estimated.

According to EPHARM, the production of tablets is planned to double in 1990, while that of capsules is to grow by about 43%. The future demand for gelatin capsules and powder was thus assessed on the basis of this anticipated expansion programme. Accordingly, the demand forecast starts at 26 tons in 1988, reaching 40 tons in 1990 and remaining at the same level until 2003 (See Table III).

b. Export Market Opportunities

As indicated earlier, the principal end-users of gelatin are the food, pharmaceutical and photographic industries; there is a much smaller demand for technical gelatin. The market share of each of these types is 55%, 25%, 15% and 5%, respectivley.

With regard to price, photographic gelatin commands the highest, whilst pharamaceutical gelatin is second. The price of edible gelatin is substantially below that of pharmaceutical gelatin and well below that commanded by photographic gelatin.

TABLE III

DOMESTIC DEMAND FORECAST FOR GELATIN IN PHARMACEUTICAL APPLICATION BASED ON EPHARM PRODUCTION PLAN

(TONS)

Year	Quantity
1988	26
1989	26
1990	40
1991	40
1992	40
1993	40
1994	40
1995	40
1996	40
1997	40
1998	40
1999	40
2000	40
2001	40
2002	40
2003	40

Since Ethiopia has never exported gelatin of any type, the export performance of selected developing countries, namely, Colombia, Ecuador, Pakistan, Portugal, Singapore and Malaysia, between 1981 and 1985 was analyzed. The average export of these six countries during the same period represents about 3.2% of the international export market (See Table IV).

TABLE IV

GELATIN EXPORT BY SELECTED DEVELOPING COUNTRIES

(TONS)

Year	COUNTRY						Total	Percent of World Total
	Colombia	Ecuador	Pakistan	Portugal	Singapore	Malaysia		
1981	1881	112	-	156	90	1	2240	3.49
1982	2228	-	174	271	73	1	2747	5.31
1983	2008	217	200	144	45	54	2668	3.7
1984	2404	-	190	154	39	14	2801	3.75
1985	-	-	192	34	34	-	260	0.32
5 - Years Average							2143	3.2

SOURCE: United Nations Conference on Trade and Development, International Trade Centre, Geneva.

The photographic and pharmaceutical gelatin production is dominated by a very small number of multinational corporations. This is mainly because the manufacture of photographic and pharmaceutical gelatin is a highly specialized operation in which only limited gelatin manufacturing companies have the required demanding expertise. As a result, there is practically no opportunity for small, local manufacturers to supply these two products at the international level.

However, the international market for edible gelatin is quite different from the two gelatin products referred to in the preceding paragraph. This is mainly due to the larger and wide spread market opportunities, the wide range of edible gelatins produced and the diversity of food products containing gelatin. Moreover, of the world aggregate export of gelatin, the bulk of it comprises edible gelatin - about 55% of the aggregate as indicated earlier.

The export of gelatin and its derivatives between 1981 and 1985 grew from 64,127 tons to 80,155 tons corresponding to an average annual growth rate of 5.74%. (See Table V). To determine the future export possibilities, because of fluctuations in the exported volume during the period indicated, it was found appropriate to apply a five-year average growth rate on the average exported figure, which was 67,577 tons, during the same period.

TABLE V

WORLD EXPORT OF GELATIN AND DERIVATIVES

Year	Quantity Tons	Value ('000 US$)
1981	64,127	224,075
1982	51,775	226,798
1983	67,129	220,189
1984	74,700	226,047
1985	80,155	246,245

SOURCE: United Nations Conference on Trade and Development, International Trade Centre, Geneva.

Accordingly, the demand for gelatin at the international level was roughly estimated to start at 79,900 tons in 1988, gradually rising to 184,500 tons in 2003. (See Table VI). About 55% of the aggregate projected demand is assumed to comprise edible gelatin , which accordingly range from about 43,950 tons in 1988 to about 101,500 tons by the year 2003.

Ethiopia with its large cattle population, has a good opportunity of producing gelatin, derived from animal skins, tendons, ligaments, and bones, for the international market. However, her success to penetrate the world market for gelatin largely depends on her acquistion of the technical capability of producing gelatin , which can be sufficiently attractive in terms of both quality and price. This capability could be developed by inviting existing getalin producers, who have already dominated the world market and acquired some degree of sophistication in the area of gelatin production, to participate either in a joint venture or in providing consultancy service to design and manage the plant. Such arrangement, with a little marketing effort, could be tantamount to guaranting a world market for the product.

Under this possibility, it is conservatively assumed that Ethiopia would be able to capture an equivalent of at least one-fourth of the combined average share of the six developing countries mentioned earlier i.e 0.8% of the expanding world market. On the basis of this assumption Ethiopia's export potential will thus start at 640 tons in 1988, gradually rising to 1480 tons in 2003 (See Table VII).

TABLE VI

WORLD DEMAND FORECAST FOR GELATIN USING

5.74% GROWTH RATE

(TONS)

Year	Projected Aggregate Demand	Share of Edible Gelatin
Base Figure	67,577	37,167
1988	79,900	43,950
1989	84,500	46,460
1990	89,300	49,130
1991	94,500	51,950
1992	99,900	54,930
1993	105,600	58,090
1994	111,700	61,420
1995	118,100	64,950
1996	124,900	68,670
1997	132,000	72,620
1998	139,600	76,780
1999	147,600	81,190
2000	156,100	85,850
2001	165,100	90,780
2002	174,500	95,990
2003	184,500	101,500

<u>TABLE VII</u>

<u>WORLD DEMAND PROJECTION FOR EDIBLE GELATIN</u>

<u>AND ESTIMATED SHARE OF ETHIOPIA</u>

<u>(TONS)</u>

Year	Projected World demand	Share of Ethiopia
1988	43,950	640
1989	46,460	680
1990	49,130	710
1991	51,950	760
1992	54.930	800
1993	58,090	840
1994	61,420	890
1995	64,950	940
1996	68,670	1000
1997	72,620	1060
1998	76,780	1120
1999	81,190	1180
2000	85,850	1250
2001	90,780	1320
2002	95,990	1400
2003	101,500	1480

3. Pricing

The 1986 CIF price of gelatin powder and gelatin capsules is shown in Table VIII. These are the prices paid by the Ethiopian Pharmaceutical Manufacturing Factory to import its annual requirement. Accordingly, the prices for gelatin powder, capsule No. 2 and capsule No. 0 are Birr 8.94, Birr 4.03 and Birr 4.93 per kg., respectively.

High grade photographic gelatin is valued at nearly US $10,000 per tonne. The edible and technical gelatins vary between US $3000 (grades below 000 'Blooms') and US $5000 per tonne (Grades above 200 'blooms').

TABLE VIII
IMPORT PRICE OF GELATIN
(BIRR PER KG)

	Gelatin Powder	Gelatin Capsule No. 2	Gelatin Capsule No.0
Price	8.94	4.03	4.93

SOURCE: Ethiopian Pharmaceutical Manufacturing Factory

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The estimated share of Ethiopia in world export of edible gelatin was forecast to reach about 1500 tons in 2003. The estimated market demand will exceed the minimum economic scale of a gelatin producing plant, which is 1000 tons a year, after the year 1997. In this connection, it should be stressed that the domestic market for edible gelatin should be promoted, especially in the food industry, as a safeguard against a possible lack of competetiveness·in the world market.

2. Production Programme

Gelatin is a hydrolysis product obtained by hot water extraction and does not exist in a natural state. The quality is measured in 'blooms', the gradings of which relate to different uses. There are principally four categories of gelatin:

- Photographic,
- Pharmaceutical,
- Edible, and
- Technical

Photographic gelatins are used in film, plate and paper emulsions. They need to be high 'bloom' grades and involve a very elaborate testing process.

Pharmaceutical applications of gelatin compris mainly hard and soft capsules and micro-capsules.

Edible gelatins account for more than half of the world production and are incorporated in desserts, confectionery, dairy and meat products. Technical gelatin is primarily used for paper and textile sizing.

Theoretically, any plant can produce the gelatin grades suitable for the range of applications mentioned above. For photographic gelatins, which require complex testing and a high level of production skill, the plant considered in this profile is suitable to make good pharmaceutical grades down to technical grade quality.

Assuming that the envisaged plant would start production in the mid 1990's, it would meet the projected demand at 90% capacity utilization in the first year. Full capacity will be reached after the third year of the plant start-up. The production programme and the capacity utilization are given in Table IX.

TABLE IX

PRODUCTION PROGRAMME AND CAPACITY UTILIZATION

Year	Projected Demand (Tons)	Production Programme (Tons)	Capacity Utilization (%)
1994	930	900	90
1995	980	950	95
1996 and on wards	1040	1000	100

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

Gelatin can be made from pigskin, beef bone or hide. The plant can, in theory, be established to handle all three raw materials but at the scale of operation considered in this profile, it would be uneconomical. Pigskin is the principal source of Type A gelatin which has an isoelectric point between pH 7 and 9. It is the easiest material to use, for the preparation involves dehairing by hot water, skinning and cutting. It also yields an edible fat by-product.

Type B gelatin has an isoelectric point between pH 4.6 and 5.2 and is made from bones and tannery waste products. The preparation of this material is more lengthy involving an alkali treatment. The tannery wastes are supplied in the form of splits, trimmings, raw hide pieces and salted hide pieces. It is important that any tanned hides used have been vegetable tanned as opposed to chrome. It is possible to dechrome but then the plant will have the problem of disposing the chrome effluent. The highest quality gelatins are usually obtained from bovine bones. The older the animal, the higher is the collagen (a fibrous protein) and hence the quality of the gelatin. In some countries, where bone is expensive, excellent grades are made from pigskin and tannery wastes.

Ethiopia is endowed with the highest livestock population in Africa. The Ministry of Agriculture, in its General Agricultural Survey of 1983/84, estimated a cattle population of about 24 million heads. The current official figure, however, stands at about 27 million heads. The stock of sheep and goats is estimated at 24 million and 18 million, respectively.

Slaughtering rates amount to:

for cattle	: 7% per year		(1.9 million/a)
for sheep	: 33%	" "	(7.9 million/a)
for goats	: 37%	" "	(6.7 million/a)

A feasibility study on slaughter house by-products utilization[1] has been carried out recently with the aim of establishing a general pattern for better use of slaughter-house by-products.

As mentioned earlier, the production of gelatin can be based on bones, untanned tannery wastes and pigskin.

1. <u>Bones</u>

Raw bone, obtained fresh from slaughtered cattle, contains from 35% - 40% water, 10% - 15% fat and about 50% dry solids as protein and minerals. In general, it can be estimated that cattle slaughtering yields 40 kg of fresh bone per animal. Other by-products from slaughtering, which can be processed for gelatin as well as bone meal production are the head with jaw (the cleaned meatless head has to be crushed beforehand) and the lower legs after scalding. However in this study only bones are considered for the production of gelatin as they account for 24% of the usable by-products from the slaughtering.

A review of the annual yield of usable by-products indicates that only 15% of the total by-products are collected through the existing slaughter-houses. This is illustrated in Table X.

---

[1]Slaughter-house By-Products Utilization in Ethiopia, Agroconsult Dresden, December 1986.

TABLE X

ANNUAL YIELD OF USABLE BY-PRODUCTS

Species	Slaughters Per Year (Million)	In Existing Slaughter-Houses (Million)	By-Products Per Animal (Tons)	Total By-Products (Tons)	Collectable in Slaughter-Houses (Tons)
Cattle	1.9	0.498	0.168	319,200	83,762
Sheep	7.9		0.016	126,400	
Goat	6.7	0.075	0.016[1]	107,200[1]	1,220
Total	16.5	0.573		552,800	84,982

SOURCE: Slaughterhouse By-products Utilization in Ethiopia, Agroconsult. Dresden, 1985

1 IPS' Estimation from the figure given in the last column of the table.

Presently, only 56,745 tons of the by-products are processed, 7,801 tons for human consumption and 48,944 tons for industrial purposes. As shown in Table XI, the percentage of sheep and goat slaughtering in existing slaughter-houses is minimal. In the case of cattle, the percentage of slaughtering in existing slaughter houses amounts to 25% of the total slaughtering. A summary of the available bone material for gelatin production in existing slaughter-houses is given in Table XI.

TABLE XI

BONE RAW MATERIAL AVAILABILITY IN EXISTING SLAUGHTER-HOUSES

	Slaughter-house/ Meat Factory	Capacity* (Animals/a)	Available Bone Raw Material (Tons/a)
1.	Addis Ababa - City Slaughter-house	Cattle: 100,000 for the private sector Cattle: 50,000 for Meat Concentrate Factory Sheep, goat: 58,000 for the private sector Pigs: 4,100	Bones from deboning sector:3790
2.	Addis Ababa - Satellite Slaughter-house	Cattle: 158,000	Bones from deboning sector are not available as the slaughtere cattle are delivered to private butchers
3.	Debre Zeit - Slaughter-house	Cattle: 20,000 Sheep: 15,600	Bones (cattle) from deboning sector: 1575
4.	Malge Wondo - Eldico Meat Factory	Cattle: 66,000	About 1303 tons of bones are processed for bone meal production
5.	Asmara - Sopral Meat Factory	Out of service (Cattle: 100/shift)	-
6.	Asmara - Incode Slaughter-house	Cattle: 17,500	About 525 tons of available bones from deboning sector are used for industrial purposes

Table XI (Cont'd)

Slaughter-house/ Meat Factory		Capacity* (Animals/a)	Available Bone Raw Material (Tons/a)
7.	Asmara - City Slaughter-house	Cattle : 20,000	Service Slaughtering
8.	Kombolcha - Sopral Slaughter-house	Cattle: 20,000	Bones (1,361 tons) are used for industrial purposes
9.	Dire Dawa - Meat Factory	Cattle: 15,000	Bones from the deboning section: 675
10.	Dire Dawa - City Slaughter-house	Cattle : 13,200	Service slaughtering
11.	Gondar - Meat Factory (Slaughter-house)	Cattle: 10,000	300 tons of bones are processed for industrial use
12.	Gondar - City Slaughter-house	Cattle: 8,000	Service Slaughtering

SOURCE: Slaughter-house By-Products Utilization in Ethiopia, Agroconsult Dresden, 1985

* Capacities are based on Plan Year 85/86.

Thus about 6000 tons of bone raw material is available from the existing slaughter-houses and meat processing factories. The bulk of the raw material could be obtained from Addis Ababa and Debre Zeit, while bones, which are available from the Dire Dawa Meat Factory, are insignificant.

Another interesting aspect in this connection is the quantity of deposited bones besides the Addis Ababa City Slaughter-house. According to a study conducted by FAO, the quantity of deposited bones is estimated to be 170,000 tons. Taking the minimum economic size for a profitable gelatin plant, i.e. one producing 1,000 tpa, the existing bone pile mentioned above could supply the plant for at least 10 years (10,000 tpa of dry degreased bone).

2. <u>Untanned Tannery Wastes</u>

The production of gelatin from untanned tannery wastes, i.e wet pieces, offcuts and splits will produce a gelatin yield of about 12%. Dry splits will yield about 50% gelatin. Fleshings, although not a preferred raw material, will yield about 5% gelatin[1].

The quantity of specific wastes multiplied by the number of hides and skins processed per unit of time gives the total quantity of the tannery wastes.

At present, there are eight tanneries under the management of the National Leather and Shoe Corporation (NLSC) with a total capacity of 737 thousand pieces for hides processing and 12,6 million pieces for skins processing at various stages.

---

1 GELATIN, An Overview of the World Market with Special Reference to the Potential for Developing Countries, ITC, Geneva, 1984.

According to the figures for 1976/77[1] (taking representative results of several measurements over a period of two months), the total quantity of untanned wastes produced by the five major tanneries (Ethiopian Tannery, Awash Tannery, Tannery of Addis, Modjo Tannery and Ethiopian Pickling Plant) amounted to 10 tons/day, corresponding to 2 tons (80% water content) of dry substance per day.

The study further indicates that untanned wastes would increase to about 18 tons per day (4 tonnes of dry substance) in 1977/78. For 1978/79, the total untanned waste from the five tanneries was estimated to reach 30 tons per day (6 tons of dry substance) as a result of full capacity utilization.

The calculation of the untanned waste products from 1980/81 to 1985/86 was based on the production of semi-processed and finished hides and skins in the same period as shown in Table XII .

The specific dry untanned tannery waste as calculated in the pre-feasibility study for the five major tanneries is given in Table XIII.

It can be seen from Table XIII that the quantity of tannery **wastes** available mainly depends on the efficiency of the tannery. In this study, the average specific dry tannery waste for hides and skins was taken to calculate the total possible supply of the untanned tannery wastes. Thus the specific dry tannery untanned waste for hides and skins amounts to 1,46 kg and 0.106 kg., respectively.

---

[1] Prefeasibility Study on the Utilization of Tannery and Leather Wastes in Ethiopia, July 1977.

TABLE XII

PRODUCTION OF SEMI-PROCESSED AND FINISHED

HIDES AND SKINS, 1980/81 - 1985/86

Product Description	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
1. **Semi-processed Hides**	94,457	144,378	105,607	188,106	937,072	258,882
2. **Finished Leather**	339,712	343,736	338,180	311,666	366,769	415,716
Total Hides	434,169	488,114	443,787	499,772	603,841	674,598
3. **Semi-Processed Skin**	4,859,106	4,964,725	5,714,106	6,665,008	5,917,935	7,408,300
4. **Finished Leather**	155,835	172,009	158,120	273,248	880,116	166,056
Total Skin	5,014,941	5,138,734	5,872,226	6,938,256	6,198,051	7,574,356

SOURCE: NLSC

TABLE XIII

SPECIFIC DRY TANNERY WASTE*

KG/HIDE OR SKIN

Nature of Waste	Addis Tannery		Awash Tannery		Ethiopian Pickling Plant		Modjo Tannery		Ethiopian Tannery	
	Hides	Skins	Hides	Skins	Hides	Skins	Hides	Skins	Hides	Skins
Total untanned Waste	1.6	0.18	1.34	0.108	-	0.106	-	0.146	1.46	0.097

SOURCE: Pre-feasibility study on the Utilization of Tannery and Leather Wastes in Ethiopia, 1977.

* Data for the remaining three tanneries not available.

By multiplying the above specific dry tannery untanned wastes by the corresponding number of hides and skins processed annually, as shown in Table XII, the total possible supply of untanned dry tannery wastes was calculated and is shown in Table XIV.

TABLE XIV

ESTIMATED SUPPLY OF UNTANNED, DRY TANNERY WASTES

1980/81 - 1985/86

(TONS)

Type of Waste \ Year	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Hides processing	633	712	648	729	535	985
Skins processing	531	545	622	735	657	802
Total	1,164	1,257	1,270	1,464	1,192	1,787

Table XIV shows that the untanned wastes produced by the tanneries in the country (including the two tanneries in Asmara and Kombolcha) has significantly increased (except in 1984/85) in the last six years. However, it must be underscored that the quantity of the available tannery waste products mainly depends on the efficiency of each tannery, whose primary aim is to convert the available hides and skins into leather, as much as possible. Notwithstanding this fact, it can be said that the quantity of untanned tannery wastes (dry substance) would, with full capacity utilization of the existing tanneries, the expansion/rehabilitation programme of the Ethiopian Tannery and the implementation of the new tannery[1], reach 3000 tons/year.

3. Pigskin

Slaughtering of pigs is carried out in two slaughter-houses, namely the Addis Ababa City Slaughter-house and Asmara City Slaughter-house. Since pig slaughtering is only by order of consumers with European eating habits, the number of pigs slaughtered per day is only 15(4000/year) in Addis Ababa and less than 1000 in Asmara. Consequently, the quantity of the available by-products is insignificant. Moreover, the winning of pigskin would require a relatively high capital investment and it is very unlikely that the required capital cost would be offset by sales of pigskin at the present scale of slaughtering. In view of this, pigskin cannot be considered as a raw material for the production of gelatin.

---

[1] Hides Tannery, Feasibility Study, IPS, April 1986.

4. Future Plans of the Livestock Sector

At present the meat production amounts to about 415,000 tons/year and is expected to increase to 800,000 tons/year by 1995. According to the Ten-Year Perspective Plan, six farms with the following capacities are planned.

Kombolcha	:	29,930 beef cattle/year, comprising 14,930 for live export and 15,000 for processing.
Dire Dawa	:	79,205 beef cattle/year, comprising 19,205 for live export and 60,000 for processing.
Malge Wondo	:	99,006 beef cattle/year; comprising 19,006 for live export and 80,000 for processing.
Debre Zeit	:	143,567 highland sheep from farms around Sheneka and Dinkiti.
Jijiga	:	17,255 beef cattle for processing in a new **Slaughter**-house.

SOURCE: Slaughter By-Product Utilization in Ethiopia, Agroconsult Dresden, December 1985.

In conclusion it may be said that the choice of raw material would be for bones, for the following reasons:

- There is a potential quantity of bones which at present are not used;

- About 6000 tons of bone raw material is available from the existing slaughter-houses and meat processing factories.

- The quantity of the available bone raw material could be substantially increased, provided efforts are exerted to reduce the percentage of the back-yard slaughtering and/or to develop a collection system for bones from the back-yard slaughtering.

- The highest quality of gelatins are usually obtained from bones. Moreover the production of gelatin from bones yields a number of usable by-products (See Chapter VI). On the contrary the production of gelatin from untanned tannery wastes yields no by-products.

Thus it is recommended in this profile that the plant be supplied with fresh raw bones as well as dry degreased bones from the bone pile beside the City Slaughter-house and manufacture pharmaceutical, edible and technical gelatins.

B. INPUTS

1. Utilities

a. Water

The amount of water intake of the plant for the production of 1000 tons gelatin is estimated at 1.0 million cu.m. However with the incorporation of a water treatment plant, the water can be recycled and therefore keep the consumption to a minimum. Thus it is estimated that the annual water requirement would be 0.25 million cu.m.

b. Electricity

The consumption of electricity is particularly high, for 2,500 kWh is required to make 1 ton of gelatin.

c. Steam

The steam requirement per ton of gelatin is about 25 tons.

2. Chemical Inputs

Hydrochloric acid (36%) is the major chemical consumed in a gelatin manufacturing plant. For every ton of gelatin produced, the quantity of hydrochloric acid required amounts to about 8 tons.

Another major chemical required is quicklime. The quantity is estimated at about 1.2 tons per ton of gelatin.

There are a number of other chemicals used in the process in small quantities (eg. resins, lithium chloride). Other materials include pulp filters and diatomaceous earth.

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

A plant producing 1,000 tons gelatin/year from bones would require the following raw materials and chemicals.

1. Bones

As indicated earlier, an average of 40 kg of fresh bone per animal can be obtained. The following mass balance can therefore be constructed.

```
Cattle
(5,000 head)
    ↓
Fresh bone
(200 tons)-------------------Tallcw
    ↓                         (30 tons)
Dry, degreased bone
(100 tons)-------------------Meat and bone meal products
    ↓                                 (40 tons)
Gelatin bone
(60 tons)-------------------Di-calcium phosphate
    ↓                              (30 tons)
Gelatin
(10 tons)
```

The overall yields are:

Gelatin from fresh, raw bone	Approx.	5%
Gelatin from gelatin bone	"	16%
Gelatin from dry ossein	"	65%

SOURCE: Gelatin International Trade Centre, UNCTAD/GATT, Geneva, 1984.

Accordingly, the bone raw material requirement will amount to:

10,000 tons of dry, degreased bone or
20,000 tons of fresh raw bone or
500,000 cattle slaughtering annually and the availability of all bone raw material

2. Chemicals

For the production of 1000 gelatin/year, the quantity of chemicals required would be as follows:

Hydrochloric acid, 36% - 8000 tons
Quicklime - 1200 tons and
Small quantities of other processing chemicals (e.g. resins, lithium chloride etc).

The annual supply programme of the raw materials is given in Table XV; this has been worked out taking the planned production programme into consideration.

TABLE XV

ANNUAL RAW MATERIALS SUPPLY PROGRAMME

INPUT	Unit	1994	1995	1996
Dry, degreased bone	Ton	9,000	9,500	10,000
(Fresh raw bone)	"	18,000	19,000	20,000
Hydrochloric acid, 35%	"	7,200	7,600	8,000
Quicklime	"	1,080	1,140	1,200

D. MATERIAL AND INPUT COSTS

1. Cost of Raw Materials

The unit costs of the raw materials and chemical inputs required for the production of gelatin broken down into foreign and local components are given in Table XVI.

TABLE XVI

RAW MATERIALS AND CHEMICALS INPUTS COSTS

('000 BIRR)

Items	F.C.	L.C.	Total
Abattoir bone[1]	-	850	850
Hydrochloric acid[2]	-	-	-
Quicklime	-	221	221
Other chemicals and materials[3]	194	48	242

1 The price assumed in this study is the one for purchasing the bone pile beside the City Slaughter-house and the bones (6000 tons) from the Addis Ababa and debre Zeit Slaughter-houses. (The international price for abattoir bone is in the range of US$ 10-30 per ton).

2 Hydrochloric acid costs are offset by sales of di-calcium phosphate, meat and bone meals, hoof and horn meals and tallow.

3 Includes costs of chemicals for water treatment.

2. Cost of Utilities

- Electricity

The cost of electric power will be Birr 0.22/kWh.

- Water

Water for potable and industrial use will cost Birr 0.5/m^3.

- Fuel

The total quantity of fuel oil required for steam generation would be about 3200 tons. The current price for fuel oil is Birr 581/ton in Addis Ababa. Furthermore, the cost of fuel for vehicles is estimated at Birr 30,000/year.

- Packing Materials

Gelatin should be kept in closed moisture-proof containers (e.g. cans, fibre drums etc.) or sacks. The containers or sacks should be properly labelled, indicating the gelatin's category. In this profile, it is assumed that gelatin will be packed in 50 kg sacks and the annual cost of packaging will amount to about Birr 12,000.

V. LOCATION

The production of gelatin requires substantial quantities of bone raw materials. In order to produce 1000 tons of gelatin, a total of about 10000 tons of bone material will be required, if dry degreased bone is used. However, if fresh raw bone is used, the bone requirement would be about 20,000 tons. In both cases, the bone raw material will account for more than 50% of the total raw material input.

In the production of gelatin from fresh raw bone, the preliminary stages of degreasing and drying can be carried out at a site separate from the main factory. Since fresh raw bone should be processed within 48 hours after slaughtering, the location of a degreasing plant must be close to the source of the raw material, namely the Addis Ababa-Debre Zeit area, where about 6000 tons/year of fresh raw bone is available, in addition to the bone pile besides the City Slaughterhouse.

Furthermore, if untanned tannery wastes are to be processed in the future, the Addis Ababa - Debre Zeit area is an ideal location for processing untanned tannery wastes generated by the five major tanneries in the Addis Ababa area.

Despite the advantages of locating the proposed plant in the Addis Ababa - Debre Zeit area, there are some major factors requiring an in-depth analysis before the final decision is made on the location of the plant, such as:

- Availability of adequate water,
- Availability of power,
- Treatment/disposal of process water, and
- Proximity to the local market of gelatin by-products.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. General

As outlined earlier in this profile, gelatin can be made from pigskin, beef bone or untanned tannery by-products. Accordingly, the processing of untanned tannery wastes and pigskin to gelatin differs from the processing of bone in the exclusion of the degreasing and demineralization processes. Since it is uneconomical to handle all three raw materials at the envisaged scale of production, the processing of raw, fresh bone as well as dried bone into gelatin is considered in this profile.

2. Manufacturing Process

There are three important phases in the manufacture of gelatin; material preparation, extraction and filtration, chilling, drying and blending.

a. Material Preparation

The bones received at the factory, have to be graded by density. This grading process is particularly important if photogrpahic gelatins were to be made.

The bones are ground to 5 - 15 mm and then passed through a degreasing operation to remove any meat or fat. Modern hot water degreasing plants can optimize the yields and quality of the bone chips and by-products, and recover the small amount of effluent which is rich in protein so that it can be used as pig feed. When sun dried bones are used, a grease content of about 5% can be simply removed by a caustic soda wash.

The production of ossein (decalcified bone) with hydrochloric acid is a critical step. The design of the maceration vessels must be such that the flow of acid over the bone chips is as uniform as possible. Acid is circulated through the vessels using either air pumps or centrifugal glandless pumps of acid resistant material. The normal concentration of hydrochloric acid is 30% - 35%. The demineralizing process yields a by-product, dicalcium phosphate. It is recovered as dicalcium salt by controlled precipitation with calcium hydroxide. The small quantity of hydrochloric acid is neutralized by lime to form more calcium chloride.

Depending on the quality and specification required, the precipitate is washed with water to reduce the chloride content. The slurry is then converted into cake by means of a rotary vacuum filter. The final moisture reduction, if necessary, can be achieved by a dryer. This byproduct can then be sold for cattle feed. As a rule of thumb, the revenue received from the dicalcium phosphate should cover its recovery cost and the cost of the hydrochloric acid.

The ossein leaving maceracion is acidic. It is necessary to alter the pH of the ossein rapidly and uniformly to the alkaline state. Preliming involves water washing, followed by immersion in an alkaline medium. Other procedures may be followed depending on the type of gelatin required. The ossein is agitated during this process to a uniform distribution of the chemical interaction.

The ossein, like hide, is then placed in the lime pits, a calcium hydroxide suspension, to depolymerize the collagen component. The length of time spent in the suspension depends on ambient conditions and the quality of the gelatin required. Generally, it is between 45 and 100 days. After deliming the ossein or hide, it is ready for processing into gelatin.

In general, 100 tons of abattoir bone yields 30 tons of bone for gelatin and 15 tons of meat/bone meal and 15 tons of tallow as by-products, in addition to the dicalcium phosphate. In turn the gelatin yield is about 15% of the degreased or sun dried bone, in other words, 4.5 tons from 100 tons of abattoir bone.

b. Extraction and Filtration

Complete neutralization of the lime and any alkalinity introduced during the preparation stage is obtained by soaking in a dilute acid solution followed by a water wash to achieve the desired pH value during the gelatin extraction stage.

Success in the extraction is highly correlated to the care taken in the preparation stage. Extraction takes place in stainless steel tanks. Four or five extractions are made at temperatures increasing from 50°C-55°C to 95°C-100°C. The best gelatin comes from the first extraction at the lower temperatures. The process time varies according to the raw material - 40/44 hours for ossein, 30/36 hours for hides and 20/30 hours for pigskin. The output is a 5% - 6% solution of gelatin in water.

The gel solution passes to the primary filtration process which removes coarse particles through a system of cellulose pulp filters. Sometimes it is necessary to install a centrifuge before the pulp filters because of the presence of collagen fibres.

For the manufacture of pharmaceutical and most edible and photographic gelatins, the gelatin is de-ionised by an ion exchange. If used, the ion exchange often reduces the pH value which has to be adjusted again by adding a suitable alkali.

Secondary filtration is concerned with the removal of fine suspended particles together with traces of residual grease.

The solution is then evaporated, in two stages under vacuum to increase the solid concentration from 5%-6% to 14% - 18%. The choice of the evaporator and its design should be carefully considered both in regard to thermal degradation of the product and thermal efficiency.

A third filtration removes any suspended particles left in the partially concentrated gelatin liquors. This filtration is particularly needed when pigskin is the raw material.

A second concentration process increases the solid content to between 20% and 38%, depending on the quality and type of gelatin being processed. The gelatin is also sterilised during this phase by an injection of steam (125°C - 140°C) for a period of 4 seconds.

c. Chilling, Drying Blending

Before chilling, it is necessary to check the pH and redox state of the gelatin. For certain types of photographic and pharmaceutical gelatins, chemicals are added at this point.

The chilling process quickly reduces the temperature of the solution from 55°C to 23°C. The unit is called a Scraped Surface Heat Exchanger. The gelatin comes out of the chiller in the form of extruded noodles.

Final dehydration is performed in a band dryer using conditioned air as the drying media. On entering the dryer, the gelatin receives an air current of about 30°C at an absolute moisture of 6 grams per kilo. The dry air on the noodle surface forms a dry skin sufficient to prevent a reversal of the sol-gel state as the temperature is increased along the band.

Conditioning of air to the correct hydroscopic state is expensive both in operating and capital costs. The degree of conditioning depends on climatic factors.

The dryer is divided into 8 or 9 zones, each zone being thermostatically controlled. Air passes in a coiled manner throughout the dryer. The temperature in each zone is higher than the previous one as the gelatin progresses along the dryer. The final zone temperature is 60°C.

Commercially dry gelatin has an inherent moisture content of 10% - 12% and will emerge from the dryer in the form of a mat which is immediately broken into pieces of about 20 mm in length by a revolving crusher.

At this stage in the production process, each batch of about 500 kilos is sampled and evaluated. The basic tests include: physical, chemical, micro-biological, and organoleptic.

From these tests, a combination of gelatin batches can be blended to match customer specifications. The gelatin is ground to a desired size and then packed. **Typical technical specification for edible and technical gelatins are given in Appendix B.**

The manufacture of gelatin demands stringent quality assurance and quality contol procedures. Further, it must have adequate supplies of water, steam and electricity 24 hours a day.

The factory can conceivably operate on the basis of 5½ days extraction, working 24 hours a day, and 1½ days off per week. It is possible to make 3 extractions a week in this time yielding between 6 and 7 tons of gelatin per extraction. This rate of production is equivalent to 1,000 tons a year. A flow diagram of the process is shown in Figure I.

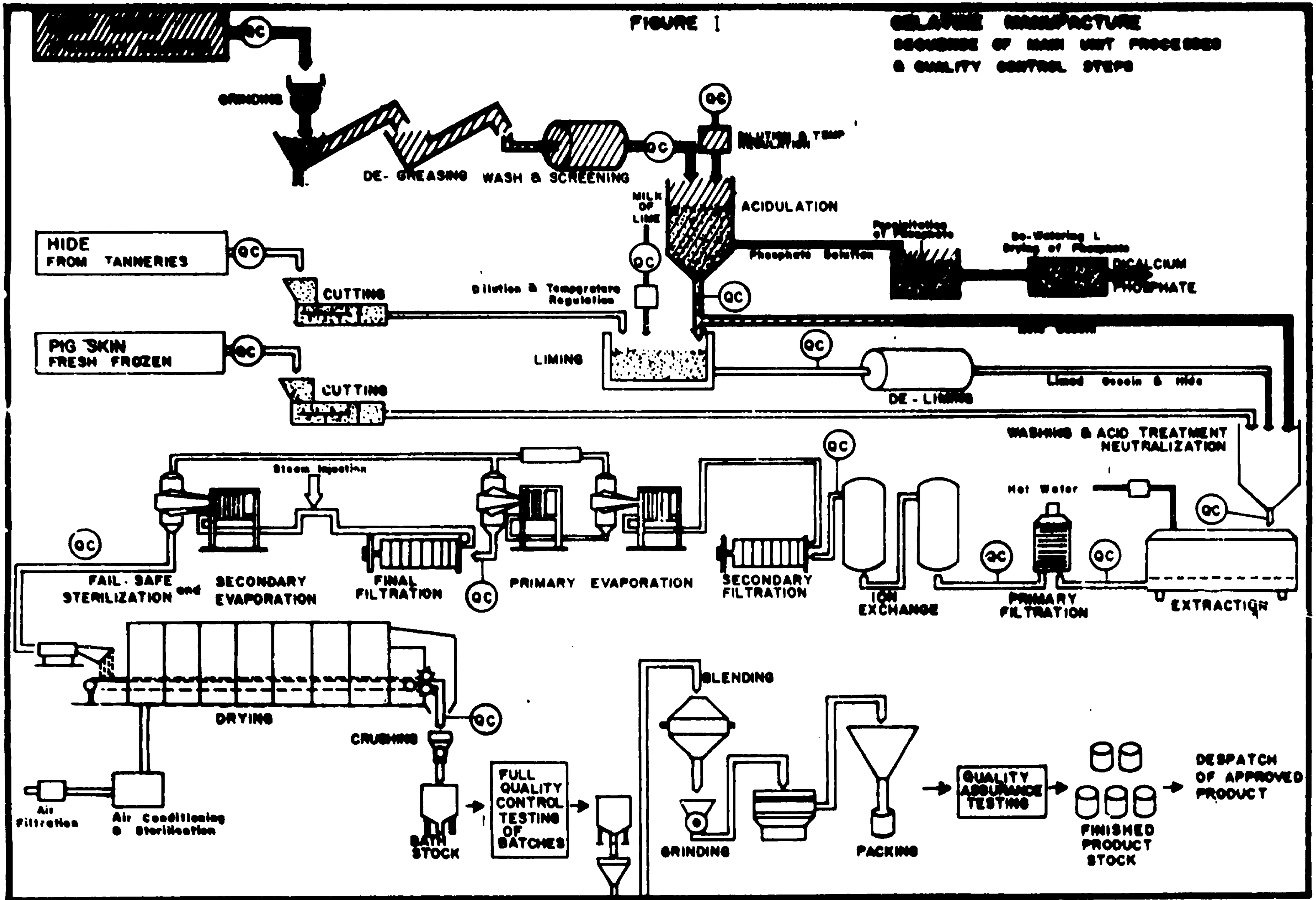
2. Source of Technology

The technology will have to be bought in. A manufacturer of the plant and equipment is:

APV Components Ltd
Manor Royal
Crawley RH10 2LB
United Kingdom

The technology is supplied by:

GT Gelatin Technology Ltd.
5 - 7 Museum Place
Cardiff CF1 3BD
United Kingdom


QC
GRINDING
DE- GREASING
WASH & SCREENING
DILUTION & TEMP REGULATION
ACIDULATION
MILK OF LIME
HIDE FROM TANNERIES
PIG SKIN FRESH FROZEN
CUTTING
CUTTING
Dilution & Temperature Regulation
Phosphate Solution
DICALCIUM PHOSPHATE
LIMING
DE - LIMING
Limed Ossein & Hide
WASHING & ACID TREATMENT NEUTRALIZATION
Steam Injection
Hot Water
FAIL - SAFE STERILIZATION and SECONDARY EVAPORATION
FINAL FILTRATION
PRIMARY EVAPORATION
SECONDARY FILTRATION
ION EXCHANGE
PRIMARY FILTRATION
EXTRACTION
DRYING
CRUSHING
BATH STOCK
FULL QUALITY CONTROL TESTING OF BATCHES
BLENDING
GRINDING
PACKING
QUALITY ASSURANCE TESTING
FINISHED PRODUCT STOCK
DESPATCH OF APPROVED PRODUCT
Air Filtration
Air Conditioning & Sterilization
FIGURE 1

Another source of technology would be an existing manufacturer of gelatin such as:

Gelatin Products Ltd.
Clifton Road
Sutton Weaver, Runcorn WA7 3EH,
United Kingdom.

B ENGINEERING

1. Machinery and Equipment

The main items of the machinery together with their estimated costs are given in Table XVII. The key items are the extractor and chilling/drying unit.

The total investment cost will vary with the need for effluent and water treatment and the need for in-house electricity generation.

2. Plant Layout

A light construction building with 4½ metres to the eaves and without cranes would be sufficient. The building area required will be 4,000 m^2 on a site at least twice its size. The factory will be oblong, measuring 135 m x 30 m. A typical area breakdown is given below:

	m^2
Preparation	2000
Extraction/filtration	900
Chilling/drying/storing	1000
Laboratories and Offices	100

TABLE XVII

TOTAL FIXED INVESTMENT COST

Description	COST ('000 Birr)		
	F.C	L.C.	TOTAL
A. Machinery and Equipment			
1. Preparation			
. Degreasing and treatment	621		621
. Liming/deliming	517		517
. Chemical processing	170		170
2. Extraction	1,242		1,242
3. Filtration	538		538
4. Ion exchanger	497		497
5. Evaporator	828		828
6. Chiller/band dryer	2,070		2,070
7. Grinder/blender/packing	538		538
8. Laboratory	104		104
9. Auxiliary facilities (effluent/water treatment, boilers, refrigeration, generators, etc.)	538		538
10. Storage tanks (hydrochloric acid)		500	500
11. Others (e.g conveyors)	124		124
12. Spare parts	828		828
Total Equipment Cost	8,596	500	9,096
Freight		828	828
Total Machinery Cost (C & F)	8,596	1,328	9,924
Local Cost (12.5% of C & F)		124	124
Technology Fee	311		311
Erection	232	99	331
Total cost of machinery and equipment (incl. 10% contingency)	10,053	1,706	11,759

TABLE XVII (Cont'd)

DESCRIPTION	COST ('000 Birr)		
	F.C	L.C	TOTAL
B. <u>Building and Civil Works</u>			
1. Building cost	1,060	2,520	3,600
2. Site Development (2% of building cost)		72	72
3. Outdoor Works (Sewage, drainage piping, etc. 10% of building cost)		360	360
Total (including 10% contingency)	1,188	3,247	4,435
C. <u>Service Equipment</u>			
Office Furniture and Equipment	15	35	50
D. <u>Vechicles</u>			
Truck	77	33	110
Service Bus (one)	53	23	76
Service car (two)	34	16	50
Total vehicle cost (incl 10% contingency)	180	79	259

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of a plant to produce 1000 tons a year of gelatin is given in Figure II.

The plant would be headed by a Plant Manager, who would be responsible for the overall activities of the factory. It will have a Technical and Production Division, Accounts Division Administration Division and Commercial Division.

The Research and Development and Quality Control Unit will be independently organized under the Technical and Production Division. The heads of these units will report directly to the Production Manager. This is important for these units, in particular the Quality Control, will play a key role in maintaining the extremely high standards of cleanliness and production control and they should not be influenced by the production and maintenance sections.

B. MANPOWER

The details of the manpower requirements for a plant of 1,000 tons capacity a year is given in Table XVIII.It is expected that the plant will operate with foreign expertise as advisers in production and in the laboratory for up to two years while national professionals are trained on-the-job in the art of gelatin manufacture. It is conceivable that other foreign staff will be required for short term periods to train operators and shift supervisors.

The production manager should be a qualified chemical engineer with possibly food processing experience, e.g. dehydration. The chief engineer should be a qualified mechanical engineer.

FIGURE II

ORGANIZATION CHART OF GELATINE MANUFACTURING PLANT

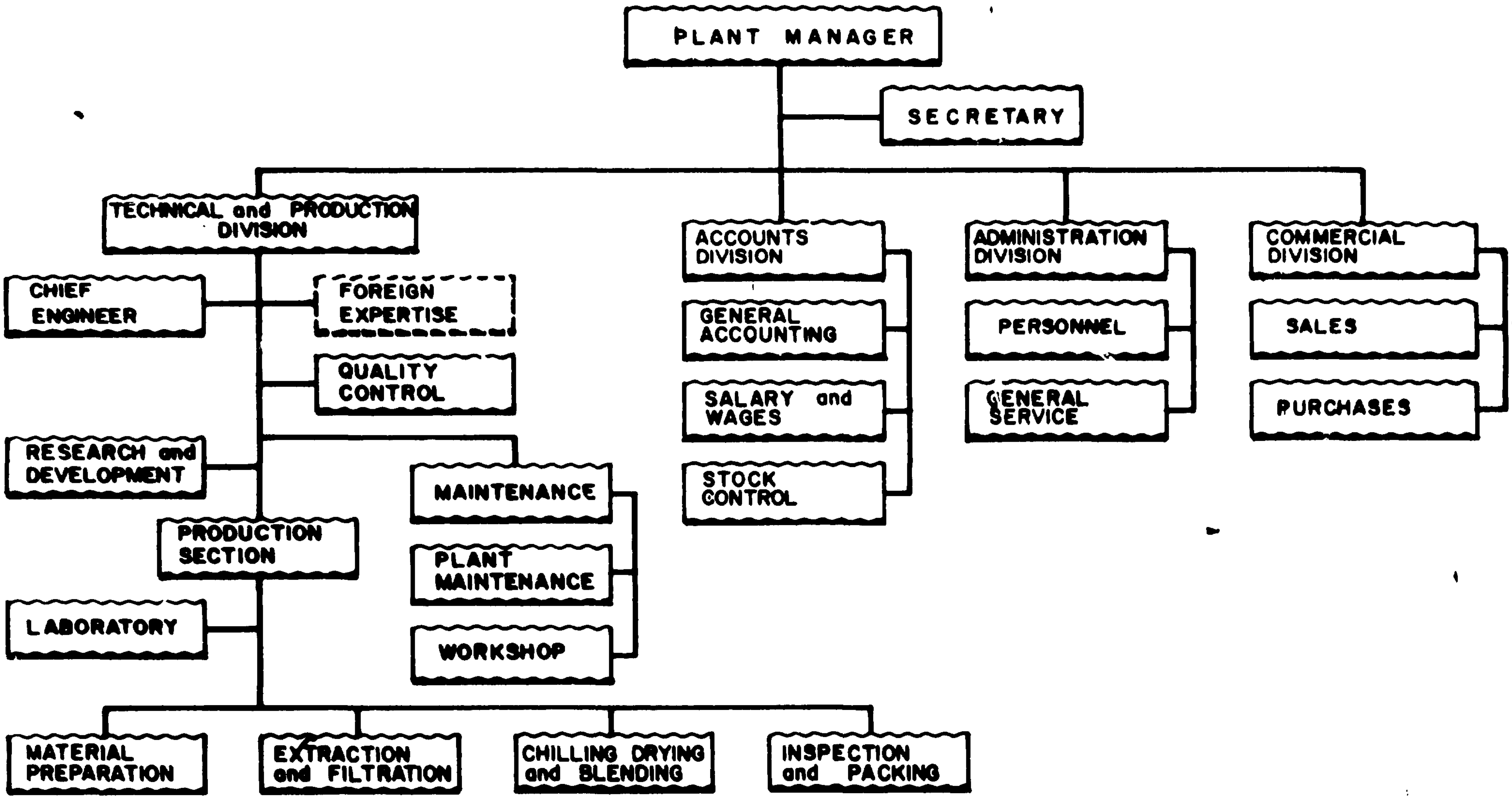


TABLE XVIII

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. of Shifts	No. Employed	Skill Level	Monthly Salary/Person (Birr)	Total Annual Salary
Plant Manager	1	1	Professional/tech.	1,200	14,400
Secretary	1	1	Skilled	350	4,200
Production Manager	1	1	Professional/tech.	1,000	12,000
Chemist	1	1	" "	700	8,400
Chief Engineer	1	1	" "	900	10,800
Accountant (chief)	1	1	Skilled	700	8,400
Accountant	1	1	"	450	5,400
Clerk	1	2	"	250	6,000
Administrator	1	1	"	600	7,200
General Service	1	2	"	350	8,400
Commercial, Head	1	1	"	600	7,200
Sales	1	1	"	450	5,400
Purchaser	1	2	"	450	10,800
Receipt/despatch/stores Personnel	3	5	"	250	15,000
Shift Supervisor	3	3	"	500	18,000
Operator, liming of bones	1	4	Semi-skilled	150	7,200
Operator, rest of process	3	12	" "	150	21,600

TABLE XVIII(Cont'd)

Personnel	No. of Shifts	No. Employed	Skill Level	Monthly Salary/Person (Birr)	Total Annual Salary
Labourer, liming of bones	1	6	Unskilled	90	6,480
Labourer, rest of process	3	9	"	90	9,720
Laboratory technician	1	2	"	450	10,800
Maintenance Engineer	3	3	Skilled	700	25,200
Electrician/Mechanic	3	6	"	450	32,400
Driver, Truck	1	1	"	500	6,000
Driver	1	3	"	250	9,000
Guard	3	6	Unskilled	90	6,480
Cleaner	1	2	"	70	1,680
Messenger	1	2	"	70	1,680
TOTAL (Includes 26% employment benefit)		80			349,800

* 3 on main day shift, 1 on each of other 2 shifts

Skill distribution

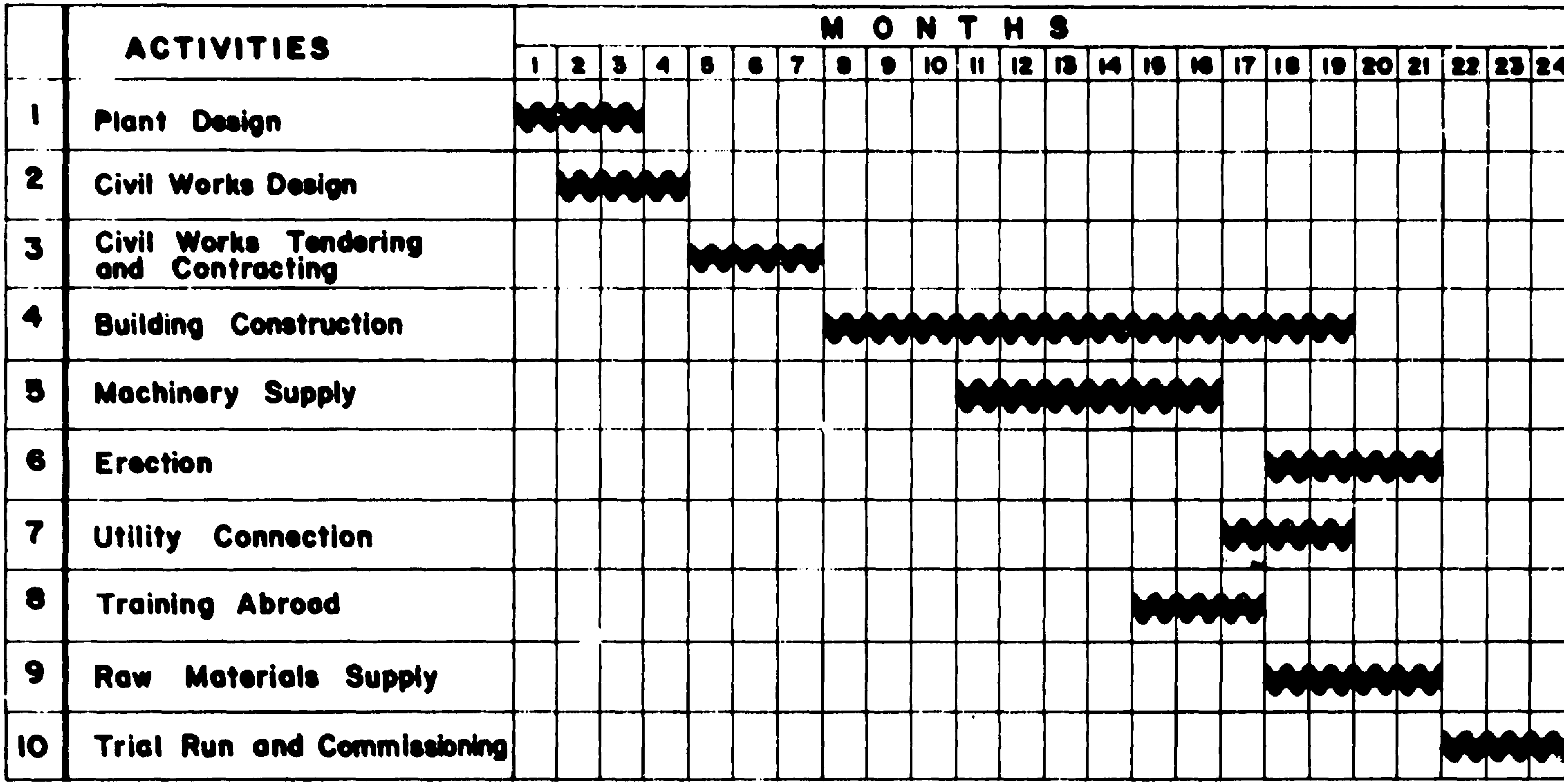
		%
Professional/technical	4	5
Skilled	35	43.8
Semi-skilled	16	20
Unskilled	25	31.2
Total	80	100

To balance the technical expertise, the plant manager should be qualified and experienced in commercial affairs and business administration. If the technology is obtained from an existing gelatin manufacturer, the production manager, chief engineer,chemist and shift supervisor should spend at least 3 months on the job-training at the manufacturer's plants.

VIII. IMPLEMENTATION SCHEDULE

An indicative project implementation schedule for the establishment of a gelatin producing plant has been worked out and given in Figure III . Accordingly about 24 months will be required for plant design and construction time.

FIGURE III
IMPLEMENTATION SCHEDULE OF
GELATIN PRODUCTION PLANT



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table XIX.

TABLE XIX

SUMMARY OF THE INITIAL INVESTMENT COST
('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Buildings and Civil Works	1188.00	3247.00	4435.00
Plant Machinery and Equipment	10053.00	1706.00	11759.00
Office furniture and equipment	15.00	35.00	50.00
Vehicles	180.00	79.00	259.00
Pre-production Expenditure	35.52	211.98	247.50
Total	11471.52	5278.98	16750.50

The gelatin plant is substantially capital intensive and requires an initial investment cost of Birr 16.75 million. The foreign currency component amounts to Birr 11.47 million which shows that the rest 31% will be required in local currency.

About 88% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirement

The following parameters were used to estimate the net working capital requirements of the gelatin plant.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	1.0
3. Raw materials - foreign	6.0
4. Raw materials - local	1.0
5. Work in progress	0.07
6. Finished products	2.0
7. Accounts payable	1.0

The net working capital requirement amounted to Birr 1.02 million when it reaches full capacity. About 23% of the total net working capital required will be in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The production cost on the third year of production amounts to Birr 6.42 million, out of which about 35% is in foreign currency.

4. Internal Rate of Return (IRR)

The gelatin plant will not be financially viable. The internal rate of return and net present value calcualted at 10% p.a. discount rate amounted to 6.23% and Birr -3.51 million, respectively. The prices of edible and technical gelatin vary between US$3000 (grades below 200 'blooms') and US $5000 per tonne (grades above 200 'blooms'). An average price of US $3600 per tonne was considered for the financial analysis. In order to make the project viable the assumed selling price has to be increased by about 15%.

5. Breakeven Analysis

The breakeven point would be reached at a production of 732 tonnes of gelatin. The total revenue generated at the breakeven point would be Birr 5.45 million. This means the plant would breakeven if it uses 73% of its capacity.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 12.59% with a net present value of Birr 3.12 million discounted at 10% p.a.

The project will create employment for about 80 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

Gelatin Plant
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	16750.50	68.485 % foreign
current assets:	0.00	0.000 % foreign
total assets:	16750.50	68.485 % foreign

Source of funds during construction phase

equity & grants:	16750.50	68.485 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	16750.50	68.465 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	4558.16	4739.33	4920.50
depreciation :	1503.95	1503.95	1503.95
interest :	0.00	0.00	0.00
production costs	6062.11	6243.28	6424.45
thereof foreign	36.07 %	35.45 %	34.86 %
total sales :	6705.00	7077.50	7450.00
gross income :	642.89	834.22	1025.55
net income :	321.44	417.11	512.77
cash balance :	878.26	1883.36	1979.03
net cashflow :	876.26	1883.36	1979 03

Net Present Value at: 10.00 % = -3507.06
Internal Rate of Return: 6.23 %
Return on equity1: -4.30 %
Return on equity2: 6.23 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Ba[illegible]
Total production costs	Net incom[illegible]ement
Working Capital requirements	Source of finance

COMFAR 21 UNIDO

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	1774.00	2661.00
Auxiliary and service facilities	25.00	234.00
Incorporated fixed assets	5.00	45.00
Plant machinery and equipment	3528.00	8231.00
Total fixed investment costs	5332.00	11171.00
Pre-production capital expenditures	87.60	159.90
Net working capital	0.00	0.00
Total initial investment costs	5419.60	11330.90
Of it foreign, in %	64.86	70.22

TABLE A.3

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9	10-12
% of nom. capacity (single product)	90.00	95.00	100.00	100.00	100.00	100.00
Raw material 1	1181.70	1247.35	1313.00	1313.00	1313.00	1313.00
Other raw materials	10.80	11.40	12.00	12.00	12.00	12.00
Utilities	604.74	634.65	664.55	664.55	664.55	664.55
Energy	1691.87	1775.54	1859.20	1859.20	1859.20	1859.20
Labour, direct	349.80	349.80	349.80	349.80	349.80	349.80
Repair, maintenance	676.95	676.95	676.95	676.95	676.95	676.95
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	14.10	14.55	15.00	15.00	15.00	15.00
Factory costs	4529.96	4710.23	4890.50	4890.50	4890.50	4890.50
Administrative overheads	28.20	29.10	30.00	30.00	30.00	30.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	1503.95	1503.95	1503.95	1402.65	1407.65	1454.45
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	6062.11	6243.28	6424.45	6323.15	6328.15	6374.95
Costs per unit (single product)	6.74	6.57	6.42	6.32	6.33	6.37
Of it foreign, %	36.07	35.45	34.86	34.74	34.76	35.02
Of it variable,%	53.79	55.13	56.40	57.30	57.26	56.84
Total labour	349.80	349.80	349.80	349.80	349.80	349.80

COMFAR 2.1 UNIDO

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	13-17
% of nom. capacity (single product)	100.00
Raw material 1	1313.00
Other raw materials	12.00
Utilities	664.55
Energy	1859.20
Labour, direct	349.80
Repair, maintenance	676.95
Spares	0.00
Factory overheads	15.00
Factory costs	4890.50
Administrative overheads	30.00
Indir. costs, sales and distribution	0.00
Direct costs, sales and distribution	0.00
Depreciation	273.55
Financial costs	0.00
Total production costs	5194 05
Costs per unit (single product)	5.19
Of it foreign, %	23.60
Of it variable,%	69.76
Total labour	349.80

COMFAR 2.1 UNIDO

TABLE A.4

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	379.05	394.94	410.04	410.04
Inventory and materials	22	16.2	110.68	116.82	122.96	122.96
Energy	1	360.0	4.70	4.93	5.16	5.16
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	2	180.0	25.17	26.17	27.17	27.17
Finished products	60	6.0	759.69	789.89	820.08	820.08
Cash in hand	15	24.0	44.54	44.60	44.86	44.86
Total current assets			1324.64	1377.36	1430.08	1430.08
Current liabilities and						
Accounts payable	30	12.0	377.50	392.52	407.54	407.54
Net working capital			947.14	984.84	1022.54	1022.54
Increase in working capital			947.14	37.70	37.70	0.30
Net working capital, local			724.93	757.30	789.66	789.66
Net working capital, foreign			222.21	227.54	232.87	232.87

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

COMFAR 2.1 UNIDO

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	5419.60	11330.90
Financial resources	5419.60	11330.90
Sales, net of tax	0.00	0.00
Total cash outflow	5419.60	11330.90
Total assets	5419.60	11330.90
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1904.34	3374.64
Outflow, local	1904.34	3374.64
Surplus (deficit)	0.00	0.00
Inflow, foreign	3515.26	7956.26
Outflow, foreign	3515.26	7956.26
Surplus (deficit)	0.00	0.00
Net cashflow	-5419.60	-11330.90
Cumulated net cashflow	-5419.60	-16750.50

TABLE A.5 (Cont'd) — COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	7082.50	7092.52	7465.02	7450.00	7450.00	7450.00
Financial resources	377.50	15.02	15.02	0.00	0.00	0.00
Sales, net of tax	6705.00	7077.50	7450.00	7450.00	7450.00	7450.00
Total cash outflow	6204.24	5209.16	5486.00	5433.27	5433.27	5508.92
Total assets	1324.64	52.72	52.72	0.00	0.00	25.00
Operating costs	4558.16	4739.33	4920.50	4920.50	4920.50	4920.50
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	321.44	417.11	512.77	512.77	512.77	563.42
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	878.26	1883.36	1979.03	2016.73	2016.73	1941.08
Cumulated cash balance	878.26	2761.62	4740.64	6757.37	8774.09	10715.17
Inflow, local	6992.73	7090.31	7462.81	7450.00	7450.00	7450.00
Outflow, local	4815.10	4097.95	4348.28	4303.10	4303.10	4361.75
Surplus (deficit)	2177.63	2992.36	3114.53	3146.90	3146.90	3088.25
Inflow, foreign	89.76	2.21	2.21	0.00	0.00	0.00
Outflow, foreign	1389.14	1111.21	1137.71	1130.17	1130.17	1147.17
Surplus (deficit)	-1299.38	-1109.00	-1135.50	-1130.17	-1130.17	-1147.17
Net cashflow	878.26	1883.36	1979.03	2016.73	2016.73	1941.08
Cumulated net cashflow	-15872.24	-13988.88	-12009.86	-9993.13	-7976.41	-6035.33

Gelatin Plant --- Financial Analysis - July 1988

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	7450.00	7450.00	7450.00	7450.30	7450.00	7450.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	7450.00	7450.00	7450.00	7450.00	7450.00	7450.00
Total cash outflow	5715.42	5458.02	5458.02	5458.02	6073.48	6282.48
Total assets	234.00	0.00	0.00	0.00	25.00	234.00
Operating costs	4920.50	4920.50	4920.50	4920.50	4920.50	4920.50
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	560.93	537.52	537.52	537.52	1127.98	1127.98
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1734.58	1991.98	1991.98	1991.98	1376.52	1167.52
Cumulated cash balance	12449.74	14441.72	16433.69	18425.67	19802.19	20969.72
Inflow, local	7450.00	7450.00	7450.00	7450.00	7450.00	7450.00
Outflow, local	4422.25	4327.85	4327.85	4327.85	4926.31	4989.31
Surplus (deficit)	3027.75	3122.15	3122.15	3122.15	2523.69	2460.69
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	1293.17	1130.17	1130.17	1130.17	1147.17	1293.17
Surplus (deficit)	-1293.17	-1130.17	-1130.17	-1130.17	-1147.17	-1293.17
Net cashflow	1734.57	1991.98	1991.98	1991.98	1376.52	1167.52
Cumulated net cashflow	-4300.76	-2308.78	-316.81	1675.17	3051.69	4219.22

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	7450.00	7450.00	7450.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	7450.00	7450.00	7450.00
Total cash outflow	6048.48	6048.48	6048.48
Total assets	0.00	0.00	0.00
Operating costs	4920.50	4920.50	4920.50
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	1127.98	1127.98	1127.98
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	1401.52	1401.52	1401.52
Cumulated cash balance	22371.24	23772.77	25174.29
Inflow, local	7450.00	7450.00	7450.00
Outflow, local	4918.31	4918.31	4918.31
Surplus (deficit)	2531.69	2531.69	2531.69
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	1130.17	1130.17	1130.17
Surplus (deficit)	-1130.17	-1130.17	-1130.17
Net cashflow	1401.52	1401.52	1401.52
Cumulated net cashflow	5620.74	7022.27	8423.79

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	729.90	at	10.00 %
Internal Rate of Return (IRRE1) ..	10.81 %		

b) Net Worth versus Net cash return:

Net present value	3117.77	at	10.00 %
Internal Rate of Return (IRRE2) ..	12.59 %		

c) Internal Rate of Return on total investment:

Net present value	3117.77	at	10.00 %
Internal Rate of Return (IRR) ..	12.59 %		

Net Worth = Equity paid plus reserves

TABLE A.6

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	6705.00	7077.50	7450.00	7450.00	7450.00
Less: variable costs, incl. sales tax.	3261.04	3442.21	3623.38	3623.38	3623.38
Variable margin	3443.96	3635.29	3826.63	3826.63	3826.63
As % of total sales	51.36	51.36	51.36	51.36	51.36
Non-variable costs, incl. depreciation	2801.07	2801.07	2801.08	2801.08	2801.08
Operational margin	642.89	834.22	1025.55	1025.55	1025.55
As % of total sales	9.59	11.79	13.77	13.77	13.77
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	642.89	834.22	1025.55	1025.55	1025.55
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	642.89	834.22	1025.55	1025.55	1025.55
Tax	321.44	417.11	512.77	512.77	512.77
Net profit	321.44	417.11	512.77	512.77	512.77
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	321.44	417.11	512.77	512.77	512.77
Accumulated undistributed profit	321.44	738.55	1251.33	1764.10	2276.88
Gross profit, % of total sales	9.59	11.79	13.77	13.77	13.77
Net profit, % of total sales	4.79	5.89	6.88	6.88	6.88
ROE, Net profit, % of equity	1.92	2.49	3.06	3.06	3.06
ROI, Net profit+interest, % of invest.	1.82	2.35	2.89	2.89	2.89

Gelatin Plant --- Financial Analysis - July 1988

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	7450.00	7450.00	7450.00	7450.00	7450.00
Less: variable costs, incl. sales tax.	3623.38	3623.38	3623.38	3623.38	3623.38
Variable margin	3826.63	3826.63	3826.63	3826.63	3826.63
As % of total sales	51.36	51.36	51.36	51.36	51.36
Non-variable costs, incl. depreciation	2699.78	2704.77	2751.58	2751.58	2751.58
Operational margin	1126.85	1121.85	1075.05	1075.05	1075.05
As % of total sales	15.13	15.06	14.43	14.43	14.43
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	1126.85	1121.85	1075.05	1075.05	1075.05
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	1126.85	1121.85	1075.05	1075.05	1075.05
Tax	563.42	560.93	537.52	537.52	537.52
Net profit	563.42	560.93	537.52	537.52	537.52
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	563.42	560.93	537.52	537.52	537.52
Accumulated undistributed profit	2840.30	3401.23	3938.75	4476.28	5013.80
Gross profit, % of total sales	15.13	15.06	14.43	14.43	14.43
Net profit, % of total sales	7.56	7.53	7.22	7.22	7.22
ROE, Net profit, % of equity	3.36	3.35	3.21	3.21	3.21
ROI, Net profit+interest, % of invest.	3.17	3.11	2.98	2.98	2.98

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	7450.00	7450.00	7450.00	7450.00	7450.00
Less: variable costs, incl. sales tax.	3623.38	3623.38	3623.38	3623.38	3623.38
Variable margin	3826.63	3826.63	3826.63	3826.63	3826.63
As % of total sales	51.36	51.36	51.36	51.36	51.36
Non-variable costs, incl. depreciation	1570.67	1570.67	1570.67	1570.67	1570.67
Operational margin	2255.95	2255.95	2255.95	2255.95	2255.95
As % of total sales	30.28	30.28	30.28	30.28	30.28
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	2255.95	2255.55	2255.95	2255.95	2255.95
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	2255.95	2255.95	2255.95	2255 55	2255.95
Tax	1127.98	1127.98	1127.98	1127.98	1127.98
Net profit	1127.98	1127.98	1127.98	1127.98	1127.98
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1127.98	1127.98	1127.98	1127.98	1127.98
Accumulated undistributed profit	6141.78	7269.75	8397.73	9525.70	10653.68
Gross profit, % of total sales	30.28	30.28	30.28	30.28	30.28
Net profit, % of total sales	15.14	15.14	15.14	15.14	15.14
ROE, Net profit, % of equity	6.73	6.73	6.73	6.73	6.73
ROI, Net profit+interest, % of invest.	6.25	6.17	6.17	6.17	6.17

TABLE A.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	5419.60	16750.50
Fixed assets, net of depreciation	0.00	5419.60
Construction in progress	5419.60	11330.90
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	5419.60	16750.50
Equity capital	5419.60	16750.50
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	17449.44	17881.57	18409.37	18922.14	19434.92	19998.35
Fixed assets, net of depreciation	15246.55	13742.60	12238.65	10734.70	9230.75	7828.10
Construction in progress	0.00	0.00	0.00	0.00	0.00	25.00
Current assets	1280.09	1332.76	1385.42	1385.42	1385.42	1385.42
Cash, bank	44.54	44.60	44.66	44.66	44.66	44.66
Cash surplus, finance available	878.26	2761.62	4740.64	6757.37	8774.09	10715.17
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	17449.44	17881.57	18409.37	18922.14	19434.92	19998.35
Equity capital	16750.50	16750.50	16750.50	16750.50	16750.50	16750.50
Reserves, retained profit	0.00	321.44	738.55	1251.33	1764.10	2276.88
Profit	321.44	417.11	512.77	512.77	512.77	563.42
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	377.50	392.52	407.54	407.54	407.54	407.54
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	377.50	392.52	407.54	407.54	407.54	407.54
Equity, % of liabilities	95.99	93.67	90.99	88.52	86.19	83.76

TABLE A.7 (Cont'd) .... COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	20559.27	21096.79	21634.32	22171.84	23299.82	24427.79
Fixed assets, net of depreciation	6445.45	5225.00	3770.55	2316.10	2042.55	1794.00
Construction in progress	234.00	0.00	0.00	0.00	25.00	234.00
Current assets	1385.42	1385.42	1385.42	1385.42	1385.42	1385.42
Cash, bank	44.66	44.66	44.66	44.66	44.66	44.66
Cash surplus, finance available	12449.74	14441.72	16433.69	18425.67	19802.19	20969.72
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	20559.27	21096.79	21634.32	22171.84	23299.82	24427.79
Equity capital	16750.50	16750.50	16750.50	16750.50	16750.50	16750.50
Reserves, retained profit	2840.30	3401.23	3938.75	4476.28	5013.80	6141.78
Profit	560.93	537.52	537.52	537.52	1127.98	1127.98
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	407.54	407.54	407.54	407.54	407.54	407.54
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	407.54	407.54	407.54	407.54	407.54	407.54
Equity, % of liabilities	81.47	79.40	77.43	75.55	71.89	68.57

Gelatin Plant --- Financial Analysis - July 1988

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	25555.77	26683.74	27811.71
Fixed assets, net of depreciation	1754.45	1480.90	1207.35
Construction in progress	0.00	0.00	0.00
Current assets	1385.42	1385.42	1385.42
Cash, bank	44.66	44.66	44.66
Cash surplus, finance available	22371.24	23772.77	25174.29
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	25555.77	26683.74	27811.72
Equity capital	16750.50	16750.50	16750.50
Reserves, retained profit	7269.75	8397.73	9525.70
Profit	1127.98	1127.98	1127.98
Long and medium term debt	0.00	0.00	0.00
Current liabilities	407.54	407.54	407.54
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	407.54	407.54	407.54
Equity, % of liabilities	65.54	62.77	60.23

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	4941.12	10465.95
Financial resources	4941.12	10465.95
Sales, net of tax	0.00	0.00
Total cash outflow	4941.12	10465.95
Total assets	4941.12	10465.95
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1425.86	2509.69
Outflow, local	1425.86	2509.69
Surplus (deficit)	0.00	0.00
Inflow, foreign	3515.26	7956.26
Outflow, foreign	3515.26	7956.26
Surplus (deficit)	0.00	0.00
Net cashflow	-4941.12	-10465.95
Cumulated net cashflow	-4941.12	-15407.07

COMFAR

TABLE A.8 (Cont'd) ---- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	5893.11	5911.32	6221.82	6210.00	6210.00	6210.00
Financial resources	304.11	11.82	11.82	0.00	0.00	0.00
Sales, net of tax	5589.00	5899.50	6210.00	6210.00	6210.00	6210.00
Total cash outflow	4736.71	3854.36	3996.87	3955.44	3955.44	3976.04
Total assets	1066.27	41.43	41.43	0.00	0.00	20.60
Operating costs	3670.44	3812.94	3955.44	3955.44	3955.44	3955.44
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1156.40	2056.95	2224.95	2254.56	2254.56	2233.96
Cumulated cash balance	1156.40	3213.35	5438.30	7692.86	9947.43	12181.39
Inflow, local	5803.34	5909.11	6219.61	6210.00	6210.00	6210.00
Outflow, local	3347.57	2743.15	2859.15	2825.27	2825.27	2828.87
Surplus (deficit)	2455.77	3165.96	3360.46	3384.73	3384.73	3381.13
Inflow, foreign	89.76	2.21	2.21	0.00	0.00	0.00
Outflow, foreign	1389.14	1111.21	1137.71	1130.17	1130.17	1147.17
Surplus (deficit)	-1299.38	-1109.00	-1135.50	-1130.17	-1130.17	-1147.17
Net cashflow	1156.40	2056.95	2224.95	2254.56	2254.56	2233.96
Cumulated net cashflow	-14250.67	-12193.72	-9968.76	-7714.20	-5459.64	-3225.68

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	6210.00	6210.00	6210.00	6210.00	6210.00	6210.00
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	6210.00	6210.00	6210.00	6210.00	6210.00	6210.00
Total cash outflow . .	4150.39	3955.44	3955.44	3955.44	3978.04	4150.39
Total assets	194.95	0.00	0.00	0.00	20.60	194.95
Operating costs . . .	3955.44	3955.44	3955.44	3955.44	3955.44	3955.44
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	2059.61	2254.56	2254.56	2254.56	2233.96	2059.61
Cumulated cash balance	14241.00	16495.56	18750.12	21004.68	23238.64	25298.25
Inflow, local	6210.00	6210.00	6210.00	6210.00	6210.00	6210.00
Outflow, local	2857.22	2825.27	2825.27	2825.27	2828.87	2857.22
Surplus (deficit) .	3352.78	3384.73	3384.73	3384.73	3381.13	3352.78
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	1293.17	1130.17	1130.17	1130.17	1147.17	1293.17
Surplus (deficit) .	-1293.17	-1130.17	-1130.17	-1130.17	-1147.17	-1293.17
Net cashflow	2959.61	2254.56	2254.56	2254.56	2233.96	2059.61
Cumulated net cashflow	-1166.07	1088.49	3343.05	5597.61	7831.57	9891.18

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	6210.00	6210.00	6210.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	6210.00	6210.00	6210.00
Total cash outflow	3955.44	3955.44	3955.44
Total assets	0.00	0.00	0.00
Operating costs	3955.44	3955.44	3955.44
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	2254.56	2254.56	2254.56
Cumulated cash balance	27552.81	29807.37	32061.93
Inflow, local	6210.00	6210.00	6210.00
Outflow, local	2825.27	2825.27	2825.27
Surplus (deficit)	3384.73	3384.73	3384.73
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	1130.17	1130.17	1130.17
Surplus (deficit)	-1130.17	-1130.17	-1130.17
Net cashflow	2254.56	2254.56	2254.56
Cumulated net cashflow	12145.74	14400.30	16654.86

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-11510.22	at	10.00 %
Internal Rate of Return (IRRE1) ..	-4.30 %		

b) Net Worth versus Net cash return:

Net present value	-3507.06	at	10.00 %
Internal Rate of Return (IRRE2) ..	6.23 %		

c) Internal Rate of Return on total investment:

Net present value	-3507.06	at	10.00 %
Internal Rate of Return (IRR) ..	6.23 %		

Net Worth = Equity paid plus reserves

APPENDIX B

TECHNICAL SPECIFICATION

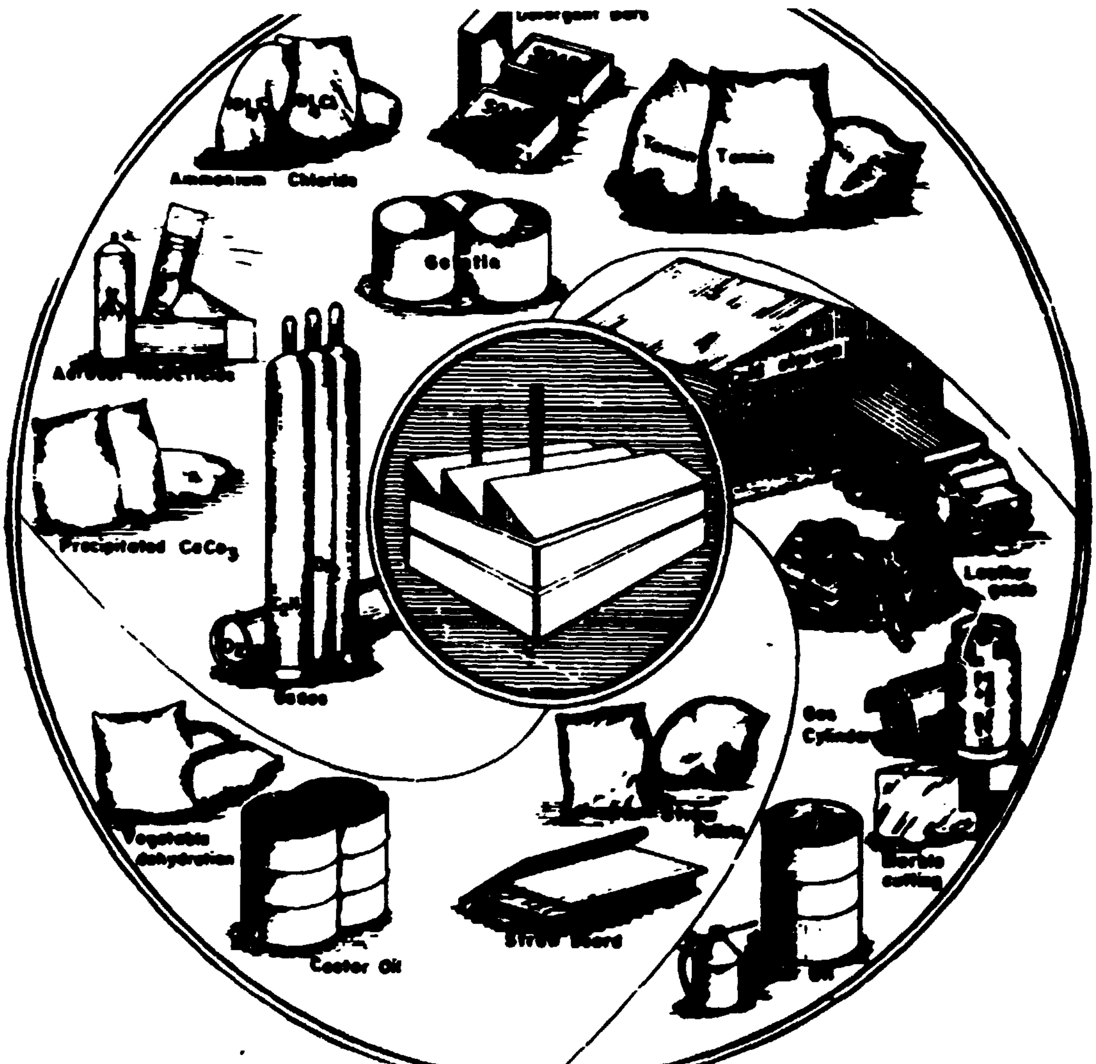
Edible Gelatin:	
Gelatin Strength 'Bloom'	100-300
Viscosity (mps at 6.67% w/w at 60°C)	20-60
Moisture %	8-12
pH (1% solution)	5.2-6.2
Ash %	max 3.0
SO_2 (mg/kg)	max 200
Arsenic (mg/kg)	max 1.0
Heavy Metals (mg/kg)	max 50
Copper (mg/kg)	max 30
Lead (mg/kg)	max 1.0
Zinc (mg/kg)	max 100
Total Bacteria Count (per g)	Max 5,000
E. coli	absent in 1 g.
Salmonella	absent in 10g.
Technical Gelatin:	
Gel Strength 'Bloom' (at 12.5% w/w)	150-400
Viscosity (at 12.5% w/w at 60° C)	50-125 mps
pH	5.5-6.8
Ash %	< 3.5
SO_2 mg/kg	< 500
Moisture%	8.0-14.0

In addition the gelatin should have an acceptable 'Colour' and 'Clarity'

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

17160 (4 of 5)



Volume II-C
Final Report

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

VOLUME II - C

AUGUST 1988

INDUSTRIAL PROJECTS SERVICE

PROJECT NUMBER 001/40 - 79

TABLE OF CONTENTS

VOLUME I

- J -

LEATHER GARMENTS

TABLE OF CONTENTS

I. SUMMARY

The project envisaged the establishment of a leather garment production plant.

The domestic demand for leather garments is estimated to be about 17,100 pieces of jacket equivalents in 1987 and is expected to reach 37,400 pieces in year 2003 at an annual growth rate of 5%. The capacity of the existing private leather garment (categorised as cottage enterprises) can meet the domestic demand. Nonetheless, this capacity is underutilized due to supply shortages caused by the preference of exporting raw and semi-processed skins than their local consumption.

There exists no local demand gap which justifies the creation of additional capacity. However, a plant which caters fur the export market has been proposed.

The project is to have a capacity of 18,000 jacket equivalents per year intially, with a possibility of doubling this capacity in future by either introducinq a second shift or duplicating the equipment and building.

The plant is to be integrated with the Universal Leather Goods Factory of the National Leather and Shoe Corporation as a production unit, in order to benefit from both reduced overhead costs and acquired experiences in manufacturing and trading of other leather articles.

The initial investment on machinery and equipment will be about Birr 82,460. The building space requirement is about 150 m².

The project is viable both financially and economically. The internal rate of return and the economic rate of return turned out to be 17.54% and 34.45%, respectively.

II. INTRODUCTION

This project investigates the possibility of establishing a leather garment manufacturing plant for export market.

Owing to its high livestock population, the country has a great potential for the development of the leather and leather products sector. Currently it exports more raw and semi-processed hides and skins than tanned leather. The finished leather export is negligible while the leather products export is practically nil.

The domestic demand for leather garment is relatively low, for the proportion of the population belonging to the middle and high income groups, which are the potential consumers, is low. There exist a number of private leather garment producing cottage enterprises in the country, with a total capacity capable of meeting the domestic demand. However, they could not utilize their capacities fully due to garment leather supply shortage. The shortage is caused by the preference of exporting raw and semi-processed skins than local consumption.

The locally available leather garment production capacity cannot meet the export market requirements. The international leather garment market is highly competitive, fashion oriented and sophosticated, requiring high level of skill and knowledge in the production technology and marketing. These could only be acquired gradually.

This profile has been worked out on the assumption that the establishment of a state-owned leather garment plant will help develop the required skill and know-how for the export market since the local demand gap does not justify additional capacity. However, such a venture presumes due preference for the produ n of leather products vis-a-vis raw and semi-processed exports.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

The types of garments made from leather include over-coats, jackets, sport coat, lumber jackets, waist coats, trousers, overalls, dresses, shirts, fashion garments, ties, approns and other protective garments. Leather garments are sophisticated products of finished leather, and generally appeal for consumers in the upper income brackets.

The markets for leather garments, especially in the developed countries, can be divided into segments on the basis of a combination of the following criteria.

Criteria	segment
Quality and price:	low, medium, high
Style and colour:	fashion and classical
Origin of leather used:	goat, pig, cow, calf.etc.
Variety of finish:	suede, split, napa,.etc.
End users:	women, men, youth

Style and colour are the most important segmentation criteria which determine the success or failure in marketing leather garments. Fashion leather garments, which are preferred by younger consumers, account for a bulk of the sales in most countries. Consumers of fashion leather garments generally give secondary consideration for quality, since in fashion durability is certainly far less important than appearance and buyers are unable to judge the quality, but they are very much concerned with the fashion and price. There are some advantages that marketing standard colour or classical leather garments offer to traders in the business. Black and brown colours are considered standard or classical colours in leather trade. Unlike the fashion garments, which have a very short life cycle, because they gain and lose popularity very quickly, the classical type of garment lasts much longer in a market. Hence, no urgent changes are likely to be called for, and deliveries may therefore be arranged over a long period of time. It is the latter type of leather garments which give a better opportunity in the export trade for a developing country.

2. Demand Analysis

a. Domestic Demand and Supply

It is difficult to find a quantified data on trade, production and consumption of leather garments in Ethiopia. The import statistics on leather garments are aggregated with articles and accessories of clothing (See Table I) and it is particularly impossible to determine the share of the leather garments in these imports. At any rate the import (in value) is so small that it is not worth disaggregating . No statistics is kept or reported on the domestic production and consumption of the product.

Hence to estimate the past and present demand of the product, data on the production of finished garment leather and a preliminary survey conducted on private leather garment producers were used. The survey was made using a structured personnel interview with five private producers of leather garments to determine the quantitative and qualitative aspects of the market and the demand of the product. (See Annex A on the questionnaire).

TABLE I

ETHIOPIA'S IMPORTS OF ARTICLES

OF APPAREL AND CLOTHING ACCESSORIES

(1977 - 1984)

(IN BIRR)

Year	Leather	Artificial Plastic	Rubber
1977	277,722	67,930	46,655
1978	201,226	144,158	202,458
1979	45,834	127,084	98,141
1980	52,475	57,781	58,264
1981	23,373	46,555	108,463
1982	115,062	34,550	179,869
1983	55,835	149,616	120,196
1984	44,159	41,984	211,833

SOURCE: Annual External Trade Statistics

The production of garment leather by tanneries in Ethiopia from 1969 to 1978 and the estimated equivalent in garments (jacket) and value are shown in Table II. The quantity of garments and value were estimated on the basis of the survey results.

It should be noted that the general trend in the production of the finished garment is on the increase. However, NLSC believes that the production of garment leather is not in any way influenced by the demand for the product. First of all, no production plan is made for garment leather contrary to what is done for other products. Secondly, no demand follow-up (orderly records of orders) of the product is made. In practice, NLSC gives priority to the use of the available hides and skins for the production of semi-processed leather for export. Only skins found to be of lower standard for processing for the export market are alloted for the production of garment leather. According to the producers surveyed, although the quality of leather supplied by NLSC is acceptable for the domestic market under the present circumstances, it is, however, considered a sub-standard product to be used for the export market.

According to the preliminary market survey, the present supply of garment leather is estimated to represent only 26% of the overall demand for the product. Allowing for any optimism by the suppliers, the present demand was estimated on the assumption that the present supply accounts for 40% of the demand. Accordingly, the 1987 demand for leather garments was estimated at about 17,100 pieces. Other results of the survey on the market for leather garment are:

TABLE II

PRODUCTION OF LEATHER BY TANNERIES

IN ETHIOPIA

1969 - 1978

YEAR	'000 [1] Sq. ft.	Garment Equivalent [2]	
		PCS	Birr
1969	23.7	538	187,224
1970	81.0	1841	640,668
1971	136.1	3093	1,076,364
1972	257.5	5852	2,036,496
1973	211.8	4814	1,675,272
1974	223.5	5080	1,767,840
1975	264.6	6013	2,092,524
1976	465.0	10567	3,677,316
1977	216.0	4910	1,708,680
1978	301.3	6848	2,383,104

[1] NLSC

[2] Units and value were estimated on the basis of the survey results of private leather garment producers.

The average finished leather requirement for each type of leather garment (in sq. ft.) is:

Men's jacket	44
Men's overcoat	89
Ladies' jacket	43
Skirt	27
Ladies trousers	40
Ladies overcoat	88

The market shares of the popular types of leather garments are:

Men's jacket	48%
Ladies' jacket	42%
Ladies' overcoat	6%
Others	4%

The respondents believe the market for leather garment consists of people in the monthly income of Birr 300 and more.

b. Demand Projection For Domestic Market

The preliminary survey on the domestic market for leather garment indicates that the demand for the product is growing. All the producers interviewed were positive that the demand has been increasing, although they could not say at what rate. The future demand for the product in Ethiopia will depend on a number of factors; the major ones include:

- The rate of improvement in the standard of living of the urban population,

- Government policy with regard to various forms of incentive to be given to the leather industry and the resulting prices to be adopted,

- The design and quality of the leather garments to be produced, and

- The quality of the leather and other accesories to be used.

Furthermore, the high rate of urbanization, 4% according to CSO's estimate, is expected to accelerate the growth rate of the demand. Assuming that the above factors will influence the demand for the product, and thereby widen the market base of the product, an annual growth rate of 5% has been assumed for the demand projection in this study. This growth rate appears modest considering the low demand base of the product. Accordingly, the 1987 base year demand of 17,100 pieces of garment was projected to grow to 37,400 pieces by the end of the projection period, 2003 (See Table III for the projected demand).

c. World Market

The world exports and imports in leather garments, broken-down by country are shown in Tables IV and V. It can be seen from the table that the international trade in leather garments was so high that in 1985 the world export of the product was about 1.4 Billion dollars (Birr 2.9 Billion) and the import w s more than 2.2 Billion dollars (Birr 4.6 Billion).

TABLE III

PROJECTION OF DOMESTIC DEMAND FOR LEATHER GARMENTS

(IN JACKET EQUIVALENT)

Year	Garment (pcs)
1987 (Base year)	17,100
1988	18,000
1989	18,900
1990	19,800
1991	20,800
1992	21,800
1993	22,900
1994	24,100
1995	25,300
1996	26,600
1997	27,900
1998	29,300
1999	30,800
2000	32,300
2001	33,900
2002	36,600
2003	37,400

In the five-year period shown in the tables, the import and export in value terms grew by 37% and 20%, respectively. The data, however, does not reveal the proportion between the inflationary pressure and the absolute volume that contributed to the growth. Nevertheless reports on consumer markets indicate that the demand prospect for leather products, including leather garments, has become favourable in the last few years because of consumers' continued preference for natural products, especially for genuine leather garments and upholstery.

Globally the market for leather garments is concentrated in the industrialized countries, especially the OECD countries. In 1985, for instance, the OECD countries accounted for more than 95% of the world import (in value) of leather clothes and accessories. Five of them (USA, Federal Germany, France, United Kingdom and Switzerland) contributed 72% of the world import of the product (See Table V). The implication of this is that any country which has an intention of entering the export market of leather garments has to assess carefully the market situation in these countries with respect to product quality, pricing, distribution and promotion.

The market for leather garments is highly competitive. It is a buyers' market with many suppliers competing. It has been reported that fashion clothing accounts for a major share of the trade crossing boundaries. This suggests that close liaison is required between exporting and importing firms to exchange information on the market situation and enable exporters to supply products that suit market requirements.

A number of developing countries, including Ethiopia, are in a comparative advantage with respect to some conditions such as raw material base (livestock population, and cheap labour to develop the leather garment industry.

TABLE IV

WORLD EXPORTS OF LEATHER CLOTHING AND ACCESSORIES

(1981 - 1985)

($ MILLION)

Exporting Country	1981	1982	1983	1984	1985
Korea Republic	422.0	454.5	508.6	619.4	540.0
Italy	176.8	195.2	210.3	233.4	246.9
Germany Fr.	58.0	62.3	78.6	89.8	102.5
France	63.9	60.4	57.7	61.8	75.8
Hong Kong	119.8	96.1	78.6	89.4	74.8
Pakistan		18.0	25.8	42.0	59.8
The Netherlands	37.8	38.9	46.1	48.6	57.3
United Kingdom	23.7	24.7	23.2	25.5	30.6
Spain	21.4	20.1	19.3	25.8	26.5
Morocco	12.9	15.9	17.7	20.8	20.9
Israel	8.9	12.9	13.6	15.9	19.9
Austria	13.1	14.6	16.0	17.0	17.6
Thailand	12.6	12.0	11.1	16.4	
India	15.8				
Japan	20.0	15.1	16.2	17.3	17.7
Finland	47.1	38.0	22.1	13.0	13.4
Argentina			14.0	13.0	
Belgium - Lux	5.8	6.2	5.7	9.0	12.2
Canada	11.0	9.6	12.6	10.2	11.7
Switzerland	10.5	9.3	9.7	11.7	11.4
Portugal	8.1	7.8	7.2	8.8	10.1
USA Puerto R.	23.4	17.5	10.7	8.4	10.0
All Others	39.4	48.8	45.3	38.8	27.2
World Total	1152.0	1178.2	1250.7	1436.0	1384.3

SOURCE: International Trade Centre

TABLE V

WORLD IMPORTS OF LEATHER CLOTHING AND ACCESSORIES

(1981 - 1985)

($ MILLION)

Importing Country	1981	1982	1983	1984	1985
USA - Puerto R	449.8	494.6	522.0	741.5	727.3
Germany, FR	431.1	404.4	467.9	502.2	503.0
France	70.6	88.0	108.2	132.1	152.5
United Kingdom	83.2	76.5	81.2	103.2	128.4
Switzerland	72.6	82.1	97.1	114.0	120.1
Hong Kong	41.3	47.2	48.6	70.8	92.1
The Netherlands	83.5	70.5	74.7	73.5	73.1
Japan	100.4	93.5	61.8	64.1	65.8
Belgium - Lux	43.6	42.8	47.3	56.2	63.9
Canada	40.0	39.7	50.6	72.2	61.8
Austria	33.9	38.1	46.5	52.7	49.0
Norway	17.0	19.1	17.6	19.5	36.9
Sweden	42.0	42.7	32.1	31.6	36.0
Denmark	14.3	15.3	18.9	24.0	32.0
Italy	37.9	39.3	28.5	22.8	27.5
Australia	18.9	18.5	13.3	21.7	21.4
Ireland	4.0	4.2	5.1	8.1	12.0
Finland	10.2	12.0	9.3	8.9	11.0
All Others	40.0	44.3	29.5	29.6	24.7
World Total	1634.3	1672.8	1759.3	2148.7	2239.1

SOURCE: International Trade Centre

However, there are a number of other requirements and problems which may deter them from entering the export market in the short and medium term. The major obstacles for the least developed countries, such as Ethiopia, in entering the export market include:

- Production of leather garments for export requires a very high standard and flexibility in the leather finishing, and the leather industries in these countries are not developed enough to meet these required standards;

- There is a keen competition from the domestic industries in the consumer target markets, with their well established quality image;

- As indicated earlier, the bulk of the sales of leather garment is accounted by fashion products which require quick response for market demands. Ethiopia and other developing countries are at a disadvantage in this respect as they are located far from the target markets e.g. the OECD countries, and

- Production of leather garments for export requires a high level of workmanship to meet the very high standard set for them, especially in ensuring uniform production. Developing countries, including Ethiopia, often suffer from a shortage of skilled labour such as tanning technologists, designers, quality controllers and marketing specialists.

Some developing countries such as South Korea, Hong Kong, Taiwan, Thailand, etc. have been able to attain a high level of export. In particular South Korea has become a leading exporter of leather clothing and accessories with a 30% share of the total world export in 1985. Such achievements were, however, made possible mainly as a result of expansion of U.S. and European firms to these countries in search of relatively low labour cost.

Because of the reasons mentioned above and others, Ethiopia might not be able to penetrate the export market on her own. That means a joint-venture partner (e.g. from Italy) could be necessary to ensure an exportable product and access to overseas distribution outlets.

3. Pricing and Distribution

The price of a leather jacket is greatly dependent on its quality. Jacket quality is determined by both the quality of leather used, and the skill and care with which the jacket is produced. An average ex-factory price of US$75 per jacket would be reasonable.

B PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The present production by private cottage producers was estimated to be about 6850 jacket equivalents. The production is restricted to this amount by the lack of a garment leather supply, rather than a capacity problem. The preliminary survey indicates that the existing private sector capacity can easily meet the present demand if the supply problem is solved.

Since the leather garment production is a very flexible and low investment enterprise, there seems to be no problem with regard to the capability of the private cottage industry to expand its capacity in the future to meet the relatively small projected demand, by extending the daily working hours and increasing the workforce or by undertaking an additional investment gradually. Hence, it is not advisable, at this stage, to invest in a new leather garment factory to meet the domestic demand. The question is rather whether to solve the domestic garment leather supply problem by foregoing some other national benefits, such as the foreign currency generation through the export of raw and semi-processed skins or to contemplate a production of leather garment for export on a joint-venture basis which perhaps increases the foreign exchange earning of the country.

In view of the above considerations, it is suggested that the cottage industries should continue to cater for the domestic market, while the Universal Leather Goods Factory should try to find a foreign partner to start leather garment production for export, initially at a level projected for the domestic market.

A plant with an initial capacity of 18,000 jackets or the equivalent has been proposed. It can easily accommodate future expansion, since it is a labour intensive process. A second shift could be used, utilizing the same equipment, or the building and equipment could be extended or duplicated and a single shift maintained. The emphasis to run the project on a joint-venture basis is only to ensure a marketable product and to find access to overseas distribution outlets. The project could also be expanded into a protective jacket market which requires heavier leather (1.2 to 1.5 mm) and quilted linings, but the production process is basically the same.

2. Production Programme

The production programme should be planned so that the plant can reach-its full capacity, i.e. 18,000 jackets or the equivalent, in the third year of its operation, and maintain this until it is expanded. An output of 10,800 and 14,400 jackets or the equivalent, which correspond to 60% and 80% of the capacity, is expected to be attained in the first and second years of operation, respectively.

The expansion or introduction of a second shift or duplication of the building and equipment for a single shift, can be realised, if deemed necessary, so that the total production of 28,800, 32,400 and 36,000 jackets or the equivalent can be reached in 2000, 2001 and in subsequent years, respectively.

IV. RAW MATERIALS AND INPUTS

A. AVAILABILITY OF GARMENT LEATHER

The main raw material for leather garment is garment leather of sheep and goat skin origin. At a rate of 44 sq. ft. per jacket a total of 792,000 sq. ft. of garment leather will be required to produce 18,000 jackets annually.

The only source of leather in the country is the National Leather and Shoe Corporation (NLSC), a public enterprise responsible for the entire hides and skins processing activities. The tanneries under the NLSC process about 7.5 million skins annually, an exceptional peak of 8.7 million was reached in the 1986/87 fiscal year. Of this production, only a small quantity was processed upto the finished leather stage for local consumption as indicated in Table VI. The rest is exported as pickle, wet blue and crust level, the pickle accounting for the major share followed by the wet blue. A considerable amount is also exported as raw skins. An average of 5241 tons of sheep and goat skin was exported per annum from 1981 to 1983 mainly by the Raw Hides and Skins Marketing Corporation of the Ministry of Foreign Trade.

With regard to finished skin leather, a differentiation has to be made between garment and upper leathers, on one hand, and lining leather, on the other, in view of the current finishing technologies and capabilities of the tanneries. Only the Ethiopian Tannery and the Awash Tannery have the capability and equipment to produce garment and upper leathers with a total annual finishing capacity of about 1,921,500 sq.ft and 1,008,000 sq. ft, respectively. The other tanneries simply hand spray the crust, which is totally rejected at the different stages of the processing (damaged grain, cuts, etc.), and are used by local shoe makers for lining, as required.

TABLE VI

FINISHED SKIN LEATHER PRODUCTION

OF TANNERIES UNDER NLSC

	UNIT	1982/83	1983/84	1984/85	1985/86	1986/87
ETHIOPIAN TANNERY						
Uppers	1000 sq.ft	365.9	479.6	884.9	274.4	40.[illegible]
Lining	"	871.1	1458.1	1428.0	1018.0	1147.[illegible]
Garment	"	264.6	465.0	216.0	301.3	90.[illegible]
Sub-Total		1501.6	2402.7	2528.9	1593.7	1278.[illegible]
AWASH TANNERY						
Uppers	"				60.8	82.8
Lining	"			770.3	712.6	575.8
Garment	"		22.7			
Sub-Total			22.7	770.3	773.4	658.6
MODJO TANNERY						
Lining	"		185.8	176.1	146.5	228.4
ASMARA PICKLING						
Lining	"	51.9	98.6	60.6	38.8	25.6
QUEY BAHIR TANNERY						
Uppers	"	31.4	62.0	83.5	61.1	
Lining	"	30.8	72.3	72.7	54.9	0.9
Sub-Total		62.2	134.3	156.2	116.0	0.9
TOTAL						
Uppers	"	397.3	541.6	968.4	396.3	123.5
Lining	"	953.8	1814.8	2507.7	1970.8	1977.8
Garment	"	264.6	487.7	216.0	301.3	90.3
Grand Total		1615.7	2844.1	3692.1	2668.4	2191.6
Skin Equivalent	1000 pcs	390	632	820	593	487
Share of uppers and garment	%	41%	36%	32%	26%	10%

The Asmara Pickling, for example, sun dries on wooden frames manually toggled wet blues before hand spraying to find some uses for its rejects, since it lacks the necessary facilities, such as vacuum driers. Such rejects made up about 5% of the total beam house input for all tanneries.

Assuming that:

- The present supply of upper and lining leathers (See Table VI) corresponds to the local demand of these commodities. (There is no finished skin leather export so far except the sporadic and negligible amount of lining).

- The finishing capacities of existing tanneries are:

Ethiopian Tannery	1,921,500	sq.ft/year
Awash Tannery	1,008,000	" "
Modjo Tannery (lining only)	202,500	" (5% of.beam house capacity)
Asmara Pickling(lining only)	100,000	" (1983/84)

The total comes to 3,232,000 sq. ft/year. Quey Bahir Tannery has to be excluded as NLSC is entertaining the idea of stopping the entire skin processing activity there .

The additional supply to meet the annual garment leather requirement of 792,000 sq. ft can be accommodated by the existing finishing capacities. The exceptional case observed in 1984/85 is well balanced by the overcapacity production of the Ethiopian Tannery in that year. Any additional future demand will, however, call for capacity expansion. Considering the existing facilities and know-how, the investment cost for expansion will be very low. Furthermore in the Ten Years Perspective Plan, the erection of a new finished skin leather tannery is envisaged and its realisation may depend on the demand.

The Corporation now gives top priority to the export market and as such it is aggressively pursuing a policy of exporting as much of its skin products as possible, at the cost of suppressing the local leather demand. Plans are already underway to export even the totally rejected skin as chamois and ASA leather. ASA is a widely accepted term standing for the German Phrase "Arbeiter Schutz Artikeln" meaning Labour Protection Articles. It serves the purpose by coating the damaged grain with synthetic materials. Under this condition, it will be impossible to secure the smooth supply of garment leather to the project under consideration, although an adequate raw skin supply and finishing capacity exist. Consequently, the realisation of the project will be questionable, unless a policy is seriously considered to secure the supply in view of its potential for the future garment export which has a higher added value.

B. OTHER MATERIALS AND INPUTS

Other inputs required are:

- Lining fabric (imported) at a rate of about 30 sq.ft (2.8 m^2) per jacket;
- Thread, buttons, zips and the like, which have to be imported;
- Electricity - about 8 kw.

The estimated annual requirement and cost of the materials and inputs for a capacity of 18,000 jackets per year are given in Table VII.

TABLE VII

MATERIALS AND INPUTS REQUIREMENTS AND COSTS

Item	Annual Requirement	Unit Price (Birr)	Total Cost (Birr)
Garment leather	792,000 sq.ft.	3.00	2,376,000
Lining fabric	50,400 m^2	3.50	176,400
Thread, buttons, zips, etc.	lump sum		94,000
Electricity	16,000 kwh	0.22	3,520
TOTAL			2,649,920

V. LOCATION

It is highly recommended that the plant should be located in Addis Ababa or in the surrounding areas. This is justified by the fact that the tanneries capable of supplying the leather, i.e. the Ethiopian Tannery and the Awash Tannery, are located in and around Addis Ababa, where a large portion of the required skilled labour force is also concentrated. Locating the plant in Addis Ababa, will further make export easy since it is the commercial centre of the country.

The project should ideally be attached physically and organisationally to the Universal Leather Goods Factory under the National Leather and Shoe Corporation, for it is involved in a similar trade and has acquired some experience in the export market of similar commodities as well. Through such an attachment, the project will benefit not only from sharing the overhead costs but also from its experience in manufacturing and trading of leather articles. The factory has already shown an interest in leather garments by contacting some private leather garment producers to assist them in finding export markets but so far with no success mainly due to the garment leather supply and quality problems of the private producers.

If located at Universal Leather Goods Factory, the existing infrastructural facilities for electricity, water for human consumption and telecommunications can easily accomodate the project without any additional investment. With regard to building, the garment production can be housed in the existing main building if a replacement building for the partitioned storage space or workshop, now all under the same roof, is built outside (enough space is available). This brings all production activities in one purpose designed and well lighted building and also saves some cost as the store requires neither such an expensive building nor trench work for electric connections.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Process

Leather jacket production is a relatively simple operation, although considerable skill is required. Leather skins (0.6 - 0.9 mm thick) are sorted, by colour and grain, into batches of 5 to 10 skins. The skins are cut by hand with a knife, one at a time, using a template. Normally 15% to 20% of the skin must be discarded either because it is damaged or because of the limitations of cutting out panels. Cloth linings (thin fabrics such as nylon or acrylic) are also cut, using a cutting machine. The jacket is stitched together on an electric sewing machine, and buttons and zips are added.

2. Technology Sources

Sewing machines are available from a variety of producers, including:

Bernina	Singer	Pfaff	Brother
(Swiss)	(US)	(Germany)	(Japan)

B. ENGINEERING

1. Machinery and Cost

Cutting the leather involves the use of a simple template, which can be metal or very heavy cardboard. A table or workbench is needed, and the work is made easier if this is covered by a 'clicking board' which holds the leather while

TABLE VIII

COST OF MACHINERY AND EQUIPMENT

Item	F C (Birr)	L.C (Birr)	Total (Birr)
10 clicking board	20,700	-	20,700
10 Sewing machines	31,500	-	31,500
Tables/Benches	-	2,100	2,100
Knives, templates	2,100	-	2,100
Cutting machine	3,200	-	3,200
Spares	2,875	105	2,980
Sub total	60,375	2,205	62,580
Sea freight (8% FOB)	-	4,830	4,830
Inland transport, handling and service charges (12.5% FOB)	-	7,550	7,550
Pick-up vehicle	27,000	18,000	45,000
Sub-Total	87,375	32,585	119,960
Contingencies (10%)	8,740	3,260	12,00
Grand Total	96,115	35,845	131,960

it is being cut. For stitching, a basic electric sewing machine would probably be adequate for the project's needs. The usual method is to work in pairs, one sewing machinist to one leather cutter. Each machinist requires a machine, and each cutter should have a clicking board. A pair can usually produce 6 to 10 jackets per day, depending on their skill, the quality of the leather, the leather wastage rate that is tolerable, and the required quality of the jacket.

A skilled operator using a cutting machine can produce up to 1,000 linings per day by cutting the cloth in stacks of 100 to 150 layers. The annual output on a single shift can therefore be as high as 300,000 linings if necessary.

The costs of the various pieces of equipment are given in Table VIII. The investment on machinery is quite low,.

2. Layout and Building

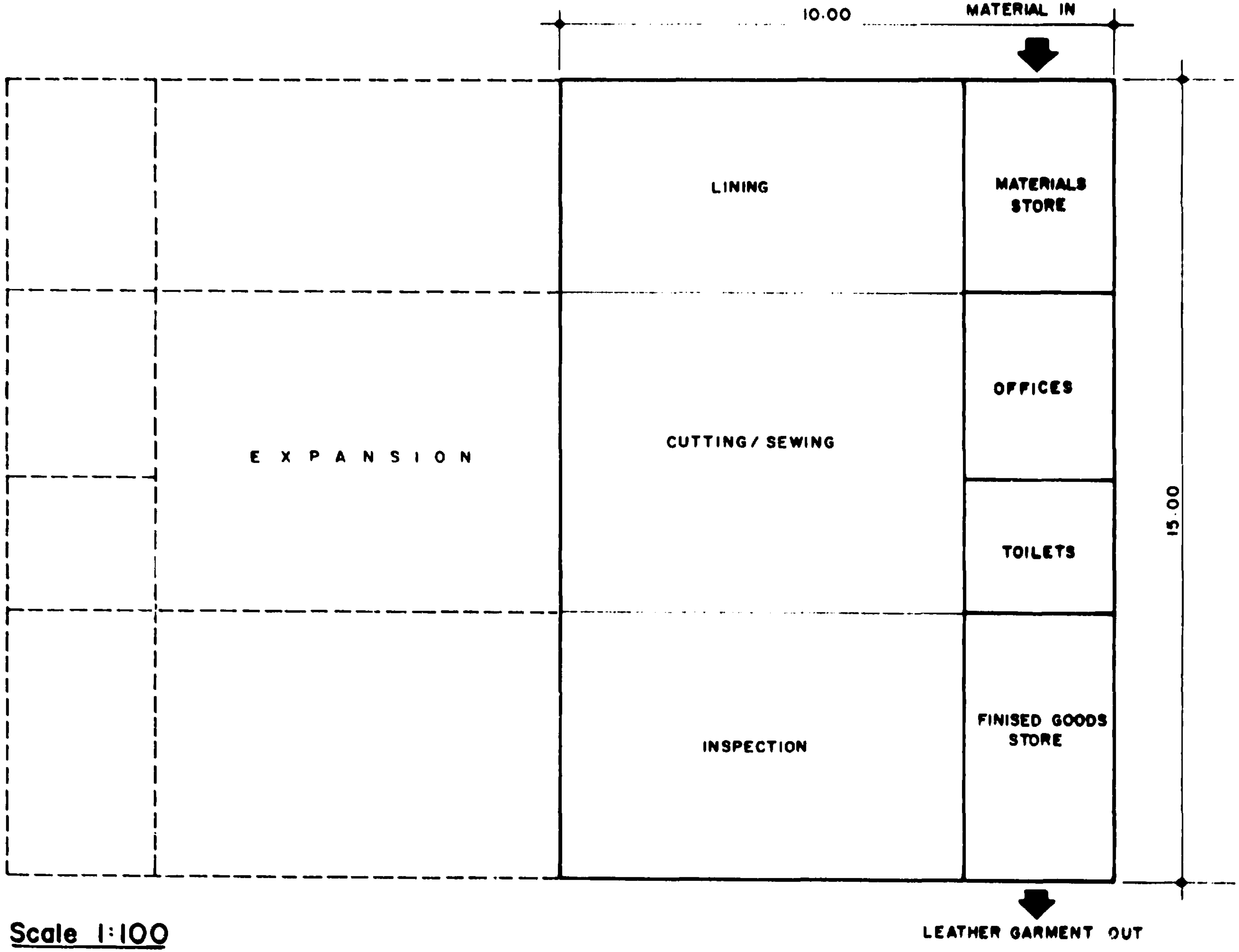
The break-down of the required built area is as follows:

	m^2
Sewing and cutting shop	80
Lining shop	30
Stores and administration	40
Total	150

The layout is shown in Figure I.

FIGURE 1

LAYOUT OF LEATHER GARMENTS FACTORY



Scale 1:100

It is assumed here that a new building of 150m^2 floor area will be constructed, since, even if the project is decided to be housed in the present main building of the Universal Leather Goods Factory, a replacement building of the same space is required for either the workshop or storage space.

The building can be of light weight construction, but it must be weather-proof to protect the leather. Cutting and stitching is a skilled operation, so the building should be well-lit and well-ventilated to ensure high productivity and efficiency.

The building and civil works costs were estimated as follows:

Building @ 900 Birr/m^2	Birr 135,000
Site and land prepartion (2%)	" 2,700
Out-door works (10%)	" 13,500
	" 151,200
Contingencies (10%)	" 15,200
Total	Birr 166,400

VII. ORGANIZATION AND MANPOWER

A. PLANT ORGANISATION

As indicated earlier, it is recommended that the leather garment project be organisationally integrated with the Universal Leather Goods factory (ULGF) of NLSC. Accordingly, the functions of overall management, finance, commerce, and administration could be taken over by the existing management staff of the ULGF. With regard to management, only the post of Leather Garment Production Head/Supervisor need to be newly created. The proposed organisation chart is shown in Figure II.

B. MANPOWER AND TRAINING

The manpower additionally required to start the project is shown in Table IX, where monthly salaries/wages and skill requirements are indicated. The total personnel requirement will be 38.

The skill and knowledge to produce leather garment are already available in the country, for there is an extensive garment making industry, and specialised training abroad will not be required.

FIGURE II

ORGANIZATION CHART

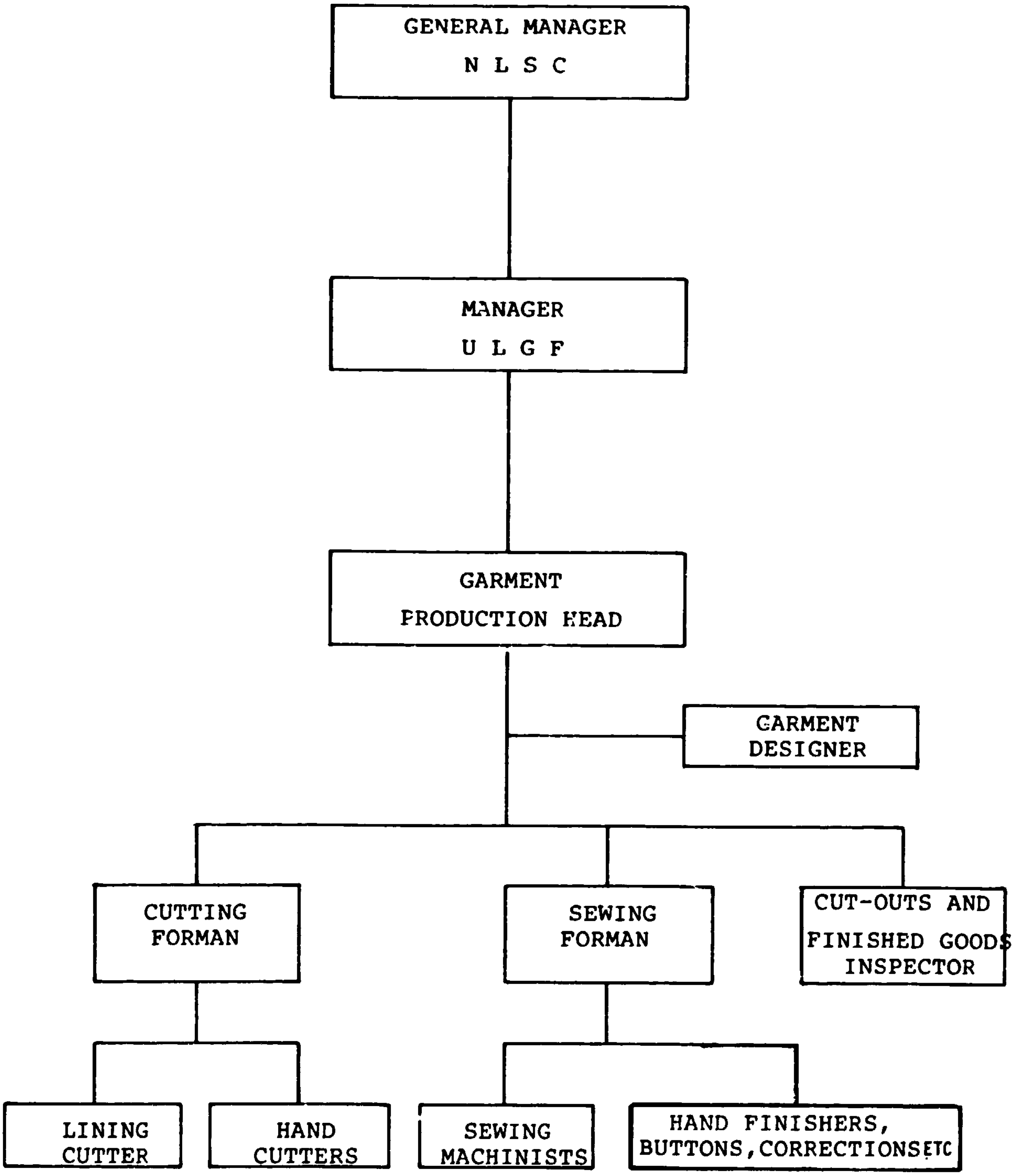


TABLE IX

MANPOWER REQUIREMENT (ADDITIONAL)

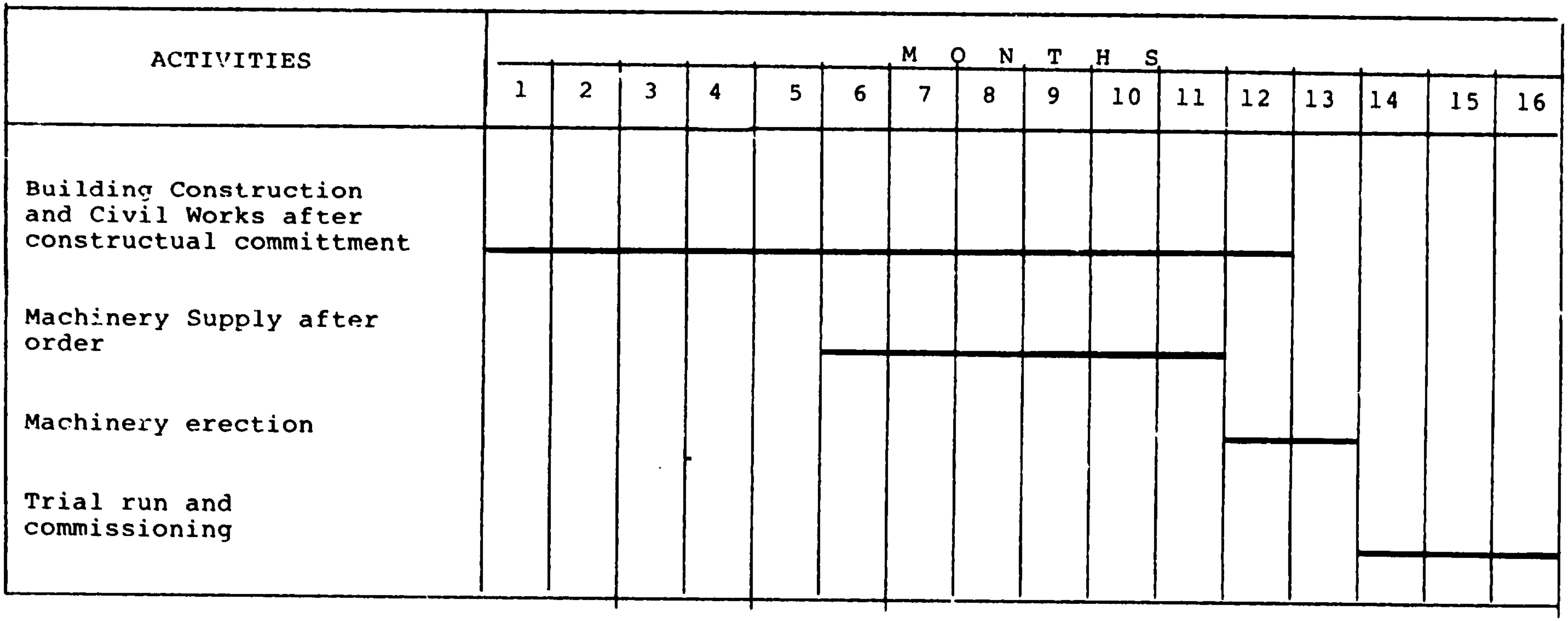
Post	No. of Persons	Salary (Birr Per Month)	Total Birr/ Month	Qualification
Garment Production Head	1	800	800	. Technical Diploma + Vocational Training + Long experience in leather garment production
Designer	1	900	900	Design Training (Diploma) + long experience in design
Clerks	2	250	500	High school certificate in commerce
Cutting Forman	1	450	450	Skilled with long experience
Lining Cutter	1	120	120	Semi-skilled
Hand Cutters	10	180	1800	Skilled
Sewing Forman	1	450	450	Skilled with long experience
Sewing Machinists	10	250	2500	Skilled with experience
Hand Finishers	3	120	360	Semi-skilled
Cutouts and finished Goods inspector	1	300	300	Skilled with experience
Maintenance/Repair	1	500	500	Poly Graduate
General Duties	5	60	300	Unskilled
Driver	1	250	250	
Total (including 25% benefits)	38	-	11,537.5	

VIII. IMPLEMENTATION SCHEDULE

As shown in Figure III, the building construction and civil works, machinery supply, erection, trial run and commissioning were estimated to take 16 months after a binding committment to implement the project.

FIGURE III

IMPLEMENTATION SCHEDULE



FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table X.

TABLE X

SUMMARY OF THE INITIAL INVESTMENT COST

Cost Items	Foreign	Local	Total
Buildings and civil works	49.92	116.48	166.40
Plant machinery and equipment	66.42	16.04	82.46
Office furniture and equipment	11.00	33.00	44.00
Vehicles	29.70	19.80	49.50
Pre-production expenditure	9.90	89.10	99.00
Total	166.94	274.42	441.36

The leather garments plant requires an initial investment cost of Birr 0.44 million. The foreign currency component amounts to Birr 0.17 million which represents about 39% of the total initial fixed investment cost.

The other 61% of the total initial fixed investment cost will be required in local currency. About 40% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the net working capital requirements of the leather garments plant.

Item	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	1.0
3. Raw materials - local	1.0
4. Other raw materials - foreign	6.0
5. Other raw materials - local	1.0
6. Work in progress	0.25
7. Finished goods	1.0
8. Accounts payable	1.0

The net working capital requirement at full capacity amounted to Birr 0.60 million, of which about 25% will be required in foreign currency.

3. Production Cost

The detailed production cost schedule is given together with other required financial statements.

The total production cost at full capacity amounts to Birr 2.76 million, out of which about 10% is in foreign currency.

4. Internal Rate of Return (IRR)

The financial viability of the leather garments plant was worked out under two alternatives. Alternative one considers the production of leather garments for export. Under this alternative the internal rate of return calculated was 17.54% with a net present value of Birr 0.44 million discounted at 10% p.a. The selling price assumed for the export market was Birr 170 per jacket equivalent.

If the leather garments to be produced by the envisaged plant do not meet upto international standards the possibility of penetrating into the world market is nil. Taking this fact into consideration alternative two was worked out assuming the production of leather garments for local consumption. The internal rate of return calculated was 117.88% with a net present value of Birr 7.97 million discounted at 10% p.a. The selling price assumed for domestic consumption was Birr 300 per jacket equivalent.

This project is very sensitive to selling price. The sensitivity analysis carried out reveals the following facts.

Conditions	IRR
- Selling price = Birr 200	61.03%
- Selling price = Birr 180	26.95%
- Selling price = Birr 150	-5.14%

5. Breakeven Analysis

The breakeven point would be reached at a production of 4253 jacket equivalents for export market. The total revenue that should be generated inorder to breakeven will be Birr 0.72 million. If we assume the production of leather garments for domestic consumption the breakeven point would be reached at a production of 610 jackets.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 34.45%, with a net present value of Birr 1.53 million discounted at 10% p.a.

The project will create employment for about 38 people.

APPENDIX A

QUESTIONNAIRE TO INVESTIGATE THE MARKET FOR LEATHER GARMENTS

Respendents: Private leather garment producers.

1. What in your opinion is the quality of the garment leather produced by National Leather and Shoe Corporation.

V.Poor	Poor	Fair	Good	V. Good

2. What is your assessment of the availability of garment leather in the country.

- [ ] always available
- [ ] sometimes not available
- [ ] often not available

3. What quantity of garment leather is required for making a unit of leather garment?

- Men's Jacket____________________
- Men's Coat____________________
- Ladies' Jacket____________________
- Ladies' Coat____________________
- Ladies' Trousers____________________
- Ladies' skirt____________________

4. What percent of your production is constituted by each type of the above (3) garments.

Men's Jacket________________________________

Men's Coat__________________________________

Ladies' Jacket______________________________

Ladies' Coat________________________________

Ladies' Trousers'___________________________

Ladies' Skirt_______________________________

5. In your opinion what percentage of leather garment worn by people in Ethiopia is locally made.

10	20	30	40	50	60	70	80	90	100

6. In your opinion what income category of people could offord to buy leather garment?

Birr________________________ Per Month.

7. How much does it cost to make a leather garment.

	Material Cost	Tailoring Cost
Men's Jacket		
Men's Coat		
Ladies Jacket		
Ladies Coat		
Ladies Trousers		
Ladies' Skirt		

8. How many units of garment do you make per month

Men's Jacket ___________________________

Men's Coat _____________________________

Ladies' Jacket _________________________

Ladies' Coat____________________________

Ladies' Trousers________________________

Ladies' Skirt __________________________

9. Which of the following do you think is true about the demand for leather garments?

	Men's Wear	Women's Wear
Increasing	______________	______________
Decreasing	______________	______________
Constant	______________	______________

10. Do you produce for export. If so what % of your total product is for export sale?

APPENDIX B

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

Leather Garments - Export Oriented
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	441.36	37.824 % foreign
current assets:	0.00	0.000 % foreign
total assets:	441.36	37.824 % foreign

Source of funds during construction phase

equity & grants:	441.36	37.824 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	441.36	37.824 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	1642.97	2176.71	2710.44
depreciation :	50.67	50.67	50.67
interest :	0.00	0.00	0.00
production costs	1693.64	2227.37	2761.11
thereof foreign	10.23 %	9.96 %	9.80 %
total sales :	1836.00	2448.00	3060.00
gross income :	142.36	220.63	298.89
net income :	71.18	110.31	149.45
cash balance :	-242.66	41.50	80.64
net cashflow :	-242.66	41.50	80.64

Net Present Value at: 10.00 % = 443.00
Internal Rate of Return: 17.54 %
Return on equity1: 25.86 %
Return on equity2: 17.54 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE B.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	66.56	99.84
Auxiliary and service facilities	19.80	29.70
Incorporated fixed assets	17.60	26.40
Plant machinery and equipment	32.99	49.47
Total fixed investment costs	136.95	205.41
Pre-production capital expenditures	39.60	59.40
Net working capital	0.00	0.00
Total initial investment costs	176.55	264.81
Of it foreign, in %	37.82	37.82

- J44 -

COMFAR

TABLE B.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9	10-12
% of nom. capacity (single product).	60.00	80.00	100.00	100 00	100.00	100.00
Raw material 1	1425.60	1900.80	2376.00	2376.00	2376.00	2376.00
Other raw materials	162.24	216.32	270.40	270.40	270.40	270.40
Utilities	5.13	6.58	8.02	8.02	8.02	8.02
Energy	7.00	7.00	7.00	7.00	7.00	7.00
Labour, direct	11.54	11.54	11 54	11.54	11.54	11 54
Repair, maintenance	12.40	12.40	12.40	12.40	12.40	12.40
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	8.66	10.03	11.40	11.40	11.40	11.40
Factory costs	1632.58	2164.67	2696.76	2696.76	2696.76	2696.76
Administrative overheads	10.40	12.04	13.68	13.68	13.68	13.68
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	50.67	59.67	50.67	20.97	24.93	30.87
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	1693.64	2227.37	2761.11	2731.41	2735.37	2741.31
Costs per unit (single product)	0.16	0.15	0.15	0.15	0.15	0.15
Of it foreign, %	10.23	9.96	9 80	9.62	9.69	9.80
Of it variable,%	94.54	95.85	96.65	97 70	97.56	97 35
Total labour	11.54	11.54	11.54	11.54	11.54	11 54

TABLE 8.3 (Cont'd)

Total Production Costs in '000 Birr

Year	13-17
% of nom. capacity (single product)	100.00
Raw material I	2376.00
Other raw materials	270.40
Utilities	8.02
Energy	7.00
Labour, direct	11.54
Repair, maintenance	12.40
Spares	0.00
Factory overheads	11.40
Factory costs	2696.76
Administrative overheads	13.68
Indir. costs, sales and distribution	0.00
Direct costs, sales and distribution	0.00
Depreciation	18.22
Financial costs	0.00
Total production costs	2728.66
Costs per unit (single product)	0.15
Of it foreign, %	9.56
Of it variable,%	97.80
Total labour	11.54

TABLE B.4

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	136.91	181.39	225.87	225.87
Inventory and materials	44	8.2	193.17	257.56	321.96	321.96
Energy	1	360.0	0.02	0.02	0.02	0.02
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	7	51.4	31.74	42.09	52.44	52.44
Finished products	30	12.0	136.91	181.39	225.87	225.87
Cash in hand	15	24.0	1.79	1.92	2.04	2.04
Total current assets			500.56	664.38	828.19	828.19
Current liabilities and						
Accounts payable	30	12.0	136.05	180.39	224.73	224.73
Net working capital			364.51	483.99	603.46	603.46
Increase in working capital			364.51	119.48	119.48	0.00
Net working capital, local			275.26	365.40	455.53	455.53
Net working capital, foreign			89.25	118.59	147.93	147.93

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

COMFAR

TABLE B.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	176.55	264.81
Financial resources	176.55	264.81
Sales, net of tax	0.00	0.00
Total cash outflow	176.55	264.81
Total assets	176.55	264.81
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	109.77	164.65
Outflow, local	109.77	164.65
Surplus (deficit)	0.00	0.00
Inflow, foreign	66.78	100.16
Outflow, foreign	66.78	100.16
Surplus (deficit)	0.00	0.00
Net cashflow	-176.55	-264.81
Cumulated net cashflow	-176.55	-441.36

COMFAR

TABLE 8.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1972.05	2492.34	3104.34	3060.00	3060.00	3060.00
Financial resources	136.05	44.34	44.34	0.00	0.00	0.00
Sales, net of tax	1836.00	2448.00	3060.00	3060.00	3060.00	3060.00
Total cash outflow	2214.71	2450.84	3023.70	2859.89	2859.89	2894.54
Total assets	500.56	163.82	163.82	0.00	0.00	19.80
Operating costs	1642.97	2176.71	2710.44	2710.44	2710.44	2710.44
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	71.18	110.31	149.45	149.45	149.45	164.30
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-242.66	41.50	80.64	200.11	200.11	165.46
Cumulated cash balance	-242.66	-201.16	-120.53	79.59	279.70	445.16
Inflow, local	1959.13	2488.28	3100.28	3060.00	3060.00	3060.00
Outflow, local	1957.48	2213.72	2737.91	2607.49	2607.49	2630.26
Surplus (deficit)	1.64	274.57	362.37	452.51	452.51	429.74
Inflow, foreign	12.92	4.06	4.06	0.00	0.00	0.00
Outflow, foreign	257.23	237.12	285.79	252.40	252.40	264.28
Surplus (deficit)	-244.31	-233.07	-281.74	-252.40	-252.40	-264.28
Net cashflow	-242.66	41.50	80.64	200.11	200.11	165.46
Cumulated net cashflow	-684.02	-642.52	-561.89	-361.77	-161.66	3.80

Leather Garments - Export Oriented - Financial Analysis - July 1988

TABLE 8.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	3060.00	3060.00	3060.00	3060.00	3060.00	3060.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3060.00	3060.00	3060.00	3060.00	3060.00	3060.00
Total cash outflow	2902.46	2869.79	2869.79	2869.79	2895.91	2905.81
Total assets	29.70	0.00	0.00	0.00	19.80	29.70
Operating costs	2710.44	2710.44	2710.44	2710.44	2710.44	2710.44
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	162.32	159.35	159.35	159.35	165.67	165.67
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	157.54	190.21	190.21	190.21	164.09	154.19
Cumulated cash balance	602.71	792.92	983.13	1173.35	1337.44	1491.63
Inflow, local	3060.00	3060.00	3060.00	3060.00	3060.00	3060.00
Outflow, local	2632.24	2617.39	2617.39	2617.39	2631.63	2635.59
Surplus (deficit)	427.76	442.61	442.61	442.61	428.37	424.41
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	270.22	252.40	252.40	252.40	264.28	270.22
Surplus (deficit)	-270.22	-252.40	-252.40	-252.40	-264.28	-270.22
Net cashflow	157.54	190.21	190.21	190.21	164.09	154.19
Cumulated net cashflow	161.35	351.56	541.77	731.[illegible]	[illegible]	[illegible]

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	3060.00	3060.00	3060.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	3060.00	3060.00	3060.00
Total cash outflow	2876.11	2876.11	2876.11
Total assets	0.00	0.00	0.00
Operating costs	2710.44	2710.44	2710.44
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	165.67	165.67	165.67
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	183.89	183.89	183.89
Cumulated cash balance	1675.52	1859.41	2043.30
Inflow, local	3060.00	3060.00	3060.00
Outflow, local	2623.71	2623.71	2623.71
Surplus (deficit)	436.29	436.29	436.29
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	252.40	252.40	252.40
Surplus (deficit)	-252.40	-252.40	-252.40
Net cashflow	183.89	183.89	183.89
Cumulated net cashflow	1234.16	1418.05	1601.94

- J51 -

TABLE B.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	568.66	at	10.00 %
Internal Rate of Return (IRRE1)	25.86 %		

b) Net Worth versus Net cash return:

Net present value	443.00	at	10.00 %
Internal Rate of Return (IRRE2)	17.54 %		

c) Internal Rate of Return on total investment:

Net present value	443.00	at	10.00 %
Internal Rate of Return (IRR)	17.54 %		

Net Worth = Equity paid plus reserves

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	1836.00	2448.00	3060.00	3060.00	3060.00
Less: variable costs, incl. sales tax.	1601.20	2134.93	2668.67	2668.67	2668.67
Variable margin	234.80	313.07	391.33	391.33	391.33
As % of total sales	12.79	12.79	12.79	12.79	12.79
Non-variable costs, incl. depreciation	92.44	92.44	92.44	92.44	92.44
Operational margin	142.36	220.63	298.89	298.89	298.89
As % of total sales	7.75	9.01	9.77	9.77	9.77
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	142.36	220.63	298.89	298.89	298.89
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	142.36	220.63	298.89	298.89	298.89
Tax	71.18	110.31	149.45	149.45	149.45
Net profit	71.18	110.31	149.45	149.45	149.45
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	71.18	110.31	149.45	149.45	149.45
Accumulated undistributed profit	71.18	181.49	330.94	480.39	629.83
Gross profit, % of total sales	7.75	9.01	9.77	9.77	9.77
Net profit, % of total sales	3.88	4.51	4.88	4.88	4.88
ROE, Net profit, % of equity	16.13	24.99	33.86	33.86	33.86
ROI, Net profit+interest, % of invest.	8.83	11.92	14.30	14.30	14.30

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	3060.00	3060.00	3060.00	3060.00	3060.00
Less: variable costs, incl. sales tax.	2668.67	2668.67	2668.67	2668.67	2668.67
Variable margin	391.33	391.33	391.33	391.33	391.33
As % of total sales	12.79	12.79	12.79	12.79	12.79
Non-variable costs, incl. depreciation	62.74	66.70	72.64	72.64	72.64
Operational margin	328.59	324.63	318.69	318.69	318.69
As % of total sales	10.74	10.61	10.41	10.41	10.41
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	328.59	324.63	318.69	318.69	318.69
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	328.59	324.63	318.69	318.69	318.69
Tax	164.30	162.32	159.35	159.35	159.35
Net profit	164.30	162.32	159.35	159.35	159.35
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	164.30	162.32	159.35	159.35	159.35
Accumulated undistributed profit	794.13	956.45	1115.80	1275.14	1434.49
Gross profit, % of total sales	10.74	10.61	10.41	10.41	10.41
Net profit, % of total sales	5.37	5.30	5.21	5.21	5.21
ROE, Net profit, % of equity	37.23	36.78	36.10	36.10	36.10
ROI, Net profit+interest, % of invest.	15.43	14.83	14.56	14.56	14.56

TABLE B.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	3060.00	3060.00	3060.00	3060.00	3060.00
Less: variable costs, incl. sales tax	2668.67	2668.67	2668.67	2668.67	2668.67
Variable margin	391.33	391.33	391.33	391.33	391.33
As % of total sales	12.79	12.79	12.79	12.79	12.79
Non-variable costs, incl. depreciation	59.99	59.99	59.99	59.99	59.99
Operational margin	331.34	331.34	331.34	331.34	331.34
As % of total sales	10.83	10.83	10.83	10.83	10.83
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	331.34	331.34	331.34	331.34	331.34
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	331.34	331.34	331.34	331.34	331.34
Tax	165.67	165.67	165.67	165.67	165.67
Net profit	165.67	165.67	165.67	165.67	165.67
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	165.67	165.67	165.67	165.67	165.67
Accumulated undistributed profit	1600.16	1765.83	1931.50	2097.17	2262.84
Gross profit, % of total sales	10.83	10.83	10.83	10.83	10.83
Net profit, % of total sales	5.41	5.41	5.41	5.41	5.41
ROE, Net profit, % of equity	37.54	37.54	37.54	37.54	37.54
ROI, Net profit+interest, % of invest.	14.87	14.48	14.48	14.48	14.48

TABLE 8.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	176.55	441.36
Fixed assets, net of depreciation	0.00	176.55
Construction in progress	176.55	264.81
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	176.55	441.36
Equity capital	176.55	441.36
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd) — COMFAR 2.1 · INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	891.25	1004.40	1117.56	1146.48	1295.92	1460.22
Fixed assets, net of depreciation	390.69	340.03	289.36	238.70	188.03	167.06
Construction in progress	0.00	0.00	0.00	0.00	0.00	19.80
Current assets	498.77	662.46	826.15	826.15	826.15	826.15
Cash, bank	1.79	1.92	2.04	2.04	2.04	2.04
Cash surplus, finance available	0.00	0.00	0.00	79.59	279.70	445.16
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	891.25	1004.40	1117.56	1146.48	1295.92	1460.22
Equity capital	441.36	441.36	441.36	441.36	441.36	441.36
Reserves, retained profit	0.00	71.18	181.49	330.94	480.39	629.83
Profit	71.18	110.31	149.45	149.45	149.45	164.30
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	136.05	180.39	224.73	224.73	224.73	224.73
Bank overdraft, finance required	242.66	201.16	120.53	0.00	0.00	0.00
Total debt	378.71	381.55	345.26	224.73	224.73	224.73
Equity, % of liabilities	49.52	43.94	39.49	38.50	34.06	30.23

TABLE B.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	1622.54	1781.89	1941.23	2100.58	2266.25	2431.92
Fixed assets, net of depreciation	161.94	160.77	129.91	99.04	80.82	82.40
Construction in progress	29.70	0.00	0.00	0.00	19.80	29.70
Current assets	826.15	826.15	826.15	826.15	826.15	826.15
Cash, bank	2.04	2.04	2.04	2.04	2.04	2.04
Cash surplus, finance available	602.71	792.92	983.13	1173.35	1337.44	1491.63
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	1622.54	1781.89	1941.23	2100.58	2266.25	2431.92
Equity capital	441.36	441.36	441.36	441.36	441.36	441.36
Reserves, retained profit	794.13	956.45	1115.80	1275.14	1434.49	1600.16
Profit	162.32	159.35	159.35	159.35	165.67	165.67
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	224.73	224.73	224.73	224.73	224.73	224.73
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	224.73	224.73	224.73	224.73	224.73	224.73
Equity, % of liabilities	27.20	24.77	22.74	21.01	19.48	18.15

TABLE B.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	2597.59	2763.26	2928.93
Fixed assets, net of depreciation	93.88	75.66	57.44
Construction in progress	0.00	0.00	0.00
Current assets	826.15	826.15	826.15
Cash, bank	2.04	2.04	2.04
Cash surplus, finance available	1675.51	1859.41	2043.30
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	2597.59	2763.26	2928.93
Equity capital	441.36	441.36	441.36
Reserves, retained profit	1765.83	1931.50	2097.17
Profit	165.67	165.67	165.67
Long and medium term debt	0.00	0.00	0.00
Current liabilities	224.73	224.73	224.73
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	224.73	224.73	224.73
Equity, % of liabilities	16.99	15.97	15.07

TABLE B.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	172.97	259.44
Financial resources	172.97	259.44
Sales, net of tax	0.00	0.00
Total cash outflow	[illegible]	259.44
Total assets	172.97	259.44
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	106.19	159.28
Outflow, local	106.19	159.28
Surplus (deficit)	0.00	0.00
Inflow, foreign	66.78	100.16
Outflow, foreign	66.78	100.16
Surplus (deficit)	0.00	0.00
Net cashflow	-172.97	-259.44
Cumulated net cashflow	-172.97	-432.41

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1971.37	2492.28	3104.28	3060.00	3060.00	3060.00
Financial resources	135.37	44.28	44.28	0.00	0.00	0.00
Sales, net of tax	1836.00	2448.00	3060.00	3060.00	3060.00	3060.00
Total cash outflow	2130.39	2328.40	2861.02	2697.43	2697.43	2712.87
Total assets	498.20	163.59	163.59	0.00	0.00	15.44
Operating costs	1632.19	2164.81	2697.43	2697.43	2697.43	2697.43
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-159.03	163.89	243.27	362.57	362.57	347.13
Cumulated cash balance	-159.03	4.86	248.13	610.70	973.27	1320.40
Inflow, local	1958.44	2488.23	3100.23	3060.00	3060.00	3060.00
Outflow, local	1873.16	2091.27	2575.22	2445.03	2445.03	2448.59
Surplus (deficit)	85.28	396.95	525.00	614.97	614.97	611.41
Inflow, foreign	12.92	4.06	4.06	0.00	0.00	0.00
Outflow, foreign	257.23	237.12	285.79	252.40	252.40	264.28
Surplus (deficit)	-244.31	-233.07	-281.74	-252.40	-252.40	-264.28
Net cashflow	-159.03	163.89	243.27	362.57	362.57	347.13
Cumulated net cashflow	-591.44	-427.55	-184.28	178.29	540.86	887.99

TABLE B.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	3060.00	3060.00	3060.00	3060.00	3060.00	3060.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3060.00	3060.00	3060.00	3060.00	3060.00	3060.00
Total cash outflow	2720.60	2697.43	2697.43	2697.43	2712.87	2720.60
Total assets	23.17	0.00	0.00	0.00	15.44	23.17
Operating costs	2697.43	2697.43	2697.43	2697.43	2697.43	2697.43
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	339.40	362.57	362.57	362.57	347.13	339.40
Cumulated cash balance	1659.80	2022.37	2384.94	2747.51	3094.64	3434.04
Inflow, local	3060.00	3060.00	3060.00	3060.00	3060.00	3060.00
Outflow, local	2450.38	2445.03	2445.03	2445.03	2448.59	2450.38
Surplus (deficit)	609.62	614.97	614.97	614.97	611.41	609.62
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	270.22	252.40	252.40	252.40	264.28	270.22
Surplus (deficit)	-270.22	-252.40	-252.40	-252.40	-264.28	-270.22
Net cashflow	339.40	362.57	362.57	362.57	347.13	339.40
Cumulated net cashflow	1227.39	1589.96	1952.53	2315.10	2662.23	3001.63

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	3060.00	3060.00	3060.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	3060.00	3060 00	3060.00
Total cash outflow	2697.43	2697.43	2697.43
Total assets	0.00	0.00	0.00
Operating costs	2697.43	2697.43	2697.43
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	362.57	362.57	362.57
Cumulated cash balance	3796 61	4159.18	4521.75
Inflow, local	3060.00	3060.00	3060.00
Outflow, local	2445 03	2445.03	2445.03
Surplus (deficit)	614.97	614.97	614.97
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	252.40	252.40	252.40
Surplus (deficit)	-252.40	-252.40	-252.40
Net cashflow	362.57	362.57	362.57
Cumulated net cashflow	3364.20	3726.77	4089.34

COMFAR

TABLE B.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	1661.83	at	10.00 %
Internal Rate of Return (IRRE1) ..	47.96 %		

b) Net Worth versus Net cash return:

Net present value	1533.80	at	10.00 %
Internal Rate of Return (IRRE2) ..	34.45 %		

c) Internal Rate of Return on total investment:

Net present value	1533.80	at	10.00 %
Internal Rate of Return (IRR) ..	34.45 %		

Net Worth : Equity paid plus reserves

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	176.55	264.81
Financial resources	176.55	264.81
Sales, net of tax	0.00	0.00
Total cash outflow	176.55	264.81
Total assets	176.55	264.81
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	109.77	164.65
Outflow, local	109.77	164.65
Surplus (deficit)	0.00	0.00
Inflow, foreign	66.78	100.16
Outflow, foreign	66.78	100.16
Surplus (deficit)	0.00	0.00
Net cashflow	-176.55	-264.81
Cumulated net cashflow	-176.55	-441.36

TABLE B.9 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	3376.05	4364.34	5444.34	5400.00	5400.00	5400.00
Financial resources	136.05	44.34	44.34	0.00	0.00	0.00
Sales, net of tax	3240.00	4320 00	5400.00	5400.00	5400 00	5400 00
Total cash outflow	2916.71	3386.84	4193.70	4029.89	4029.89	4064.54
Total assets	500.56	163.82	163.82	0.00	0 00	19.80
Operating costs	1642.97	2176.71	2710.44	2710.44	2710.44	2710.44
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	773.18	1046.31	1319.45	1319.45	1319.45	1334.30
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	459.34	977.50	1250.64	1370.11	1370.11	1335 46
Cumulated cash balance	459.34	1436.84	2687.47	4057.59	5427.70	6763.16
Inflow, local	3363.13	4360.28	5440.28	5400.00	5400.00	5400.00
Outflow, local	2659.48	3149.72	3907.91	3777.49	3777.49	3800.26
Surplus (deficit)	703.64	1210.57	1532.37	1622.51	1622.51	1599.74
Inflow, foreign	12.92	4.06	4.06	0.00	0.00	0.00
Outflow, foreign	257.23	237.12	285.79	252.40	252.40	264.28
Surplus (deficit)	-244.31	-233.07	-281.74	-252.40	-252.40	-264.28
Net cashflow	459.34	977.50	1250.64	1370.11	1370.11	1335.46
Cumulated net cashflow	17.98	995.48	2246.11	3616.23	4986.34	6321.80

TABLE B.9 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	5400.00	5400.00	5400.00	5400.00	5400.00	5400.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	5400.00	5400.00	5400.00	5400.00	5400.00	5400.00
Total cash outflow	4072.46	4039.79	4039.79	4039.79	4065.91	4075.81
Total assets	29.70	0.00	0.00	0.00	19.80	29.70
Operating costs	2710.44	2710.44	2710.44	2710.44	2710.44	2710.44
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	1332.32	1329.35	1329.35	1329.35	1335.67	1335.67
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1327.54	1360.21	1360.21	1360.21	1334.09	1324.19
Cumulated cash balance	8090.71	9450.92	10811.13	12171.34	13505.43	14829.62
Inflow, local	5400.00	5400.00	5400.00	5400.00	5400.00	5400.00
Outflow, local	3802.24	3787.39	3787.39	3787.39	3801.63	3805.59
Surplus (deficit)	1597.76	1612.61	1612.61	1612.61	1598.37	1594.41
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	270.22	252.40	252.40	252.40	264.28	270.22
Surplus (deficit)	-270.22	-252.40	-252.40	-252.40	-264.28	-270.22
Net cashflow	1327.54	1360.21	1360.21	1360.21	1334.09	1324.19
Cumulated net cashflow	7649.35	9009.56	10369.77	11729.98	13064.07	14388.26

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	5400.00	5400.00	5400.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	5400.00	5400.00	5400.00
Total cash outflow	4046.11	4046.11	4046.11
Total assets	0.00	0.00	0.00
Operating costs	2710.44	2710.44	2710.44
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	1335.67	1335.67	1335.67
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	1353.89	1353.89	1353.89
Cumulated cash balance	16183.51	17537.40	18891.29
Inflow, local	5400.00	5400.00	5400.00
Outflow, local	3793.71	3793.71	3793.71
Surplus (deficit)	1606.29	1606.29	1606.29
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	252.40	252.40	252.40
Surplus (deficit)	-252.40	-252.40	-252.40
Net cashflow	1353.89	1353.89	1353.89
Cumulated net cashflow	15742.15	17096.04	18449.93

TABLE B.9 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	8096.18	at	10.00 %
Internal Rate of Return (IRRE1) ..	137.12 %		

b) Net Worth versus Net cash return:

Net present value	7970.52	at	10.00 %
Internal Rate of Return (IRRE2) ..	117.88 %		

c) Internal Rate of Return on total investment:

Net present value	7970.52	at	10.00 %
Internal Rate of Return (IRR) ..	117.88 %		

Net Worth : Equity paid plus reserves

- K -

VEGETABLE TANNIN

TABLE OF CONTENTS

I. SUMMARY

The project envisages the establishment of a plant for extracting vegetable tannins from planted mimosa.

The domestic demand for vegetable tannins is estimated to be 245 tons in 1987 and expected to reach 570 tons in year 2003. Hence a plant capacity of 450 tons/yr has been proposed.

This is a fairly long-term project for the plantation requires about 15 years lead time.

Bale and Illubabor administrative regions are possible alternative locations for the plantation in view of climatic and soil conditions and space availability. The extraction plant should be located near the plantation.

The investment cost for machinery and equipment is about Birr 1.76 million. The building requirement is roughly $480m^2$.

The extraction plant can provide employment for 81 people. The fairly complex nature of the operation calls for well trained technical staff and operators.

Both financially and economically, the project is not viable. The internal rate of return and the economic rate of return turned out to be -0.07% and 6.28%. This is understandable considering the low capacity detrmined by the local demand. The minimum economic size for tannin production is generally considered to be 2000 tons/year.

II. INTRODUCTION

This project considers the production of vegetable tannin for the domestic market, i.e. the tanning industry.

The country's tanning industry is fairly developed, owing to the high livestock population. However, in line with the international practices and trend, chrome tanning has become dominant, resulting in a very low requirement for vegetable tannins.

Nonetheless, a considerable amount of vegetable tannins is still being imported. On the other hand, it is known that a number of tannin bearing plant species grow naturally in the country. In view of these the project idea, promoted particularly the National Leather and Shoe Corporation, had been evolving around for a long time. As a result, mimosa tree plantation trials have been carried out at Edjere, Shoa, and the results are promising. The exploitation of the naturally growing species has become not so attractive, for their tannin contents are generally believed to be low and their occurance has been victimised by the deforestation process.

Vegetable tannin production is a very capital intensive industry requiring imported high technology equipment. Since the world demand for vegetable tannin has been historically declining, the major exporting countries are using agressive pricing policies by employing high quality equipment in a highly efficient manner inorder to maintain their market share.

The usual scale of mimosa tannin production is 4000 to 5000 tons of powder per year. There are considerable economies of scale, and the minimum economic size is generally considered to be 2000 tons of powder per year.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Tannins or tannic acids, are a group of pale yellow to light-brown amorphous substances produced in the form of powder, flakes or a spongy mass. Tannins may be of vegetable, mineral or synthetic origin and they are chiefly used in tanning of leather. In leather tanning, the tannin displaces the water and then combines with and coats the collagen fibres. Tanning increases the resistance to heat, hydrolysis (decomposition caused by water), and micro-organisms.

In addition to their main use in tanning leather, tannins are also used for dying of fabric, making ink, clarification of wine and beer, and as a constituent to reduce viscosity drilling mud for oil wells, and to prevent scale formation in boiler water. They are also used for various medical applications such as treatment of tonsilites, pharyngitis, homorrhoids and skin eruptions checking diarrhea and intestinal bleeding, and as antidotes for certain types of poisons with which it forms insoluble precipitates.

In this study, vegetable tannins, the earliest of the tannin groups to be used for leather tanning have been considered. The available records indicate that vegetable tannins have been in use by the turn of the 18th, century.

Vegetable tannin is a substance found in a wide variety of plants. It occurs in suitably high concentrations, however, only in specific parts of some species, for example, nuts, bark, stems and heartwood. Tannins are used in considerable quantities in the production of leather, some tannins are ideal for some types of leather.

This profile deals specifically with mimosa tannin, which is derived from the bark of the South African 'mimosa' wattle. It is used in a powder form, containing 70% tannin, plus water and organic impurities, in the production of shoe leather (mainly soles).

Vegetable tanning imparts a natural brown or red colour to the leather. The resulting products will have special desirable characteristics: sole leather gradually moulds to the shape of foot, belting leather will gain exceptional dimensional stability, and upholstery leather has the desired softness. Vegetable tannins are now mainly used in the manufacture of sole leather and other heavy leathers which are sold by weight. The vegetable extracts are also used in the retanning of chrome tanned leathers. To tan other types of leather, tannins of other origins (mineral and synthetic)are preferred to vegetable tannins because of a number of the desirable performance characteristics of these alternative sources.

Mineral tannage, chromium salts being the principal chemical (tannin) from this source, is comparatively a recent development, and shortens the tanning process and gives the leather a greater duration, uniformity and a wide variety of performance characteristics. Synthetic tanning materials which are commonly known as "syntans" are the most recently developed among the tannin groups and are made by condensing formaldehyde with sulphonated naphtalines or phenols. Synthetic tans are used to bleach chrome - tanned and vegetable tanned leathers; to produce shrunken grain and to aid dyeing; to produce white, light and fast leathers, and to make special products of vegetable extracts-the most widely available and used for leather tanning are of quebracho, mimosa and chestnut origin.

2. Demand Analysis

a. World Demand and Supply

The world demand for vegetable tannins is reported to have become stagnant, for it is being replaced more and more by minerals (chromium oxide) and synthetic tannins. The production statistics from 1973 to 1982 proves this assertion. (See Table I).

As shown in the table, the production was about 175,000 tons in 1973; it has been below this level and fluctuated in the subsequent years. In 1982 the production increased to 179,000 tons. In the USA, one of the major consumers of the product, vegetable tannins have been largely replaced by chromium tanning which at present is estimated to represent 95% of all the tannins consumed in that country. Between 60% to 70% of the supply (production) of vegetable tannins from 1973 to 1982 was accounted by Latin American countries (See Table I). No developing country in Africa has been reported to have produced tannins during this period.

The vegetable and other types of tannins requirement from 1980 - 2000 has been estimated for UNIDO and reported in a publication titled "Strategies For Increasing the Production of Tanning Chemicals in Developing Countries". (See Table II for details). From the table, the demand for vegetable tannins is to grow to 338,000 tons in 1990 and 371,000 in 2000, from demand level of 305,000 tons in 1980. During the first 10 years, the demand is expected to grow by an annual average of about 1.03%, but in the second 10 years, the growth rate is expected

TABLE I

PRODUCTION OF VEGETABLE TANNING EXTRACTS

(TONS)

Country or Area	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
America, South	107273	92615	83188	109833	117869	114550	110973	111127	105455	123815
Argentina	90096	86345	69095	91929	104752	97198	104314	95433	92248	110572
Paragauay	17177	6270	14093	17904	13117	17352	6659	15694	13207	-
Asia	2173	2218	2485	2130	2499	2114	2753	2559	2614	2669
Turkey	-	2218	2485	2130	2499	2114	2753	-	-	-
Europe	65629	54269	57597	52397	53232	55067	59292	53874	54386	52462
EEC	58000	47046	51009	47235	46913	49351	52866	48218	47687	47155
France	15950	-	-	-	-	-	-	-	-	-
Italy	42050	31096	35059	31285	30963	33401	36916	-	-	-
East Europe	5825	5409	4874	4815	4900	4297	5007	4237	5280	3898
Bulgaria	597	243	250	104	24	-	-	-	-	-
Poland	2964	2959	2583	2735	2961	2456	3139	2431	2429	907
Romania	2264	2207	2041	1976	1915	1841	1868	1806	2851	2981
Other Europe	1804	1814	1714	347	1419	1419	1419	1419	1419	1419
Spain	1804	1814	1714	347	-	-	-	-	-	-
Total	175075	149102	143270	164360	173600	171731	173018	167560	162455	178946

SOURCE: UN Industrial Statistics Year Book, 1982.

TABLE II

CHROME SALTS, VEGETABLE TANNING MATERIAL, AND SYNTANS REQUIRED FOR LEATHER PRODUCTIOIN, 1980 TO 2000

('000 TONS)

Regions	Chrome Salts			Vegetable Tannins			Syntans		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Developed Market Economies	253.9	275.7	296.6	107.9	111.3	116.1	76.2	82.7	89.0
CPE Eurpose (inc. USSR)	118.8	140.1	161.5	71.4	73.0	71.6	35.6	42.1	48.4
Developing Market Economies	237.8	301.1	367.5	106.9	132.3	157.8	71.3	90.3	110.2
Sub-Saharan Africa	10.0	13.3	18.8	3.4	4.5	6.3	3.0	4.0	5.6
North African & West Asia	24.0	37.8	52.0	12.2	17.2	22.2	7.2	11.3	15.6
South Asia	75.2	92.0	109.3	35.2	43.4	51.5	22.5	27.6	32.8
South East Asia	22.9	27.6	32.1	10.9	13.5	15.7	6.9	8.3	9.6
Latin America	105.7	130.4	155.3	45.2	53.7	62.1	31.7	38.1	46.6
CPE Asia	35.7	43.0	50.2	19.0	21.8	25.3	10.7	12.9	15.1
World	646.2	759.9	875.8	305.2	338.4	370.8	193.8	228.00	262.7

SOURCE: UNIDO, "Strategies for Increasing the Production of Tanning Chemicals in Developing Countries".

to decline to 0.94%. The demand for the competing products, chrome salts and synthans, is expected to grow by 1.64% (chrome) and by 1.63% (synthans) during the first half of the projection period, and by 1.43% (chrome) and by 1.44% (synthans) during the second half of the projection period (1990 - 2000). The world maket of the product has thus reached a declining stage, implying a stiff competition from the supply side. However, this may not hold true for individual countries since factors such as resource endowment, development level of the country and government policies may influence the trend in the opposite direction.

b. Domestic Demand: Past and Present

In the past, vegetable tannins were used in Ethiopia for tanning and retanning sole leather and heavy upper leather. According to the National Leather and Shoes Corporation (NLSC), the average consumption of tannins by these two groups of leather was about 90% and 10%, respectively. Recently, however, they have been used only for the manufacture of sole leather because chrome tanning has been found to result in a better product in case of leather for upper.

NLSC has been importing three types of tannins of vegetable origin. They are mimosa powder, quebrach powder and velonia powder; mimosa accounting for the major share. The volume and value consumption of vegetable tannins by tanneries under NLSC from 1979/80 to 1985/86 is shown in Table III. The consumption has been fluctuating with the highest being 329.3 tons in 1980/81 and the lowest 199.2 tons in 1982/83 due to a variety of recipes, change in the product mix and fluctuation in the production of sole leather.

TABLE III

VEGETABLE TANNINS CONSUMED BY TANNERIES IN ETHIOPIA

(1979 - 1986)

Year	Volume (Kgs)	Value (Birr)
1979/89	243,579	346,252
1980/81	329,317	623.711
1981/82	262,875	525,030
1982/83	199,198	589,523
1983/84	204,000	469,641
1984/85	247,243	720,000
1985/86	255,472	633,000

SOURCE: NLSC

c. Projection of Demand

The future demand for vegetable tannins is likely to be determined by the production volume of leather sole since NLSC has not indicated any intention of resuming the use of these extracts in the production of other types of leather. Furthermore, there is no way of knowing the other sectors, which would require vegetable tannins during the production period. Hence the demand forecast carried out in this study is limited to the requirement for the manufacture of leather soles.

From the 1986/87 to 1988/89 fiscal period, the planned production of sole leather and the corresponding requirement of vegetable tannins are shown in Table IV.

TABLE IV

1986-89 PLANNED PRODUCTION OF SOLE LEATHER AND PLANNED CONSUMPTION OF VEGETABLE TANNINS (IN TONS)

Year	Production of Sole Leather	Consumption of Vegetable Tannins
1986/87	459	259
1987/88	482	260
1988/89	523	260

Though production of sole leather has been planned to increase during the plan period, the planned requirement has been virtually kept constant. No adequate explanation has been given by NLSC for this anomalous provision.

Two alternative approaches have been used to project the demand for tannins of vegetable origin. The first is a production coefficient approach which requires establishment of fixed input and output relationship between vegetable tannins and leather soles. The second alternative is an annual growth rate method. A third alternative, time trend extrapolation (least square method), has also been considered. But this alternative was dropped since it assumes that the same demand factors that had been in operation in the past would also prevail unchanged in future, whereas the available information indicate that this may not hold true in this particular case since NLSC has rehabilitation plans and new projects which are expected to increase the production of leather soles, which would increase the consumption of vegetable tannins, to a large extent.

Under the first alternative a consumption coefficient was established based on the planned sole leather production from 1986/87 to 1988/89 and the planned consumption requirement of vegetable tannins during the same period. The production of a ton of leather sole is computed to require 0.533 tons of vegetable tannins. This approach, however, requires a leather sole production forecast for the projection period of the project. For this, information from a study prepared by IPS on the feasibility of increasing the tanning capacity of NLSC has been used. In the study, the production of hides for the domestic market has been reported as follows:

- Current production capacity of hides	=	658,000
- Capacity after rehabilitation	=	724,000
- New capacity to be created by 1992	=	370,000

For the projection of leather soles the present proportion of the sole leather to hides processed has been assumed to remain the same during the forecast period. For the years subsequent to 1992, the production of sole leather is assumed to grow anually by 3.1% which is the growth rate adopted in the IPS study for the domestic demand of hides.

Other assumptions are that the new capacities to be created will be realized as follows:

Rehabilitation (Additional):

1990	=	50%
1991	=	1005

New capacity:

1992	=	70%
1993	=	80%
1994	=	100%

This procedure implies one basic assumption, that is, the Corporation will create tanning capacities which will adequately cover the demand for leather in the domestic market in addition to that to be exported.

Under the second alternative, an annual growth rate of 3.1%,[1] the growth rate of demand for hides in the domestic market, starting from 1987. For 1987, the quantity ear marked for the budget year 1986/87 - 1988/89, i.e. 260 tons, has been adopted.

The first alternative projection is recommended in this study as it partly takes into account the present and future capacities of the tanneries to be created by NLSC. Under the second alternative, on the other hand, a flat growth rate has been considered irrespective of the facilities of the new capacities to be created. The results of the projections under the two alternatives have given in Table V. Based on the selected approach, the demand for vegetable tannins is expected to grow from 245 tons in 1987, the base year, to 570 tons by 2003.

3. Pricing and Distribution

The average annual purchase cost of vegetable tannins by NLSC from 1979/80 to 1985/86 is shown in Table VI.

---

1 The same growth rate has been adopted in the UNIDO's estimate of the vegetable extracts requirement for Sub-Saharan Africa from 1980 to 2000 in "Strategies for Increasing the Production of Tanning Chemicals in Developing Countries".

TABLE V

PROJECTION OF DEMAND OF VEGETABLE TANNINS

(TONS)

Year	Consumption Coefficient Approach		Growth Rate Approach (3.1%)
	Leather Sales	Vegetable Tannins	
1987 (based year)	459	245	260
1988	482	257	268
1989	523	279	276
1990	549	293	285
1991	575	306	294
1992	742	395	303
1993	766	408	312
1994	813	433	322
1995	838	447	332
1996	864	460	342
1997	891	475	353
1998	919	490	364
1999	947	505	375
2000	976	520	387
2001	1007	537	399
2002	1028	553	411
2003	1070	570	424

TABLE VI

ANNUAL PURCHASE COST OF VEGETABLE TANNINS BY NLSC

(PER KG.)

Year	Cost (Birr/Kg.)
1979/80	1.42
1980/81	1.89
1981/82	2.00
1982/83	2.96
1983/84	2.30
1984/85	2.91
1985/86	2.48

It can be seen from the table that the general price trend is upward. The current foreign and local cost of the three types of vegetable tannins are given below:

	F.C	L.C.	TOTAL
Quebrach powder	1.99	0.91	2.90
Velonia powder	2.61	1.05	3.66
Mimosa powder	1.70	0.84	2.54

Since mimosa powder accounts for a major share in the consumption of vegetable tannins, it is recommended that its price be adopted for the evaluation of this project.

Vegetable tannin is a single buyer product in the Ethiopian market, and no difficulty is to be anticipated in distributing the product.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The usual scale of mimosa tannin production is 4,000 to 5,000 tons of powder per year. There are considerable economies of scale, and the minimum economic size is generally considered to be 2,000 tons of output per year. However, from the technical point of view, there are still smaller plants as well.

The domestic demand for vegetable tannin powder will increase from 260 tons in 1988 to 420 tons in 1993, 490 tons in 1998 and 570 tons in 2003. These demand figures are mimosa, all quebracho and valonia powders, with the 'major share' being for mimosa. In this profile, a plant with a capacity of 450 tons of mimosa powder per year is assumed. The production of quebracho and valonia is not considered, but may prove feasible using the same equipment.

2. Production Programme

The production output is planned to reach 270 and 360 tons of mimosa powder in the first, (the 12th year of the first round of plantation) and second years of operation, respectively, which correspond to 60% and 80% of the plant capacity. A full capacity operation, i.e. 450 tons of mimosa powder per year is to be reached in the third operation year and maintained subsequently.

IV. MATERIALS AND INPUTS

A. RAW MATERIAL

1. General Background and Availability

Vegetable tannins are obtained from barks, wood, pods, fruits, and leaves of different plants. Those plants predominantly used world wide are:

- Wattle (family: mimosaceae; genus: acacia)
- Quebracho (e.g. schinopsis lorentzii, iodina rhombifolia)
- Tara (genus; caesalpinia, specially the species caesalpinia tincotoria)
- Chest Wood (genus: castanea)
- Velonia oak (particularly quercus aegilops)
- Sumac (family; anacardiaceas, genus; rhus)

Of the above, wattle (acacia species), particularly black wattle (especially acacia mollissima, acacia mearnssii, and acacia decurrens) and to a lesser extent Golden Wattle (especially acacia pycnantha) have the lion's share in the world productioin of vegetable tannins, mainly because of their fast growth, availability and high tannin content. Tannins from other plants are usually used by tanners as a blend with the above, because of their higher prices as well as their characteristics and concentrations.

Vegetable tannins used by the tanneries in Ethiopia upto now are:

Mimosa powder (black wattle);
Quebracho powder, and
Velonia powder.

Of these mimosa powder accounts for a major share. There are many acacia species in Ethiopia growing naturally. However, little investigation has been made on these indigenous trees with regard to their use for tannin extraction. The available data so far indicates that only three species, i.e. acacia albida, acacia nilotica and acacia seyal (local generic name for most acacia species is grahr in Amharic, cha'a in Tigrigna and Wachu in Oromigna) are useable for extracting tannins.[1] Their rotation period is generally estimated to be about 20 years.

Acacia Albida (Syn. Faidherbia Albida) grows at altitudes between 100 - 2000 m (30°N - 25°S latitude) and requires an annual mean rainfall of 250 - 1000 mm. It naturally occurs in the Weina Dega regions of Ethiopia, such as Debre Zeit town. Besides tannin extraction, it is useable for furniture, boxes and boat building as sawn timber, and for household utensils, fence poles and cartwheels as round wood. As fuel it has caloric value (c.v.) of 19741 KJ/kg. It is a good source of gum and the leaves and pods are also useable as fodder (400 - 600 kg pods/hectar/year). As a source of tanning agent, the bark contains 29% tannin and the pods 5%.

---

[1] Fredrich Von Breitenbach, The Indigenous Trees of Ethiopia, Published by the Ethiopian Forestry Association, 1963.

A Guide to Species Selection for Tropical and Sub-Tropical Plantation, by D.B. Webb, P.J. Wood, J.P. Smith and G.S. Henman,

Common Wealth Forestry Institute, University of Oxford, Tropical Forestry Papers No.15, 2nd Revised Edition, 1984.

Acacia Nilotica (syn. - Acacia Arabica) grows at altitudes between 0-1700 m (latitude 30°N - 20°S) and requires an annual mean rainfall of 200 - 1000 mm. It favours river banks, flood plains and other localities where the water table is near the surface. It is a former source of gum arabic and as fuel it has caloric value of 16,896 - 20,790 KJ/kg. Tannins are obtained from the bark and pods. Although no record is available on the tannin content, it is generally believed to be not less than that of acacia albida.

Acacia Seyal grows naturally at altitudes between 0 - 1800 m. It grows in the rift valley lakes of Ethiopia, although widely scattered as a result of the deforestation. The bark contains 18 - 20% tannin. Acacia seyal also gives edible gum of good quality.

The above mentioned indigenous acacia species have been affected by the ongoing deforestation process, requiring new or replacement plantation, which has a considerably long rotation period. This assumes that enough trees will be available in a reasonably limited single area to justify exploitation. No data is available with regard to the inventory of the natural occurence. Furthermore their exploitation for vegetable tannin production requires detailed investigation with regard to their merits and demerits vis-a-vis the conventionally used species, i.e. acacia mollissima (acacia mearnssii) and acacia decurrens.

This profile was prepared on the basis of acacia mollissima which has a high tannin content (bark 36% - 44%). This species is not indigenous, but its plantation in Ethiopia has shown good results as demonstrated by a pilot plantation by the Forestry Research Centre of the Ministry of Agriculture at Edjere (near Modjo). More information on Acacia mollissima is given in Appendix A.

Assuming a 20-ton dry bark yield per hectar and a 12-year rotation period, about 1800 hectars or 45 "gasha" of plantation area will be required to meet the 3000 ton dry bark per year requirement of a 450-ton per year mimosa powder production plant.

It was assumed in this study that the bark will be supplied by a plantation, and international prices of mimossa bark have been used.

B. OTHER INPUTS

The only input materials other than mimosa bark are water, fuel and packaging material (bags). Fuel is required to generate hot water and steam for the leacher, concentrator and spray drier. The leacher and concentrator can be fueled using bark chips, after sun drying, but the spray drier should be oil-fired and will require 600,000 kWh of thermal energy.

The concentrator removes water which may not be clean enough for recycling as an input to the leacher. Several thousand litres per day of effluent have to be removed from the site. The spray drier produces 3 tons steam per day, most of which is discharged into the atmosphere.

C. SUPPLY REQUIREMENTS OF MATERIALS AND INPUTS AND COSTS

To produce 450 tons of mimosa powder per year, the plant will rоquire the following annual inputs:

TABLE VII

INPUTS REQUIREMENT AND COSTS

Item	Annual Input	Unit Price	Total Price
Mimosa bark (dry)	3000 tons	170 Birr	510,000 Birr
Water	900 m^3	0.50 Birr	450 Birr
Fuel	60,000 lt	0.90 Birr	54,000 Birr
Bags(20 kg packs)	23,000 pcs	0.65 Birr	14,950 Birr
Electricity	75,000 kWh	0.22 Birr	16,500 Birr
Total	-	-	595,900 Birr

V. LOCATION

The production of vegetable tannin powder is a raw material oriented undertaking. As the process involves the extraction of tannins amounting to much less than 50% of the bark, it is highly recommended to locate the plant near the source of the main raw material, i.e the plantation, as long as water and an electric power line as well as basic infrastructural facilities (which are also necessary for the plantation) are available in the vicinity. Transporting the small quantity of fuel-oil to the source of material and the end-product to the consumer is much cheaper and convenient than transporting the bark to a plant located near the consumer.

In view of the above, the location identification has to be limited to broad indication of possible plantation sites for it will be too early to go beyond that at this stage considering the 12-year lead time required for the plantation as well as the determination of the plantation site. As far as natural conditions are concerned, the mimosa plantation (acacia mollissima, acacia mearnssii and acacia decurrens) could ideally be located around Addis Ababa, where most of the tanneries are located, and where there are good infrastructural facilities. The fuel wood, the major by-product, if not the main product of the plantation, is also in great demand. The only problem is getting at least 1800 hectares of free space, for this purpose for it is a densely populated agricultural area. In this respect it is worth noting the land problem also being encountered by the Fire Wood Project of the Ministry of Agriculture, which is running the mimosa pilot plantation at Edjere.

Possible alternative locations for the plantation could be the Bale or Illubabor Administrative Regions in view of climatic, soil and enviromental conditions as well as space availability and regional distribution of commercial/industrial undertakings.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

Vegetable tannin production from mimosa consists of four stages, chipping, leaching, concentration and spray-drying:

- Chipping

Sheets of mimosa bark are fed into a machine which chops it into small chips. The bark contains 15% - 20% tannin.

- Leaching

The chipped bark is fed into a counter-current leather, which uses hot water to dissolve out the tannin from the bark. The resulting solution (or 'liquor') contains about 7% tannin (and 93% water). Details of the leaching process are described in Appendix B.

- Concentration

The liquor has too low a concentration of tannin, usually less than 10%, so the excess water must be removed. Unfortunately, simple heating in an open container is not practical, because high temperatures damage the tannin by causing darkening of colour, loss of solubility and reduced effectiveness in tanning. To avoid high temperatures, the liquor is exposed to partial vacuum. At the reduced pressure, a substantial evaporation occurs during only moderate heating. The usual method of heating is to pipe the liquor through a casing containing steam. A liquid extract is then formed.

- Spray Drying

A powder of very high tannin content (70%) is required, so the liquid extract must be spray dried. This involves spraying the droplets into the top of a very tall vertical cylinder so that they spiral down around the sides. The falling droplets are snap dried into powder by a draught of very hot air rising from a (usually oilfired) jet. The powder accumulates at the bottom of the cylinder, where it is collected and bagged.

Tannin production has common features with sugar and instant coffee manufacturing, and similarly requires specialist equipment. Leaching, concentrating and spray-drying equipment can be obtained from:

NIRO Atomiser Ltd.
305 Gladesaxevej
Copenhagen
DK-2860 Soeborg
DENMARK

B. ENGINEERING

1. Machinery And Cost

The machinery required and their costs are given in Table VIII. The conveyor of the liquor from the leaching process is of the continuous screw type. It operates under pressure to improve the yield, the speed of extraction and the quality of the product.

The concentrator uses an indirect steam heating under partial vacuum to produce an extract containing 30% tannin. It is about 8 metres high.

The spray drier is also 8 metres high and has a capacity to evaporate 75 kg/hr. of water (500 tons per year).

TABLE VIII

MACHINERY AND COST

ITEM	F.C. (Birr '000)	L.C. (Birr '000)	TOTAL (Birr '000)
Cutter	103.50		103.5
Screw Conveyor	310.5		310.5
Concentrator	310.5		310.5
Spray Drier	310.5		310.5
Sub-Total - FOB	1035.5		1035.0
Freight (sea)		103.5	103.5
Inland Transport, Handling and Services (125 of FOB)		129.4	129.4
Ten Tons Truck	72	48.0	120.0
A vehicle - Four wheel drive	27	18.0	45.0
Pre-operation expenditure	82.8	82.8	165.6
Contingency (10%)	121.7	38.2	159.9
TOTAL	1338.5	419.9	1758.4

2. Layout and Building

The layout is as shown in Figure I, with a total building area of 360 m^2. The cutter (A-B in Figure I) requires only a height of 4.5 metres, to the eaves while the leacher (B-C) must have a ceiling at least 6 metres high. The concentrator and drier (C-D) require at least 10 metres.

An additional office building of 120 m^2 will be required for the managerial and clerical staff.

The estimated costs for the building and civil works are shown in Table IX.

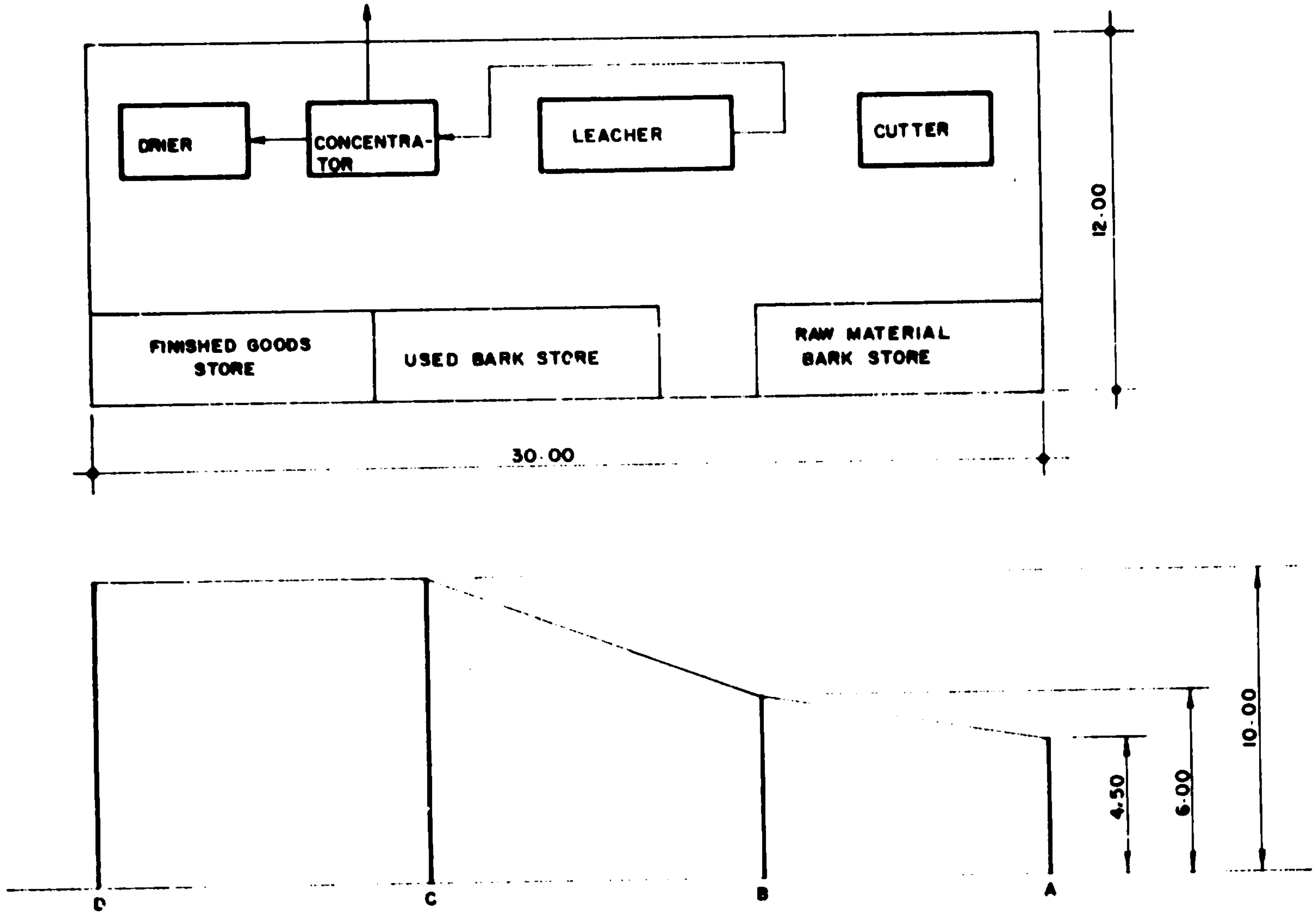
TABLE IX

BUILDING AND CIVIL WORKS COSTS

ITEM	m^2	Birr/m^2	TOTAL (Birr)
Factory Building (elevated)	360	1000	360,000
Offices	120	850	102,000
Sub-Total	480	-	462,000
Out door works (10%)	-	-	46,200
Sub-Total	480	-	508,200
Contingencies (10%)	-	-	50,800
TOTAL	480	-	559,000

FIGURE I

LAYOUT OF VEGETABLE TANNIN PLANT



Scale 1:200

VII. ORGANISATION AND MANPOWER

A. PLANT ORGANISATION

Considering the linkage of the project with the public tanning industry which is the sole consumer and the required larger plantation project which, as a matter of policy, can only fall under a state forestry enterprise, it is recommended that the project should be publicly owned. Because of the nature of the product and its process, the National Chemicals Corporation can be considered as a potential owner. Being the sole consumer, the National Leather and Shoe Corporation can also be considered as an alternative owner.

Taking into account the above considerations, the proposed plant organisation is shown in Figure II.

B. MANPOWER AND TRAINING

The total workforce required will be 81 and their functions are specified in Table X.

The operation is fairly complex, and considerable skill and judgement will be required to deal with emergencies. The Production/Technical manager should be an experienced chemical process engineer and would require an overseas training in the product and process technologies. The supervisors and operators would only require on-the-job-training during the plant commissioning.

FIGURE II

ORGANIZATION CHART

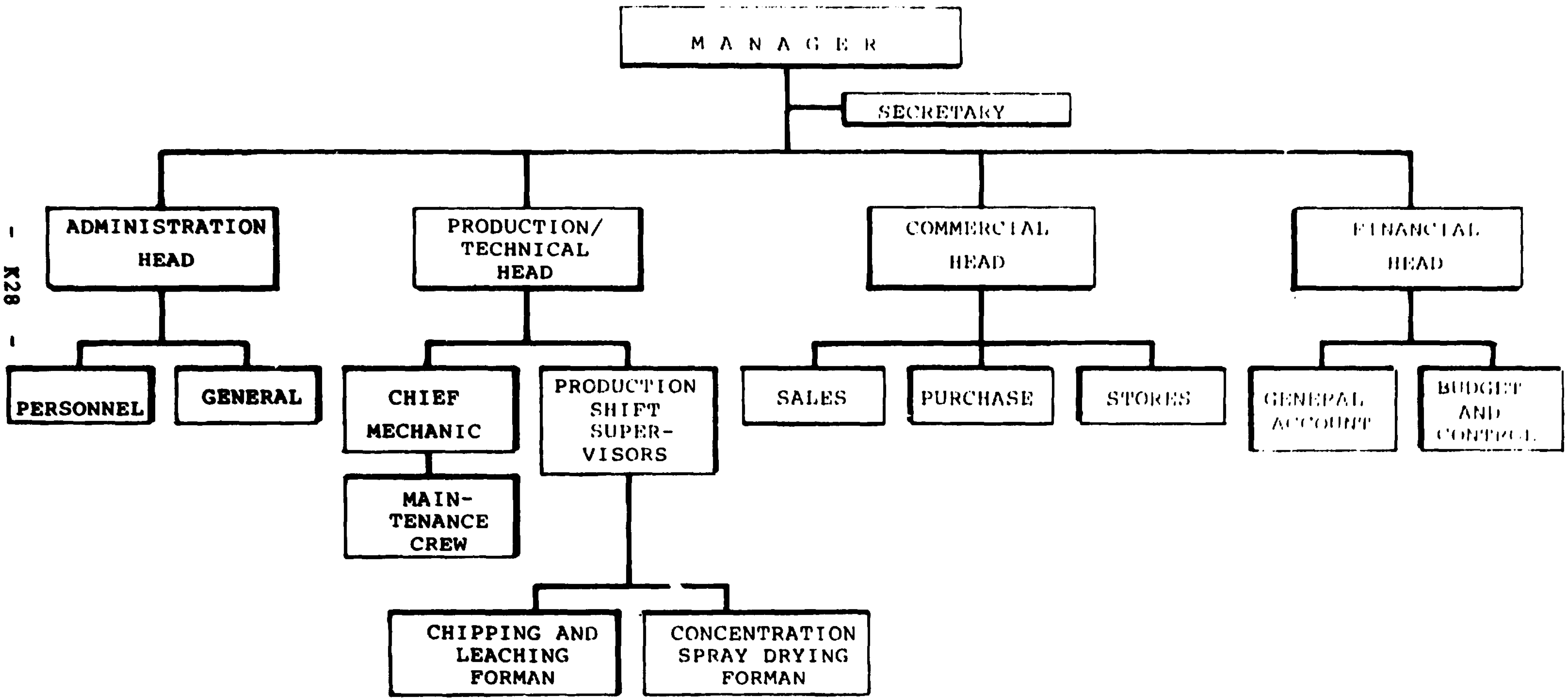


TABLE X
MANPOWER REQUIREMENT

Post	Qualification	Persons Per Shift	No. of Shifts	Total No. Of Persons	Salary (Birr/ Person/ Month)	Total (Birr/ Month)
Manager	Degree	1	1	1	1,200	1,200
Secretary	Diploma or Certifiate+ Experience	1	1	1	400	400
Administration Head	Diploma+Experience or Degree	1	1	1	700	700
Personnel Officer	Diploma	1	1	1	500	500
General Service	Certificate	1	1	1	350	350
Guards	Unskilled	2	4	8	60	480
Cleaners	Unskilled	2	1	2	60	120
Drivers	Skilled	2	1	2	250	500
Commercial Head	Diploma+Experience or Degree	1	1	1	700	700
Sales Clerk	Diploma	1	1	1	400	400
Purchaser	Diploma	1	1	1	400	400
Financial Head	Diploma+Experience or Degree	1	1	1	700	700
Production/Technical Head	Chemical Engineer+ Training	1	1	1	1,000	1,000
Chief Mechanic	Polytechnic Diploma	1	1	1	6,000	6,000
Day Mechanic	Skilled	1	1	1	350	350
Shift Mechanics	Skilled	1	3	3	350	1,050
Electrician	Skilled	1	3	3	350	1,050
Shift Supervisors	Certifiate	1	3	3	250	750
Foreman	Skilled	2	3	6	180	1,080
Operators	Skilled	4	3	12	120	1,440
Labourers	Unskilled	10	3	30	60	1,800
TOTAL				81		16,370

VIII. IMPLEMENTATION

Assuming that mimosa from a plantation will be used as a source for the tannin, the realisation of the factory has to be delayed until the plantation is ready. This will require at least 15 years lead time; 3 years for preparation and to start the plantation project and 12 years for the plant to mature. Hence, the factory can run at full capacity after 15 years after the intiation of the whole project, including the plantation, if the factory building, plant machinery supply, erection and commissioning as well as trial and under capacity production are undertaken in the last 5 years of the 15-year plantation lead time.

IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table XI.

TABLE XI

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Items	Currency		
	Foreign	Local	Total
Buildings and civil works	167.70	391.30	559.00
Plant machinery and equipment	2277.55	256.19	2533.74
Office furniture and equipment	14.00	42.00	56.00
Vehicles	108.90	72.60	181.50
Pre-production expenditure	91.08	91.08	182.16
Total	2659.23	853.17	3512.40

The foreign currency component of the total initial investment cost will be about 76%. About 86% of the total foreign currency requirement will be for machinery and equipment.

2. <u>Working Capital Requirement</u>

The following parameters were used to estimate the net working capital requirements of the vegetable tannin plant.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	1.0
3. Raw materials - local	1.0
4. Work in progress	0.17
5. Finished products	1.0
6. Accounts payable	1.0

The net working capital requirement at full capacity operation amounted to Birr 0.14 million. About Birr 0.12 million of the total net working capital will be required in local currency. This means only 15% of the total net working capital requirement will be in foreign currency.

3. <u>Production Costs</u>

The detailed production cost schedule is given together with other required financial statements.

The total production cost at full capacity operation amounts to Birr 1.19 million, out of which about 36% is in foreign currency.

4. <u>Internal Rate of Return (IRR)</u>

The vegetable tannin plant will not be financially viable. The internal rate of return calculated was -0.07% with a net present value of Birr -1.81 million discounted at 10% p.a.

The average selling price assumed for the financial analysis was Birr 2.54 per kg.

5. Breakeven Analysis

The breakeven point would be reached at a production of 487 tons of vegetable tannin. The total revenue generated at the breakeven point would be Birr 1.24 million. Inorder to attain this the plant should either operate at 108% capacity or increase the selling price-from Birr 2.54 per kg to Birr 2.80 per kg.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 6.28%, with a net present value of Birr -0.97 million discounted at 10% p.a.

The project will create employment for about 81 people.

APPENDIX A

ACACIA MOLLISSIMA (A. MEARNSII)

Black wattle.

Use: Nitrogne fixing (Green manure); Erosion control; Tannin; Fuel wood; paper pulp.

Rotation: (Fuel wood + Tannin) 7 - 12 years.

Climate: Mean max. Temp:- 22 - 27°C
Mean min. Temp:- 1 - 6°C
Altitude : - 1500 - 2500 m.a.s.l
Rainfall : - 900 - 1600 m.m

Soil: moist, relatively deep, light - textured and well drained.
Reaction (PH) = 5 - 6.5 (acidic)

Tannin Production: The bark is very reach in tannin (36 - 44%) but yields are influenced by environmental factors. In addition to its use for leather tanning, the powdered bark extract is used to prepare tanning formalidehyde adhesives for exterior grade plywood, particle board and laminated timber.

Yield: Plantations are usually managed for tan bark on a rotation of 7-12 years. Typical yields for well managed South African commerical plantations 10-11 years old in Natal, are 21 ton/ha of bark (dry) and 112 ton/ha. of wood (airdry) and in the colder southern Transvaal 16.6 ton/ha. and 74.8 ton/ha, respectively. At this age, the trees are 17.4 m. tall and 14.5 cm diameter in Natal, and 14.4m tall and 13.4 cm diameter in Transvaal.

Mimosa Pilot Plantation at Edjere

Site: Near Edjere (115 km south east of Addis Ababa). The site is located on rugged and hilly land in order to avoid touching farm land.

First Plantation - 1985

Height of Plants at the age of 2 years Those on the road side where the soil is deep are 5-7 meters heigh and the rest are 1-3 meters, depending on the slope of the land they are planted on, the shortest ones being those on slopy surface where erosion is high.

Planted area 10 hectars

Plantation Density	2500 plants/hectar i.e. $4m^2$ for ecach plant. (The density can vary from 2500 - 5000 plants/hectar depending on the type of tree required. Dense plantation gives thin and tall trees while thin plantation gives thick and short trees with possible bends. Thinning can be carried out on dense plnatation as required).
Survival rate	60%; bitting up is carried out as required.

Plantation Expenses (the existing practice):

Seedling - 0.15 Birr/seedling
Labour - 3.50 Birr/day/labourer
Performance rate set for each labourer:
Pit digging (Preparation) - 50 pits/day
Plantation - 100 pits/day
Spot hoeing/weeding - 50 plants/day

(Spot hoeing/weeding is carried out twice a year for the first two years and once on the third year. In case a wood land is chosen as site one has to budget 25 man-days per hectar for land clearing).

APPENDIX B
COUNTER-CURRENT LEACHING

Counter-current leaching can be performed as a batch or as a continuous process.

Counter-current batch leaching begins by feeding the bark into a vat, which is then filled with warm water (70°C - 80°C for mimosa) and left to stand. A commercial operation would use a battery of 6 vats, operating on a counter current basis. Bark which has already had most of its tannin extracted has fresh water run onto it, in order to extract the final available tannin. The tannin-bearing water is termed 'liquor'.

As the liquor is passed from vat to vat it becomes progressively stronger and must be run onto progressively fresher bark, culminating in very strong liquor being run on to completely fresh bark.

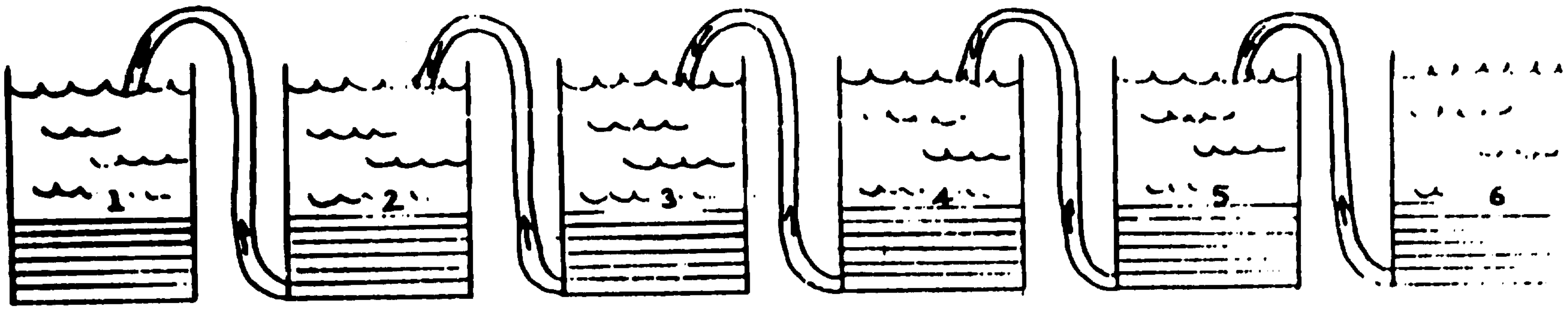
The vats contain a perforated floor to enable the liquor to be removed, but the bark remains until it is 'spent' when it is replaced with fresh bark.

The total process takes about 10 hours to produce a liquor of 7% tannin content.

The continuous version of the process uses a horizontal screw conveyor to transfer the bark in one direction, while water slowly flows in the opposite direction with similar results to the batch version. (See Figure III). The labelling system (1 to 6) used in Figure III refers not to a specific vat, but to the status of the bark it contains; 1, bark being leached for the first time, 6, bark on its sixth leaching.

FIGURE III

FLOW PROCESS OF THE LEACHING OF THE BARK



Tank :	1	2	3	4	5	6
Bark :	Fresh	Nearly Fresh	Twice-used	Thrice-used	Four-times used	Nearly Spent
Liquor:	Very Strong from 2	Strong from 3	Moderately Strong from 4	Moderately Weak from 5	Weak from 6	Fresh Water

APPENDIX C

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

COMFAR

TABLE C.1

Vegetable Tannin Plant
November 1987
Opportunity Studies

1 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 000 Birr

Total initial investment during construction phase

fixed assets:	3512.40	75.710 % foreign
current assets:	0.00	0.000 % foreign
total assets:	3512.40	75.710 % foreign

Source of funds during construction phase

equity & grants:	3512.40	75.710 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	3512.40	75.710 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	600.94	715.39	829.85
depreciation :	359.66	359.66	359.66
interest :	0.00	0.00	0.00
production costs	960.59	1075.05	1189.51
thereof foreign	44.33 %	39.70 %	35.95 %
total sales :	685.80	914.40	1143.00
gross income :	-274.79	-160.65	-46.51
net income :	-274.79	-160.65	-46.51
cash balance :	-10.59	178.61	292.75
net cashflow :	-10.59	178.61	292.75

Net Present Value at: 10.00 % = -1811.54
Internal Rate of Return: -0.07 %
Return on equity1: -13.64 %
Return on equity2: -0.07 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

- K41 -

COMFAR 2.1 UNIDO

TABLE C.2

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	223.60	335.40
Auxiliary and service facilities	72.60	108.90
Incorporated fixed assets	22.40	33.60
Plant machinery and equipment	1013.50	1520.24
Total fixed investment costs	1332.10	1998.14
Pre-production capital expenditures	109.30	72.86
Net working capital	0.00	0.00
Total initial investment costs	1441.40	2071.00
Of it foreign, in %	75.06	76.16

Vegetable Tannin Plant --- November 1987

TABLE C.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9	10-12
% of nom. capacity (single product).	60.00	80.00	100.00	100.00	100.00	100.00
Raw material 1	306.00	408.00	510.00	510.00	510.00	510.00
Other raw materials	8.97	11.96	14.95	14.95	14.95	14.95
Utilities	10.85	13.90	16.95	16.95	16.95	16.95
Energy	58.00	58.00	58.00	58.00	58.00	58.00
Labour, direct	20.46	20.46	20.46	20.46	20.46	20.46
Repair, maintenance	156.03	156.03	156.03	156.03	156.03	156.03
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	18.47	21.38	24.30	24.30	24.30	24.30
Factory costs	578.78	689.73	800.69	800.69	800.69	800.69
Administrative overheads	22.16	25.66	29.16	29.16	29.16	29.16
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	359.66	359.66	359.66	286.92	306.57	[illegible]
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	960.59	1075.05	1189.51	1116.77	1136.42	1156.77
Costs per unit (single product)	3.56	2.99	2.64	2.48	2.53	2.57
Of it foreign, %	44.33	39.70	35.95	34.71	34.88	35.40
Of it variable,%	35.75	42.59	48.11	51.24	50.36	49.47
Total labour	20.46	20.46	20.46	20.46	20.46	20.46

Vegetable Tannin Plant November 1987

TABLE C.3 CONT'D

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	13-17
% of nom. capacity (single product).	100.00
Raw material 1	510.00
Other raw materials	14.95
Utilities	16.95
Energy	58.00
Labour, direct	20.46
Repair, maintenance	156.03
Spares	0.00
Factory overheads	24.30
Factory costs	800.69
Administrative overheads	29.16
Indir. costs, sales and distribution	0.00
Direct costs, sales and distribution	0.00
Depreciation	67.95
Financial costs	0.00
Total production costs	897.80
Costs per unit (single product)	2.00
Of it foreign, %	20.08
Of it variable,%	63.74
Total labour	20.46

COMFAR 21 UNIDO

TABLE C.4

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

	mdc	coto	3	4	5	6-17
Year			3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable . . .	30	12.0	50.08	59.62	69.15	69.15
Inventory and materials .	29	12.4	26.28	35.04	43.79	43.79
Energy	1	360.0	0.16	0.16	0.16	0.16
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	5	72.0	8.04	9.58	11.12	11.12
Finished products . . .	30	12.0	50.08	59.62	69.15	69.15
Cash in hand	15	24.0	9.05	9.31	9.58	9.58
Total current assets			143.68	173.32	202.96	202.96
Current liabilities and accounts payable	30	12.0	48.23	57.48	66.72	66.72
Net working capital			95.45	115.84	136.24	136.24
Increase in working capital			95.45	20.40	20.40	0.00
Net working capital, local			75.56	95.84	116.12	116.12
Net working capital, foreign			19.89	20.00	20.12	20.12

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

COMFAR

TABLE C.5 ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA ----

Cashflow Tables, construction in '000 birr

Year	1	2
Total cash inflow . .	1342.82	1934.54
Financial resources .	1342.82	1934.54
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	1342.82	1934.54
Total assets	1342.82	1934.54
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	260.91	357.22
Outflow, local	260.91	357.22
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	1081.91	1577.32
Outflow, foreign . . .	1081.91	1577.32
Surplus (deficit) .	0.00	0.00
Net cashflow	-1342.82	-1934.54
Cumulated net cashflow	-1342.82	-3277.36

TABLE C.5 CONT'D

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	598.08	752.15	938.45	931.50	931.50	931.50
Financial resources .	39.18	6.95	6.95	0.00	0.00	0.00
Sales, net of tax . .	558.90	745.20	931.50	931.50	931.50	931.50
Total cash outflow . .	602.39	595.13	681.20	658.92	658.92	715.55
Total assets	115.60	22.28	22.28	0.00	0.00	56.63
Operating costs . . .	486.79	572.85	658.92	658.92	658.92	658.92
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-4.31	157.02	257.25	272.58	272.58	215.95
Cumulated cash balance	-4.31	152.72	409.97	682.55	955.13	1171.08
Inflow, local	585.72	752.08	938.38	931.50	931.50	931.50
Outflow, local	421.79	445.71	530.88	508.79	508.79	521.86
Surplus (deficit) .	163.93	306.37	407.50	422.71	422.71	409.64
Inflow, foreign . . .	12.36	0.07	0.07	0.00	0.00	0.00
Outflow, foreign . . .	180.59	149.42	150.32	150.13	150.13	193.69
Surplus (deficit) .	-168.23	-149.35	-150.24	-150.13	-150.13	-193.69
Net cashflow	-4.31	157.02	257.25	272.58	272.58	215.95
Cumulated net cashflow	-3281.67	-3124.64	-2867.39	-2594.81	-2322.23	-2106.28

- K47 -

TABLE C.5 CONT'D

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	931.50	931.50	931.50	931.50	931.50	931.50
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	931.50	931.50	931.50	931.50	931.50	931.50
Total cash outflow . .	743.87	658.92	658.92	658.92	715.55	743.87
Total assets	84.95	0.00	0.00	0.00	56.63	84.95
Operating costs . . .	658.92	658.92	658.92	658.92	658.92	658.92
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	187.63	272.58	272.58	272.58	215.95	187.63
Cumulated cash balance	1358.71	1631.29	1903.87	2176.45	2392.40	2580.03
Inflow, local	931.50	931.50	931.50	931.50	931.50	931.50
Outflow, local	528.40	508.79	508.79	508.79	521.86	528.40
Surplus (deficit) .	403.10	422.71	422.71	422.71	409.64	403.10
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	215.47	150.13	150.13	150.13	193.69	215.47
Surplus (deficit) .	-215.47	-150.13	-150.13	-150.13	-193.69	-215.47
Net cashflow	187.63	272.58	272.58	272.58	215.95	187.63
Cumulated net cashflow	-1918.65	-1646.07	-1373.49	-1100.91	-884.96	-697.33

TABLE C.5 CONT'D

COMFAR

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	931.50	931.50	931.50
Financial resources	0.00	0.00	0.00
Sales, net of tax	931.50	931.50	931.50
Total cash outflow	658.92	658.92	658.92
Total assets	0.00	0.00	0.00
Operating costs	658.92	658.92	658.92
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	272.58	272.58	272.58
Cumulated cash balance	2852.61	3125.19	3397.77
Inflow, local	931.50	931.50	931.50
Outflow, local	508.79	508.79	508.79
Surplus (deficit)	422.71	422.71	422.71
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	150.13	150.13	150.13
Surplus (deficit)	-150.13	-150.13	-150.13
Net cashflow	272.58	272.58	272.58
Cumulated net cashflow	-424.75	-152.17	120.41

Vegetable Tannin Plant --- November 1987

TABLE C.5 CONT'D

COMFAR (c)
2.1 UNIDO

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-3603.64	at	10.00 %
Internal Rate of Return (IRRE1) ..	-13.64 %		

b) Net Worth versus Net cash return:

Net present value	-1811.54	at	10.00 %
Internal Rate of Return (IRRE2) ..	-0.07 %		

c) Internal Rate of Return on total investment:

Net present value	-1811.54	at	10.00 %
Internal Rate of Return (IRR) ..	-0.07 %		

Net Worth = Equity paid plus reserves

COMFAR

TABLE C.6

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, construction in '000 birr

Year	1	2
Total assets	1441.40	3512.40
Fixed assets, net of depreciation	0.00	1441.40
Construction in progress	1441.40	2071.00
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	1441.40	3512.40
Equity capital	1441.40	3512.40
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

COMFAR

TABLE C. 6 CONT'D

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	3571.22	3569.88	3579.12	3579.12	3579.12	3592.24
Fixed assets, net of depreciation	3152.74	2793.09	2433.43	2073.78	1714.12	1427.20
Construction in progress	0.00	0.00	0.00	0.00	0.00	98.21
Current assets	134.63	164.01	193.38	193.38	193.38	193.38
Cash, bank	9.65	9.31	9.58	9.58	9.58	9.58
Cash surplus, finance available	0.00	168.02	460.78	773.93	1087.06	1288.91
Loss carried forward	0.00	274.79	435.44	481.95	528.46	574.96
Loss	274.79	160.65	46.51	46.51	46.51	0.00
Total liabilities	3571.22	3569.88	3579.12	3579.12	3579.12	3592.24
Equity capital	3512.40	3512.40	3512.40	3512.40	3512.40	3512.40
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	13.11
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	48.23	57.48	66.72	66.72	66.72	66.72
Bank overdraft, finance required	10.59	0.00	0.00	0.00	0.00	0.00
Total debt	58.82	57.48	66.72	66.72	66.72	66.72
Equity, % of liabilities	98.35	98.39	98.14	98.14	98.14	97.78

Vegetable Tannin Plant --- November 19[illegible]

TABLE C.6 CONT'D

--- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	3582.42	3579.12	3579.12	3579.12	3701.73	3701.73
Fixed assets, net of depreciation	1218.84	993.69	666.77	339.85	271.90	302.17
Construction in progress	101.77	0.00	0.00	0.00	98.21	101.77
Current assets	193.38	193.38	193.38	193.38	193.38	193.38
Cash, bank	9.58	9.58	9.58	9.58	9.58	9.58
Cash surplus, finance available	1496.99	1810.14	2123.29	2436.44	2528.78	2617.56
Loss carried forward	561.85	558.56	572.33	586.10	599.87	477.26
Loss	0.00	13.77	13.77	13.77	0.00	0.00
Total liabilities	3582.42	3579.12	3579.12	3579.12	3701.73	3701.73
Equity capital	3512.40	3512.40	3512.40	3512.40	3512.40	3512.40
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	3.29	0.00	0.00	0.00	122.60	122.60
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	66.72	66.72	66.72	66.72	66.72	66.72
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	66.72	66.72	66.72	66.72	66.72	66.72
Equity, % of liabilities	98.05	98.14	98.14	98.14	94.89	94.89

Vegetable Tannin Plant --- November 1987

TABLE C. 6 CONT'D

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	3701.73	3701.73	3701.73
Fixed assets, net of depreciation	335.99	268.05	200.10
Construction in progress	0.00	0.00	0.00
Current assets	193.38	193.38	193.38
Cash, bank	9.58	9.58	9.58
Cash surplus, finance available	2808.11	2998.66	3189.20
Loss carried forward	354.66	232.06	109.46
Loss	0.00	0.00	0.00
Total liabilities	3701.73	3701.73	3701.73
Equity capital	3512.40	3512.40	3512.40
Reserves, retained profit	0.00	0.00	0.00
Profit	122.60	122.60	122.60
Long and medium term debt	0.00	0.00	0.00
Current liabilities	66.72	66.72	66.72
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	66.72	66.72	66.72
Equity, % of liabilities	94.89	94.89	94.89

TABLE C.7

-- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	685.80	914.40	1143.00	1143.00	1143.00
Less: variable costs, incl. sales tax.	343.37	457.82	572.28	572.26	572.28
Variable margin	342.43	456.58	570.72	570.72	570.72
As % of total sales	49.93	49.93	49.93	49.93	49.93
Non-variable costs, incl. depreciation	617.23	617.22	617.23	617.23	617.23
Operational margin	-274.79	-160.65	-46.51	-46.51	-46.51
As % of total sales	-40.07	-17.57	-4.07	-4.07	-4.07
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-274.79	-160.65	-46.51	-46.51	-46.51
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-274.79	-160.65	-46.51	-46.51	-46.51
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-274.79	-160.65	-46.51	-46.51	-46.51
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-274.79	-160.65	-46.51	-46.51	-46.51
Accumulated undistributed profit	-274.79	-435.44	-481.95	-528.46	-574.96
Gross profit, % of total sales	-40.07	-17.57	-4.07	-4.07	-4.07
Net profit, % of total sales	-40.07	-17.57	-4.07	-4.07	-4.07
ROE, Net profit, % of equity	-7.82	-4.57	-1.32	-1.32	-1.32
ROI, Net profit+interest, % of invest.	-7.62	-4.43	-1.27	-1.27	-1.27

TABLE C. 7 CONT'D

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	1143.00	1143.00	1143.00	1143.00	1143.00
less: variable costs, incl. sales tax.	572.28	572.28	572.28	572.28	572.28
Variable margin	570.72	570.72	570.72	570.72	570.72
As % of total sales	49.93	49.93	49.93	49.93	49.93
Non-variable costs, incl. depreciation	544.49	564.14	584.49	584.49	584.49
Operational margin	26.23	6.58	-13.77	-13.77	-13.77
As % of total sales	2.29	0.58	-1.20	-1.20	-1.20
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	26.23	6.58	-13.77	-13.77	-13.77
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	26.23	6.58	-13.77	-13.77	-13.77
Tax	13.11	3.29	0.00	0.00	0.00
Net profit	13.11	3.29	-13.77	-13.77	-13.77
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	13.11	3.29	-13.77	-13.77	-13.77
Accumulated undistributed profit	-561.85	-558.56	-572.33	-586.10	599.87
Gross profit, % of total sales	2.29	0.58	-1.20	-1.20	-1.20
Net profit, % of total sales	1.15	0.29	-1.20	-1.20	-1.20
ROE, Net profit, % of equity	0.37	0.09	-0.39	-0.39	-0.39
ROI, Net profit+interest, % of invest.	0.35	0.09	-0.36	-0.36	-0.36

COMFAR

TABLE C. 7 CONT'D

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in 000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	1143.00	1143.00	1143.00	1143.00	1143.00
Less: variable costs, incl. sales tax.	572.28	572.28	572.28	572.28	572.28
Variable margin	570.72	570.72	570.72	570.72	570.72
As % of total sales	49.93	49.93	49.93	49.93	49.93
Non-variable costs, incl. depreciation	325.52	325.52	325.52	325.52	325.52
Operational margin	245.20	245.20	245.20	245.20	245.20
As % of total sales	21.45	21.45	21.45	21.45	21.45
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	245.20	245.20	245.20	245.20	245.20
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	245.20	245.20	245.20	245.20	245.20
Tax	122.60	122.60	122.60	122.60	122.60
Net profit	122.60	122.60	122.60	122.60	122.60
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	122.60	122.60	122.60	122.60	122.60
Accumulated undistributed profit	-477.26	-354.66	-232.06	-109.46	13.14
Gross profit, % of total sales	21.45	21.45	21.45	21.45	21.45
Net profit, % of total sales	10.73	10.73	10.73	10.73	10.73
ROE, Net profit, % of equity	3.49	3.49	3.49	3.49	3.49
ROI, Net profit+interest, % of invest.	3.11	3.03	3.03	3.03	3.03

TABLE C. 8

COMFAR

ECONOMIC ANALYSIS

Casnflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	1441.40	2071.00
Financial resources .	1441.40	2071.00
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	1441.40	2071.00
Total assets	1441.40	2071.00
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0 00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	359.49	493.68
Outflow, local	359.49	493.68
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	1081.91	1577.32
Outflow, foreign . . .	1081.91	1577.32
Surplus (deficit) .	0.00	0.00
Net cashflow	-1441.40	-2071.00
Cumulated net cashflow	-1441.40	-3512.40

- K57 -

TABLE C.8 CONT'D

COMFAR

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	734.03	923.65	1152.25	1143.00	1143.00	1143.00
Financial resources .	48.23	9.25	9.25	0.00	0.00	0.00
Sales, net of tax . .	685.80	914.40	1143.00	1143.00	1143.00	1143.00
Total cash-outflow . .	744.62	745.04	859.49	829.85	829.85	941.17
Total assets	143.68	29.64	29.64	0.00	0.00	98.21
Operating costs . . .	600.94	715.39	829.85	829.85	829.85	829.85
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	13.11
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-10.59	178.61	292.75	313.15	313.15	201.83
Cumulated cash balance	-10.59	168.02	460.78	773.93	1087.08	1288.91
Inflow, local	721.67	923.57	1152.17	1143.00	1143.00	1143.00
Outflow, local	564.02	595.61	709.17	679.72	679.72	747.48
Surplus (deficit) .	157.65	327.96	443.00	463.28	463.28	395.52
Inflow, foreign . . .	12.36	0.07	0.07	0.00	0.00	0.00
Outflow, foreign . . .	180.59	149.42	150.32	150.13	150.13	193.69
Surplus (deficit) .	-168.23	-149.35	-150.24	-150.13	-150.13	-193.69
Net cashflow	-10.59	178.61	292.75	313.15	313.15	201.83
Cumulated net cashflow	-3522.99	-3344.38	-3051.62	-2738.47	-2425.32	-2223.49

COMFAR

---------- TABLE C.8 CONT'D ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA ---

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	1143.00	1143.00	1143.00	1143.00	1143.00	1143.00
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	1143.00	1143.00	1143.00	1143.00	1143.00	1143.00
Total cash outflow . .	934.91	829.85	829.85	829.85	1050.66	1054.22
Total assets	101.77	0.00	0.00	0.00	98.21	101.77
Operating costs . . .	829.85	829.85	829.85	829.85	829.85	829.85
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	3.29	0.00	0.00	0.00	122.60	122.60
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	208.09	313.15	313.15	313.15	92.34	88.78
Cumulated cash balance	1496.99	1810.14	2123.29	2436.44	2528.78	2617.56
Inflow, local	1143.00	1143.00	1143.00	1143.00	1143.00	1143.00
Outflow, local	719.44	679.72	679.72	679.72	856.97	838.75
Surplus (deficit) .	423.56	463.28	463.28	463.28	286.03	304.25
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	215.47	150.13	150.13	150.13	193.69	215.47
Surplus (deficit) .	-215.47	-150.13	-150.13	-150.13	-193.69	-215.47
Net cashflow	208.09	313.15	313.15	313.15	92.34	88.78
Cumulated net cashflow	-2015.41	-1702.26	-1389.11	-1075.96	-983.62	-894.84

COMFAR

TABLE C.8 CONT'D

Cashflow tables, production in 000 Birr

Year	15	16	17
Total cash inflow	1143.00	1143.00	1143.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	1143.00	1143.00	1143.00
Total cash outflow	952.45	952.45	952.45
Total assets	0.00	0.00	0.00
Operating costs	829.85	829.85	829.85
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	122.60	122.60	122.60
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	190.55	190.55	190.55
Cumulated cash balance	2808.11	2998.65	3189.20
Inflow, local	1143.00	1143.00	1143.00
Outflow, local	802.32	802.32	802.32
Surplus (deficit)	340.68	340.68	340.68
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	150.13	150.13	150.13
Surplus (deficit)	-150.13	-150.13	-150.13
Net cashflow	190.55	190.55	190.55
Cumulated net cashflow	-704.29	-513.75	-323.20

TABLE C .8 CONT'D

COMFAR 2.1 UNIDO

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-1457.69	at	10.00 %
Internal Rate of Return (IRRE1) ..	1.66 %		

b) Net Worth versus Net cash return:

Net present value	-971.64	at	10.00 %
Internal Rate of Return (IRRE2) ..	6.28 %		

c) Internal Rate of Return on total investment:

Net present value	-971.64	at	10.00 %
Internal Rate of Return (IRR) ..	6.28 %		

Net Worth = Equity paid plus reserves

- L -

VEGETABLE DEHYDRATION

TABLE OF CONTENTS

I. SUMMARY

This profile investigates the techno-economic viability of producing dehydrated vegetables for export.

Local demand for dehydrated vegetables is limited to few big hotels and army units, and the quantity required is not that significant.

The export market on the other hand seems to be promising. The country's possible share of selected major export markets, is estimated at 1100 tons in 1988; and it would reach 1510 tons by the year 2003. A minimum economic size plant with an annual output of 825 tons is considered to be appropriate for the estimated demand.

The plant would require a total initial investment of about Birr 2.4 million, of which about Birr 1.03 million (43%) is in foreign currency. About 63% of the foreign currency will be required for the purchase of machinery and equipment.

At the indicated output level, the project is neither financially nor economically viable. Its internal rate of return would be much below zero and the economic rate of return is -3.08%. This is mainly due to the relatively high prices of the raw material inputs.

The project is capable of providing direct employment for 79 people. The number of people indirectly employed in the production of the raw material inputs however is quite high.

The Nura Era region is found to be the most appropriate location to start with. As the export market for dehydrated vegetables shows up significantly additional plants of similar sizes can be established at various other agro-industrial centres of high potential.

II. INTRODUCTION

Dehydration or drying is the earliest method of preservation known to man-kind as a means of reducing the moisture content of food items to a level at which micro-organisms will not be able to feed-on, grow and spoil them.

It is particularly useful in preserving perishable seasonal vegetables with relatively short shelf lives to make them available for another season when they are scarce. The considerable reduction in weight during the drying process makes the storage, packing and transportation of dehydrated vegetables much more easier and cheaper.

Nowadays, many African countries like Egypt, Kenya, Morocco and Sudan are earning a significant amount of foreign currency from the export of dehydrated vegetables. Ethiopia on the other-hand, despite its similar favourable climatic conditions and adequate knowhow in the commercial production of fresh vegetables, has so far not involved itself neither in the production nor in the export of dehydrated vegetables.

A list of the various vegetable types that can be dehydrated includes onions, tomatoes, potatoes, carrots, mushrooms, garlic, leeks, celeriac, french beans, sweet peppers, parsnips, sweet corn, cabbages and cauliflowers. Onions share over 50% of the market for dehydrated vegetables in Europe followed by potatoes, garlic and carrots.

A significant proportion of the above mentioned vegetable types is produced and exported fresh by the Horticulture Development Corporation operating under the Ministry of State Farms Development. Local demand for fresh vegetables is also partly satisfied by Farmers Cooperatives. The quality, quantity and price at which the vegetables can be available to the dehydration plant are very important factors in determing the viability of a vegetable dehydrating plant.

Apart from earning a significant amount of foreign currency through export, the project will have a remarkable impact in developing the agro-industrial sector. It is also capable of creating employment opportunities for the rural population in particular.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Vegetable dehydration is a technique that has existed for a very long time in different parts of the world. Dehydration requires artificial heat to vaporize water and a special means to expel the water vapour from the system. Vegetables are usually prepared for a dehydration process for one or more operations, such as washing, peeling, treating with sulphur dioxide or a bisulfite solution.

With the advent of industrialization and the gradual concentration of large urban centres, the supply of different forms of food stuff has become an urgent matter. To meet the ever rising requirements of these urban centres, new and sophisticated food processing techniques had to be developed using modern technologies. It is worth noting that dehydrated vegetables have gained importance in terms of variety, quantity and quality in the last 40 years.

Dehydrated vegetables appear in the market in various forms and types depending on the intended use of the products. Generally, the list of dehydrated vegetables includes onions, potatoes, tomatoes, mushrooms, garlic, carrots, leaks, celeriac, french beans, cabbages, cauli-flower, greenbeens, sweet peppers, parsnips, and sweet corn.

Vegetable dehydration is a useful means of preserving perishable agricultural products especially vegetables with a short shelf life. Through such technique, it has become possible to make available a specific product which could only be available for a certain season of the year. Thus the major advantages of dehydrated vegetables are that they are easy to store, easy and cheap to transport, easy to pack, and they do not require refrigerated store.

Dehydrated vegetables are mainly used as a constituent in various food products. For example, instant potato granules or flakes are a staple item in institutional cooking, from cafeterias to expensive hotels. Practically all potato catsup made today use onion powder as an important ingredient; a host of convenient food, and dry salad dressing mixes use a variety of dehydrated vegetables.

2. Vegetable Production in Ethiopia

With its diverse climatic conditions and extensive agricultural land to cultivate different types of vegetables, Ethiopia has a tremendous potential that can be tapped. However, this will require a proper understanding of the potential and the required technical know-how to exploit the natural endowments of the nation. Through proper and careful planning and programming of the type of vegetables to be cultivated and by developing the appropriate marketing and distribution strategies, the country can export its vegetables to European and Middle Eastern countries.

Vegetable production is now mainly carried out in Ethiopia by the peasant sector (including cooperatives) who supply about 95% of the total to the local market. The remaining 5% is produced by the public sector which exports it.

The Addis Ababa area vegetable consumer, is supplied from adjacent areas, such as Debre Zeit, Sebeta, Woliso, Wolkite, Ziway, Shashemene, Holeta, Ambo, etc. According to title of publication footnote, about 105,500 tons of fresh vegetables were supplied to Addis Ababa in 1982/83. The share of the public sector in this supply was estimated at about 4%.

The other two major urban centres, namely Asmara, and Dire Dawa are also supplied from areas adjacent to the cities, but the quantity supplied to these cities is not known.

The Horticultural Development Corporation (HDC), under the Ministry of State Farms Development, is responsible for organizing and operating large estates and at the same time distributing its produce. Currently, the anticipated total area under vegetable cultivation is about 1372 hectars and the corresponding total annual production is about 8866 tons of various types of vegetables. These vegetables include onions, garlic, beans, carrots, cabbages, radish, leek, spinach, sweet pepper, okra and potato; onion, beans and potato account for 74.6% of the production.[1]

Vegetable production operations range from small areas producing a few vegetables for family use to the large highly organized and mechanized farms similar to those in the technologically advanced countries. Such mechanized vegetable farming requires expensive investment in machinery, infrastructure, manpower and production operations which include insect, disease and weed control and efficient marketing.

---

[1] Horticultural Development Corporation.

As indicated in the preceding paragraph, the public sector is expected to play a critical role in promoting large vegetable farms in Ethiopia, primarily because, it has a better opportunity in securing large cultivable areas, finance and developing foreign markets.

The importance of vegetable in the human dietry system does not need any emphasis. Many elements are required to make up a diet that is nutritionally adequate; and no single natural food supplies all. Vegetables supply some elements in which other food materials are deficient, and they are useful in neutralizing the acid substances produced in the course of digestion of meat, cheese, and other foods and are an important source of mineral elements the body requires; they are especially rich in calcium and iron and also contribute sodium, chlorine, cobalt, copper, manganese, magnesium, phosphorus and potassium. Various vegetables provide important vitamins.

The composition of fresh vegetables indicates that the water content is usually more than 70%, protein about 3.5% or less and the fat content 0.5% or less.

The type of vegetable grown is mainly determined by the consumer demand, which can be defined in terms of variety, size, tenderness, flavour, freshness, etc.

Fresh vegetables are living organisms, and there is a continuation of life processes in the vegetable after harvest. Changes that occur in the harvested, non-processed vegetable include water loss, conversion of starches to sugar, conversion of sugar to starches, flavour changes, colour changes, toughening, vitamin gain or loss, sprouting, rooting, softening and decay.

Post harvest changes are influenced by such factors as kind of crop, air temperature and circulation, oxygen and carbon dioxide contents, relative humidity and temperature, and disease incitant organisms. To maintain the fresh vegetable in the living state, it is usually necessary to slow the life processes through avoiding death of the tissues, which produce gross deterioration and drastic differences in flavour, texture, and appearance.

Storage of vegetables contributes to price stabilization by carrying over the produce from periods of high production to periods of low production. It also extends the period of consumption of many types of vegetables. Storage conditions can contribute to the preservation of the natural living state of the edible portion and to the prevention of deterioration through control of temperature, relative humidity and the quality of the product to be stored. Vegetables for storage must be free from mechanical, insect and disease injury and should be at the proper stage of maturity.

3. Past and Future Demand Analysis

Dehydrated vegetables are not well known in Ethiopia, and as such, the past and present effective demand does not apply to the product. The past and future demand for dehydrated vegetables was thus assessed by taking the past import of the product by industrialized western nations, which are the major market centres. The import of dehydrated vegetables by these nations grew at an average of about 5% per annum as shown in Table I.

TABLE I

IMPORT OF DEHYDRATED VEGETABLES

BY SELECTED MAJOR MARKETS

Year	Quantity (Tons)
1975	58,548
1976	83,319
1977	84,062
1978	77,185
1979	84,911
1980	87,441[1]
1981	90,713
1982	84,301
1983	85,546
1984	94,713
1985	95,327

[1] Extrapolated on the basis of the import figures between 1975 and 1985.

SOURCE: United Nations Conference on Trade and Development, Interntional Trade Centre, Geneva.

In order to assess the future demand for dehydrated vegetables in these selected markets, a simple linear model, of the form $Y = a + bt$ was applied to the figures presented in Table I where, Y is the volume of demand for dehydrated vegetables, a and b are constants estimated using least square method and t stands for time. The forecasting equation is found to be $Y = 70335.02 + 2308.75\ t$. The value of the forecast using this equation is given in Table II.

TABLE II

WORLD DEMAND FORECAST FOR DEHYDRATED VEGETABLE USING IMPORT DATA OF SELECTED MAJOR MARKETS

(Tons)

Year	World Demand Forecast
1988	102,657
1989	104,966
1990	107,275
1991	109,583
1992	111,893
1993	114,201
1994	116,510
1995	118,819
1996	121,127
1997	123,436
1998	125,745
1999	128,054
2000	130,362
2001	132,671
2002	134,980
2003	137,288

The export to these selected markets was projected to vary between 102,657 tons and 137,288 tons in 1988 and 2003, respectively.

In order to assess Ethiopia's export potential of dehydrated vegetables, it was found appropriate to examine the export performance of a few African countries, namely, Egypt, Kenya, Morocco and the Sudan.

Of the four countries, the highest share was held by Egypt followed by Morocco during the period 1981-1985. However, Egypt's Export was not fairely consistent. Morocco, on the other hand, seemed to gain some access to new markets and/or to show a modest improvement every year. Export from Kenya dropped year after year. Such a pull-out could either be attributed to increasing demand at home or losing some potential foreign markets. The Sudan's export performance seemed rather shakey (See Table III).

It is necessary at this juncture to emphasise that it may be difficult for a country like Ethiopia, with hardly no experience in foreign market for processed food, to penetrate world market so easily. However, taking a simultaneous step to promote the domestic market as a safeguard against failure in foreign market, the country could be promted to export annually a quantity varying between 1000 tons and 1500 tons. This is based on the assumption that the country could at least capture a share roughly equivalent to three-fourth of Moroccos average export during 1981-85 i.e. corresponding to 1.1% of the average world export (See Table IV).

TABLE III

DEHYDRATED VEGETABLES EXPORT SHARE

OF SELECTED AFRICAN COUNTRIES

(TONS)

Country	1981		1982		1983		1984		1985		5-Years Average	
	Qty.	% Share	Qty.	% Share	Qty	% Share	Qty.	% Share	Qty.	% Share	Qty.	% Share
Export to selected major markets of which:	90713		84301		85546		94713		95327		90120	
Egypt Exported	8527	9.4	6550	7.8	6555	7.7	6715	7.1	4712	4.9	6612	7.3
Kenya Exported	1164	1.3	784	0.9	160	0.2	133	0.1	150	0.2	478	0.5
Morocco Exported	1010	1.1	1316	1.2	1609	1.9	1353	1.4	1689	1.8	1395	1.5
Sudan Exported	149	0.2	371	0.4	-	-	394	0.4	-	-	305[1]	0.3

SOURCE: United Nations Conference on Trade and Development, International Trade Centre, Geneva and IPS Calculation.

---

[1] 3-years average

TABLE IV

WORLD PROJECTED DEMAND FOR DEHYDRATED VEGETABLES AND ESTIMATED MARKET SHARE OF ETHIOPIA

(TONS)

Year	World Projected Demand	Estimated Market Share Of Ethiopia
1988	102,700	1100
1989	105,000	1160
1990	107,300	1180
1991	109,600	1200
1992	111,900	1230
1993	114,200	1260
1994	116,500	1280
1995	118,800	1300
1996	121,100	1330
1997	123,400	1360
1998	125,700	1380
1999	128,000	1400
2000	130,400	1430
2001	132,700	1460
2002	135,000	1490
2003	137,300	1510

4. Pricing

The range of the selling prices for the various dehydrated vegetables is given in Table V. The price trend covering the period 1981-85, of dehydrated vegetables did not show any significant change over the years. However, the current CIF (European Ports) price of carrots and onion,which this project considers to produce,stands at US$2.1 per kgs and US$2.00/kg., respectively,which are substantially lower than the 1984 price.

TABLE V
AVERAGE SELLING PRICES
(US$ PER KG.)

Product	Average Price	Price Range
Parsnip	2.16	
Carrots	2.19	1.40 - 2.43
Potatoes	1.62	1.40 - 1.73
Celeriac	3.29	2.55 - 3.80
Leek	2.43	1.89 - 2.67
Green beans	4.00	3.89 - 4.27
Onion Powder, 10%	1.85	1.67 - 1.89
Kibled Powder, 30%	2.11	
Onion Slices	2.59	2.61 - 2.64
Garlic Powder	2.38	1.68 - 3.78
Sweet Peppers	5.99	3.68 - 6.07

SOURCE: Compiled and Reported by the Irish Sugar Company, August, 1984.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The volume of dehydrated vegetables that Ethiopia can export was estimated to reach up-to 1000 tons per year. The profitabililty of the project, therefore, very much depends on the price and availability of the various raw materials required, the international prices of dehydrated vegetables and the marketing strategy adopted to attract the target markets. The modern dehydrated vegetable producing venture is highly capital intensive, and the minimum economic scale of such a project is about 7 tons per day, but the capacity considered in this project is only just over one-third.

Thus, at this low level of production, it is highly unlikely that the project could effectivley compete against capital intensive plants with lower unit costs from other countries.

The envisaged plant can produce 2 tons of dehydrated onions and carrots in a three 8-hour shift. The annual output working 275 days will be 550 tons. This is based on an assumption that vegetables would be available for at least 46 weeks of the year through irrigation. An expansion in the capacity by one t .. per day is quite possible without major changes in design, in which case the annual output would become 825 tons.

At the initial stage, the plant would produce only onions (60%) and carrots (40%) for they have a more promising export potential than other vegetable types. The labour intensive characteristics of the plant will also facilitate the dehydration of sweet potatoes, parsnips, celeriac, leeks and garlic without any additional major investment.

2. Production Programme

Assuming that the feasibility study will be completed in one year and the implementation in two years, the production is expected to commence in 1991.

During the first year of production about 60% of the nominal capacity is expected to be achieved. This would gradually increase to 80% and 90% during the second and third years, respectively.

The production programme of the plant is shown in Table VI.

TABLE VI
PRODUCTION PROGRAMME

Year	Capacity Utilization (%)	Annual Output		
		Onions (Tons)	Carrots (Tons)	Total
1991	70	347	231	578
1992	80	396	264	660
1993	90	446	297	743
1994	95	470	314	784

IV. MATERIALS AND INPUTS

A. RAW MATERIAL SUPPLY

Suitable climatic and soil conditions are available throughout the country for the cultivation of quite a large variety of vegetables. The growing seasons of these vegetables vary considerably, but all can be grown and cultivated by irrigation during off-seasons (winter) for European markets.

Vegetables are now produced by the peasant and public sectors, for both the domestic and export markets.

1. Peasant Sector

About 95% of the total local market demand for fresh vegetables is supplied by farmers cooperatives and individual producers living in, and very near to Addis Ababa, Asmara and Dire Dawa.

The Addis Ababa area is supplied with fresh vegetables mainly cultivated by peasants living near Debre Zeit, Sebeta, Woliso, Wolkite, Ziway, Shashemene, Holeta, Menagesha, Ambo and Guder. A total of 105,000 tons of fresh vegetables were supplied to the Addis Ababa market in 1982/83.[1] Out of this only 4,000 tons (4%) was supplied by the public sector.

Asmara is also supplied mainly by farmers cooperatives or individual producers living in Ghinda, Elaberet, Akordat, Massawa, Mendefera, Adi-Keyih and Decamehare.

[1] Horman, Dioter M. and Hailu Shawel, The Domestic Market for Fresh and Processed Fruits and vegetables, GTZ, Eschborn, 1985.

2. Public Sector

As indicated earlier, the Horticultural Development Corporation, under the Ministry of State Farms Development is mainly responsible for the production of vegetables by the public sector. In 1982 about 8,600 hectares of land, largely irrigable, had been cultivated. Out of this, 11% was allotted for vegetables and the rest for fruits, cotton, tobacco and grain.

The HDC is organized into the Nura Era and Small Farms Enterprises. The total area of land allocated for vegetable production in the coming two years is given in Table VII. The production plan was prepared on the basis of an assessment of the demand for fresh vegetables for the local and export markets. The Corporation can grow more vegetables by allocating more land if there is a market for its products at reasonable prices.

B. RAW MATERIAL REQUIREMENT

In addition to an adequate and regular supply, the methods of production and harvesting, the cost of hauling and handling, variety, quality and price of the raw materials are also major factors which determine the success of a vegetable dehydration plant.

TABLE VII

PRODUCTION PLAN OF HORTICULTURAL DEVELOPMENT CORPORATION FOR 1988 AND 1989

Production Centre	Veg. Type	Cultivated Land (Hectares)	Estimated Yield (Tons/ Hectare)	Estimated Total Production (Tons)	Price Of Veg.On Farm (Birr/Ton)	Distance From (Km)
Nura Era Enterprise						
Tibila	Onions	100	12	1200	800	157
	Beans	150	2.5	375	500	
	Okra	45	5	225	300	
	Mellon	42	19	420	600	
Merti Jeju	Onion	100	12	1200	800	203
Nura Era	Beans	200	2.5	500	500	193
Small Farm Enterprise						
Gibe	Sweet Peper	20	8	160	600	201
	Mellon	5	10	50	600	
Ziwai	Beans	150	2.5	375	500	172
	Sweet Peper	25	8	200	600	
Guder	Garlic	20	3	60	1000	135
Tsedei	Potato	90	20	1800	400	41
	Cabbage	10	25	250	300	
	Carrots	10	13	130	300	
	Radish	8	13	104	300	
	Garlic	10	4	40	1000	
	Leek	1.2	10	12	400	
	Spinach	1.0	12	12	200	
Erer Gota	Pepper	70	0.8	56	2500	590
	Onions	10	10	100	800	
Debre Zeit	Onions	70	10	700	800	63
	Beans	150	2.5	375	500	
	Garlic	40	4	160	1000	
	Chillies	45	8.5	382.5	400	
Total	-	1372.2	-	8886.5	-	-

TABLE VIII

PLANNED PRODUCTION BY VEGETABLE TYPE BY HDC

(1988 - 1989)

Vegetable Type	Cultivated Land (Hectare)	Estimated Total Production (Tons)
Onions	280	3200
Garlic	70	260
Beans	650	1625
Carrots	10	130
Cabbage	10	250
Radish	8	104
Leek	1.2	12
Spinach	1.0	12
Sweet Pepper	45	360
Chillies	45	382.5
Pepper	70	56
Okra	45	225
Potato	90	1800
Mellon	47	470
TOTAL	1372.2	8886.5

Source: Horticultural Development Corporation, Ministry of State Farms Development, June 30, 1987.

Practically all varieties of vegetables can be dehydrated. The produces which are considered to be potentially most promising for the export market in Ethiopia are the following:

Onion	-	flakes and powder
Leek	-	flakes
Garlic	-	powder
Green beans	-	bobby type, sliced, fine whole
Sweet pepper	-	red and green dice
Chillies	-	powder
Roselle		
Mustard		
Tomato	-	flakes and powder
Carrots		
Celeriac		
Asparagus	-	powder

Dried herbs, such as thyme, parsely, rosemary, saga etc.

Depending on the export market demand and current price as well as the adequacy and regularity of the raw material supply, the most appropriate types can be selected from the above list.

Onions and carrots are the most appropriate vegetable types. Dehydrated potatoes are already produced in Europe at competetive prices and qualities; green beans require specialized costly preparation equipment; tomatoes use a very costly drying process, and red peppers have small demand in the world market. The annual throughput requirement of onions and carrots is 4,760 and 3,666 tons respectively. (See also Table IX).

TABLE IX

ANNUAL REQUIREMENT OF RAW MATERIALS AND OTHER INPUTS

Item Description	Quantity	Annual Cost ('000 Birr)
Onions (60%)	4,760 tons	3,807.60
Carrots (40%)	3,666 tons	1,099.80
Water	33,000 m^3	16.50
Electric Power	540,000 kwh	118.80
Furnace Fuel	525,000 litres	283.50
Packaging Materials	45,000 (20 kg packs)	67.50
Other chemicals		3.105
Sub-Total		5,396.805

The cost of dehydrated products mainly depends on the overall shrinkage ratio which is the weight of the incoming raw materials to the weight of the finished products ready for packing. The higher the shrinkage ratio, the greater the unit cost of the dehydrated product. The shrinkage ratio in turn depends on the moisture content of the raw materials, the undesirable portions, such as peels, cores, roots, bruises, deep eyes and outer leaves that must be removed and discarded; the size and shape of the raw material (small or irregular shapes) have greater peeling, trimming, sizing and inspection losses; and rejects for poor color, odor, composition and screen size.

C. RAW MATERIAL HANDLING AND STORAGE

Raw materials must be of the proper maturity for dehydration. Immature vegetables are generally unsatisfactory in size, type, amount of solid content, flavour and texture. Over-mature raw materials may be woody, fibrous, overly soft or decayed. Sizing and grading operations are carried out in the field prior to hauling to the dehydration plant.

Sacks, crates, baskets and barrels can be used for haulage to minimize bruising. However, bulk handling in large boxes, trailers or trucks could greatly reduce handling costs.

Raw materials handling and storing have to be done under conditions that preserve their fresh quality. Strict measures such as avoiding contamination from dirt, insects, rodents, micro-organisms and moisture; preventing from damage to tissue by bruising, cutting and abrasion; and providing proper storage temeprature, humidity, air circulation and light exposure should be observed. The optimum storage temperature and humidity for most fresh vegetables are 32°F and 85% - 90% RH respectively. Under adverse storage conditions, the physical appearance and moisture content are highly affected, resulting in undesireable changes in chemical composition and nutritient value.

Storage space and facilities should be adequate to ensure a continuous supply of raw materials to the processing line of the dehydration plant. The storage can also serve other purposes, such as extending the length of the processing season, conditioning and ripening certain vegetable varieties such as onions, and holding raw materials during favourable price situations. The space should be large enough to hold quantities needed to operate the plant for at least 10 days.

D. RAW MATERIALS PROCUREMENT

Two basic types of procurement methods are used in securing raw materials supply for a dehydration plant. The plant can contract for a future supply or buy all its requirements in the open market.

1. Open Market Purchase

Open market purchases can only work in areas where extremely large quantities of vegetables are grown. The quantity required for processing would have to be small compared to the total supply so that a sufficient amount is left for fresh consumption.

Since the purchase is subject to prevailing market prices, the plant is likely to be affected by price fluctuations, which is usually higher. Moreover, securing a regular supply would be very difficult because of the competition from fresh vegetable consumers.

The cost of transport and the overhead cost of collecting raw materials from various market centres of locations is quite significant. The open market purchase can not thus be considered as the best procurement method. However, it can be used to supplement a procurement through contract.

2. Contracting for Future Supply

This is considered to be the most satisfactory way of obtaining raw materials for vegetable dehydration.

Under this method of procurement, the vegetable growers commit themselves to a contractual agreement to supply the plant with the required amount of raw materials at a predetermined price and delivery schedule before a crop is planted or harvested. The price is usually determined by the processing plant.

With this method of procurement, the dehydration plant is assured of:

- a raw material supply of a desired variety, quality and quantity delivered according to a schedule designed to meet the requirements of the dehydration operation;

- a fixed price for raw materials unaffected by fluctuations of market prices at the time of harvest, and

- a sound basis for planning operations, deliveries of finished products, and other export requirements.

The success of this method of procurement depends highly on the integrity, skill, ability and reputation of the grower in producing raw materials of the desired variety, quality and quantity.

The Horticulture Development Corporation is the only organization expected to play the role of a grower, because:

- A sufficient area of irrigable land is already under its control which is partly utilized for vegetable production;

- It is expected to develop and improve cultural and harvesting practices using fertilizers, better seed varieties, pesticides and farm implements;

- It is given priority in Government assistance to develop the horticulture sector.

E. UTILITIES AND OTHER INPUTS

Water of potable quality, electricity and fuel oil are the essential utility items required for vegetable dehydration.

The plant uses water for washing the raw materials at the various stages of the preparation, for steam generation, for plant cleanup and sanitation, for cooling and other purposes. Since the water (steam) comes into contact with the products directly or indirectly it should not contain any off-odors or contaminants. Generally, it should comply with the standards of potability. The annual consumption is estimated at 33,000m^3 (40 m^3 of water per ton of product). This high rate of consumption would require the plant to be located where a sufficient quantity of water is available throughout the processing season.

Electric power would be required to run the various plant machinery and equipment. It will also be used for lighting. The annual requirement is estimated at 540,000 kWh. (See Table IX).

Fuel oil will be required to generate steam for drying and blanching purposes. The hourly requirement of steam is estimated at 1500 kgs. To generate the total amount of steam consumed annually, about 350,000 litres of fuel oil will be necessary.

Apart from the major utility items described above chemical inputs, such as sulfites or sulfur dioxide will also be required to protect the product from nonenzimatic browning or scorching during dehydration and to increase the storage life of the product under adverse temperature conditions. The estimated annual cost is given in Table IX. Multi-wall kraft paper bags of 20 kgs capacity would also be required for packing.

V. LOCATION

A. GENERAL REQUIREMENTS

The dehydration plant must be located in an area selected on the basis of the cost and revenue factors directly or indirectly related to the processing of the raw materials. With regard to the selection of an appropriate location, a financial analysis of all the costs involving the raw materials and market locations, direct and indirect labour costs, transportation and storage facilities, utilities such as water and power, and an adequate waste disposal system have to be made for all potential locations.

The most important factors in selecting an appropriate location for a dehydration plant are as follows:

- Availability of an adequate supply of raw materials;
- Adequate facilities for disposing solid and liquid wastes and for prevention of nuisance odors;
- An ample supply of pure water;
- Sufficient fuel and electric power to operate the various plant machinery and equipment;
- Qualified manpower for processing supervision and management;
- A surrounding free from contamination of all kinds;
- Availability of adequate transport facilities;
- Adequate space for possible future expansion with appropriate physical characteristics;
- Proper temperature and humidity for the dehydration process, and
- Proximity to similar or related plants and vegetable production centres.

B. SPECIFIC REQUIREMENTS

1. Raw Material Source

The success of a dehydration plant mainly depends on the selection of a proper plant location where adequate and suitble raw materials are available at minimum cost. Giving improper attention to this factor has resulted in failures in the establishment and operation of several dehydration plants.

Raw material related factors which have contributed to the failure of a dehydration plant are:

- Insufficient and irregular supply of raw materials;
- Low quality and unsuitability of raw materials;
- Poor production and harvesting practices;
- Excessive costs of hauling and handling;
- High prices of raw materials, often resulting from fresh market competition;
- High raw material production costs, and
- Poor procurement practices, resulting from inadequate transport facilities.

2. Waste Disposal

Next to an inadequate raw material supply, the disposal of both solid and liquid waste materials is a serious problem in a dehydration plant.

About 30% by weight of the raw material input comes in the form of solid waste from the peeling, trimming, coring and sorting operations. The waste can be processed into saleable products such as animal feeds, yeasts, alcohol, starch and other useful products; hauled and accummulated as garbage dumps, land fill, or used as mulch and fertilizer. All of these outlets not only provide profit for the parent plant, but they also offer a cheaper means of solid waste disposal.

An enormous amount of liquid waste is also produced at various operation stages of the manufacturing process, such as washing, fluming and blanching. Depending upon its initial characteristics, the waste stream is made to pass through a series of treatment stages to arrive at a useful or harmless disposable product. The cost will vary widely depending on the nature and concentration of the pollutants, effluent characteristics, the treatment process selected and the cost of construction and supervision. It varies between 1% and 2% of the finished product cost.

An exhaustive comparision of all potential locations in terms of cost, suitability and adequacy of providing waste disposal facilities will have to be carried out before deciding on a specific location.

3. Utilities

Water is very essential for a dehydration plant. It is essential for washing the raw material at various stages of the manufacturing process, for steam generation, plant cleanup and sanitation, cooling and drinking. A reliable source of potable water with an adequate amount of supply is a prerequisite for locating a dehydration plant.

Fuel in the form of coal, wood or low grade oil in sufficient quantity and appropriate quality for generating heat for the blanching and drying stages must be available. Electrical power to operate various types of machinery and equipment as well as for lighting must be within an easy reach of the dehydration plant.

C. POTENTIAL LOCATIONS

A significant portion of all the vegetable types grown for local consumption and export is produced by the peasant sector scattered throughout the country. The surplus marketable produce from all of these scattered production centres is delivered to Addis Ababa, Asmara and Dire Dawa for the local and export markets. These three cities and their neighbouring centres with a significant vegetable production, such as Debre Zeit, Ziway, Holetta, Wolisso, Elaberet, Ghinda and Alemaya can only be considered as reserves to supplement the supply of raw materials at times of shortage.

The Horticulture Development Corporation has numerous vegetable production centres as shown in Table VII in the raw materials section. The Nura Era Enterprise (Nura Era, Tibila and Merti Jeju), Debre Zeit and Ziway account for more than 80% of the total area under vegetable production. Future plans to develop these areas as major agro-industrial centres are already underway. Irrigation schemes have already been introduced in all three areas. They are therefore highly potential locations for the envisaged dehydration plant.

D. MOST APPROPRIATE LOCATIONS

The Meki-Ziway project, a joint venture with the Peoples Democratic Republic of Korea, is expected to develop a total of about 3000 hectares of irrigated land near lake Ziway, about 170 kms south of Addis Ababa. Two-thirds of the total irrigated land will be under the Ministry of State Farms Development, and is planned mainly for the production of flowers and grapes. The remaining will be given to outgrowers.

Debre Zeit could be another potential location for the dehydration plant. Two mini-dams have already been constructed to irrigate a total of about 2000 hectares. About 300 hectares are ear-marked for the production of vegetables in the coming two years. Moreover this location can provide a good opportunity for the procurement of vegetables from the open market in and around Addis Ababa for it is only 63 kms from the capital. In terms of yield per hectar, the soil condition and other cultural practices this location appears to be less promising.

The Nura Era region is considered to be the most appropriate location. There are three major vegetable production centres (Merti Jeju, Tibila and Nura Era) under its control within an easy access to each other. A total of 637 hectares of irrigated land is allocated for the production of vegetables in the coming two years. The Corporation has a plan to extend the total area of irrigated land to increase its horticulutral produce if a reliable market exists.

Electric power and water required for the operation of the plant are available in the area. An agro-industry oriented labour with relevant experience would be available from the fruit and vegetable processing plant already operational at Merti Jeju.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. General Description

Dehydration is an ancient art of preserving perishable food items. Today it is considered as the most important method of preserving agricultural produce in both advanced and developing countries.

The primary purpose of dehydrating vegetables is to preserve the food content including nutrients, flavours, texture and colour without any damage by microbial attack or through chemical or physiological change. The secondary purpose would be to prepare various types of vegetables in such a form that they are suitable and convenient for consumption during off-seasons. Because of a considerable reduction in weight, a significant amount of storage and transport cost can be saved through dehydration.

In addition to dehydration, canning and deep freezing can also be used to preserve perishable foods, including vegetables. However, the former method requires expensive tinplates for packaging and the latter high investment costs in plant machinery and equipment.

2. Alternative Technologies

The characteristic operation in vegetable dehydration is a near complete removal of the water content from the food item through evaporation. Depending on the method of drying used two alterntive technologies can be distingushed. They are conventional sun-drying and industrial drying.

a. Conventional Sun Drying

Sun drying of vegetables is the cheapest method of dehydration because it requires minimal investment.

Sun drying can be used on a commercial scale as well as at a village level provided that the climate is hot, relatively dry and free of rain during and immediately after the normal harvesting period.

At a village level, sun drying is the principal method of preserving agricultural produce for domestic consumption. Sun drying on a commercial scale, especially for export markets, is quite difficult because of the following limitations.

- Lack of technical inputs in the form of technical services to produce vegetables of the required quantity and standard quality;
- Unsuitable methods of storage;
- Difficulty in achieving standard and acceptable packaging, and
- Lack of essential channels for efficient distribution and marketing.

b. Industrial Drying

This is an advanced method of drying involving dehydration of food items in centralized plants. It is believed to overcome all the limitations of conventional sun drying. It is thus the most appropriate method of dehydrating vegetables for export markets.

Compared with sun drying, industrial drying is totally independent of weather changes; drying and hygienic conditions can be more closely controlled, particularly with respect to microbial and dust contamination.

High capital investment on machinery, equipment and factory building, high operating costs particualrly for energy and technical staff, and shortage of raw materials due to lack of integration with growers, are some of the constraints that require full attention.

There are many possible industrial drying methods (sun, drum, forced air, fluid bed, vaccum, foam, spray, osmotic, freeze and solvent drying) for dehydration, each appropriate to different food products, and requirements. Forced air drying is the most applied method of drying for vegetable dehydration.

3. Most Appropriate Technology

A combination of the two levels of technology is recommended for the envisaged dehydration plant. The combination would enable the plant to exploit specific advantages from each level of technology.

The combination would also allow the grower to produce the desired quantity and quality of raw materials and sun dry them to the highest possible standard before delivery to the dehydration plant.

The semi-finished or semi-dried products are further dried,conditioned to the final moisture content, graded for quality, packed and marketed by the centralized dehydration plant.

The major advantages of such a combination would be:

- Direct involvement of raw material producers with the processing operation, thus providing a better opportunity of meeting the quantitative and qualitative requirements;

- Removal of most of the moisture content of the raw materials by solar energy, thus significantly reducing the fuel consumption;

- Creation of employment opportunities for people living nearby;

- An increased scale of production with a limited increment in investment cost and a relatively lower cost of production for export markets.

Such a cooperative processing technology has been in use in the Sudan for the production of dehydrated Roselle (Hibiscus Sabdarifa) for both the local consumption and export.

Not all dehydrated products are suitable for the application of such a technology. The raw materials have to be suitable for hand prepartion, i.e. peeling and cutting into equal pieces with only simple hand slicers, and they should not require blanching and the addition of preservatives such as sulphur dioxide before dehydration. Products which meet the above requirements are dehydrated onion, garlic powder, dehydrated roselle, pepper and chillies. Other products requiring more complex processing operations can be employed at a later stage depending on the success at the initial stage.

B. ENGINEERING

1. Process Description

Vegetable dehydration involves three basic phases of processing:

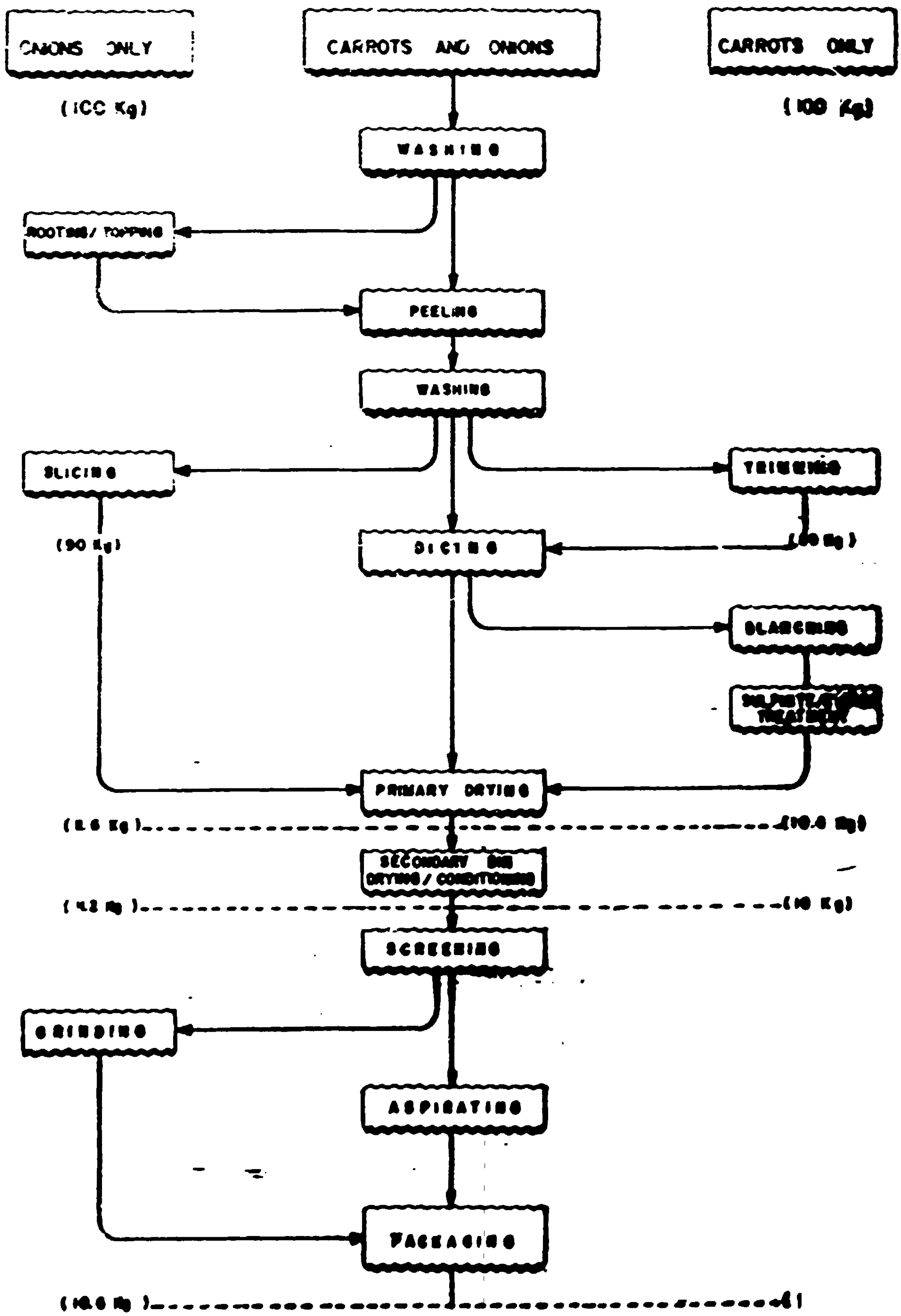
- Preparation,
- Drying,
- Handling and packing.

The preparation phase consists of washing, peeling, and dicing. Onions, garlic and leeks have to be rooted or topped before peeling. After peeling, they are rewashed, sliced and spread on trays for drying. Carrots, sweet potatoes, celeriac and parsnips are trimmed and diced, instead of being sliced, after being peeled and rewashed. Diced vegetables are futher blanched with steam or hot water to inactivate the enzymes, hence reducing the development of undesirable odors, flavors and colours. Blanching also partially cooks the tissues and renders the cell membranes more permeability to lose their moisture content readily. It also reduces the quantity of micro-organisms significantly. A sulfite solution of 0.2% - 1% concentration is finally sprayed over the dice at the end of the blanching process. (See also Figure I).

Drying takes place on batch type air-driers. The diced or sliced vegetable pieces are spread on trays and loaded onto the dryers manually. An automated dryer system with a continuous conveyor loading is highly capital intensive and inappropriate for the envisaged scale of output. Through this primary drying process, the mositure content can be reduced from about 88% to 8%. A final and uniform moisture content of 5% is achieved by secondary drying in bin dryers.

FIGURE I

PROCESS FLOW CHART FOR DEHYDRATION OF ONIONS AND CARROTS



Excessively large or small chunks are removed by screening. If powdered products are required, the vegetables are ground in a mill. Carrots and kibbled onions have to be aspirated. Finally, the finished products are weighed into 20 kgs packs, heat-sealed and stored in sacks.

Sophisticated machinery may be required for product handling and packaging depending on the product type and marketing requirement. This has to be examined in detail at the feasibility study stage.

2. Machinery and Equipment

The basic machinery and equipment required by the dehydration plant are given in Table X.

The dryer is the most important item around which the whole dehydration process is built. For the envisaged relatively small output, the cabinet type batch dryer is the most appropriate compared with the tunnel and conveyor type dryers which are capital intensive and operate on a continuous basis. A typical cabinet dryer consists of a framed structure with well insulated walls, roof and floor. It is fitted with an internal fan that drives the drying air through a heating system. Hot air from the heater is directed vertically up or down the perforated trays holding the products by means of adjustable buffles. About 1000 perforated trays made from stainless steel will be sufficient. The final drying is carried out by two bin dryers.

An indirect oil-fired boiler with a capacity of 1.5 t/hr can generate an adequate quantity of steam for heating and blanching.

A rotary, screw-type hot water blancher is preferred to the rotary or conveyor type steam blancher because it uses less steam. Sulfite additives can be introduced directly into the blanching liquid; and the control with hot water blanching is much more efficient than with steam blanching.

Mechanical equipment for dicing and grinding have also been included. Peeling and trimming are to be carried out manually on stainless steel tables and benches. Washing will also be done manually in galvanized iron washing tanks. This is expected to reduce the investment cost significantly.

TABLE X

LIST OF MAJOR MACHIENRY AND EQUIPMENT FOR VEGETABLE DEHYDRATION

Item Description	No. Of Units
Cabinet dryer with 1000 trays	2
Boiler (oil-fired; 1.5 tons/hr)	1
Peeler	1
Dicer (600 kg/hr)	1
Hot water blancher	1
Grinding mill	1
Bin dryers (secondary drying/conditioning)	2
Stainless steel tables for peeling and trimming	8
Stainless steel carry trays	-
Galvanized iron washing tanks	12
Sticher, sealer, weighing and packing equipment	-
Benches and tables	-
Laboratory equipment and bulk scales	-
Miscellaneous tools and spares	-
Transformer and water supply equipment	-

3. Plant Layout

The dehydration plant will require a total of about 3850 m^2. The building space needed is estimated at 1064 m^2. The remaining open space will be for parking, road, foot path and for future expansion. (See Table XI).

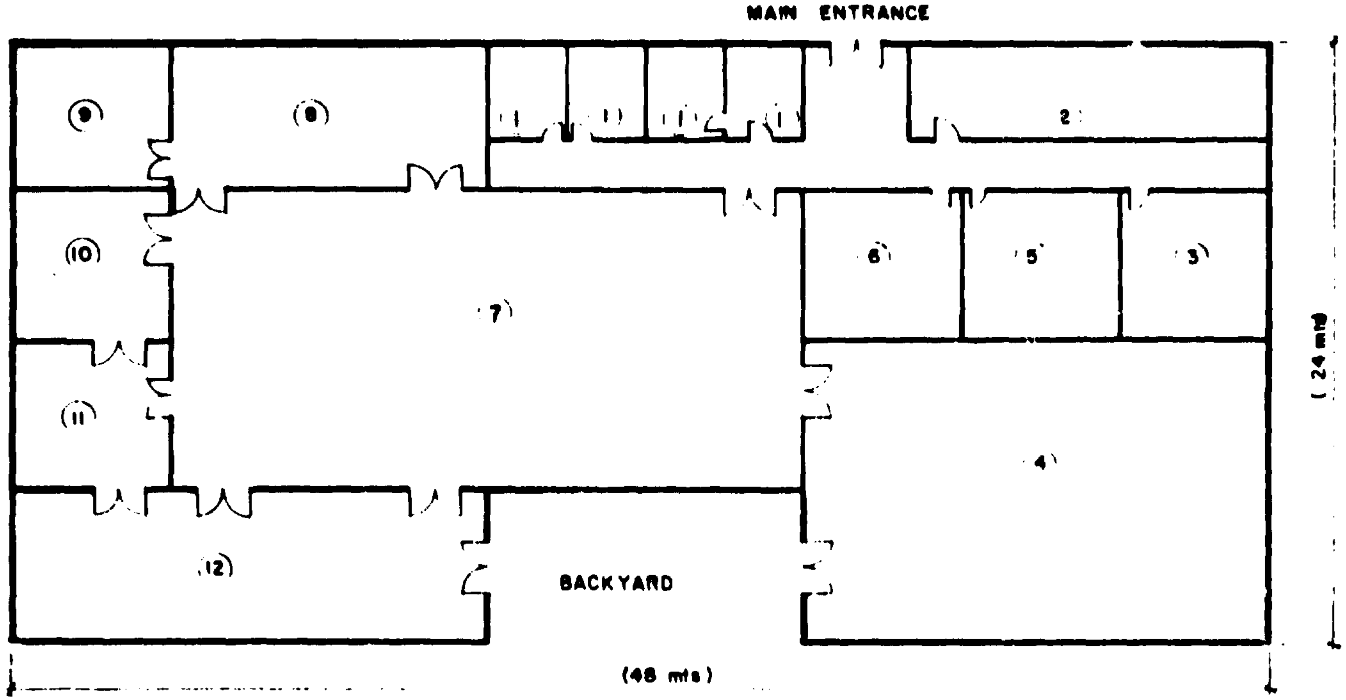
As shown in Figure II, the various processing areas and sections have been separated to prevent moisture, odor, dust, noise, etc. from traveling between the areas. Especially the wet and dry ends of the process must be separate, because the mositure from the washers and blanchers cannot be tolerated where the dried product is being handled. The raw material preparation section is allocated the highest space to avoid any over-crowding of workers and to provide accessibility and sufficient space for repair, maintenance, and replacement of equipment. The boiler room is adjacent to the point of greatest steam use, i.e. to the driers and blanchers.

The loading and unloading of the raw materials and finished products take place at the backyard to reduce congestion at the main entrance.

If the dehydration plant is amalgamated with the Merti-Jiju vegetable processing plant and independent office, workshop and laboratory are no longer required because the existing facilities of the old plant can be utilized. The investment cost saved on buildings and civil works as a result of this venture is estimated at Birr 351,900.

FIGURE II

LAYOUT OF THE VEGETABLE DEHYDRATION PLANT



DESCRIPTION

1	OFFICE	5	WORKSHOP	9	BOILER ROOM
2	LOCKER & WC	6	LABORATORY	10	BIN DRYING
3	TRANSFORMER ROOM	7	RAWMATERIALS PREPARATION	11	INSPECTION & PACKAGING

INDUSTRIAL PROJECTS SERVICE

PROJECT	DRAWN BY	SIGN.	DATE	CLIENT
	CHECKED BY			
	APPROVED BY			

TABLE XI

SPACE REQUIREMENT FOR VEGETABLE DEHYDRATION PLANT

Item	SPACE REQUIRED (M^2)
Office	48
Lockers and WC	56
Transformer room	36
Raw material store	216
Warkshop	36
Laboratory	36
Raw material preparation	288
Primary drying	72
Boiler room	36
Bin drying	36
Inspection and packaging	36
Finished products store	108
Aisle	60
Total of building space	1064
Free space (road, parking, expansion)	2660
Total of site area	3724
Plot size (55 x 70)	3850

VII. ORGANIZATION AND MANPOWER

A. ORGANIZATION

The organizational structure proposed for the dehydration plant comprises of four major sections as shown in Figure III, namely, Administration, Financial, Technical and Commercial Sections. The technical section is further divided into quality control, production and maitnenance. All four major sections will be directly responsible to the plant manager who directs, controls and supervises the overall activity of the plant. The proposed organizational structure is in line with the practice of most manufacturing and processing industries throughout the country.

B. MANPOWER AND TRAINING

The dehydration plant will require a total of 79 employees. The Administration, Financial and Commercial Sections will require 12 skilled and 10 unskilled workers for the single shift operation.

The Technical Section will operate in three shifts (except the quality control) and will rquire a total of 55 workers. Out of this, 21 will be unskilled, 24 semi-skilled and 10 skilled. (See Table XII for further details).

The hand trimming, rooting, peeling, slicing, inspection and packaging operations can be done by women living in nearby rural areas. Manual handling of raw materials and finished products, operation of machines, such as the blancher, dicer and packer, and the repair and maintenance will require male employees. The labour for these operations can be available from small towns or farms in the viscinity of the dehydration plant.

Amalgamating the dehydration plant with that of the Merti-Jeju Vegetable Processing Plant would eliminate the need for recruiting people for the administration, financial and commercial sections including the plant manager and his secretary. The corresponding cost saving is estimated at Birr 126,225.

FIGURE [illegible]

ORGANIZATIONAL CHART OF VEGETABLE DEHYDRATION PLANT

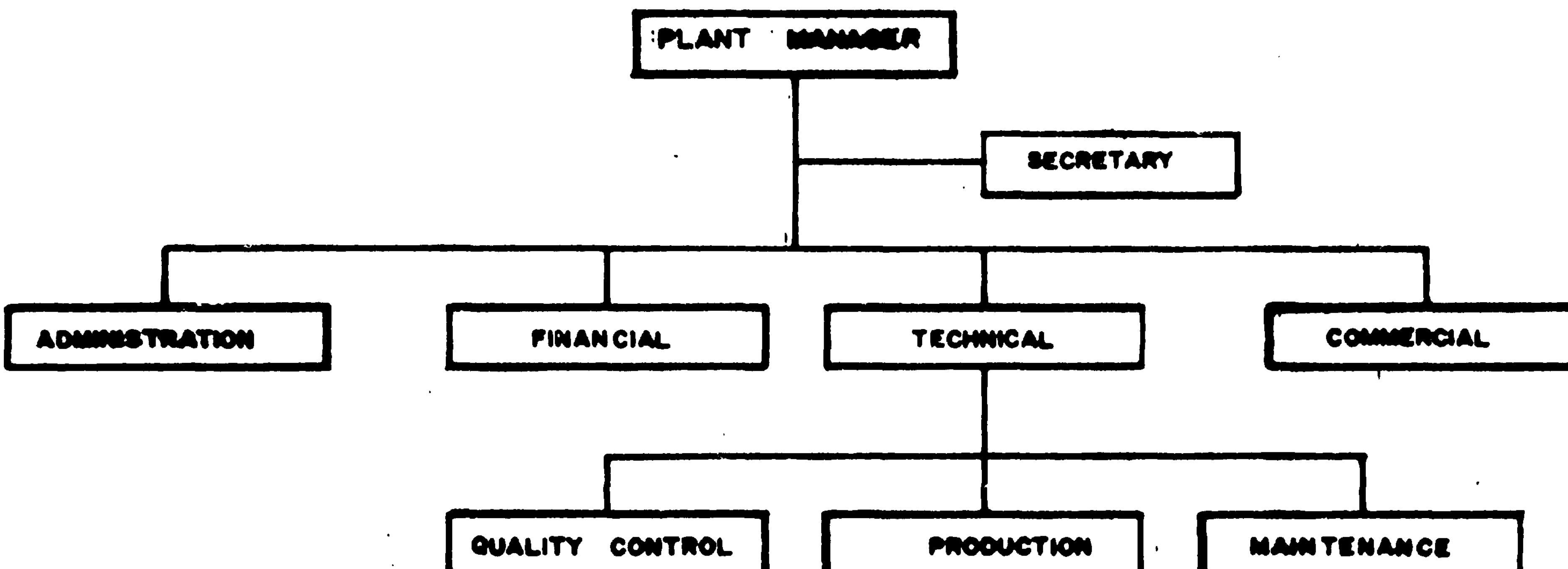


TABLE XII

MANPOWER REQUIREMENT OF VEGETABLES DEHYDRATION PLANT

ITEM NO.	DESCRIPTION	QTY.	MONTHLY SALARY (BIRR)	ANUUAL SALARY (BIRR)
1	Plant Manager	1	1200	14,400
2	Secretary	1	450	5,400
	ADMINISTRATION			
3	Personnel Officer	1	750	9,000
4	Typist	1	230	2,760
5	Drivers	2	400	4,800
6	Cleaners	2	120	1,440
7	Messanger	1	120	1,440
8	Guards	3	225	2,700
	FINANCIAL SECTION			
9	Chief Accountant	1	850	10,200
10	Accountant	1	650	7,800
11	Clerk	1	300	3,600
	COMMERCIAL SECTION			
12	Procurement and Sales Head	1	750	9,000
13	Cashier/payroll	1	500	6,000
14	Time Keeper	1	230	2,760
15	Store Chief	1	450	5,400
16	Store Keepers	2	600	7,200
17	Store Helpers	2	360	4,320
18	Typist	1	230	2,760
	TECHNICAL SECTION			
19	Technical Section Head	1	850	10,200
	MAINTENANCE			
20	Electrician - skilled	1	550	6,600

TABLE XII (Cont'd)

ITEM NO.	DESCRIPTION	QTY.	MONTHLY SALARY (BIRR)	ANNUAL SALARY (BIRR)
21	Mechanics - skilled	2	1,100	13,200
	QUALITY CONTROL			
22	Technologist - skilled	1	750	9,000
23	Laboratory Technicians - skilled	2	900	10,800
	PRODUCTION			
24	Foremen - skilled	3	1,650	19,800
25	Raw materials feeding - unskilled	3	360	4,320
26	Washing - unskilled	3	360	4,320
27	Peeling/rooting - unskilled	6	720	8,640
28	Washing - unskilled	3	360	4,320
29	Trimming/slicing - unskilled	6	720	8,640
30	Dicing - semi-skilled	3	750	9,000
31	Blanching - semi-skilled	3	750	9,000
32	Drying - semi-skilled	3	750	9,000
33	Screening /Grinding - semi-skilled	6	1,500	18,000
34	Inspection and packaging - semi-skilled	6	1,500	18,000
35	Boiler attendants - semi-skilled	3	750	9,000
	Sub-total	79	22,735	272,820
	Employment Benefits (25%)	-	-	68,205
	Total Annual Expense	-	-	341,025

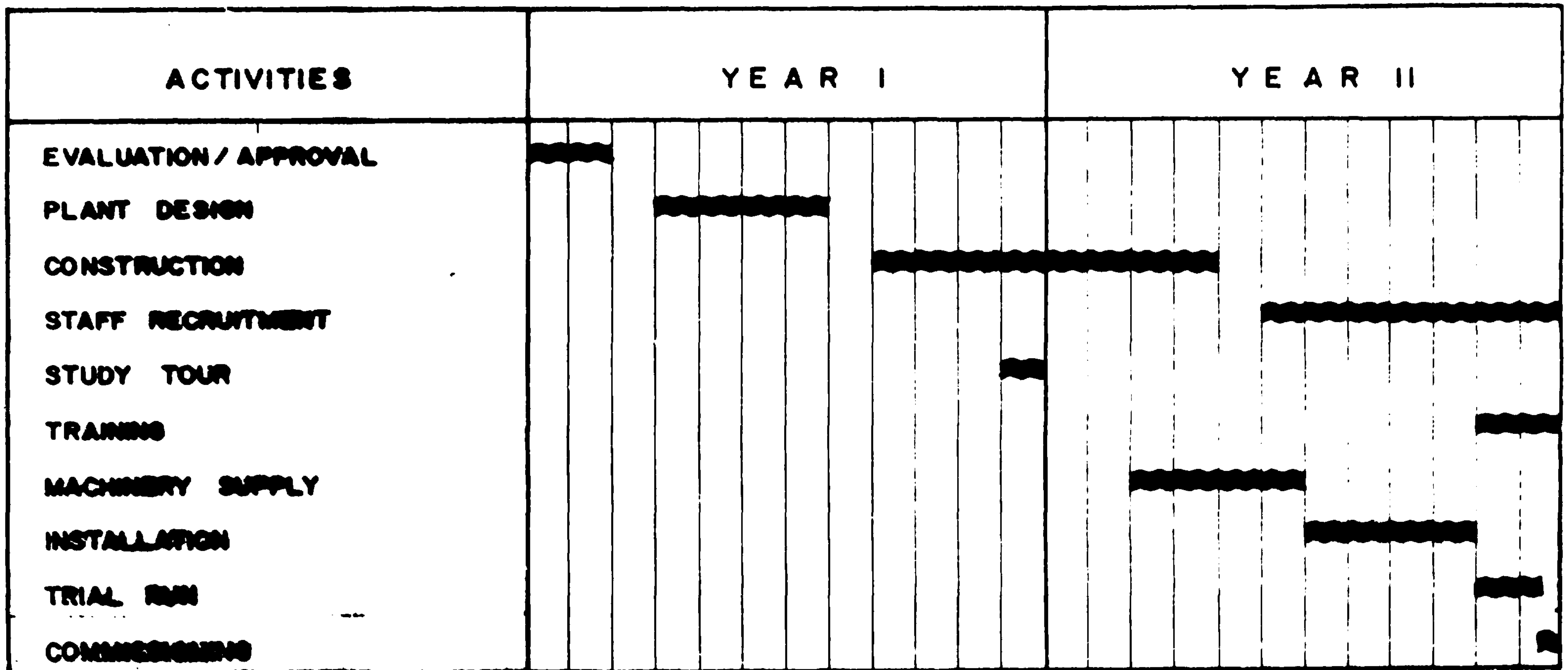
A labour-intensive technology has been selected for the small output of the plant. The machinery and equipment as well as the processing technology are not sophisticated. Hence most of the labour needed in the dehydration plant can readily be trained on site before and after commissioning. Experts from the suppliers can provide this training. A study tour of three to four weeks to well-known vegetable dehydrators in developing and developed countries is recommended for the plant manager, the technical section head, and the quality control specialist.

VIII. IMPLEMENTATION

The dehydration plant can be implemented within a two years period. (See Figure IV). The evaluation of the feasibility study and approval are estimated to take two months. The recommended study tour should be taken sometime in the middle of the construction period to provide sufficient time to contact and visit machinery and equipment suppliers before shipment. Recruitment of employees would start just before installation to acquaint the technical personnel with the machinery and equipment. On-the-job training would commence with the trial run and extends into the production period depending on the types of product and output level.

FIGURE IV

IMPLEMENTATION SCHEDULE



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table XIII.

TABLE XIII

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

	Foreign	Local	Total
Buildings and civil works	321.75	750.76	1072.51
Plant machinery and equipment	651.22	81.40	732.62
Office furniture and equipment	11.25	33.75	45.00
Vehicles	11.25	14.44	25.69
Pre-production expenditure	34.12	484.84	518.96
Total	1029.59	1365.19	2394.78

The foreign currency component of the total initial investment cost will be about 43%. About 63% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirement

The following parameters were used to estimate the net working capital requirements of the vegetable dehydration plant.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	2.0
3. Raw materials - foreign	6.0
4. Raw materials - local	1.0
5. Work in progress	0.25
6. Finished products	0.5
7. Accounts payable	1.0

The net working capital requirement at full capacity will be Birr 0.74 million, of which only 7% will be required in foreign currency.

3. Production Costs

The detailed production cost estimation is given together with other required financial statements. The production cost at full capacity amounts to Birr 4.26 million, out of which only 3% will be in foreign currency.

4. Internal Rate of Return (IRR)

The vegetable dehydration plant will not be a financially viable venture. The internal rate of return turned out to be below zero with net present value of Birr -9.82 million discounted at 10% p.a.

If this plant is to be integrated with the merti-Jeju Vegetable Processing Plant there will be cost reductions amounting to Birr 0.35 million and 0.13 million fixed investment and operating costs respectively. The viability of the project was tested after taking the cost reductions. The net present value turned out to be Birr -8.52 million discounted at 10% p.a.

The typical international CIF prices per tonne of carrots and onions is US$2100 and US$2000, respectively.

The average selling price assumed for financial analysis was US $1.75 per kg for carrots and US $1.85 per kg. for onion after deducting 12% for insurance and freight charges..

5. Breakeven Analyses

The average variable cost per unit by far exceeds the average selling price per unit. Inorder to breakeven the unit selling price of onions and carrots has to be increased to Birr 5 and 4.50 respectively.

B. ECONOMIC ANALYSIS

The economic rate of return is -3.08% with a net present value of Birr -2.47 million discounted at 10% p.a.

The project will create employment for a total of 79 people.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

COMFAR

TABLE A.1

Vegetable Dehydration Plant
Financial Analysis _ July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 000 Birr

Total initial investment during construction phase

fixed assets:	2394.78	42.993 % foreign
current assets:	0.00	0.000 % foreign
total assets:	2394.78	42.993 % foreign

Source of funds during construction phase

equity & grants:	2394.78	42.993 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	2394.78	42.993 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	3085.96	3458.03	3837.69
depreciation :	240.32	240.32	240.32
interest :	0.00	0.00	0.00
production costs	3326.28	3698.35	4078.01
thereof foreign	3.89 %	3.51 %	3.19 %
total sales :	2179.10	2488.20	2801.15
gross income :	-1147.18	-1210.15	-1276.86
net income :	-1147.18	-1210.15	-1276.86
cash balance :	-1474.07	-1038.13	-1106.23
net cashflow :	-1474.07	-1038.13	-1106.23

Net Present Value at: 10.00 % = -9820.36
Internal Rate of Return: not found
Return on equity1: not found
Return on equity2: not found

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	643.51	429.00
Auxiliary and service facilities	25.69	0.00
Incorporated fixed assets	15.00	30.00
Plant machinery and equipment	293.05	439.57
Total fixed investment costs	977.25	898.57
Pre-production capital expenditures	55.78	463.18
Net working capital	0.00	0.00
Total initial investment costs	1033.03	1361.75
Of it foreign, in %	48.51	38.81

Total Production Costs in '000 Birr

Year	3	4	5	6- 7	8	9-12
% of nom. capacity (single product).	0.00	0.00	0.00	0.00	0.00	0.00
Raw material 1	2415.42	2756.50	3104.54	3271.60	3271.60	3271.60
Other raw materials	1.53	1.74	1.96	2.07	2.07	2.07
Utilities	68.96	77.42	86.05	90.20	90.20	90.20
Energy	155.19	174.23	193.67	203.00	203.00	203.00
Labour, direct	341.03	341.03	341.03	341.03	341.03	341.03
Repair, maintenance	59.89	59.89	59.89	59.89	59.89	59.89
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	19.98	21.46	22.97	23.70	23.70	23.70
Factory costs	3061.98	3432.28	3810.12	3991.49	3991.49	3991.49
Administrative overheads	23.97	25.75	27.57	28.44	28.44	28.44
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.0C
Depreciation	240.32	240.32	240.32	240.32	131.39	136.52
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	3326.28	3698.35	4078.01	4260.25	4151.32	4156.46
Costs per unit (single product)	0.00	0.00	0.00	0.00	0.00	0.00
Of it foreign, %	3.09	3.51	3.19	3.05	2.91	2.96
Of it variable,%	79.21	81.30	83.05	83.77	85.97	85.86
Total labour	341.03	341.03	341.03	341.03	341.03	341.03

Total Production Costs in '000 Birr

Year	13-17
% of nom. capacity (single product).	0.00
Raw material 1	3271.60
Other raw materials	2.07
Utilities	90.20
Energy	203.00
Labour, direct	341.03
Repair, maintenance	59.89
Spares	0.00
Factory overheads	23.70
Factory costs	3991.49
Administrative overheads	28.44
Indir. costs, sales and distribution	0.00
Direct costs, sales and distribution	0.00
Depreciation	58.76
Financial costs	0.00
Total production costs	4078.69
Costs per unit (single product) .	0.00
Of it foreign, %	1.40
Of it variable,%	87.50
Total labour	341.03

TABLE A.4 ---- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

	mdc	coto	3	4	5	6	7-17
Year			3	4	5	6	7-17
Coverage	mdc	coto					
Current assets &							
Accounts receivable	60	6.0	514.33	576.34	639.62	669.99	669.99
Inventory and materials	15	24.0	100.96	115.21	129.76	136.74	136.74
Energy	1	360.0	0.43	0.48	0.54	0.56	0.56
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	7	51.4	59.54	66.74	74.09	77.61	77.61
Finished products	15	24.0	128.58	144.08	159.90	167.50	167.50
Cash in hand	15	24.0	18.54	18.67	18.81	18.88	18.88
Total current assets			822.38	921.53	1022.71	1071.28	1071.28
Current liabilities and Accounts payable	30	12.0	255.17	286.02	317.51	332.62	332.62
Net working capital			567.21	635.51	705.20	738.65	738.65
Increase in working capital			567.21	68.30	69.69	33.45	0.00
Net working capital, local			560.06	628.31	697.95	731.38	731.38
Net working capital, foreign			7.15	7.20	7.25	7.27	7.27

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	1033.03	1361.75
Financial resources	1033.03	1361.75
Sales, net of tax	0.00	0.00
Total cash outflow	1033.03	1361.75
Total assets	1033.03	1361.75
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	531.93	833.26
Outflow, local	531.93	833.26
Surplus (deficit)	0.00	0.00
Inflow, foreign	501.10	528.49
Outflow, foreign	501.10	528.49
Surplus (deficit)	0.00	0.00
Net cashflow	-1033.03	-1361.75
Cumulated net cashflow	-1033.03	-2394.78

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	2434.27	2519.06	2832.64	2970.71	2955.60	2955.60
Financial resources .	255.17	30.86	31.49	15.11	0.00	0.00
Sales, net of tax . .	2179.10	2488.20	2801.15	2955.60	2955.60	2955.60
Total cash outflow . .	3908.33	3557.19	3938.87	4068.50	4019.93	4045.62
Total assets	822.38	99.16	101.18	48.57	0.00	25.69
Operating costs . . .	3085.96	3458.03	3837.69	4019.93	4019.93	4019.93
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-1474.07	-1038.13	-1106.24	-1097.78	-1064.33	-1090.02
Cumulated cash balance	-1474.07	-2512.20	-3618.43	-4716.21	-5780.54	-6870.56
Inflow, local	2431.09	2519.04	2832.62	2970.71	2955.60	2955.60
Outflow, local	3859.93	3518.82	3900.29	4029.84	3981.31	3995.75
Surplus (deficit) .	-1428.84	-999.78	-1067.67	-1059.14	-1025.71	-1040.15
Inflow, foreign . . .	3.17	0.02	0.02	0.01	0.00	0.00
Outflow, foreign . . .	48.40	38.36	38.58	38.65	38.62	49.87
Surplus (deficit) .	-45.23	-38.34	-38.56	-38.64	-38.62	-49.87
Net cashflow	-1474.07	-1038.13	-1106.24	-1097.78	-1064.33	-1090.02
Cumulated net cashflow	-3868.85	-4906.98	-6013.21	-7111.00	-8175.33	-9265.35

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	2955.60	2955.60	2955.60	2955.60	2955.60	2955.60
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	2955.60	2955.60	2955.60	2955.60	2955.60	2955.60
Total cash outflow . .	4019.93	4019.93	4019.93	4019.93	4045.62	4019.93
Total assets	0.00	0.00	0.00	0.00	25.69	0.00
Operating costs . . .	4019.93	4019.93	4019.93	4019.93	4019.93	4019.93
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-1064.33	-1064.33	-1064.33	-1064.33	-1090.02	-1064.33
Cumulated cash balance	-7934.90	-8999.22	-10063.55	-11127.88	-12217.90	-13282.23
Inflow, local	2955.60	2955.60	2955.60	2955.60	2955.60	2955.60
Outflow, local	3981.31	3981.31	3981.31	3981.31	3995.75	3981.31
Surplus (deficit) .	-1025.71	-1025.71	-1025.71	-1025.71	-1040.15	-1025.71
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	38.62	38.62	38.62	38.62	49.87	38.62
Surplus (deficit) .	-38.62	-38.62	-38.62	-38.62	-49.87	-38.62
Net cashflow	-1064.33	-1064.33	-1064.33	-1064.33	-1090.02	-1064.33
Cumulated net cashflow	-10329.68	-11394.01	-12458.34	-13522.67	-14612.69	-15677.02

TABLE A.5 (Cont'd)

COMFAR

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	2955.60	2955.60	2955.60
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	2955.60	2955.60	2955.60
Total cash outflow . .	4019.93	4019.93	4019.93
Total assets	0.00	0.00	0.00
Operating costs . . .	4019.93	4019.93	4019.93
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	-1064.33	-1064.33	-1064.33
Cumulated cash balance	-14346.56	-15410.89	-16475.22
Inflow, local	2955.60	2955.60	2955.60
Outflow, local	3981.31	3981.31	3981.31
Surplus (deficit) .	-1025.71	-1025.71	-1025.71
Inflow, foreign . . .	0.00	0.00	0.00
Outflow, foreign . . .	38.62	38.62	38.62
Surplus (deficit) .	-38.62	-38.62	-38.62
Net cashflow	-1064.33	-1064.33	-1064.33
Cumulated net cashflow	-16741.35	-17805.68	-18870.01

COMFAR

TABLE A.5 (Cont'd) COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-10606.04	at	10.00 %
Internal Rate of Return (IRRE1) ..	not found		

b) Net Worth versus Net cash return:

Net present value	-9820.36	at	10.00 %
Internal Rate of Return (IRRE2) ..	not found		

c) Internal Rate of Return on total investment:

Net present value	-9820.36	at	10.00 %
Internal Rate of Return (IRR) ..	not found		

Net Worth = Equity paid plus reserves

COMFAR

TABLE A.6 .... COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	2179.10	2488.20	2801.15	2955.60	2955.60
Less: variable costs, incl. sales tax.	2634.86	3006.93	3386.60	3568.83	3568.83
Variable margin	-455.76	-518.73	-585.45	-613.23	-613.23
As % of total sales	-20.92	-20.85	-20.90	-20.75	-20.75
Non-variable costs, incl. depreciation	691.41	691.41	691.41	691.41	691.41
Operational margin	-1147.18	-1210.15	-1276.86	-1304.65	-1304.65
As % of total sales	-52.64	-48.64	-45.58	-44.14	-44.14
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-1147.18	-1210.15	-1276.86	-1304.65	-1304.65
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-1147.18	-1210.15	-1276.86	-1304.65	-1304.65
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-1147.18	-1210.15	-1276.86	-1304.65	-1304.65
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-1147.18	-1210.15	-1276.86	-1304.65	-1304.65
Accumulated undistributed profit	-1147.18	-2357.32	-3634.18	-4938.83	-6243.47
Gross profit, % of total sales	-52.64	-48.64	-45.58	-44.14	-44.14
Net profit, % of total sales	-52.64	-48.64	-45.58	-44.14	-44.14
ROE, Net profit, % of equity	-47.90	-50.53	-53.32	-54.48	-54.48
ROI, Net profit+interest, % of invest.	-38.73	-39.93	-41.19	-41.64	-41.64

Vegetable Dehydration Plant --- Financial Analysis . July 1988

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	2955.60	2955.60	2955.60	2955.60	2955.60
Less: variable costs, incl. sales tax	3568.83	3568.83	3568.83	3568.83	3568.83
Variable margin	-613.23	-613.23	-613.23	-613.23	-613.23
As % of total sales	-20.75	-20.75	-20.75	-20.75	-20.75
Non-variable costs, incl. depreciation	582.48	587.62	587.62	587.62	587.62
Operational margin	-1195.72	-1200.85	-1200.85	-1200.95	-1200.85
As % of total sales	-40.46	-40.63	-40.63	-40.63	-40.63
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-1195.72	-1200.85	-1200.85	-1200.85	-1200.85
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-1195.72	-1200.85	-1200.85	-1200.85	-1200.85
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-1195.72	-1200.85	-1200.85	-1200.85	-1200.85
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-1195.72	-1200.85	-1200.85	-1200.85	-1200.85
Accumulated undistributed profit	-7439.19	-8640.05	-9840.90	-11041.76	-12242.61
Gross profit, % of total sales	-40.46	-40.63	-40.63	-40.63	-40.63
Net profit, % of total sales	-40.46	-40.63	-40.63	-40.63	-40.63
ROE, Net profit, % of equity	-49.93	-50.14	-50.14	-50.14	-50.14
ROI, Net profit+interest, % of invest.	-37.85	-38.01	-38.01	-38.01	-38.01

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	2955.60	2955.60	2955.60	2955.60	2955.60
Less: variable costs, incl. sales tax.	3568.83	3568.83	3568.83	3568.83	3568.83
Variable margin	-613.23	-613.23	-613.23	-613.23	-613.23
As % of total sales	-20.75	-20.75	-20.75	-20.75	-20.75
Non-variable costs, incl. depreciation	509.86	509.86	509.86	509.86	509.87
Operational margin	-1123.09	-1123.09	-1123.09	-1123.09	-1123.10
As % of total sales	-38.00	-38.00	-38.00	-38.00	-38.00
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-1123.09	-1123.09	-1123.09	-1123.09	-1123.10
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-1123.09	-1123.09	-1123.09	-1123.09	-1123 10
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-1123.09	-1123.09	-1123.09	-1123.09	-1123.10
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-1123.09	-1123.09	-1123.09	-1123.09	-1123.10
Accumulated undistributed profit	-13365.70	-14488.80	-15611.89	-16734.98	-17858.08
Gross profit, % of total sales	-38.00	-38.00	-38.00	-38.00	-38.00
Net profit, % of total sales	-38.00	-38.00	-38.00	-38.00	-38.00
ROE, Net profit, % of equity	-46.90	-46.90	-46.90	-46.90	-46.90
ROI, Net profit+interest, % of invest.	-35.26	-35.26	-35.26	-35.26	-35.26

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	1033.03	2394.78
Fixed assets, net of depreciation	0.00	1033.03
Construction in progress	1033.03	1361.75
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	1033.03	2394.78
Equity capital	1033.03	2394.78
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	4124.01	5193.00	6330.72	7443.62	8507.95	9597.97
Fixed assets, net of depreciation	2154.46	1914.15	1673.83	1433.51	1193.19	1061.81
Construction in progress	0.00	0.00	0.00	0.00	0.00	25.69
Current assets	803.84	902.86	1003.90	1052.40	1052.40	1052.40
Cash, bank	10.54	10.67	10.81	10.80	10.80	10.80
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	0.00	1147.18	2357.32	3634.18	4938.83	6243.47
Loss	1147.18	1210.15	1276.86	1304.65	1304.65	1195.72
Total liabilities	4124.01	5193.00	6330.72	7443.62	8507.95	9597.97
Equity capital	2394.78	2394.78	2394.78	2394.78	2394.78	2394.78
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	255.17	286.02	317.51	332.62	332.62	332.62
Bank overdraft, finance required	1474.07	2512.20	3618.43	4716.21	5780.54	6870.56
Total debt	1729.23	2798.22	3935.94	5048.84	6113.17	7203.19
Equity, % of liabilities	58.07	46.12	37.83	32.17	28.15	24.

Vegetable Dehydration Plant --- Financial Analysis , July 1986

TABLE A.7 (Cont'd)

Year	9	10	11	12	13	14
Total assets	10662.30	11726.63	12790.96	13855.29	14945.31	16009.64
Fixed assets, net of depreciation	950.97	814.45	677.92	541.40	482.63	449.56
Construction in progress	0.00	0.00	0.00	0.00	25.69	0.00
Current assets	1052.40	1052.40	1052.40	1052.40	1052.40	1052.40
Cash, bank	18.88	18.88	18.88	18.88	18.88	18.88
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	7439.19	8640.05	9840.90	11041.76	12242.61	13365.70
Loss	1200.85	1200.85	1200.85	1200.85	1123.09	1123.09
Total liabilities	10662.30	11726.63	12790.96	13855.29	14945.31	16009.64
Equity capital	2394.78	2394.78	2394.78	2394.78	2394.78	2394.78
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	332.62	332.62	332.62	332.62	332.62	332.62
Bank overdraft, finance required	7934.89	8999.22	10063.55	11127.88	12217.90	13282.23
Total debt	8267.52	9331.85	10396.18	11460.51	12550.53	13614.86
Equity, % of liabilities	22.46	20.42	18.72	17.28	16.02	14.96

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	17073.97	18138.30	19202.63
Fixed assets, net of depreciation	390.80	332.04	273.27
Construction in progress	0.00	0.00	0.00
Current assets	1052.40	1052.40	1052.40
Cash, bank	18.88	18.88	18.88
Cash surplus, finance available	0.00	0.00	0.00
Loss carried forward	14488.80	15611.89	16734.98
Loss	1123.09	1123.09	1123.10
Total liabilities	17073.97	18138.30	19202.63
Equity capital	2394.78	2394.78	2394.78
Reserves, retained profit	0.00	0.00	0.00
Profit	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00
Current liabilities	332.62	332.62	332.62
Bank overdraft, finance required.	14346.56	15410.89	16475.22
Total debt	14679.19	15743.52	16807.85
Equity, % of liabilities	14.03	13.20	12.47

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	2371.27	2511.35	2824.77	2966.94	2955.60	2955.60
Financial resources	192.17	23.15	23.62	11.34	0.00	0.00
Sales, net of tax	2179.10	2488.20	2801.15	2955.60	2955.60	2955.60
Total cash outflow	2950.86	2684.05	2970.82	3066.22	3031.73	3049.48
Total assets	620.87	74.50	76.02	36.49	0.00	17.75
Operating costs	2330.00	2609.55	2894.81	3031.73	3031.73	3031.73
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-579.60	-172.70	-146.05	-101.28	-76.13	-93.88
Cumulated cash balance	-579.60	-752.29	-898.35	-999.63	-1075.75	-1169.64
Inflow, local	2368.10	2511.33	2824.75	2966.93	2955.60	2955.60
Outflow, local	2902.46	2645.69	2932.24	3029.56	2993.11	2999.61
Surplus (deficit)	-534.37	-134.36	-107.49	-62.64	-37.51	-44.01
Inflow, foreign	3.17	0.02	0.02	0.01	0.00	0.00
Outflow, foreign	48.40	38.36	38.58	38.65	38.62	49.87
Surplus (deficit)	-45.23	-38.34	-38.56	-38.64	-38.62	-49.87
Net cashflow	-579.60	-172.70	-146.05	-101.28	-76.13	-93.88
Cumulated net cashflow	-2557.11	-2729.80	-2875.86	-2977.14	-3053.27	-3147.15

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	2955.60	2955.60	2955.60	2955.60	2955.60	2955.60
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	2955.60	2955.60	2955.60	2955.60	2955.60	2955.60
Total cash outflow	3031.73	3031.73	3031.73	3031.73	3049.48	3031.73
Total assets	0.00	0.00	0.00	0.00	17.75	0.00
Operating costs	3031.73	3031.73	3031.73	3031.73	3031.73	3031.73
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-76.13	-76.13	-76.13	-76.13	-93.88	-76.13
Cumulated cash balance	-1245.77	-1321.90	-1398.03	-1474.16	-1568.04	-1644.17
Inflow, local	2955.60	2955.60	2955.60	2955.60	2955.60	2955.60
Outflow, local	2993.11	2993.11	2993.11	2993.11	2999.61	2993.11
Surplus (deficit)	-37.51	-37.51	-37.51	-37.51	-44.01	-37.51
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	38.62	38.62	38.62	38.62	49.87	38.62
Surplus (deficit)	-38.62	-38.62	-38.62	-38.62	-49.87	-38.62
Net cashflow	-76.13	-76.13	-76.13	-76.13	-93.88	-76.13
Cumulated net cashflow	-3223.28	-3299.41	-3375.54	-3451.67	-3545.55	-3621.68

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	892.48	1085.03
Financial resources .	892.48	1085.03
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	892.48	1085.03
Total assets	892.48	1085.03
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	394.63	624.96
Outflow, local	394.63	624.96
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	497.85	460.07
Outflow, foreign . . .	497.85	460.07
Surplus (deficit) .	0.00	0.00
Net cashflow	-892.48	-1085.03
Cumulated net cashflow	-892.48	-1977.51

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	2955.60	2955.60	2955.60
Financial resources	0.00	0.00	0.00
Sales, net of tax	2955.60	2955.60	2955.60
Total cash outflow	3031.73	3031.73	3031.73
Total assets	0.00	0.00	0.00
Operating costs	3031.73	3031.73	3031.73
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	-76.13	-76.13	-76.13
Cumulated cash balance	-1720.30	-1796.43	-1872.56
Inflow, local	2955.60	2955.60	2955.60
Outflow, local	2993.11	2993.11	2993.11
Surplus (deficit)	-37.51	-37.51	-37.51
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	38.62	38.62	38.62
Surplus (deficit)	-38.62	-38.62	-38.62
Net cashflow	-76.13	-76.13	-76.13
Cumulated net cashflow	-3697.81	-3773.94	-3850.07

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:
  Net present value .... -2513.02 at 10.00 %
  Internal Rate of Return (IRRE1) .. not found

b) Net Worth versus Net cash return:
  Net present value .... -2467.93 at 10.00 %
  Internal Rate of Return (IRRE2) .. -3.08 %

c) Internal Rate of Return on total investment:
  Net present value .... -2467.93 at 10.00 %
  Internal Rate of Return (IRR) .. -3.08 %

Net Worth = Equity paid plus reserves

- M -

CASTOR OIL

TABLE OF CONTENTS

I. SUMMARY

Castor oil is processed from castor beans for applications in various chemical industries such as pharmaceutical, cosmetics, paints and paper industries. In the case of Ethiopia, though castor oil can find domestic application in the production of laundry soap, it seems more economical to process the product for the export market.

In view of the likely constraints in the supply of the raw material, castor beans, a minimum economic size plant of 2,350 tons has been proposed.

The envisaged volume of production is estimated to require 5,000 to 6,000 tons of castor beans per year. Such quantity is anticipated to be met from collection of castor seeds from wild growing plants as well as through systematic cultivation.

The manufacturing process of the castor oil involves cleaning and preparation, pressing, and filtering.

The plant is estimated to cost about Birr 2.3 million, of which about 63% is in foreign currency. It is expected to generate employment for 61 people other than those to be engaged in marketing the product and in cultivation and collection of the raw material.

The project is not financially viable. The economic rate of return (23.04%) is, however, attractive enough to recommend the project for a further detailed study, especially with respect to the possibility of cultivating the castor plant.

II. INTRODUCTION

Castor oil is a non-edible vegetable oil which has multiple industrial applications. These applications, among others, include the production of soap, paints, cosmetics, and other chemical production.

Castor oil production is highly raw material oriented. Accordingly major producers are those countries which cultivate castor beans, the raw material used in castor oil production, in large quantities. Its further processing for various applications, however, is carried out mainly by industrialized countries, consequently making them major importers of castor oil.

Castor plant is known to grow wild in many tropical countries among which Ethiopia has been reported to be one.

Earlier estimates of Ethiopia's yearly production of castor beans range between 10,000 and 15,000 tons. A very small portion of these were exported. Some quantities were also used to be processed, for quite a few years, by one of the oil mills in the country for use in the production of soap. The production, however, had to be suspended as it was found inappropriate to process the castor beans in facilities used for other types of oil seeds.

Castor oil production as a project idea has been identified in the Ten Years Perspective Plan as one of the projects to be implemented during the plan period (1985 - 94). The idea was, however, for domestic application in the production of soaps and paints rather than for the export market as suggested in this project profile.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Descirption and Application

a. Product Description

Castor oil is derived from seeds of a castor plant which grows in many parts of the world, especially in the tropical regions. Castor oil has a distinctive offensive odour and unpleasant flavour with nauseating effect after taste. It is viscous and clear, its colour ranging from colourless to amber or greenish. Chemically castor oil contains recinoleic acid which gives it a unique characteristic, among vegetable oils, of solubility in alcohol. It easily mixes with ethanol, methanol, ether, chloroform, and glacial acetic acid. Castor oil is also non-volatile and stores well without becoming rancid with the passage of time. Another chemical property of the oil is that it is insoluble in mineral oils unless it is mixed with another vegetable oil.

Castor oil could be classified by the stages of its processing, crude or refined; by quality as first, second, etc. grades; and by its derivatives (through further processing) as dehydrated castor oil, hydrogeneted castor oil, polymerized castor oil, and sulphonated castor oil (commonly known as Turkey Red oil).

Crude castor oil results in the intermediary stage of the processing of castor seeds. Usually it is further processed to the final stage to obtain refined castor oil. Sometimes the crude oil itself is used in the production of soaps. Both crude oil and refined oil are quoted in the international market.

Refined castor oil itself is differentiated by grades which are based on the ability of meeting standards for quality specifications. The specifications and the designation of the grades may differ from country to country. (See Table V for British and U.S. Standards for first grade castor oil).

Dehydrated castor oil, usually identified as DCO, is obtained by removing the water content in the refined castor oil by heating the oil in the presence of chemicals and minerals such as sulphuric acid, phosphoric acid, clays and metallic oxides. It is mainly used in protective coating and in the production of alkyd resins.

Hydrogenated castor oil is a hard, waxy item produced by hydrogenation process. It is used in making hydroxystearic acid which is used as grease and as an intermediate chemical.

Polymerized castor oil is a rubber like item produced by combining refined castor oil with sulphur or diisocyanates. It can be blended with polystyrene to make it an impact resistant product.

Sulfonated castor oil, which is also known by other names, is a viscous liquid which is produced by sulfonating castor oil with sulfuric acid and washing it. It is used in the textile, leather, soap and paper industries.

b. Applications

Castor oil is a multiple use product which can be applied in the pharmaceutical, cosmetics, textile, leather, soap, paper and in other chemical industries.

Castor oil and its derivatives are used in:

- The production of protective coating, lacquer paints, and printing inks,
- The production of oil cloth, artificial leather and coated fabrics,
- Hydraulic fluids and polish production,
- Electrical insulating compound,
- Industrial lubricants,
- Paper coating,
- Medicine, as laxative,
- Manufacture of foamed plastics and rubber goods,
- Cosmetics for the production of lipsticks, ointment, hair dressing, etc....,
- Dyeing and finishing textiles and leather,
- Soap manufacture, and
- As source of sebacic acid which is used as a basic ingredient in the production of synthetic resins and fibers.

The use of castor oil in Ethiopia has been very limited. Products such as laxatives and alkyd resins, which use castor oil or its derivatives in their production, have been imported in a very limited quantity. The Addis Ababa Edible Oil Factory, a soap and oil producing plant under the Ethiopian Food Corporation, used to extract castor oil to produce soap. But this was suspended as it was found dangerous to process castor seeds with other oil seeds in the same line. The oil meal, which is highly toxic, also created a disposal problem for the plant.

Two potential applications for castor oil in Ethiopia have been suggested, for the production of soaps and paints. These are discussed below. The export potential of the product has also been assessed.

2. Market and Demand Analysis

a. World Supply and Demand

(1) Production of Castor Beans

The world production of castor beans, from which castor oil is extracted, has been showing a constant growth in the past few years as shown in Table I. The average annual growth rate of production from 1979 to 1985 was more than 9%. During this period, 76% - 82% of the world production was attributed to three countries, namely, Brazil, India and China. Africa's share was only 3% - 4% of the world production.

TABLE I

WORLD PRODUCTION OF AND TRADE IN CASTOR BEANS

('000 TONS)

Year	Production	Export	Import
1974 - 76	N.A.	99	108
1977 - 78	N.A.	93	100
1979 - 81	842	68	78
1983	920	82	91
1984	1037	112	106
1985	1298	87	91

SOURCE: FAO

Various studies indicate that a substantial proportion of the reported castor bean production is from wildly growing castor plants.

The trade statistics of castor beans show no apparent trend. They indicate, however, that the import and export of the product have not grown from what they were in 1974 to 1976. The share of the trade as a proportion of the total production is also very low, 8.7% from 1979 to 1981 and 7% in 1985, indicating that the producer countries process them. The supply in the international trade mainly comes from countries whose production is very small to justify the processing of the castor beans by them. An exception is China which has a substantial export during the indicated period.

(2) World Trade in Castor Oil

The world import and export of castor oil from 1974 to 1985 is shown in Table II. Although there are fluctuations during some years, the overall picture is that the product has a stable demand in the international market. During the period indicated, the annual average export was 170,000 tons; the lowest and the highest export being 127,000 tons in 1975 and 217,000 tons in 1979.

India and Brazil dominate the export trade with a combined share of about 90% during the indicated period. Except South Africa, which has been reported as having a very insignificant export, no African country has been reported to have made any castor oil export.

TABLE II

WORLD TRADE IN CASTOR OIL

(1974 - 1985)

Year	EXPORT		IMPORT	
	Quantity ('000 Tons)	Value (US$ Million)	Quantity ('000 Tons)	Value (US$ Million)
1974	194.5	162.9	197.0	178.8
1975	127.2	73.2	129.2	79.5
1976	186.2	102.0	184.8	107.0
1977	139.7	123.2	162.1	141.9
1978	165.3	133.1	189.0	163.7
1979	217.1	172.6	213.4	178.0
1980	185.4	179.9	179.8	182.9
1981	184.2	157.4	179.5	164.3
1982	136.6	111.8	152.0	130.8
1983	143.0	129.7	139.8	132.1
1984	176.8	196.8	180.3	225.2
1985	183.0	129.4	163.2	145.8

SOURCE: FAO

From 1983 to 1985, the major importers of castor oil were France (27%), US (22%), USSR (21%), West Germany (6%), and United Kingdom (4%). During this period, Africa's import share was about 1.4%, about 2200 tons.

b. Supply and Demand in Domestic Market

Except for soap manufacturing no industry uses castor oil as a direct or indirect input. As mentioned earlier, the Addis Ababa Edible Oil Factory used to produce castor oil for use in the production of laundry soap. The production was, however, discontinued for the reasons indicated earlier. There is, however, a feeling that it may be possible to use castor oil in the production of laundry soap and paints.

(1) Castor Oil in Soap Production

It is not generally recommended to use castor oil for the production of soap for it can be economically used in other applications or for export. Countries reported to use castor oil for soap production, such as India, are major producers of the castor oil and mainly they use lower grades of it for soap production. Since it is one of the highest priced vegetable oils in the international market, it is better to export it and import a much less costly vegetable oils, such as palm or cocunut oils, or animal fat for use in the production of laundry soaps. In fact, specialists in the field indicate that the latter results in a better quality soap than when castor oil is used as an input.

(2) Castor Oil in Paint Production

In the production of paint, oil is used as a direct input as well as via alkyd resins which are a major input in the paint production. An alkyd resin project is being considered for implementation and is expected to be reallized in the near future. An assessment of the application of castor oil in the domestic paints industry indicates the following:

- Dehydrated castor oil (DCO) is recommended for high quality, resistant alkyd and in stoving alkyds which are different from the type envisaged to be produced by the alkyd resin project. Linseed oil is recommended for the project in preference to other drying oils. Castor oil, on the other hand, was not found appropriate for the following two basic reasons:

  . DCO is not required for the type of alkyd resin to be manufactured at the envisaged plant, and

  . Dehydration of castor oil is not recommended for local production as the process involved is not simple.

- Oil is also used as a direct input in the production of oil paints, but castor oil is not recommended for that. The paint factories in the country have now suspended production of oil paints and even if production is resumed in the future, the annual requirement for oil will not exceed 200 tons, and

- Dehydrated castor oil (DCO) can be used as a direct input in the production of car paints, but the quantity required is estimated to be very insignificant.

c. <u>Export Potential</u>

The demand for castor oil in the international market is generally stable. It is, however, a competitive market with two suppliers, Brazil and india, dominating the export trade. Nevertheless information on the international market for the product indicates that it is attractive enough for a country like Ethiopia to start production of castor oil with the sole intention of exporting it. In fact, an European firm, which has dealings in castor oil trading, has already indicated an interest to buy castor oil from Ethiopia. According to this particular firm there will not be a problem in selling annually 35,000 tons to 50,000 tons of castor oil from Ethiopia in the European market. A similar point of view was expressed by a foreign oil technologist working on contract with another project. The underlying assumption is that the castor oil to be offered will meet the quality standard required by the market.

The major factor which encourages production of castor oil for export, rather than for domestic use, is its high price in the international market relative to the prices of other vegetable oils. A comparative average price of castor oil and those of other vegetable oils from 1977 to 1985 is shown in Table III.

TABLE III

AVERAGE FOB PRICE OF VEGETABLE OILS

(US$ PER MT)

Year	Rape and Mustard Oil	Linseed Oil	Palm Oil	Coconut Oil	Palm Kermel Oil	Castor Oil
1977	593	500	521	556	535	882
1978	611	373	564	624	613	805
1979	648	602	633	933	876	795
1980	629	611	564	651	662	970
1981	537	662	528	547	548	855
1982	484	536	450	464	463	818
1983	505	416	441	555	575	907
1984	694	534	661	1018	900	1113
1985	610	620	502	601	537	707

SOURCE: FAO

d. Demand Projection

In the preceding sections, it was pointed out that the production of castor oil for domestic consumption is not recommendable. The export market analysis, however, indicates that there is a potential for export that would justify establishing a castor oil processing plant. The quantity to be produced is to be determined by the available quantity of castor beans to be pressed rather than by the demand for castor oil. It can be assumed, for the purpose of this project, that any quantity that can be supplied by Ethiopia can be absorbed by the international market. It is recommended, however, that a 'minimum economic scale plant' be established given the local supply of the castor beans.

3. Pricing and Distribution

The current world price of castor oil is about US $800.00 per ton, which includes insurance and freight to a major European port. Assuming US $150.00 per ton for shipping and insurance, this gives an ex-factory export price of US $650.00 per ton which is equivalent to Birr 1345.50. This is the selling price adopted to calculate the revenue of the project.

The castor oil is to be packed and shipped in 200-litre drums.

B. PLANT CAPACITY AND PRODUCTION PROGAMME

1. Plant Capacity

The global castor oil trade is about 200,000 tons, with Brazil, India and China accounting for the bulk of the exports; the US and Western Europe are the main importers. It is estimated that a plant producing 3,000 tons to 5,000 tons per year could have an opportunity to export to the markets of the main buyers in Europe if the price and quality were competitive, for the additional supply in the internationally traded market would be relatively small.

In this profile a plant producing 2,350 tons per year has been examined. The rate of production of oil is 8 tons per 24 hours (18 tons of seeds per 24 hours). The plant is assumed to run 7 days per week for 42 weeks in a year and it would be shut down for 2 months every year for maintenance and plant overhaul. If the future demand warrants it, the output can be doubled by simply duplicating the plant.

2. Production Programme

For efficient operation, the proposed castor oil plant considered in this profile is the minimum size. As indicated above, the additional supply in the international market would be too small to create any marketing and sales problems. On the assumption that the required amount of seeds would be made available at the time of the plant start-up, probably in the mid-1990's, the castor oil plant could achieve full production in the first year.

IV. RAW MATERIALS AND INPUTS

A. RAW MATERIALS

The castor plant, Ricinus communis L, is a member of the spurge family, which consists of a vast number of plants mostly native to the tropics. The plant is found practically all over the continent of Africa except in regions which are too dry, too high or too wet. In Ethiopia, considered to be the original home of the species, it is found widespread, but less above an altitude of 2400 m, in the forested regions, and in the semi-deserts and deserts. It is hardly cultivated.

The seed is mainly collected from wild plants, but often some plants can be found close to dwellings. The castor plant varies greatly in its growth habit, colour and foliage, stems, seed size, colour and oil content, so that varieties often bear little resemblance to each other. Some are large perennials after developing into small trees, others behave like short lived dwarf plants and every gradation between extremes can be found. The type found in Ethiopia[1] is usually a small tree or a shrub, reaching a height of about 4.5 m, usually from branching 1 m upward.

The production data in Ethiopia, where the seeds are mainly collected from a few cultivated or wild plants, are not accurate. Ethiopia exports castor as seed only in limited quantities, about 500 tons in 1986. However, earlier statistical data[2] indicates that the Ethiopian annual production has varied between 10 and 15,000 tons. The country used to export a small portion of the locally produced oil to neighbouring countries.

---

[1] Oil Plants in Ethiopia

[2] Weiss, 1971: FAO Production Year Book 1973 - 1980.

The Addis Ababa Edible Oil Factory, which produced castor oil for several years, stopped its production about nine years ago. The presses have been dismantled.

According to various studies on castor plants in Ethiopia, there are large areas, especially, on the eastern and western escarpments of the highlands, in Gojjam and in the Chercher highlands which are suitable for castor production. Small trials on some of the irrigated estates[1] in the Awash Valley indicate that castor grew well with an irrigation. Yields varied between 280 - 1233 kg/ha. In an earlier literature (Tozzi, 1943) it is reported that experiments showed excellent growing conditions in the region near Asbe Teferi at altitudes of 1600 - 1900 m. Taralleto (1935) made the following remarks on the situation in Eritrea, which could well apply to most of Ethiopia. 'The hot lowlands are less suitable for castor production because rain is lacking though they have good temperatures. The escarpments are suitable, as is a part of the altiplane. But there the rain distribution is unfavourable; the time between the onset of the rains and the cold season is too short for full development of the plant. Thus a perennial type is necessary and the treelike forms are most suitable because of their drought resistance.

The lowlands in northern and eastern Ethiopia lack sufficient precipitation for unirrigated castor. The south west highlands have a surplus of water, but castor can still be found there. In view of the absence of a pronounced dry season, it is doubtful whether castor will become a profitable crop in that area. It is also possible that the areas where wild castor beans grow,

[1] Weiss, Castor, Sesame, Safflower, 1971

particularly Illubabor and Wellega, might become commercial production areas in the future. Other areas that might prove viable are the Desert Valley near Massawa and the Gash Valley in Western Eritrea.[1]

As indicated in the market study, production of castor oil is recommended only for the export market. For the recommended production of about 2350 tons of castor oil annually and an extraction rate of around 45%, about 5,000 tons - 6,000 tons of castor seed will be required.

In principle, it may be possible to harvest the required amount of seed from 'wild' plants. Since the castor seed can quickly colonize suitable habitats, a considerable increase in 'castor seed production' can be achieved if there is sufficient incentive to harvest these plants. However, a castor oil production plant should not entirely depend on the supply of castor seed from wild plants. With an increasing demand of this versatile natural product, a systematic cultivation should be encouraged.

It might be necessary for the processing factory to acquire initially an area in its immediate vicinity to be directly used for planting to give added impetus to the local production. The factory plantation must be capable of producing the minimum amount of seed required for an efficient operation of the factory. Castor seeds from individual producers could be processed as they become available. This would make the factory independent of the fluctuations in supply. In general the following can be concluded about the castor seed production:

---

[1] Development of Castor Seed Production and Processing in Ethiopia, SRI, February, 1969.

- Every attempt should be made to encourage the collection of castor seeds from wild or semi-wild plants. In this respect the establishment of a marketing system and its extension into remote regions will be important; and

- The introduction of a systematic cultivation of high-yielding types should be given high priority. This will require an extensive research in the field to meet the ecological requirements(soil, water, hail damage, weed control etc.) in order to obtain a sufficient yield.

B. UTILITIES

Power and steam would have to be supplied to the plant for continuous, around the clock operation, irrespective of the actual time the plant is working, for an interruption of the power and steam supplies would have an unfavourable effect on the quality of the oil. For crushing 18 tons of seeds daily, the following amounts of power, water, steam and fuel will be required:

Power	:	1,700 kWh/day
Steam	:	1 ton/hr. at 150°C
Water	:	20 m^3/day
Fuel oil	:	1 ton/day

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

As indicated earlier, castor seeds comprise nearly 50% oil, but the commercial yield would be more like 45%, the remaining 7% - 8% of oil contained in the cake has to be extracted by a solvent extraction system. The process is too expensive at the envisaged scale of production. Therefore it is assumed in this study that the yield of castor oil will be about 45%. Thus, the annual requirement of castor seeds will be 5200 tons. The plant is envisaged to achieve full production in the first year and thus 18 tons of castor seed would be required for the daily production.

D. MATERIALS AND INPUT COSTS

1. Raw Material

The castor oil processing plant proposed in this profile will require 18 tons of seeds per day. The total quantity needed for a 294-working day would be 5200 tons. The exports of seed from 1976 to 1984[1] has ranged from 115 to 2,200 tons. The average price (FOB Assab) was estimated at Birr 800/ton. Although the country used to export upto 15,000 tons of seed per year, it is very difficult to assume at this stage that the required quantity of seed would be made availble to the new plant.

New supplies might come through increased harvesting of wild plants and small plantations but, in this study it is assumed that the new supplies would be mainly from commercial cultivation. The price assumed for one ton of seed at the factory gate is Birr 520. The gap in price, i.e. the difference between this price and the export price, mainly arises as a result of additional costs incurred in transporting the seeds to the port of Assab.

[1] Annual External Trade Statistics, 1976 - 1984.

2. Cost of Utilities

Electricity

The cost of electric power will be Birr 0.22/kWh.

Water

Water for potable and industrial use will cost Birr 0.5/m^3.

Fuel

Fuel cost for a boiler at Addis Ababa is Birr 581/ton.

Packing Materials

Castor oil can be transported in suitable drums, tanker trucks, rail cars, or bulk steamers. In Ethiopia, petroleum products are transported by tanker trucks, which generally return empty to Assab. Their use for castor oil, particularly on the return journey, can probably be arranged as it is more economical than transporting the oil in drums. However arrangements must be made for the shipment of whole truck loads, so they may remain sealed upto the destination.

In this profile, it is assumed that castor oil will be transported in 200 litre drums. Each drum costs Birr 50 and with an annual requirement of about 12,250 drums, the total cost for transporting castor oil will amount to Birr 612,500 per year.

Laboratory Supplies

Cost of laboratory supplies for quality control tests were estimated at Birr 5000 per year.

V. LOCATION

As discussed earlier, the major aspect to be considered in establishing a factory for castor oil production is the continued supply for castor seeds. If the plant is to be located far from the region where the castor seeds are collected from wild plants, it is likely that such seeds may remain for some time at the growers' store before sufficient quantities are collected to make a trip to the factory worthwhile. Under such a situation, an efficient factory operation may not be possible.

It must also be noted that a major loss of the oil quality could result from seeds kept in unsuitable stores or from prolonged storage. On the other hand, setting up the processing factory in the vicinity where the plant grows wild will encourage the seed production. It will also allow the development of related enterprises, for the residues from the oil production are suitable for stock feed after detoxification. However, the largest market for castor meal is still in the use as fertilizer which has also been considered in this study. A fattening or dairy unit can thus be established.

The oil seed factory cannot entirely depend on the supply of seeds from wild plants. The factory should have its own plantation which must be capable of supplying the required amount of seeds for an efficient factory operation. Castor seeds collected from wild plants could still be processed in the factory as they become available.

It is usually difficult to integrate castor oil production with edible oil mills, since special precautions will be necessary not only for the personnel (sensitivity of individuals to the seed) but also for the equipment cleaning and maintenance. It is thus recommended that the factory be set up near one of the regions where castor grows wild and also where it can be commercially cultivated. At this stage of the study, it is not possible to indicate a specific location, for this requires an extensive field work whereby various environmental factors and other local conditions have to be explored. It must be understood, however, that there is no advantage in locating the plant within a seed production area if commercial cultivation expands at a rapid rate and the castor oil for export increases. In such an event, the plant should be located at one of the ports where the oil, and possibly the cake produced, could be stored and shipped in bulk.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Alternative Technologies for Castor Oil Production

Castor oil, like any other vegetable oil, is commercially produced by one of three basic methods, which can be modified or combined to suit specific conditions. These are:

- Batch hydraulic pressing in which the oil is pressed by hydraulic pressure from a mass of oil-bearing seeds;

- Continuous mechanical pressing, in which the oil-bearing material is squeezed through a tapering outlet. The oil is pressed by the increasing pressure, and

- Solvent extraction in which the oil-bearing material is taken into solution with a solvent, the solution is separated from the insoluble residue, and the oil recovered from the solvent solution.

A combination of these processes in commercial production is continuous mechanical pressing (expelling) with continuous solvent extraction, or batch hydraulic pressing and solvent extraction. The production of castor oil has a specific feature in that it requires special treatment and equipment cleaning procedures.

Generally, the majority of presses were originally hydraulic, but most operations have switched to mechanical screw presses because of the saving in labour (unlike the batch type hydraulic press, it need not be stopped for recharging) and increased yield of oil (it operates at a greater pressure than the hydraulic press). The mechanical screw press commonly known as expeller is less expensive than the hydraulic press and thus reduces the capital investment required. These advantages of the mechanical press over the hydraulic press are overshadowed when castor beans are processed by mechanical screw presses. Screw presses wear out very quickly when used with castor seeds. The seeds must also be reduced to smaller sizes, steam treated and dryed.

2. Manufacturing Process of Selected Technology

a. Cleaning and Preparation

The castor seeds are first separated from larger particles such as stones, wood etc. by passing them through vibrating sieves of various sizes. These foreign particles are filtered out into a discharge bin for discarding.

b. Pressing

Before pressing, the seed must be warmed to about 60°C. The warming and drying of the seed is done in a multifloor dryer. The seeds are carried by by a metal sieve-belt through the different floors of the drying machine, which is heated by hot air to 120°C.

Another system developed for warming and drying of the seeds is the dielectric - capacity process, under which a high frequency current is produced in a tube generator upon the steel plates of a condenser, and between which the seeds are led for heating. Although this system greatly improves the efficiency of the warming and drying process, it is too expensive to be considered.

After the pre-heating operation, the seeds are taken to the expeller (press) as needed. The expeller breaks up the seeds and subjects them to pressure, thus removing oil which is expelled from the machine and can be stored in 200 litre drums. The residual oil cake is also forced out of the expeller and since it is poisonous, it must be removed for use as fertilizer.

The expelled oil should be left to settle for a couple of days, so the sediment will fall to the bottom and the oil can be decanted. The settled oil is pumped to the filter for added 'clarification'. The oil discharged from the filter, which is of 'No. 1' quality, is removed to storage or packing facilities. The process flow is given in Figure I. The composition and specifications for castor oil are shown in Table IV and V, respectively.

TABLE IV

FATTY ACID COMPOSITION OF CASTOR OIL

Fatty Acid	%
Ricinoleic acid	87 - 90
Oleic acid	4 - 7
Linoleic acid	3
Palmitic acid	2
Stearic	1

FIGURE 1

PROCESS FLOW CHART OF CASTOR OIL PRODUCTION

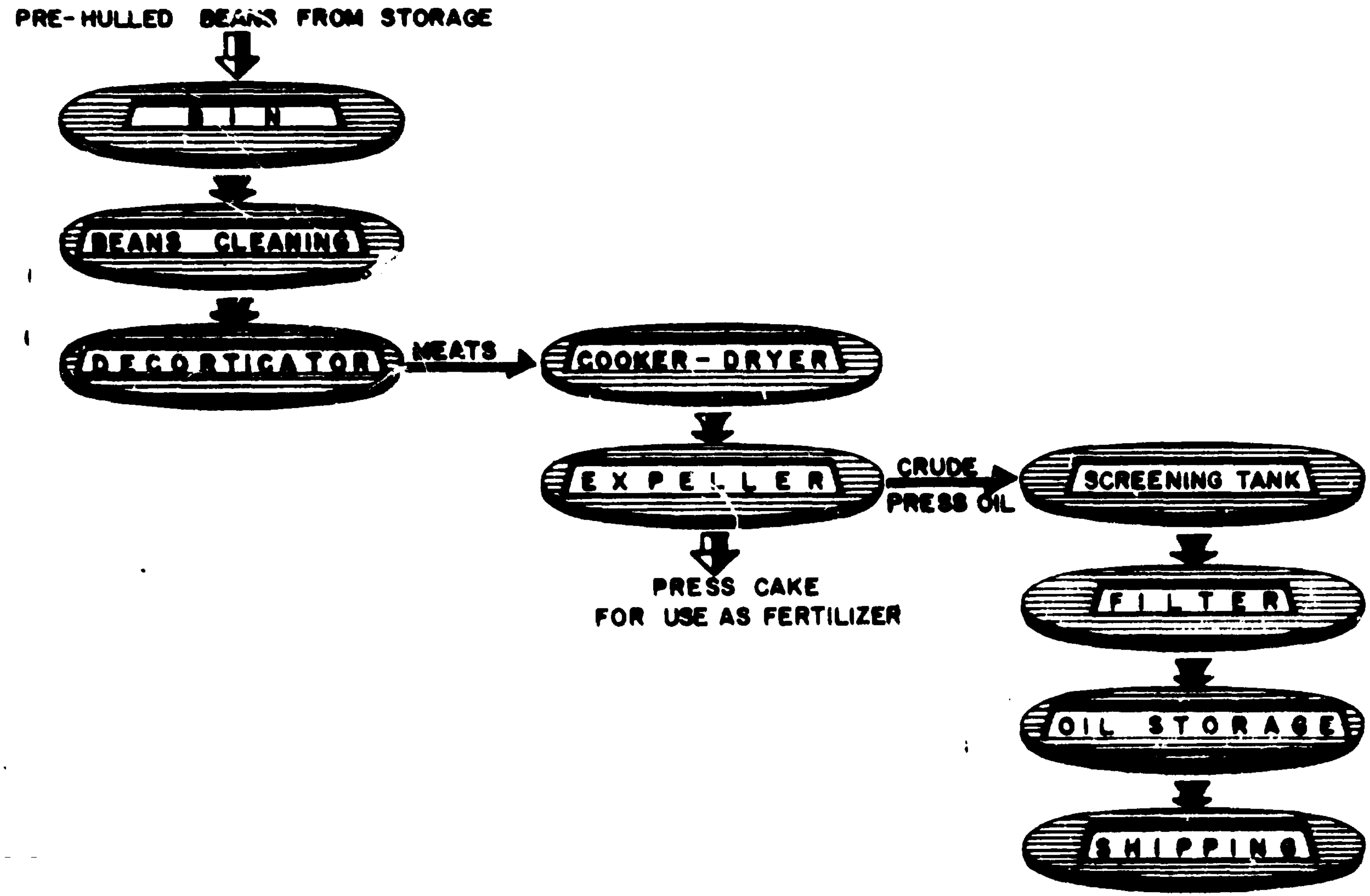


TABLE V

INTERNATIONAL CASTOR OIL SPECIFICATIONS

Specification	British Standard* First Quality	US No. 1
Acid value	4 max	3 max
Saponification value	177 - 187	179 - 185
Iodine value,	82 - 90	82 - 83
Acetyl value	140 min	
Hydroxyl value	156	
Unsaponifiable (%)	1.0 max	0.5 max
Refractive index, 20°C	1.477 - 1.481	
Specific gravity 15.5°C	0.958 - 0.969	0.961 - 0.963

*Indian BSS and Brazilian BSS conform to this specification

The oil cake, also known as pomace or poonac, unlike most other oil seeds, contains poisonous substances such as ricin, a highly toxic protein; ricinine, a relatively harmless alkaloid and an extremely potent allergen, the castor bean allergen (CBA). As mentioned earlier, the use of the oil cake is limited to use as fertilizer, mainly as a source of organic nitrogen. The oil cake represents 50% -55% of the seed by weight after the extraction of the oil. The shipment of castor meal poses a number of problems due to its allergic properties. In fact the storage of the oil cake may present problems in more humid areas, as it deteriorates rapidly with rises in temperature and humidity. Moreover, a fence round the cake storage area is essential to prevent accidental poisoning of children and livestock.

In this profile it is assumed that the oil cake will be used as fertilizer for horticultural crops. The fertilizer value of the meal, which contains 6% - 8% nitrogen, 3% phosphate and 6% potassium, would be about Birr 200/ton, based on imported prices for nitrogen, phosphorus and potassium (NPK) compounds. An analysis of the castor meal used as fertilizer in the US is shown in Table VI below:

3. Source of Technology

The main technology is the expeller. The main suppliers are:

Simon Rosedowns Limited
Cannon Street
Haul 1
Humberside HU2 OAD
UK
Telephone 0482-29864

United Engineering (Eastern) Crop.
India
CeCo Co
Japan
IBG Monforts and Reiners GmbH
West Germany
Krupps
West Germany

TABLE VI

ANALYSIS OF CASTOR MEAL

Constituent	%
N	5.5 - 6
Ammonia	0.0 - 0.31
Nitrate	0.12 - 0.35
Sol organic	0.2 - 0.56
Active insol	2.31 - 2.92
P_2O_5	
K_2O	
Ca	0.07 - 0.77
Mg	0.08 - 0.53
Organic matter	79 - 87
Moisture	3.8 - 13.8
Ash	4.7 - 14.7

SOURCE: Oilseed Crops, E.A Weiss

B. ENGINEERING

1. Machinery and Equipment

The machinery required for screening, heating and expulsion is normally supplied as a single unit, linked by conveyor. The seeds pass from the screen to the cooker, which uses steam to pre-heat the seeds. The cooker is mounted above the expeller, and requires a conveyor feed system to ensure a steady rate of input. The expeller is of the 'wormshaft' (screw-press) type, operating continuously. The seeds enter at one end, as subjected to increasing pressure as they are pushed to the other end, and finally are expelled as cake. It is assumed that the oil will be allowed to settle for 2 days in storage tanks having a capacity of 16,000 litres. This could be achieved by using 80 x 200 litre drums. The list of the major machinery and equipment, and their costs are given in Table VII.

2. Plant Layout

The building will have an area of 250 m^2, with a layout as shown in Figure II. The height to the caves may be up to 6 metres, depending on the exact cooker configuration. The area requirements will be broken down as follows:

	m^2
Castor Bean Store	25
Finished Goods Store	55
Production Area	145
Offices	25

TABLE VII

TOTAL FIXED INVESTMENT COST

DESCRIPTION	COST ('000 BIRR)		
	FC	LC	TOTAL
A. MACHINERY & EQUIPMENT			
Cooker	103.5	-	100,5
Expeller	414	-	414
Filter press, seed cleaner	311	-	311
Conveyors, elevators,pipes, storage tanks, spares etc.	311		311
Total Equipment Cost	1139.5	-	1139.5
Freight	-	114	114
Total Machinery Cost(C&F)	1139.5	114	1253.5
Local Cost (12,5% of C & F)		157	157
Total Cost of Machinery and Equipment(including 10% cont.)	1254	298	1552

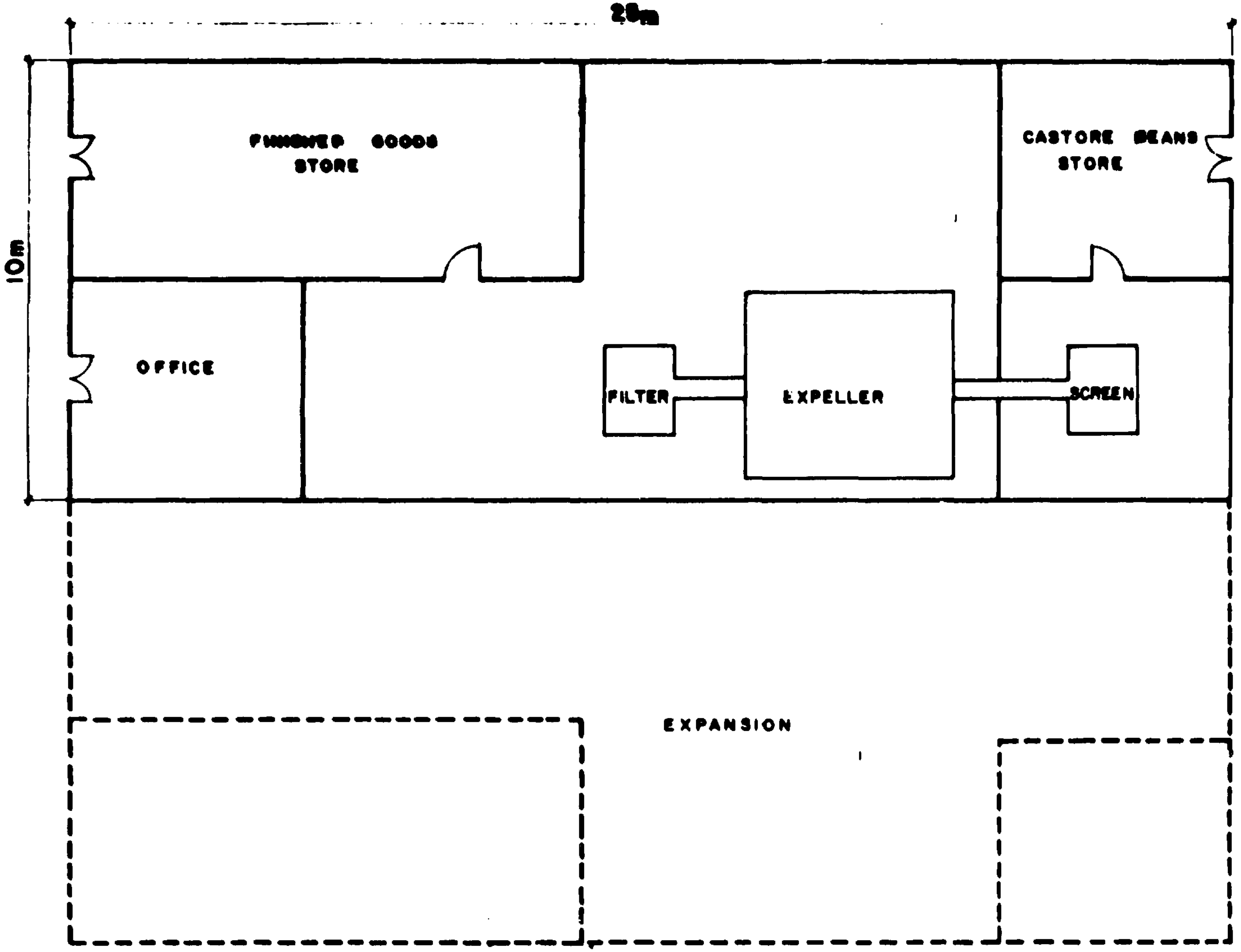
NOTE: There are possibilities of obtaining a less expensive plant, particularly from Brazilian and Indian manufacturers. In this profile, the higher price was used.

TABLE VII (Cont'd)

DESCRIPTION	COST ('000 BIRR)		
	FC	LC	TOTAL
B. BUILDING AND CIVIL WORKS			
Building Cost	67.5	157.5	225
Site Development (2% of building cost)	-	4.5	4.5
Outdoor Works(Sewage, drainage piping, etc. and 10% of building cost)	-	22	22
Total building and Civil Works Cost(including 10% contingency)	74	203	277
C. SERVICE EQUIPMENT			
Office Furniture and Equipmnt	13	29	42
D. VEHICLES			
1. Truck (10 ton capacity)	33	77	110
2. Small cars(two) .	34	16	50
Sub-Total incl. 10% Contingency	74	102	176

FIGURE 11

PLANT LAYOUT FOR CASTOR OIL PRODUCTION



INDUSTRIAL PROJECTS SERVICE

PROJECT	Drawn by	Sign	Date	CLIENT
	Checked by			
	Approved by			Scale

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of the proposed castor oil producing plant is given in Figure III. It will have four divisions, i.e. Administration, Maintenance, Production, Accounts and Commercial.

Because of the high quality standards required for commercial grade castor oil, a quality control unit will be indispensable. The quality control unit will be responsible for the determination and inspection of the castor oil to comply with International Standards.

B. MANPOWER

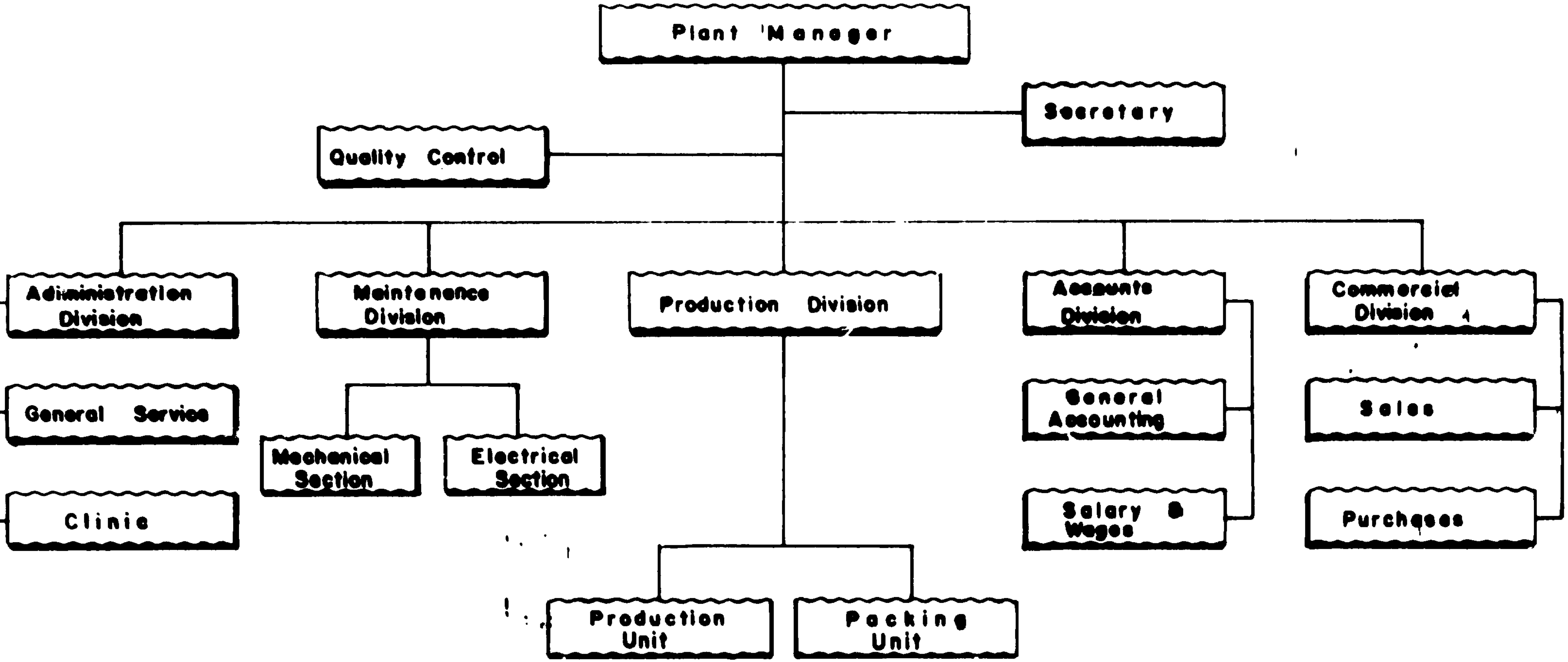
The manning of the proposed castor oil plant is given in Table VIII. The plant will employ 61 people. In addition, the plant will require buying agents for the raw material and selling agents for the export.

The plant manager and production manager would require production training. The former should be familiar with potential markets and the latter with the process involved to produce acceptable grades of castor oil. Both should have chemical engineering training and experience.

The sensitivity of individuals to the seed should be kept in mind and it is thus necessary to screen prospective employees before employment. This can be done by simply exposing individuals

FIGURE III

ORGANIZATION CHART OF CASTOR OIL PLANT



to the castor seed processing plant. An individual who is allergic to castor seed develops congestion of the nasal passage, the eyes and nose become irritated and watery, and with continued exposure coughing and congestion of the nasal passages become severe. Suitable antidotes should be maintained in the first-aid room to treat emergency cases.

TABLE VIII

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. of Shifts	Total No. Employed	Skill Level	Monthly Salary/ Person/ (Birr)	Annual Salary (Birr)
Plant Manager	1	1	Professional/tech.	1,200	14,400
Secretary	1	1	Skilled	350	4,200
Aministrator	1	1	"	600	7,200
Chief Accountant	1	1	"	700	8,400
Commercial Section Head	1	1	"	600	7,200
Sales	1	1	"	400	4,800
Purchaser	1	2	"	400	9,600
Secretary	1	3	"	250	9,600
Production Manager	1	1	Professional/tech.	900	10,800
Laboratory Tech.	1	1	Skilled	500	6,000
Maintenance	1	1	"	700	8,400
Mechanic/Elect.	4	4	"	400	19,200
Shift Supervisor	4	4	"	500	24,000
Operator	4	12	Semi-skilled	200	28,880
Labourer	4	16	Unskilled	120	23,040
Truck Driver	1	1	Skilled	500	6,000

Personnel	No. of Shifts	Total No. Employed	Skill Level	Monthly Salary/ Person/ (Birr)	Annual Salary (Birr)
Assistant	1	1	Semi-skilled	150	1,850
Car Driver	1	1	Skilled	250	3,000
Guard	3	6	Unskilled	120	8,640
Cleaner	1	2	"	90	2,160
Total (incl. 25% empl. benefits)		61			258,375

Skill distribution		%
Professional/technical	2	33
Skilled	22	36
Semi-skilled	13	21
Unskilled	24	39
Total	61	100

VIII. IMPLEMENTATION SCHEDULE

The implementation of the proposed castor oil plant can be divided into two stages, namely, the seed production stage and the seed processing stage.

A. CASTOR SEED PRODUCTION

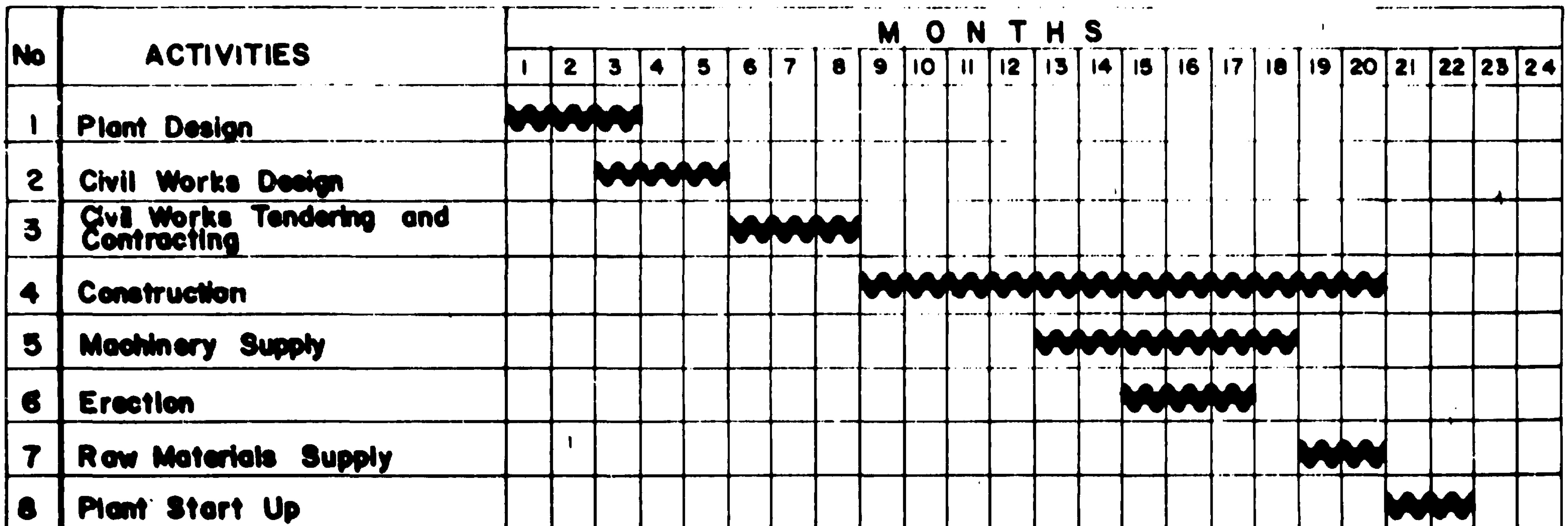
As pointed out earlier, the proposed plant must be supplied with an adequate raw material right from the production start-up and any fluctuations in raw material supply should be avoided. Some efforts must thus be exerted to promote the crop through the introduction of systematic cultivation of high yielding varieties. Similarly the collection of castor seeds from wild plants must be encouraged.

B. CASTOR SEED PROCESSING STAGE

After all the necessary measures are taken to increase the production of castor seeds and thereby ascertain their adequate supply to the proposed plant, the establishment of the processing plant should be planned. However, planning of the increased production alongside with the building of the processing plant would be ideal. In this profile, a general schedule for the construction of the proposed plant is given in Figure IV. A total of about 22 months are required for the building of the processing plant.

Figure IV

Implementation Schedule For Castor oil Plant



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table IX.

TABLE IX

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Buildings and Civil Works	74.00	203.00	277.00
Plant Machinery and Equipment	1254.00	298.00	1552.00
Office Furniture and Equipment	13.00	29.00	42.00
Vehicles	74.00	102.00	176.00
Pre-production expenditure	23.04	207.36	230.40
Total	1438.04	839.36	2277.40

The foreign currency component of the total initial investment cost will be about 63%. About 87% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following Parameters were used to estimate the working capital requirements of the Castor Oil Plant.

	Items	Months of Coverage
1.	Cash in hand	0.5
2.	Accounts receivable	0.5
3.	Raw materials - local	1.0
4.	Finished products	1.0
5.	Accounts payable	1.0

The working capital requirement at full capacity will be Birr 0.461 million, of which Birr 0.006 million will be required in foreign currency.

3. Production costs

The detailed production cost estimation is given together with other required financial statements. The production costs at full capacity amounts to Birr 4.25 million, out of which 5.2% is in foreign currency.

4. Internal rate of Return (IRR)

The castor oil plant will not be financially viable. The internal rate of return was calculated to be -36.09% with a net present value of Birr -4.59 million discounted at 10% p.a. The selling price assumed was Birr 1350 per ton for castor oil and Birr 200 per ton for the oil cake. The revenue generated cannot even cover the production costs. This project will not be viable unless the selling price of the castor oil is increased by at least 20%.

Castor oil production is a fierecely competitve industry and is subject to wide fluctuations in both prices and bean costs. This project needs special attention regarding attainable yield, shipping/handling charges, availability of low cost machinery, and the likelihood of future changes in the 'extraction margin' on world markets.

5. Breakeven Analysis

Assuming a selling price of Birr 1372 ton of castor oil the breakeven point would be reached at a production of 6867 tons of castor oil which is much higher than the proposed capacity of the plant. The total revenue that should be generated in order to breakeven would be Birr 11.12 million, out of which Birr 1.7 million is the share of the by-product.

B. ECONOMIC ANALYSIS

The economic rate of return amounted to 23.04% with a net present value of Birr 2.117 million discounted at 10% p.a.

The project will create employment for about 61 people when operating at full capacity.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

Castor Oil Plant
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	2277.40	63.144 % foreign
current assets:	0.00	0.000 % foreign
total assets:	2277.40	63.144 % foreign

Source of funds during construction phase

equity & grants:	2277.40	63.144 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	2277.40	63.144 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	3994.46	3994.46	3994.46
depreciation :	254.53	254.53	254.53
interest :	0.00	0.00	0.00
production costs	4248.99	4248.99	4248.99
thereof foreign	5.21 %	5.21 %	5.21 %
total sales :	3692.50	3692.50	3692.50
gross income :	-556.49	-556.49	-556.49
net income :	-556.49	-556.49	-556.49
cash balance :	-763.28	-301.96	-301.96
net cashflow :	-763.28	-301.96	-301.96

Net Present Value at: 10.00 % = -4596.76
Internal Rate of Return: -36.09 %
Return on equity1: not found
Return on equity2: -36.09 %

Index of Schedules produced by COMFAR

Total initial investment
Total investment during production
Total production costs
Working Capital requirements
Cashflow Tables
Projected Balance
Net income statement
Source of finance

- M45 -

COMFAR 2.1 UNIDO

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	111.00	166.00
Auxiliary and service facilities	85.20	90.80
Incorporated fixed assets	4.20	37.80
Plant machinery and equipment	0.00	1552.00
Total fixed investment costs	200.40	1846.60
Pre-production capital expenditures	119.70	110.70
Net working capital	0.00	0.00
Total initial investment costs	320.10	1957.30
Of it foreign, in %	27.39	68.99

COMFAR (s) 2.1

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3- 7	8	9	10-12	13-17
% of nom. capacity (single product).	0.00	0.00	0.00	0.00	0.00
Raw material 1	2704.00	2704.00	2704.00	2704.00	2704.00
Other raw materials	612.50	612.50	612.50	612.50	612.50
Utilities	113.00	113.00	113.00	113.00	113.00
Energy	170.82	170.82	170.82	170.82	170.82
Labour, direct	258.40	258.40	258.40	258.40	258.40
Repair, maintenance	100.74	100.74	100.74	100.74	100.74
Spares	0.00	0.00	0.00	0.00	0.00
Factory overheads	10.00	10.00	10.00	10.00	10.00
Factory costs	3969.46	3969.46	3969.46	3969.46	3969.46
Administrative overheads	25.00	25.00	25.00	25.00	25.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00
Depreciation	254.53	173.25	190.29	208.45	49.05
Financial costs	0.00	0.00	0.00	0.00	0.00
Total production costs	4248.99	4167.71	4184.75	4202.91	4043.51
Costs per unit (single product)	0.00	0.00	0.00	0.00	0.00
Of it foreign, %	5.21	4.85	5.04	5.16	2.23
Of it variable,%	84.16	85.80	85.45	85.08	88.44
Total labour	258.40	258.40	258.40	258.40	258.40

TABLE A.4

Net Working Capital in '000 Birr

Year			3	4-17
Coverage	mdc	coto		
Current assets &				
Accounts receivable	15	24.0	166.44	166.44
Inventory and materials	30	12.0	276.38	276.38
Energy	0	---	0.00	0.00
Spares	0	---	0.00	0.00
Work in progress	0	---	0.00	0.00
Finished products	30	12.0	332.87	332.87
Cash in hand	15	24.0	16.42	16.42
Total current assets			792.10	792.10
Current liabilities and Accounts payable	30	12.0	330.79	330.79
Net working capital			461.32	461.32
Increase in working capital			461.32	0.00
Net working capital, local			455.35	455.35
Net working capital, foreign			5.97	5.97

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

- M48 -

TABLE A.5

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	320.10	1957.30
Financial resources	320.10	1957.30
Sales, net of tax	0.00	0.00
Total cash outflow	320.10	1957.30
Total assets	320.10	1957.30
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	232.43	606.93
Outflow, local	232.43	606.93
Surplus (deficit)	0.00	0.00
Inflow, foreign	87.67	1350.37
Outflow, foreign	87.67	1350.37
Surplus (deficit)	0.00	0.00
Net cashflow	-320.10	-1957.30
Cumulated net cashflow	-320.10	-2277.40

COMFAR

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	4023.29	3692.50	3692.50	3692.50	3692.50	3692.50
Financial resources	330.79	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3692.50	3692.50	3692.50	3692.50	3692.50	3692.50
Total cash outflow	4786.56	3994.46	3994.46	3994.46	3994.46	4079.66
Total assets	792.10	0.00	0.00	0.00	0.00	85.20
Operating costs	3994.46	3994.46	3994.46	3994.46	3994.46	3994.46
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-763.28	-301.96	-301.96	-301.96	-301.96	-387.16
Cumulated cash balance	-763.28	-1065.24	-1367.20	-1669.16	-1971.12	-2358.28
Inflow, local	4017.32	3692.50	3692.50	3692.50	3692.50	3692.50
Outflow, local	4703.05	3922.88	3922.88	3922.88	3922.88	3963.68
Surplus (deficit)	-685.73	-230.38	-230.38	-230.38	-230.38	-271.18
Inflow, foreign	5.97	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	83.51	71.58	71.58	71.58	71.58	115.98
Surplus (deficit)	-77.54	-71.58	-71.58	-71.58	-71.58	-115.98
Net cashflow	-763.28	-301.96	-301.96	-301.96	-301.96	-387.16
Cumulated net cashflow	-3040.68	-3342.64	-3644.60	-3946.56	-4248.52	-4635.68

TABLE A.5 (Cont'd) ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	3692.50	3692.50	3692.50	3692.50	3692.50	3692.50
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3692.50	3692.50	3692.50	3692.50	3692.50	3692.50
Total cash outflow	4085.26	3994.46	3994.46	3994.46	4079.66	4085.26
Total assets	90.80	0.00	0.00	0.00	85.20	90.80
Operating costs	3994.46	3994.46	3994.46	3994.46	3994.46	3994.46
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-392.76	-301.96	-301.96	-301.96	-387.16	-392.76
Cumulated cash balance	-2751.04	-3053.00	-3354.96	-3656.92	-4044.08	-4436.84
Inflow, local	3692.50	3692.50	3692.50	3692.50	3692.50	3692.50
Outflow, local	3984.08	3922.88	3922.88	3922.88	3963.68	3984.08
Surplus (deficit)	-291.58	-230.38	-230.38	-230.38	-271.18	-291.58
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	101.18	71.58	71.58	71.58	115.98	101.18
Surplus (deficit)	-101.18	-71.58	-71.58	-71.58	-115.98	-101.18
Net cashflow	-392.76	301.96	-301.96	-301.96	-387.16	-392.76
Cumulated net cashflow	-5028.44	-5330.40	-5632.36	-5934.32	-6321.48	-6714.24

Castor Oil Plant --- Financial Analysis - July 1988

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	3692.50	3692.50	3692.50
Financial resources	0.00	0.00	0.00
Sales, net of tax	3692.50	3692.50	3692.50
Total cash outflow	3994.46	3994.46	3994.46
Total assets	0.00	0.00	0.00
Operating costs	3994.46	3994.46	3994.46
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	-301.96	-301.96	-301.96
Cumulated cash balance	-4738.80	-5040.76	-5342.72
Inflow, local	3692.50	3692.50	3692.50
Outflow, local	3922.88	3922.88	3922.88
Surplus (deficit)	-230.38	-230.38	-230.38
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	71.58	71.58	71.58
Surplus (deficit)	-71.58	-71.58	-71.58
Net cashflow	-301.96	-301.96	-301.96
Cumulated net cashflow	-7016.20	-7318.16	-7620.12

COMFAR

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:
- Net present value .... -5549.23 at 10.00 %
- Internal Rate of Return (IRRE1) .. not found

b) Net Worth versus Net cash return:
- Net present value .... -4596.76 at 10.00 %
- Internal Rate of Return (IRRE2) .. -36.09 %

c) Internal Rate of Return on total investment:
- Net present value .... -4596.76 at 10.00 %
- Internal Rate of Return (IRR) .. -36.09 %

Net Worth = Equity paid plus reserves

TABLE A.6 .... COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	3692.50	3692.50	3692.50	3692.50	3692.50
Less: variable costs, incl. sales tax.	3575.99	3575.99	3575.99	3575.99	3575.99
Variable margin	116.51	116.51	116.51	116.51	116.51
As % of total sales	3.16	3.16	3.16	3.16	3.16
Non-variable costs, incl. depreciation	673.00	673.00	673.00	673.00	673.00
Operational margin	-556.49	-556.49	-556.49	-556.49	-556.49
As % of total sales	-15.07	-15.07	-15.07	-15.07	-15.07
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-556.49	-556.49	-556.49	-556.49	-556.49
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-556.49	-556.49	-556.49	-556.49	-556.49
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-556.49	-556.49	-556.49	-556.49	-556.49
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-556.49	-556.49	-556.49	-556.49	-556.49
Accumulated undistributed profit	-556.49	-1112.98	-1669.47	-2225.96	-2782.45
Gross profit, % of total sales	-15.07	-15.07	-15.07	-15.07	-15.07
Net profit, % of total sales	-15.07	-15.07	-15.07	-15.07	-15.07
ROE, Net profit, % of equity	-24.44	-24.44	-24.44	-24.44	-24.44
ROI, Net profit+interest, % of invest.	-20.32	-20.32	-20.32	-20.32	-20.32

Castor Oil Plant --- Financial Analysis - July 1988

TABLE A.6 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	3692.50	3692.50	3692.50	3692.50	3692.50
Less: variable costs, incl. sales tax.	3575.99	3575.99	3575.99	3575.99	3575.99
Variable margin	116.51	116.51	116.51	116.51	116.51
As % of total sales	3.16	3.16	3.16	3.16	3.16
Non-variable costs, incl. depreciation	591.72	608.76	626.92	626.92	626.92
Operational margin	-475.21	-492.25	-510.41	-510.41	-510.41
As % of total sales	-12.87	-13.33	-13.82	-13.82	-13.82
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-475.21	-492.25	-510.41	-510.41	-510.41
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-475.21	-492.25	-510.41	-510.41	-510.41
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-475.21	-492.25	-510.41	-510.41	-510.41
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-475.21	-492.25	-510.41	-510.41	-510.41
Accumulated undistributed profit	-3257.66	-3749.91	-4260.32	-4770.73	-5281.14
Gross profit, % of total sales	-12.87	-13.33	-13.82	-13.82	-13.82
Net profit, % of total sales	-12.87	-13.33	-13.82	-13.82	-13.82
ROE, Net profit, % of equity	-20.87	-21.61	-22.41	-22.41	-22.41
ROI, Net profit+interest, % of invest.	-16.83	-16.89	-17.51	-17.51	-17.51

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	3692.50	3692.50	3692.50	3692.50	3692.50
Less: variable costs, incl. sales tax.	3575.99	3575.99	3575.99	3575.99	3575.99
Variable margin	116.51	116.51	116.51	116.51	116.51
As % of total sales	3.16	3.16	3.16	3.16	3.16
Non-variable costs, incl. depreciation	467.52	467.52	467.52	467.52	467.52
Operational margin	-351.01	-351.01	-351.01	-351.01	-351.01
As % of total sales	-9.51	-9.51	-9.51	-9.51	-9.51
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-351.01	-351.01	-351.01	-351.01	-351.01
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-351.01	-351.01	-351.01	-351.01	-351.01
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-351.01	-351.01	-351.01	-351.01	-351.01
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-351.01	-351.01	-351.01	-351.01	-351.01
Accumulated undistributed profit	-5632.15	-5983.16	-6334.17	-6685.18	-7036.19
Gross profit, % of total sales	-9.51	-9.51	-9.51	-9.51	-9.51
Net profit, % of total sales	-9.51	-9.51	-9.51	-9.51	-9.51
ROE, Net profit, % of equity	-15.41	-15.41	-15.41	-15.41	-15.41
ROI, Net profit+interest, % of invest.	-11.70	-11.36	-11.36	-11.36	-11.36

COMFAR

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	320.10	2277.40
Fixed assets, net of depreciation	0.00	320.10
Construction in progress	320.10	1957.30
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	320.10	2277.40
Equity capital	320.10	2277.40
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	3371.46	3673.42	3975.38	4277.34	4579.30	4966.46
Fixed assets, net of depreciation	2022.87	1768.34	1513.81	1259.28	1004.75	831.50
Construction in progress	0.00	0.00	0.00	0.00	0.00	85.20
Current assets	775.68	775.68	775.68	775.68	775.68	775.68
Cash, bank	16.42	16.42	16.42	16.42	16.42	16.42
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	0.00	556.49	1112.98	1669.47	2225.96	2782.45
Loss	556.49	556.49	556.49	556.49	556.49	475.21
Total liabilities	3371.46	3673.42	3975.38	4277.34	4579.30	4966.46
Equity capital	2277.40	2277.40	2277.40	2277.40	2277.40	2277.40
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	330.79	330.79	330.79	330.79	330.79	330.79
Bank overdraft, finance required	763.28	1065.24	1367.20	1669.16	1971.11	2358.28
Total debt	1094.06	1396.02	1697.98	1999.94	2301.90	2689.06
Equity, % of liabilities	67.55	62.00	57.29	53.24	49.73	45.86

Castor Oil Plant --- Financial Analysis - July 1986

TABLE A.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	5359.22	5661.18	5963.14	6265.10	6652.26	7045.02
Fixed assets, net of depreciation	726.41	608.76	400.31	191.86	142.81	178.96
Construction in progress	90.80	0.00	0.00	0.00	85.20	90.80
Current assets	775.68	775.68	775.68	775.68	775.68	775.68
Cash, bank	16.42	16.42	16.42	16.42	16.42	16.42
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	3257.66	3749.91	4260.32	4770.73	5281.14	5632.15
Loss	492.25	510.41	510.41	510.41	351.01	351.01
Total liabilities	5359.22	5661.18	5963.14	6265.10	6652.26	7045.02
Equity capital	2277.40	2277.40	2277.40	2277.40	2277.40	2277.40
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	330.79	330.79	330.79	330.79	330.79	330.79
Bank overdraft, finance required.	2751.04	3052.99	3354.95	3656.91	4044.07	4436.83
Total debt	3081.82	3383.78	3685.74	3987.70	4374.86	4767.62
Equity, % of liabilities	42.49	40.23	38.19	36.35	34.23	32.33

Castor Oil Plant --- Financial Analysis - July 1988

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	7346.98	7648.94	7950.90
Fixed assets, net of depreciation	220.71	171.66	122.61
Construction in progress	0.00	0.00	0.00
Current assets	775.68	775.68	775.68
Cash, bank	16.42	16.42	16.42
Cash surplus, finance available	0.00	0.00	0.00
Loss carried forward	5983.16	6334.17	6685.18
Loss	351.01	351.01	351.01
Total liabilities	7346.98	7648.94	7950.90
Equity capital	2277.40	2277.40	2277.40
Reserves, retained profit	0.00	0.00	0.00
Profit	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00
Current liabilities	330.79	330.79	330.79
Bank overdraft, finance required.	4738.79	5040.75	5342.71
Total debt	5069.58	5371.54	5673.50
Equity, % of liabilities	31.00	29.77	28.64

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	249.76	1787.21
Financial resources .	249.76	1787.21
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	249.76	1787.21
Total assets	249.76	1787.21
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	162.09	436.84
Outflow, local	162.09	436.84
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	87.67	1350.37
Outflow, foreign . . .	87.67	1350.37
Surplus (deficit) .	0.00	0.00
Net cashflow	-249.76	-1787.21
Cumulated net cashflow	-249.76	-2036.97

TABLE A.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	3811.01	3562.50	3562.50	3562.50	3562.50	3562.50
Financial resources .	248.51	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	3562.50	3562.50	3562.50	3562.50	3562.50	3562.50
Total cash outflow . .	3595.74	3000.83	3000.83	3000.83	3000.83	3063.59
Total assets	594.91	0.00	0.00	0.00	0.00	62.76
Operating costs . . .	3000.83	3000.83	3000.83	3000.83	3000.83	3000.83
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	215.27	561.67	561.67	561.67	561.67	498.91
Cumulated cash balance	215.27	776.94	1338.61	1900.28	2461.95	2960.86
Inflow, local	3805.04	3562.50	3562.50	3562.50	3562.50	3562.50
Outflow, local	3512.23	2929.25	2929.25	2929.25	2929.25	2947.61
Surplus (deficit) .	292.81	633.25	633.25	633.25	633.25	614.89
Inflow, foreign . . .	5.97	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	83.51	71.58	71.58	71.58	71.58	115.98
Surplus (deficit) .	-77.54	-71.58	-71.58	-71.58	-71.58	-115.98
Net cashflow	215.27	561.67	561.67	561.67	561.67	498.91
Cumulated net cashflow	-1821.70	-1260.03	-698.36	-136.69	424.98	923.89

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	3562.50	3562.50	3562.50	3562.50	3562.50	3562.50
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	3562.50	3562.50	3562.50	3562.50	3562.50	3562.50
Total cash outflow	3057.97	3000.83	3000.83	3000.83	3063.59	3057.97
Total assets	57.14	0.00	0.00	0.00	62.76	57.14
Operating costs	3000.83	3000.83	3000.83	3000.83	3000.83	3000.83
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	504.53	561.67	561.67	561.67	498.91	504.53
Cumulated cash balance	3465.39	4027.06	4588.73	5150.40	5649.31	6153.84
Inflow, local	3562.50	3562.50	3562.50	3562.50	3562.50	3562.50
Outflow, local	2956.79	2929.25	2929.25	2929.25	2947.61	2956.79
Surplus (deficit)	605.71	633.25	633.25	633.25	614.89	605.71
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	101.18	71.58	71.58	71.58	115.98	101.18
Surplus (deficit)	-101.18	-71.58	-71.58	-71.58	-115.98	-101.18
Net cashflow	504.53	561.67	561.67	561.67	498.91	504.53
Cumulated net cashflow	1428.42	1990.09	2551.76	3113.43	3612.34	4116.87

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	3562.50	3562.50	3562.50
Financial resources	0.00	0.00	0.00
Sales, net of tax	3562.50	3562.50	3562.50
Total cash outflow	3000.83	3000.83	3000.83
Total assets	0.00	0.00	0.00
Operating costs	3000.83	3000.83	3000.83
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	561.67	561.67	561.67
Cumulated cash balance	6715.51	7277.18	7838.85
Inflow, local	3562.50	3562.50	3562.50
Outflow, local	2929.25	2929.25	2929.25
Surplus (deficit)	633.25	633.25	633.25
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	71.58	71.58	71.58
Surplus (deficit)	-71.58	-71.58	-71.58
Net cashflow	561.67	561.67	561.67
Cumulated net cashflow	4678.54	5240.21	5801.88

TABLE A.8 (Cont'd)

- M64 -

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	2009.24	at	10.00 %
Internal Rate of Return (IRRE1) ..	25.88 %		

b) Net Worth versus Net cash return:

Net present value	2117.24	at	10.00 %
Internal Rate of Return (IRRE2) ..	23.04 %		

c) Internal Rate of Return on total investment:

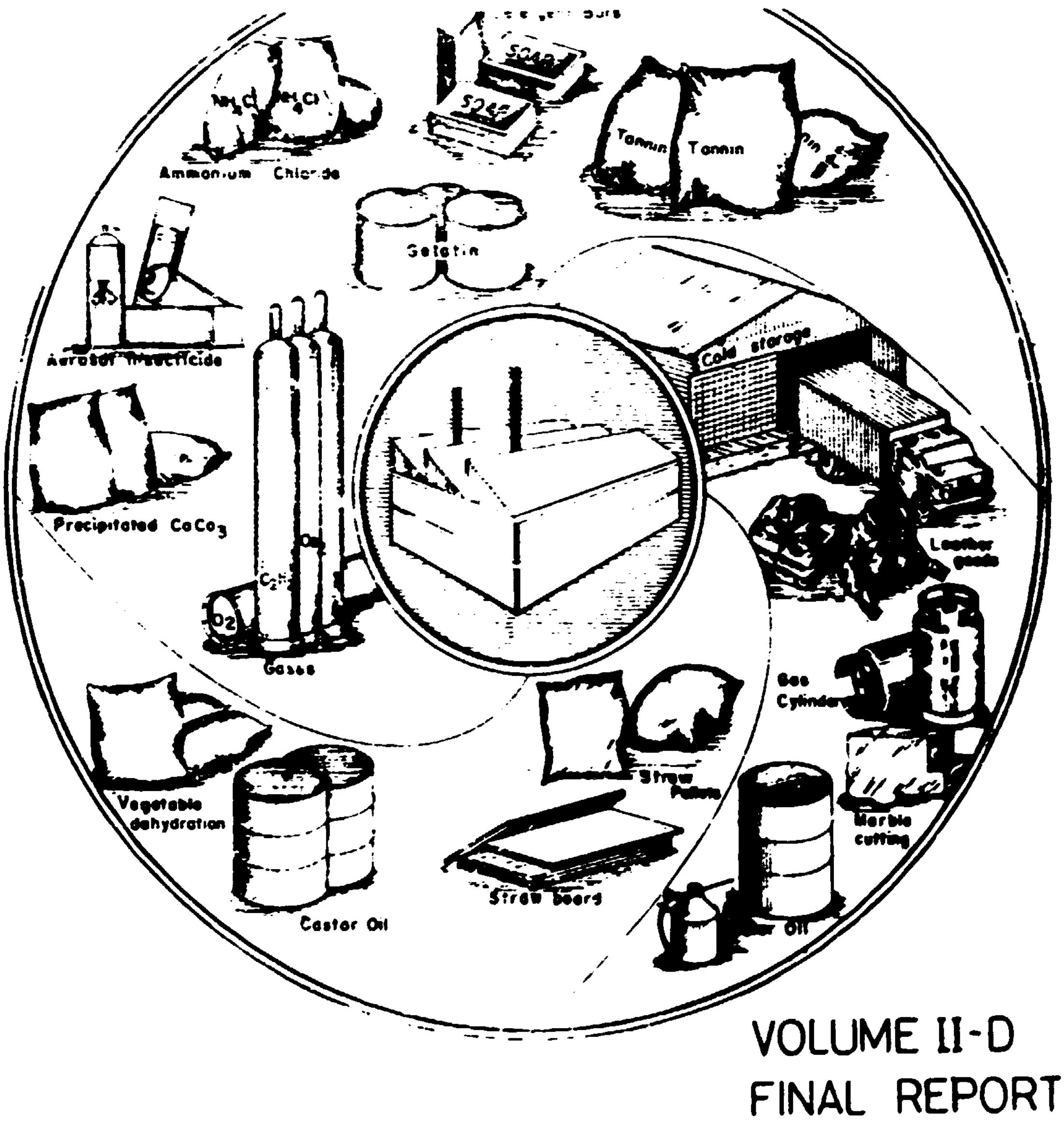
Net present value	2117.24	at	10.00 %
Internal Rate of Return (IRR) ..	23.04 %		

Net Worth = Equity paid plus reserves

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

17160 (5 of 5)



VOLUME II-D
FINAL REPORT

የኢንዱስትሪ ፕሮጀክቶች አገልግሎት
INDUSTRIAL PROJECTS SERVICE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

DEVELOPMENT OF A PORTFOLIO OF INDUSTRIAL OPPORTUNITY STUDIES FOR EXISTING INDUSTRIES IN ETHIOPIA

VOLUME II - D

AUGUST 1988

INDUSTRIAL PROJECTS SERVICE

PROJECT NUMBER 001/40 - 79

TABLE OF CONTENTS

VOLUME I

- N -

COLD STORAGE

TABLE OF CONTENTS

I. SUMMARY

The role played by cold storage units in the production, handling and distribution of perishable food products like meat, fish, vegetables and fruits in particular is quite significant.

Public firms like the Ethiopian Livestock Development and Meat Corporation (ELDMCO), the Fish Production and Marketing Corporation, and the Horticulture Development Corporation that are directly associated with the production and distribution of above mentioned food products, already have or plan to have cold storage units of their own at various production and distribution centres. Hence, demand for commercially operated cold storage plants capable of providing storage services on hire is practically non-existent.

However, without disputing the findings of the market study, this profile attempts to provide technical and financial information on three arbitrarily selected cold storage plants for possible installation at Assab, Masawa and Bahr Dar. They have storage capacities of 11,000, 1920 and 720 tons, respectivley.

The Assab plant, with an initial fixed investment of Birr 7.82 million out of which Birr 3.8 million (49%) is in foreign currency, a net working capital of Birr 19.37 million and an annual operating cost of Birr 1.94 million, has financial and economic rates of returns amounting to 6.78% and 7.86%, respectively.

The remaining cold storage plants intended for Massawa and Bahr Dar are more likely to result in much lower rates of returns because of their high operating costs and relatively lower storage capacities.

II. INTRODUCTION

In many developing countries including Ethiopia, numerous studies indicate that quite a considerable amount of perishable foods like meat, fish, vegetables and fruits is wasted annually due to lack of modern preservation techniques and facilities.

Bacteria, yeast and molds, that feed and grow on these food items are the main causes of the spoilage. Their effect is nowadays arrested through the use of cold storage units that provide low temperature storage conditions unfavourable for the existence and reproduction of these destructive agents.

The country has the biggest animal stock in Africa. The Red Sea cost, Lake Tana and the Rift Valley Lakes provide highly potential fishing grounds for fish production. Its climate and soils are also quite favourable for the production of various types of fruits and vegetables. However, non of these resources has so far been exploited effectivley.

Quite a considerable effort is being made by the public sector through three corporations, namely the Ethiopian Livestock Development and Meat Corporation (ELDMCO), the Fish Production and Marketing Corporation and the Horticulture Development Corporation. They are fully responsible for the production and marketing of meat, fish, vegetables and fruits. These firms have already launched various projects including the setting up of cold storage units at various production and distribution centres. Studies are also underway to investigate the export potential of these food products.

Apart from minimizing the spoilage of valuable food items like meat, fish, vegetables and fruits at various production, processing and marketing centres, cold storage units also create favourable conditions for improving the nutritional habits of the population. Their contribution towards the country's economic development through generating additional income for farmers and fishermen, as well as earning foreign currency through export is quite significant.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

The general application of any type of storage is to match production with consumption. The specific purpose of a cold storage is mainly to preserve perishable products, such as meat, egg, fish, vegetables, etc. until they are needed for consumption. Cold storages may also be required for intermediate stages in the production process of some products. Thus cold storage services are integral parts of the production and marketing aspects of many products. Within this context two types of storage facilities can be distinguished. The first is to equalize seasonal production with the pattern of demand. The other is to facilitate the smooth operation of the production and marketing processes.

Most agricultural products are seasonal but their demand is almost evenly distributed throughout a year. Such a situation accentuates the need for storage facilities. But in markets where the demand for fresh products outstrips their supply, which is the case in most developing countries including Ethiopia, the need for cold storage facilities will be minimal.

The type, size and location of cold storage facilities are determined by a number of factors; the most important ones include:

- The type of product to be stored;
- The volume of the production and sales and their rate of turnover;
- The temperature and humidity of the storage facilities;

- Proximity of the production source to the final market area, e.g. export or domestic market;
- Seasonality of the production;
- Supply and demand gap, and
- Availability of transportation services.

The compatibility of the different types of products to be stored also determines the size and number of cold rooms to be maintained.

The importance of cold storage facilities in developing countries, especially where abundant food resources exist, is apparent from the substantial percentage of the food products which are wasted due to lack of modern preservation techniques. The estimate of the wastage ranges from 20% to 30% of the total agricultural food production.

A cold storage or refrigeration unit works on the principle of inhibiting the growth of bacteria, yeast and molds which are the main causes for food deterioration. At low temperatures the growth of these agents of food destroyers is generally retarded. The specific level of temperature at which food deterioration is inhibited varies from product to product. Nevertheless, to stop totally the developments of these agents, the temperature should be in the range of -12°C, or lower, which is the temperature level for frozen products.

Cold storages can be used for chilled or frozen products. A chill room temperature is a low temperature but not low enough to cause freezing. In most cases, the minimum temperature level of chill rooms is taken to be 0°C. The recommended temperature level, however, varies from product to product. The temperature of cold storage facilities for frozen products ranges from 18°C to -30°C. The storage life of chilled products is short, often measured in days or weeks, but frozen products can be stored for more than two years in some cases.

Cold storage facilities may be required at different stages in the production process and during the period of consumption, namely:

- At farm sites to store harvested products;
- At industrial locations to store raw inputs, and semi-processed and finished products;
- At shipping ports for export or import;
- During transportation (trucks, ships, planes, rail wagons);
- At distribution points (wholesale and retail stores), and
- At consumption points (hotels, restaurants, and homes).

The above storage facilities can be 'captive' or commercially operated. Captive cold storages are those owned and operated by a firm for its own use. Such storage facilities will not be available to others for rent. Most cold storage facilities fall under this category. Commercially operated cold storage facilities, on the other hand, are available in an open market on a rental basis to anyone who wants the service. Such cold storage facilities are mainly required at distribution centres and shipping points. In the case of commercially operated cold storages, the normal practice is to sell 'space and temperature' on a time basis. Most developed countries have tariffs for freezing and for chill storage.

In this profile, the opportunity of establishing the latter type of cold storage service facilities is considered. As a project idea, cold storage facilities in Ethiopia have been identified for the meat, fish, and vegetable and fruit sectors.

2. Demand and Supply

a. Meat Sector

The meat supply sources in Ethiopia can be grouped as follows:

- Individual household slaughtering;
- Village butchers;
- Commercially licensed private butchers, and
- Public abattoirs and meat processing industries.

The first two sources account for a substantial share of the meat consumed in the country. Virtually all the sheep slaughtering for domestic consumption is done at individual household levels. Village butchers, on the other hand, slaughter bovine animals, specially during holidays, and sell the meat to household consumers. These two sources, will not be part of the market for cold storage facilities.

Licensed private commercial butchers, mainly found in cities and big towns, buy the animals which are slaughtered at publicly controlled abattoirs. The butchers pay fees and transport charges to the abattoirs. Most of these butchers have no cold storage facilities since they receive their supply on a day to-day basis.

The Addis Ababa Abattoir , for example, supplies to the butchers in the city immediately after the animals are slaughtered, requiring no cold storage facilities, although it has now two deep freezers with a combined capacity of $100m^3$ and a chiller with a capacity of 45 m^3. In the coming three years, it has a plan to increase its deep freezer capacity by an additional 800 m^3. It has also long term plan to enter the meat retail market by opening its own meat distribution shops.

This would require installation of cold storage facilities at the abattoir and at the market centres. Thus no additional market for commercially operated cold storage facilities is needed for this sub-sector of the meat industry.

The public meat processing industry in the country consists of six meat processing factories, an abattoir , and a livestock development and marketing enterprise which are all controlled and administered by the Ethiopian Livestock Development and Meat Corporation (ELDMCO). The meat processing factories now produce processed meat which requires cold storage facilities only at the production centres but not at the distribution points.

ELDMCO is now constructing cold storage facilities for some of its enterprises (See Table I). The corporation also has plans to expand substantially its cold storage capacities as shown in Table II.

The current quantity of raw meat sold by the corporation is very small; in 1985/86, it was below 700 tons. The raw meat is mainly intended for export to the Middle East by air; each shipment consists of about 35 tons. The cold storage facility at Bole Airport, whose capacity is estimated to be 200 tons, is more than adequate for the present frequency and volume of shipment.

The Corporation does not export frozen or chilled meat through the sea ports of the country. There have been, however, enquiries from importers, especially from Egypt, for supply of a substantial quantity of frozen meat. The corporation could not give quotations to the enquiries for a number

TABLE I

FREEZING AND COLD STORAGE FACILITIES OF MEAT PROCESSING FACTORIES UNDER ETHIOPIAN LIVESTOCK DEVELOPMENT AND MEAT CORPORATION

Name of Plant	Location	Existing Freezer Capacity	Existing Cold Store Capacity	Cold Stores Under Construction
Sopral Asmara	Asmara	-	400 Tons	
Encode "	"	9 Tons	30 "	
Sopral Combolcha	Combolcha	6 "	120 "	
Dire Dawa Meat Factory	Dire Dawa	-	250 "	
Eth. Livestock Dev't Co.	Malgue Wondo	12 Tons	120 "	
Eth. Meat Concentrate	Addis Abeba	-	40 "	
Debre Zeit Abattoir	Debre Zeit	-	6 "	240 Tons
Gondar Meat Factory	Gondar	-	-	120 Tons
Bole Airport Cold Store	Addis Abeba	-	120 "	

SOURCE: Ethiopian Livestock Development and Meat Corporation (ELDMCO).

TABLE II

COLD STORE FACILITIES CONSTRUCTION PLAN

BY ETHIOPIAN LIVESTOCK DEVELOPMENT AND MEAT CORPORATION

Name of Plant	Type and Purpose of Cold Storage	Capacity (M^3)
Dire Dawa Meat, Processing Factory	Precooling beef carcasses (2 rooms)	1200
	Preserving beef carcasses (1 room)	945
	freezing meat (1 room)	310
	Preserving frozen meat (1 room)	1370
Sopral Combolcha	Precooling beef carcasses (2 rooms)	940
	Preserving " " (1 room)	392
	Preserving meat (2 rooms)	900
	Preserving meat (2 rooms)	280
Malgue Wondo	Precooling beef carcasses (3 rooms)	1455
	Preserving " " (1 room)	1320
	Freezing room	705
	Cold stores	1265

SOURCE: ELDMCO

of reasons, of which lack of any appropriate cold storage facility is one. Although it has no programme now to export meat through sea ports, it plans to send a team of experts to target markets, mainly Middle Eastern and European countries, to undertake market studies and to determine the volume and quality requirement of the markets. It may also be necessary to investigate the implication of the market study results on the supply of live animals. Presently Ethiopia exports a substantial number of live animals to the Middle East countries.

It would thus be unrealistic, at this stage, to make any estimate of the size and type of cold storage facilities to be required at export ports such as Assab. Not only would it be necessary to estimate the anticipated annual export volume but also the frequency of shipment should be known to determine the capacity of the cold storage to be constructed. However, ELDMCO officials estimate the holding capacity of the storage for frozen meat to range from 1000 tons to 2000 tons if the meat export is found to be viable.

b. Fish Sector

Commercial fishing is now carried out by fishermen cooperatives; the marketing and distribution being undertaken by a public corporation - the Fish Production and Marketing Corporation. The present level of the fish catch in the country is very small as can be seen in Table III. The highest amount of fish distributed by the corporation was reported to be 1342 tons in 1982/83. The reason for such a low level of sales is mainly because fish does not form part of the regular diet of the population. Fish is mainly consumed in Ethiopia in cities and towns and mainly during the fasting period. Nevertheless consumption of fish as a regular diet needs to be promoted for its high dietry value in terms of protein content, and it can greatly contribute in helping to alleviate the food shortage in the country

TABLE III
FISH CATCH DISTRIBUTED
BY FISH PRODUCTION AND MARKETING CORPORATION
(QUINTALS)

Site of Catch	1979/80			1980/81			1981/82			1982/83			1983/84			1984/85			1985/86		
	Qty.	Price	Value	Qty.	Price	Value	Qty.	Price	Value	Qty.	Price	Value	Qty.	Price	Value	Qty.	Price	Value	Qty.	Price	Value
Lake Abbaya and Chamo	779	175	138,328	733	175	128,275	851	175	143,925	957	175	167,475	733	175	128,275	775	175	132,125	3125	175	581,875
Lake Awassa							2213	35	77,455	2220	35	77,700	1172	35	41,020	2853	35	99,855	3954	35	138,390
Lake Langano	3862	40	154,480	2103	45	94,635	1150	45	51,750	1255	45	56,475	2932	45	131,940	2697	45	12,1365	1865	4[illegible]	173,9[illegible]
Lake Zeway	3509	50	175,450	8178	55	449,790	7128	55	392,040	7242	55	398,310	5731	55	315,205	943	55	51,865	.	.	.
Lake Koka	629	55	34,595	28	55	1,540													.	.	.
Inland Total	8779		500,850	11,042		674,240	11,342		670,170	11,674		699,960	10568		616,440	7248		40,5210	11144		494,1[illegible]
Assab	384	175	48,000	796	150	119,400	1,142	150	171,300	750	150	112,500	248	150	37,200	167	150	25,050	60	150	9,[illegible]
Massawa	598	180	107,640	1,018	220	223,960	915	220	201,300	990	220	217,800	1,180	220	259,600	1,410	220	310,200	846	220	186,[illegible]
Marine Total	982		155,640	1,814		143,360	2,057		372,600	1,740		330,300	1,428		296,800	1,577		335,250	906		195,1[illegible]
Grand Total	9761		656,490	12,856		1,017,600	13,199		1,042,770	13,414		1,030,260	11,996		913,240	8,825		740,460	17050		1,089,1[illegible]

SOURCE: Fish Production and Marketing Corporation.

Commercial fishing is now carried out in the Red Sea area and in the Rift Valley Lakes. The highest fish catch recorded is at Zewai, 818 tons in 1980/81. In recent years, however, fishing from this lake has declined substantially. The highest annual catch from the other sources were Abbaya and Chamo, 333 tons; Awassa, 395 tons; Langano, 387 tons; Koka 63 tons; Assab, 114 tons; and Massawa, 141 tons. These figures indicate that commercial fishing in Ethiopia is still in its infant stage.

The Fish Prodution and Marketing Corporation has now cold storage facilities in Addis Ababa, Arba Minch, Zewai and Asmara (See Table IV). These facilities are considered adequate for the present level of the fish catch and distribution. The corporation has also a plan to construct new cold storage facilities at Assab and Massawa to serve anticipated increase in production in these regions. The other projects of the corporation include the following:

- A marine fish marketing development project at Assab;
- Massawa and Dahlak Islands fishery resources development;
- Inland fishery resources development and marine fishery resources study, and
- Fish farming development project at Assab.

The implementation of the above projects will depend on the results of the projects under study, and these studies are expected to consider additional cold storage requirements.

The situation in the fish sector as has been described in the preceding paragraphs shows that there is no apparent need for additional cold storage facilities other than those planned by the Corporation.

TABLE IV

COLD STORE FACILITIES

FISH PRODUCTION AND MARKETING CORPORATION

Location	Types	Temperature Level	Capacity (each)		Number of Facilities
			Tons	M³	
A. Existing	Chillers (shops)	0-(+5)°C	2	8	10
Addis Ababa	Chiller (store)	0-(+5)°C	10	42	1
	Cold storage	- 20°C	50	147	2
	Blast Freezers	- 35°C	10	42	4
	Flake ice machine	-	4/24 hrs	-	1
Zeway	Chillers	0-(+5)°C	10	42	2
	Flake ice machine	-	4/24 hrs	-	2
Arba Minch	Cold store	-20°C	10	42	1
B. Future Plan					
Assab	Cold store	-20°C	10	42	1
	Block ice machine	-	4/24 hrs	-	1

SOURCE: Fish Production and Marketing Corporation.

c. Fruit and Vegetable Sector

The cultivation of fruits and vegetables for commercial purposes is undertaken mainly by state and cooperative farms. The planned and actual production of these products from 1978/79 to 1983/84 is shown in Table V. The highest yearly volume of the production was about 15,600 tons for vegetables and 33,600 tons for fruits in 1981/82 and 1982/83, respectively. State farms account for 94% to 100% of the fruit cultivation during the two years whereas their share for vegetables during the same period ranged between 41% and 71%. Part of the produce is exported to neighbouring countries, mainly to Djibouti. The annual export of vegetables and fruits from 1976 to 1984 is given in Table VI. About 90% and 95% of the export in 1983 and 1984 was to Djibouti.

The nature of these products requires cold storage facilities. The Horticultural Development Corporation, which cultivates and markets vegetables and fruits, has cold storage facilities in the following areas:

Addis ababa:

- Cold storage with a 900 m^3 capacity
- New cold storage with 2500 m^3 capacity

Dire Dawa:

- 2500 m^3 capacity (Being installed)

Debre Zeit: about 300 m^3

Zewai: about 300 m^3

TABLE V

PRODUCTION OF FRUITS AND VEGETABLES

1978/79 - 1983/84

(TONS)

Year of Production By Source	Vegetables planned	Vegetables actual	Vegetables %	Fruits Planned	Fruits Actual	Fruits %	Total Planned	Total Actual	Total %
1978/79 Total	14150	2490	18	19700	8880	45	33850	11370	34
1979/80 Total	13450	4520	34	22760	22540	99	36210	27060	75
1980/81 Total	19293	6543	34	22760	19091	84	42053	25634	61
State Farms	13450	4620		22760	19090		36210	23710	
Cooperatives	5843	1923					5843	1923	
1981/82 Total	64400	15552	24		19478			35030	
State Farms	38629	6360			19030			25390	
Cooperatives	25779	9099			448			9547	
Settlement		93						93	
1982/83 Total	65570	13140	20	27308	20506	75	92878	33646	37
State Farms	34410	7550		26010	19210		60420	26760	
Cooperatives	26277	5590		1104	386		27381	5976	
Settlements	4883			194	910		5077	910	
1983/84 Total	53710			23720			77430		
State Farms	27500			22810			50310		
Cooperatives	26210			910			27120		

SOURCE: Annual Plan, NRDC.

TABLE VI

EXPORTS OF VEGETABLES AND FRUITS

1976 - 1984

YEAR	QUANTITY (TONS)
1976	20091
1977	11031
1978	4420
1979	3911
1980	8739
1981	8143
1982	7780
1983	8655
1984	10863

SOURCE: External Trade Statistics

The corporation has also a fleet of 30 refrigerated vehicles which transport the product from farm areas to storage or distribution centres or shipping points. These vehicles are reported to be under-utilized.

The corporation has been considering installation of cold storage facilities of about 2500 m^3 capacity each at Assab, Dire Dawa, Nura Era, and at two locations in Addis Ababa (Bole Airport and near the old cold storage).

One of those envisaged for Addis Ababa (near the old cold store) has already been installed with the planned capacity of 2500 m^3. The existing capacity in Addis Ababa is to be more than adequate for the present level of operation in the area. In fact there is an excess capacity which can be used for future expansion by the Corporation. The one planned at the Bole Airport has been shelved for it is not deemed necessary, at least in the short run. Vegetables are now transported by cold storage vans and loaded directly on planes.

The cold storage facilities at Dire Dawa (2500 m^3) which is being installed would adequately meet the present and future demand in the area.

The cold storage facility to be installed at Nura Era, has been scaled down to a level equivalent to that of Debre Zeit. The demand for vegetables and fruits far outstrips their supply, requiring a very short storage time, which in turn does not require large cold storage facilities at production sites.

The construction of cold storage facilities at Assab has also been delayed, for the need is not yet apparent. Originally, the envisaged cold storage was to serve the export shipment, mainly to the Middle East. However, subsequent investigation of the target markets did not indicate any potential export to these countries. The corporation has thus no concrete plan to export vegetables and fruits through Assab.

Since data on the present and future production and sales as well as the rate of turnover at different locations is not available, it is very difficult to give a quantitative estimate of the cold storage facilities for vegetables and fruits at those locations. However, a comparison of the existing and planned cold storage facilities with the present level of production of vegetables and fruits indicates that there will be an excess capacity of storage facilities in the short run. For instance, the combined new capacities of the cold storages at Addis Ababa and Dire Dawa (5000 m^3) can handle about 45000 tons of vegetables and fruits annually taking an average storage life of 15 days, a space requirement of 450 kgs. per m^3, and 300 operating days in a year. The storage space requirement for vegetables and fruits is estimated to range from 300 kgs to 600 kgs per m^3 depending on the specific type of product to be stored.

B. PLANT CAPACITY

The market study, as discussed in the previous section, indicates that there is no apparent additional need now and in the near future for commercial cold storage facilities to serve the meat, fish, and vegetable and fruit sectors. Since the requirement for cold storage facilities is a derived demand, the future demand will depend on the growth of the production, consumption and export of these products. Since the sectors are in the process of being examined, their future prospects, the support services, including cold storage facilities, they may need, cannot be estimated at this time.

However, to provide a general technical and financial information on cold storage facilities, different capacities at three locations were considered in this profile (See Table VII). It is assumed that these units may be needed at the three locations in the near future.

The storage volumes at Massawa and Bahr Dar are very small. A large western supermarket may have facilities of this size. That of Assab on the other hand is quite significant.

TABLE VII
PROPOSED COLD STORAGE FACILITIES
AT ASSAB, MASSAWA AND BAHR DAR

Description	Assab Port	Massawa Port	Bahr Dar
Blast freezer for fish (-35°C)	5 tpd	3 tpd	2.5 tpd
Cold store for frozen meat (-20°C)	2000 t	-	20 t
Cold store for fish (-20°C)	30 t	20 t	10 t
Chill room for packed meat (0°C)	500 t	-	100 t
Chill room for fish (0°C)	20 t	10 t	10 t
Flake ice maker	5 tpd	5 tpd	4 tpd

The total annual storage capacity of each of the three plants considered to be installed at Assab, Massawa and Bahr Dar is estimated at 11,000, 1920 and 720 tons of meat and fish, respectively (See Table VIII).

The stores are assumed to operate for 40 and 48 weeks annually as shown in Table VIII. The remaining 12 and 4 weeks are for major repairs and maintenance.

The chargeable tonnage for the plants has been calculated assuming that 80% of the actual useful volume will be utilized during each rotation. The blast freezers are taken as auxillary facilities supporting the overall cold storage service; hence they cannot be charged independently.

The chargeable annual storage capacities of the Assab, Massawa and Bahr Dar units are 8,800, 1536 and 576 tonnes, respectively. Service charges should be based on the quantity of product stored during each rotational period.

TABLE VIII

PROPOSED STORAGE CAPACITY OF COLD STORE UNITS

(TONS)

DESCRIPTION	ASSAB				MASSAWA				BAHR DAR			
	Storage Capacity (Nominal)	Duration of Rotation (Weeks)	Annual Capacity (Nominal)	Annual Chargeable Capacity	Storage Capacity (Nominal)	Duration of Rotation (Weeks)	Annual Capacity (Nominal)	Annual Chargeable Capacity	Storage Capacity (Nominal)	Duration of Rotation (Weeks)	Annual Capacity (Nominal)	Annual Chargeable Capacity
Blast freezer for fish (-35°C)	5 tpd				2.5 tpd				3 tpd			
Cold store for forzen meat(-20°C)	200	10	8,000	6,400	200	10	960	768	-	-	-	-
Cold store for fish (-20°C)	30	2	600	480	10	2	240	192	20	2	480	384
Chill room for packed meat(0°C)	500	10	2,000	1,600	100	10	480	384	-	-	-	-
Chill room for fish (0°C)	20	2	400	320	10	2	240	192	10	2	240	192
TOTAL	-	-	11,000	8,800	-	-	1,920	1,536	-	-	720	576

NOTE:

1. The Assab unit is assumed to be in operation for 40 weeks annually.
2. The Massawa and Bahr Dar units will operate for 48 weeks annually.
3. The annual chargeable capacity was calculated by assuming that 80% of the useful volume, which is 60% of the gross volume, will be utilized during each rotation.
4. The blast freezer is an auxillary facility, hence cannot be charged independently.

IV. MATERIALS AND INPUTS

A. MATERIALS

A cold storage plant does not require raw material inputs. However refrigerants and insulants may be required for repair and maintenance.

Ammonia and Halocarbons are the two types of refrigerants most commonly used in cold storage units. Ammonia is the cheapest fluid, but it is inflammable and toxic. Halocarbons mostly R12, R22 and R502 (FREON is their commercial name) are the most widely used types because they are odorless, inflammable and very suitable for all types of refigeration equipment. To avoid accidental introduction of oil or moisture into the system, and to eliminate leakage, the motor compressor assembly should be contained in an enclosure. Since all plants leak freon gas to some extent, a sufficient amount of gas has to be kept in stock as an allowance for leakage. The annual requirement is estimated to cost about Birr 124,200 for Assab (See Table IX).

Pre-fabricated panels consisting of polystyrene foam with a thermal conductivity of about 0.03 W/°C are used as insulating walls. Local insulants of vegetable origin (cork, sawdust, cereal husks, etc.) or mineral (rock wool) may be used, but then their thermal conductivity is almost twice as much as polystyrene foam and the thickness of the insulants has to be doubled. Moreover due to their hygroscopicity, they are quickly filled with water or ice and their efficiency is significantly reduced. Although they are comparatively cheap, local insulants should be used with prudence, even for repair.

TABLE IX
ANNUAL MATERIALS AND INPUTS REQUIREMENT

Description	BAHR DAR		MASSAWA		A S S A B	
	Qty.	Cost (Birr)	Qty.	Cost (Birr)	Qty.	Cost (Birr)
Electric power (kWh)*	184,800	40,656	619,520	136,290	2,428,600	534,290
Water (m^3)	6,023	3,012	9,490	4,745	9,745	4,873
Freon Gas		27,600		38,810	-	124,200
Pallets and general consumables		2,760		5,520	-	41,400
Maintenance materi-als and spares		4,343		20,872	-	82,800
Sub-total		78,371		206,237	-	787,473

NOTE: * The kWh quantities represent peak requirements.

B. UTILITIES

1. Electricity

Electric power is the major utility item required in the operation of cold storage plants, absorbing a significant portion of the operating cost. The electric power demand of the various equipment at unit in Assab is given in Table X. For the remaining two units the total power requirements are given on Table IX. Sufficient power is available at Assab, Bahr Dar and Massawa to satisfy the peak-demands of the cold storage units.

Consumption of electricity is considerably reduced by allowing very little "cold" to escape through walls and doors by:

- installing vapour barriers carefully put in place;
- strictly limiting the time during which doors are opened;
- maintaining and servicing doors, gaskets, screens and other equipment;
- carefully operating and controlling temperatures, and
- adopting some form of protective device such as pliable plastic tunnels for loading and unloading transport vehicles.

2. Water

Water is another utility item essential in cold storage plants. It is used mainly for ice formation, drinking, washing, and sanitation purposes. It has to be of potable quality. (See Table IX for the annual consumption and cost).

TABLE X
ELECTRIC POWER REQUIREMENT
(ASSAB PORT)

Equipment Description	Installed Power (kW)	Operation Time Hrs/Day	Total Annual Requirement ('000.kWh)
Meat Chiller	80	8	179.2
Meat Blast Freezer	180	20	1,008.0
Meat Cold Store	150	24	1,008.0
Fish Blast Freezer	45	5	63.0
Fish Cold store	10	24	67.2
Ice Machine	20	8	44.8
Other uses	10	16	58.4
Sub-Total			2,428.6

V. LOCATION AND SITE

A. LOCATION

As indicated under the chapter on Market and Plant Capacity, the cold storage plants are envisaged to be installed at Assab, Massawa and Bahr Dar. This is mainly because of their high potential for fish production. Assab is also an important outlet for meat and other products.

B. SITE

The sites of the cold storage units should be very near to main roads, and to sources of clean water and electric power. The ground should be well drained, preferably level and of good mechanical resistance. The space should be adequate to cover not only the cold store but also the office, package store, transformer house, roads, parking areas and an open space for future expansion.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. General Description

Preservation of nutritious but perishable foods, such as meat, fish, poultry and vegetables, has always been important to mankind. It is also essential to maintain the quality of these food items during storage as well as at times of distribution and marketing. Freezing and storing at low temperatures are the cheapest method of maintaining the qualities of these food items.

In the market study it was recommended that small scale cold storage facilities should be installed at Assab, Massawa and Bahr Dar. The storage volumes specified for Massawa and Lake Tana are very small. They can use simple technology and require standard equipment which can be imported readily and installed without any difficulty.

The volume of the cold storage specified for Assab is quite significant (about 2200 tons per rotation). It is intended mainly for meat and fish. It has facilities for cold storage (divided into partitions), blast freezing and ice-making, all serviced by a centralized refrigeration system. These are described in detail in the engineering section.

All the proposed cold storage plants are intended to provide cold storage services i.e. to sell 'space and temperature' on a time basis to potential customers. The services should also guarantee the maximum possible quality, safety and nutritional value of the stored food items which in turn depend on the design of the building, insulating material, machinery and equipment, operating temperature and humidity, odor control, storage methods and handling facilities employed. Otherwise all the careful production and quality control methods that the producer has used could easily be lost before the product is delivered to the final consumer.

2. Types of Products Cold Stored

Meat, Fish, poultry and perishable vegetables are the major product types that require provision of public cold storage facilities. As has been discussed earlier in the market study, meat and fish are the most potential food items requiring cold storage facilities at Assab, Bahr Dar and Massawa.

(a) Meat

The most effective means of preserving meat is by means of a freezer storage whose main function is the inhibition of growth of various types of micro-organisms and enzymatic activities that cause spoilage.

The optimum low temperature at which meat is stored with minimum quality changes is 0°F (-18°C). The allowable storage life of frozen meat at this temperature is about six months. (See Table XI). After six months, minor quality changes, particularly in flavour, are likely to occur. Although there is a possibility of extending the storage life at much lower temperatures, the cost of maintaining these temperatures is quite high and may not be warranted by the resulting increase in value attributed to quality improvements.

Drip and autoxidation are the two most serious problems that take place in fresh, cured, cooked meat and meat products that are freeze - stored. Drip can be minimized by freezing caracasses immediately after slaughter. On the autoxidation of lipids that causes off-flavours on the other hand, little can be done because it is caused by the availability of and contact with oxygen.

Nowadays it is quite common to sell frozen beef in packed form as 'boxed beef'. This provides reduced freezing time, greater storage density, lower handling and transportation costs, and an extended shelf life.

TABLE XI
STORAGE LIFE OF FROZEN MEAT
(MONTHS)

Meat Type	Storage Temperature (°F)			
	10	0	-10	-20
Beef*	4	6	12	12
Lamb	3	6	12	12
Veal	3	4	8	12
Pork**	2	4	8	10

* Diced products have shorter storage life.

** Cured products such as ham and bacon can be stored for a few weeks only.

SOURCE: Fundamentals of Food freezing, Norman W. Desrosier and Donald K. Tressler, 1977.

(b) Fish

Spoilage of fish is caused by the action of enzymes naturally present in the body of the fish or secreted by psychrophilic or cold loving bacteria. Spoilage commences soon after catch and death.

To arrest this spoilage or postmortem change, the product is chilled using ice immediately after catch and gutting. Proper icing can store the quality for 7 to 15 days, depending on the species. Flake ice is preferred to crushed block ice for it does not cause rupture of the fish. This can be explained by its relatively high melting rate due to increased surface area. It is common practice to use one volume of ice for every three volumes of frozen fish.

Long-term preservation of fish either for further processing or direct consumption in thawed and packed form is effected through freezing and cold storage. The quality of both types of products mainly depends on temperature, humidity and shelf life. A temprature of (-23) — (-18)°C, a relative humidity of 90% and a shelf-life of 2-3 months are generally recommended.

A maximum storage life can be achieved by glazing frozen fish prior to packaging, using moisture-vapour-resistant packaging materials, fitting package tightly around product, freezing fish immediately after packaging and storing at -20°C or lower temperatures. Refrigerated carriers for fish should have a temperature of -18°C.

Freezing times vary according to packaging but the following times are given as an indication:

. 25 mm thick package fillets: 2.5 hours

. 50 mm thick packaged fillets: 5.0 hours

. 38 mm thick packaged fish sticks: 2.5 hours

The composition of a particular species of fish affects its frozen storage life. Fish with high oil content (e.g. salmon, tuna, mackerel and herring), have comparatively short frozen storage life because of the development of rancidity as a result of the oxidation of the oils and pigments in the flesh.

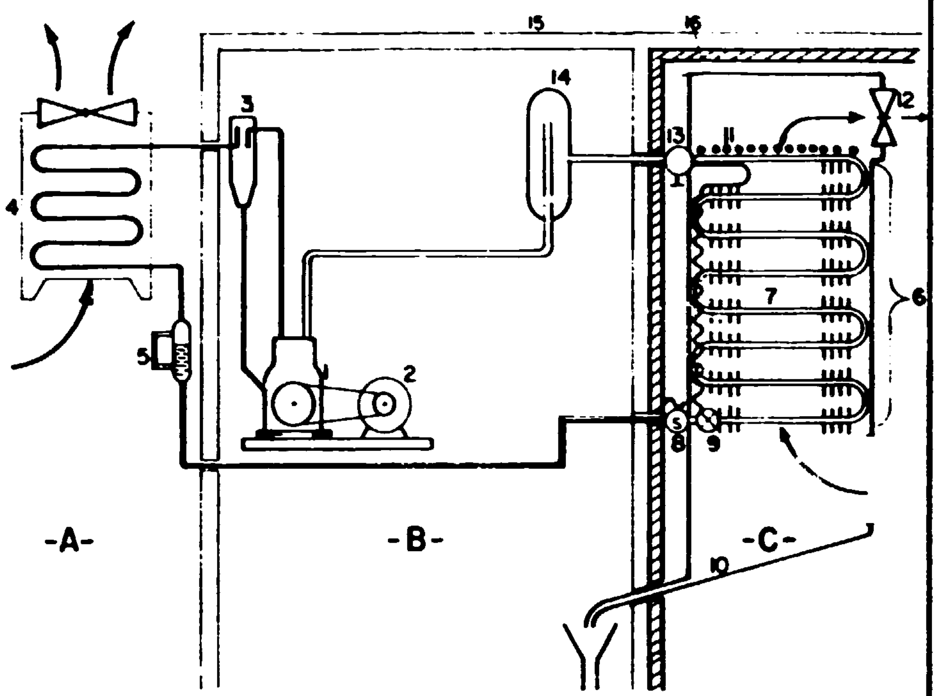
3. Refrigeration Systems for Cold storage

There are two types of refrigeration systems commonly in use. They are the direct expansion and the brine systems. In brine systems, a brine is cooled by contact with the evaporator surface, and the cooled brine goes to the space which is to be refrigerated. In direct expansion systems, the evaporator is placed in the space to be cooled.

The direct expansion system is more attractive and recommended for the envisaged cold storage plants because it requires 40% to 60% less surface, and utilizes better controls and newer piping methods. A sketch describing this system is given in Figure I.

FIGURE I

SKETCH OF A REFRIGERATION SYSTEM



A. External ambient into which the heat is rejected

B. Machine room

C. Cold room (in which the heat is absorbed)

1. Compressor
2. Motor
3. Oil trap
4. Air Condenser
5. Liquid receiver
6. Air cooler
7. Evaporator
8. Solenoid valve
9. Thermostatic expansion valve
10. Gutter for evacuating defrost water
11. Water spray
12. Fans
13. Constant pressure valve
14. Liquid anti-slugging device
15. Insulation
16. Wall

4. Cold Storage Buildings

Two types of building designs are commonly in use for cold storage plants. They are referred to as internally insulated (envelop) and externally insulated wall type designs. (See Figure IV).

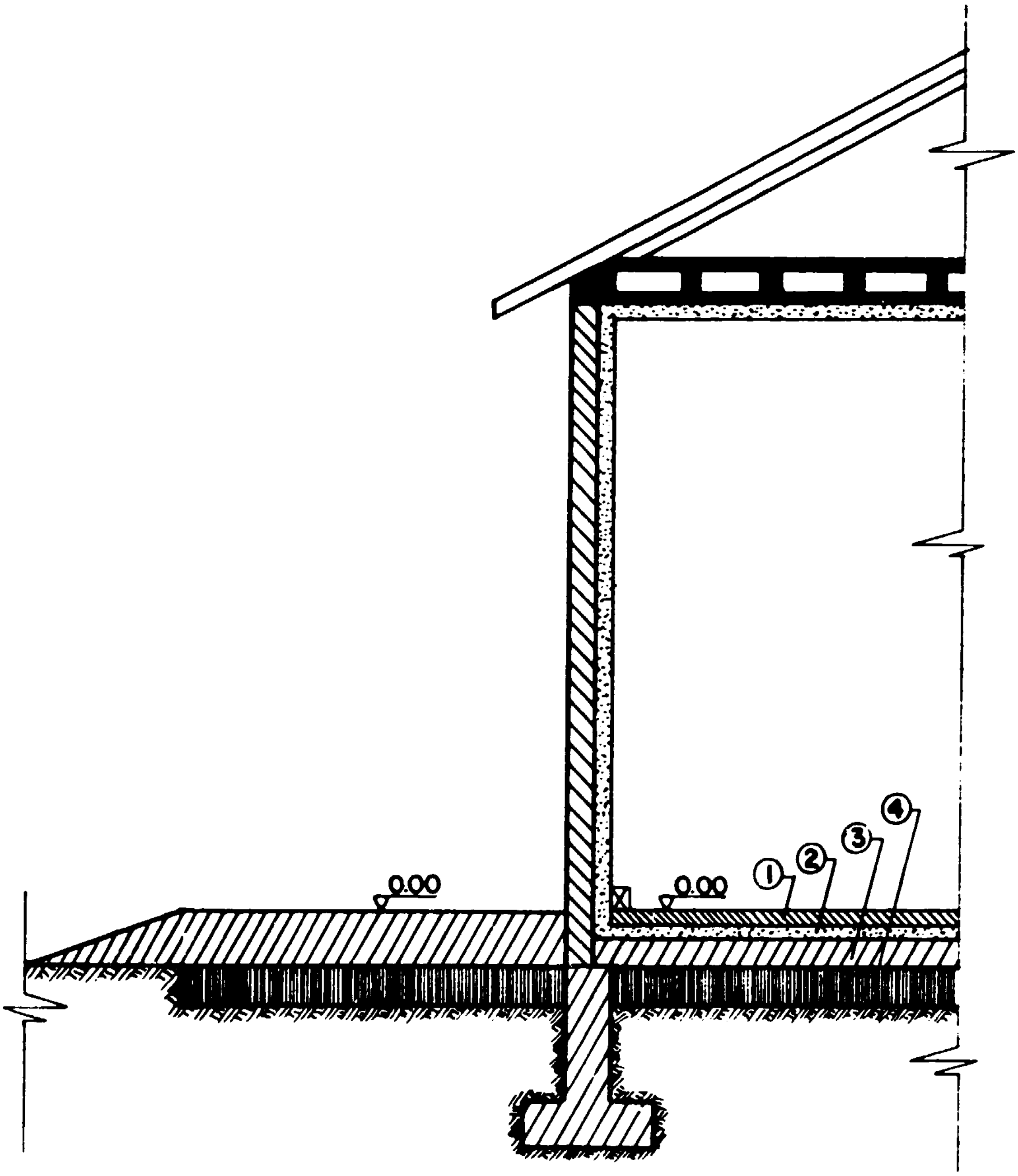
The envelop wall type cold storage building is a completely insulated structure within independent walls of the exterior enclosing structure. The outer walls are constructed independently of the interior insulated envelop package. A continuous heavy vapour seal is placed between the outer wall and the insulating package.

The externally insulated type of warehouse design differs from the envelop wall type in that all the floors and ceilings become an integral part of the supporting side walls. This makes it essential to supplement the insulation of all outside junctures, floors and ceilings in their relation to the side walls to prevent excessive heat leakage.

The envelop wall type design is the most preferred one because of its simplicity, ease of maintenance and low investment cost. It is recommended specifically for single floor cold storage plants. (See Appendix A for further details on cold storage building design requirements). The two types of cold store buildings constructed at level ground and on guard space are shown in Figures II and III.

FIGURE I

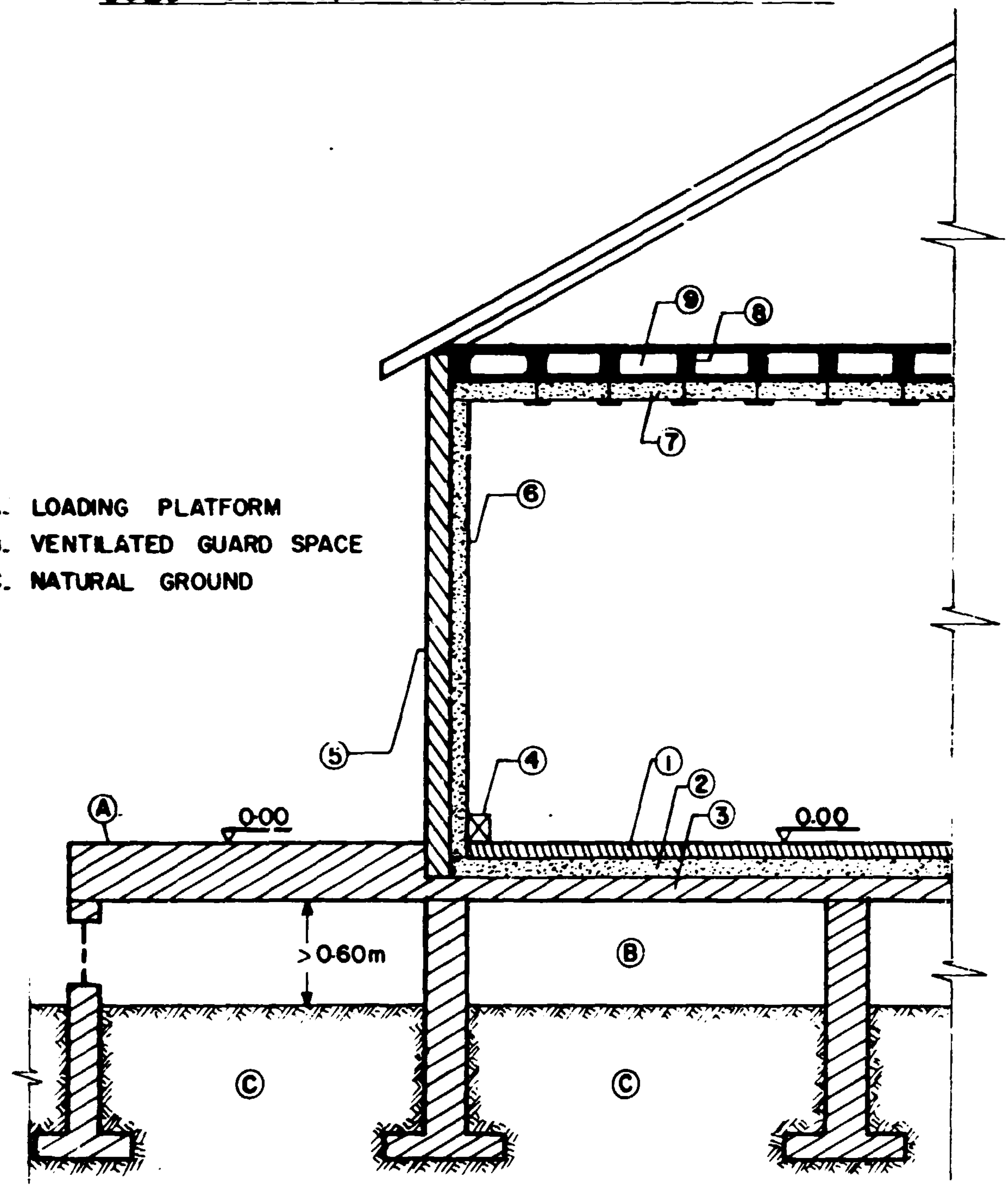
COLD STORAGE BUILT ON LEVEL GROUND



1. Rolling surface floor slab
2. Insulation
3. Concrete base
4. Rough-casting in broken stone

FIGURE II

COLD STORAGE BUILT ON GUARD SPACE



1. Rolling surface floor slab
2. Insulation
3. Reinforced concrete support slab
4. Protective peripheral plinth
5. Supporting wall
6. Insulation
7. Suspended insulating ceiling
8. Insulated rafter
9. Framework ties

B. ENGINEERING

1. Plant Description

The plant description given below refers to the cold storage plant envisaged to be installed at Assab port. The basic principle applies to the Bahr Dar and Massawa cold storage plants but their capacities are quite small.

The cold storage plant envisaged for Assab consists of four major sections:

- Refrigerating machinery section,
- Cold storage section,
- Freezer section, and
- Ice-making section.

a. Refrigerating Machinery Section

The refrigeration system employed is of the direct expansion type and operates on the basic science of a refrigeration cycle. The major machinery and equipment required are a compressor, evaporator (refrigeration coils) and condensor. All the equipment, except the evaporator, are installed in a separate room referred to as a machine room. The air-cooled direct expansion coils with blower units are installed in the cold room itself.

A reciprocating type compressor compresses Freon gas which condenses and then flows into the refrigeration coils where it evaporates and as a consequence immediately cools the surrounding air. Circulation of the cooled air is effected by blowers. The compression results in a temperature increase in the Freon and the compressed gas is then condensed in an air cooled condenser located outside the cold room.

The engine room should be located very close to the cold room to minimize the length of insulated piping for refrigerant circulation.

b. Cold Storage Section

This section consists of cold rooms separated by partitions to contain various types of cold stored products.

The walls are essentially from thick polystyrene panels which can be purchased ready made at metre wide and full height of the store. The inner and outer skins of the panels are usually made of galvanized and/or organic (plastic) coated thin steel sheets. The panels may be tongued and grooved to ensure correct joining and sealing. The thickness of the insulation is between 150 and 200 mms. Freezers have thicker walls than cold rooms or chill rooms.

It is essential that no moisture is allowed to enter the wall structure. Therefore the metal strips covering the joints are usually vapour sealed with thick adhesive tape or other non-setting compounds. Moisture which does enter the walls freezes later and opens the joints.

Cold store rooms are supported on a light steel structure. Often, the rooms are suspended within an outer steel structure, the wall panels and the roof being attached to the framework with the use of lugs fixed on to the outer panel skin. The whole room is subject to thermal movement, and this should be taken into account in the fixing and design.

The temperture of the ground beneath the cold room must not fall below freezing. If it does, the ground expands and the room structure becomes distorted. The floor is therefore electrically heated and layered in the following manner:

<u>Top</u> . Cold room floor - 100 mm screed
. Styrofoam insulation - 125 mm
. Cement screed - 50 mm
. Electric heater mat

<u>Bottom</u> . De-stoned ground surface

The power requirement of the electric heater mat is minimal.

c. <u>Freezer Section</u>

Food products are usually given freezing treatments to preserve their integrity, quality, and to reduce any possible physical, biological and microbiological changes that may arise during storage. This can be accomplished by using blast freezers (tunnel and continuous track types) or simple cold boxes.

Blast freezers are high thermal output units with more sophisticated designs. Hence, they are not appropriate to the low volume storage plants considered in this study. Simple cold box freezer units are quite sufficient.

The blast freezer for beef has a lengthy cycle time, 20 - 40 hours. It is suggested that for Assab three blast freezers with a capacity of 10 tonnes per cycle each, are used to allow flexibility in the freezing process while keeping loading and unloading to a single shift. For a 24 hour cycle, it is assumed that the blast freezer will operate at an air temperature of -41°C and a refrigeration load of 60 kW.

The time required for product freezing depends on the temeprature and velocity of the surrounding air, the shape of the product, the method and thermal properties of packing, and the placement of loads in the freezer. The most efficient loading and use of space in the freezer is not always compatible with the most efficient rate of freezing. Typical 27 kgs. of lean boneless meat packed in a solid cardboard carton of 152 mm thick, and freezing at an air temeprature of -40°C and a velocity of 3.05 m/s, takes about 27 hours to reach -25°C which is a normal cold storage temperature for beef.

The blast freezer for fish is able to operate one or two freezing cycles during a single day shift. Freezing time is usually about 2-5 hours. Loading and unloading will add an hour or more to that. This sizing obviously gives the freezer a much higher capacity if it is used on a 24 hour basis, although this is rarely practiced as a precaution against pilferage. Therefore, it is suggested that the blast freezer capacity is 5 tonnes.

The quick freezing of fish offers the best results for preventing bacterial spoilage. Blast freezers are commonly used instead of the less flexible plate freezing for the range of fish to be handled.

d. Ice-Making Section

Ice is mainly required for chilling or pre-cooling of fish right after catch untill its final storage. It can be made in tin cans (block ice) or with a flake ice machine. As described earlier, flake ice is more appropriate for chilling and hence the plant is equipped with a flake ice making machine.

The machine consists of a fixed drum standing vertically and containing refrigeration coils. As water trickles down the sides of the drum, it freezes into ice crust which is stacked continuously with a rake of knives and is collected in a silo. The water which does not freeze is collected at the base of the drum and recirculated.

2. Operation of Cold Storage Plants

a. Storage Capacity Determination

Capacities of cold storage plants are commonly expressed in cubic metres (m^3) of gross volume, which is equal to the useful volume increased by the volume necessary for product handling and air circulation (40%).

The useful volume is calculated on the basis of the types and quantities of products cold stored. Useful storage densities for various products are given in Appendix B.

The internal height depends on the means of handling and stacking. For the cold store at Assab, a height of 6.5 metres is recommended. The remaining cold rooms for chilling and freezing, a height of 3 m is quite sufficient, because most of the stacking can be accomplished manually.

The determination of the storage capacities of each of the cold storage units is summarized in Table XII.

b. Storage Conditions

Wide variation of temperature cannot be allowed in cold stores because it induces biochemical or physiological changes on the products. It can also cause periodic condensation of water vapour on the cold stored item which favours growth of micro-organisms. Variation in temperature can be avoided by insulating the chamber, and if the refrigerating capacity has been carefully calculated, and if the packaging and stacking of the stored products allow sufficient air circulation. The atmosphere in a cold store should have to be changed frequently to get rid of odours given off by the cold stored products.

It is essential to maintain a high relative humidity of 85% to 95% in cold rooms to avoid excessive loss of water by evaporation.

Hygienic procedures such as elimination of all waste, cleaning of pallets and storage containers, washing and disinfecting of cold stores when they are empty and immediate extermination of rats and mice, should be strictly observed.

c. Product Handling

To avoid tainting and thermal incompatibility, unpacked cold stored products should be placed in independent compartments separated by partitions.

A loading plan that takes into account the areas reserved for access to the air coolers and the thermostat, product storage, transfer of goods and air circulation should be well prepared in advance and utilized to avoid loss of usable storage space.

TABLE XII

COLD STORE SPACE REQUIREMENT

Location	Product To Be Stored	Type of Storage Facility	Storage Capacity[1] (Tons)	Average Density[2] (Kg/M^3)	Useful Volume[3] (M^3)	Gross Volume[4] (M^3)	Floor Area (M^2)
Assab							
	Frozen meat	Cold store	2000	1300	1538	10257	1578
	Packed meat	Chill room	500	1300	384.5	2561	394
	Fish	Cold store	30	800	37.5	189	63
	Fish	Chill room	20	800	25	126	42
	Fish	Freezing	10	800	12.5	63	21
Sub-Total			2560	-	1997.5	13196	2098
Massawa							
	Frozen meat	Cold store	200	1300	153.8	768	256
	Packed meat	Chill room	100	1300	76.9	384	128
	Fish	Cold store	10	800	12.5	63	21
	Fish	Chill room	10	800	12.5	63	21
	Fish	Freezing	10	800	12.5	63	21
Total for Massawa			330	-	268.2	1341	447
Bahr Dar							
	Fish	Cold store	20	800	25	126	42
	Fish	Chill room	10	800	12.5	63	21
	Fish	Freezing	10	800	12.5	63	21
Total for Bahr Dar			40	-	50	252	84

NOTE:

(1) Taken from Table VII
(2) Average typical storage densities selected from Appendix B.
(3) Obtained by dividing (1) by (2)
(4) Assumes a $3m^2$ working area for every $1m^2$ storage space for the 2000 and 500 tons capacity stores, and a $2m^2$ working area for every $1m^2$ storage space. An additional 40% space is left for air circulation
(5) The floor area is calculated by assuming a building height of 6.5m for the 2000 and 500 ton capacity stores and a 3m height for the others. The maximum stacking heights are 3.9 and 1.8 m respectively.

The nature of the cold stored products and conditions of stacking, transport etc. are the basic factors determining the type of packaging required. Caracasses of fresh meat are not wrapped. Frozen caracasses are enclosed in films of polyethylene and a cotton stockinette. Other products are generally protected against mechanical damage, soiling and contamination by a less complex package that comprises of an envelop coming in contact with the product, a packet which is the unit of sale and boxes or cartons to contain the packets. Frozen fish are usually contained in open boxes made of wood, plastic or fibreboard.

Cold stored products should be stacked in solid piles so as to maximize the storage space utilized and to allow sufficient air circulation. Stacking is highly facilitated by using pallets, hand trucks and fork-lift trucks. Platform hand trucks have a significant cost advantage over fork-lift trucks. However, when the distance between the loading platform and the storage point is quite significant, and when great stacking heights are expected, fork-lift trucks are indispensable.

To avoid desiccation and oxidation care has to be taken not to pile products against warm walls and to move in only products that are as cold or colder than the storage itself.

In order to make the best use of cold room space the "first in - first out" rule should be adhered to whenever possible.

d. Mintenance and Servicing

(1) Defrosting

The moisture content of the air in cold stores is quite high. Water vapour condenses and forms ice on the surface of evaporators. The performance of the evaporators deteriorates significantly with the thickness of ice formed on the surfaces. The ice deposits have to be removed periodically by defrosting to keep the evaporators under optimum operating conditions.

Defrosting is accomplished by supplying heat to melt the ice. The source of heat could be water, electricity or hot gas. The hot gas defrosting method is based on the use of the re-evaporated refrigerant in the form of gas to circulate through the evaporator in a reverse circuit. The iced evaporator condenses the refrigerant; and at the same time it melts the ice on its surface.

Water defrosting is only used in rooms for chilled products. Electric defrosting can be used for all types of cold stores, but it is costly. Hot gas or reverse circuit defrosting is the cheapest and most widely utilized method. The optimum frequency of defrosting is usually determined experimentally.

(2) Condenser

The condenser is another important item requiring frequent servicing and maintenance because it may become blocked resulting in a reduction in performance as a result of the rise of the condensation temperature.

Servicing the air type condenser is relatively simple and rapid. It consists of washing the battery with hose by stopping the fans. This can be done once in a month if the atmosphere is dusty. It is also necessary to purge the circuit of non-condensing gases.

(2) Compressor

The multi-cylinder reciprocating type compressor and its drive motor assembly should be mounted on a base and enclosed in a casing where they are directly visible and accessible for repair and maintenance. The compressor is also fitted with a capacity reducer to allow adjustment of the capacity to the needs of the cold store. It is advisable to have a stock of one or several pistons complete with connecting-rod bearings.

Safety and regulation devices such as pressostats and thermostates, solenoid valves, expansion valves, filters, dehydrators, pumps and fans should also be regularly checked and repaired if found to be malfunctioning.

(3) Spare Parts

It is very essential to plan and keep a considerable type and variety of spares. The most frequent and important ones are:

- Coils for solenoid valves,
- Pistons, piston rings, connecting-rod bearings and suction valves for the compressors,
- Several bottles of refrigerant fluid,

- Several complete sets of gaskets and scrapers for the doors,
- Fan motors for the air coolers.
- Electrical devices such as cut-outs, fuses, coils for contactors, etc.

The list of machinery and equipment and their corresponding costs are given in Table XIV.

3. Plant Layout

The success of a cold storage unit mainly depends on the design and construction of the building. The type of design appropriate for the envisaged plants is the envelop type. (See Fig. IV-A). For economical reasons and ease of handling and operation, all buildings should be on ground level.

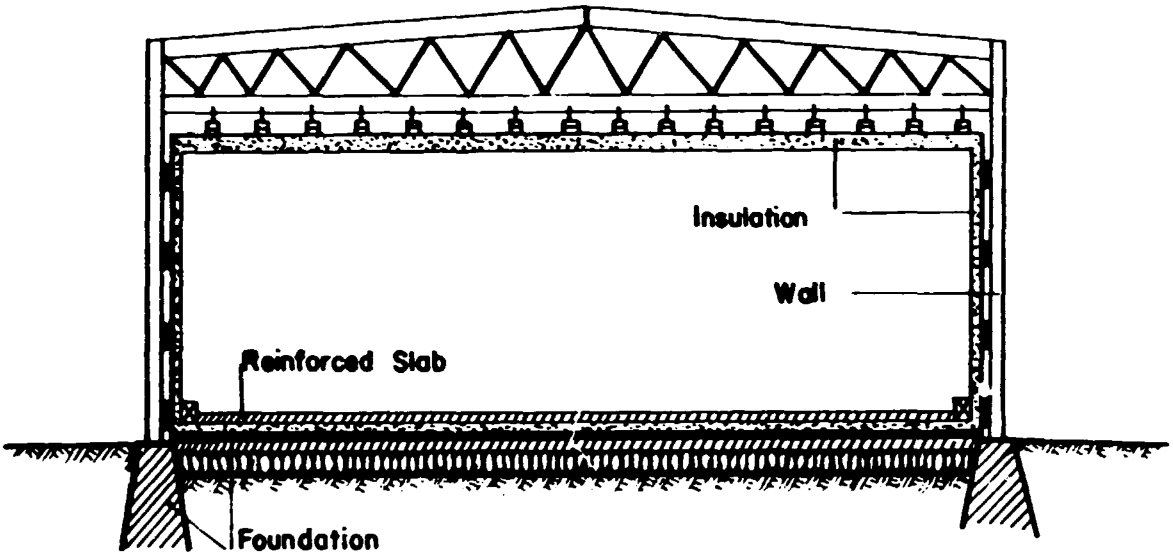
The quantity of food products to be stored at Assab is quite significant. Therefore, the height of the building should be 7-8 metres to allow stacking upto 6.5 metres. About 60% of the entire space will be occupied with frozen products, and 40% for overhead air space and for aisles. Fork-lift trucks will be essential.

The other two cold storage units at Massawa and Bahr Dar will handle a relatively lower volume of products. They should thus be low-roofed to facilitate manual handling with hand drawn pallet trucks.

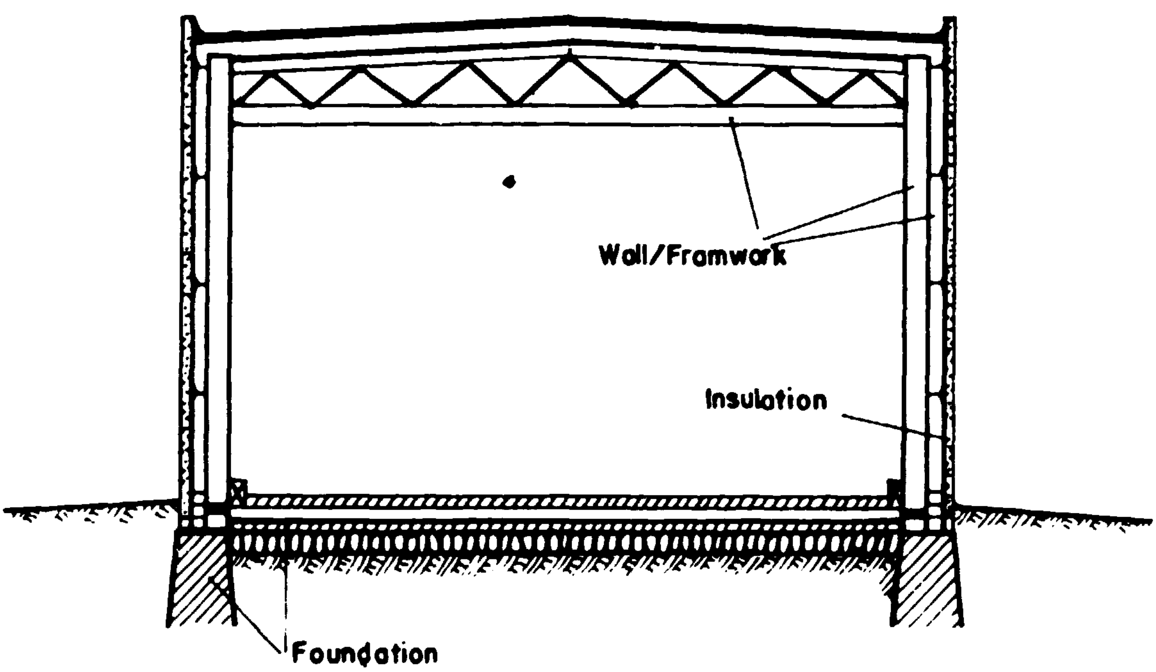
A centralised system of installation is recommended for all the units whereby the high pressure sides of the equipment (motor-compressor and condensor) as well as the associated equipment and automatic control are placed in a common room, referred to as machine room. This allows a flexible operation and an

FIGURE IV

TYPES OF COLD STORAGE BUILDING DESIGNS



A- INTERNALLY INSULATED (ENVELOP) WALL



B- EXTERNALLY INSULATED WALL

easy replacement of damaged parts. The installed power requirement is also lower. The machine room should be located as near as possible to reduce the length of piping for the refrigerant circulation.

A concrete ramp should be built for vehicles approaching the doors for loading and unloading so that their tailgates are nearly level with the cold store floor. This avoids the need for raising the building, and facilitates handling of heavy loads without having to lift to additional heights.

It is very essential to locate the office where the supervisor has a good view of the cold store doors and the loading and unloading operations. The office and other rooms should be air conditioned.

The space requirement of each cold storage unit is given in Table XIII. The layouts are also shown in Figures V, VI and VII.

FIGURE V

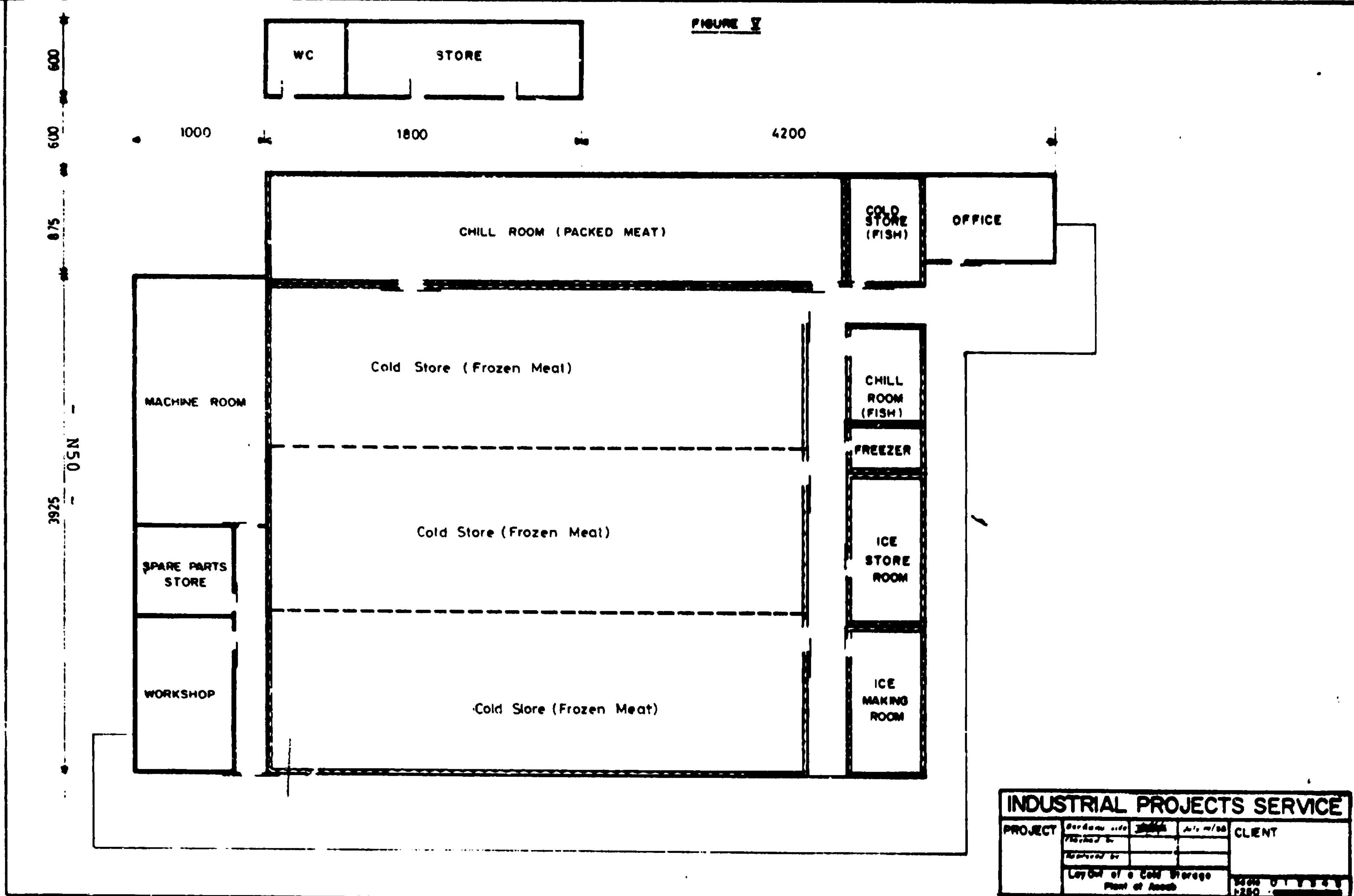
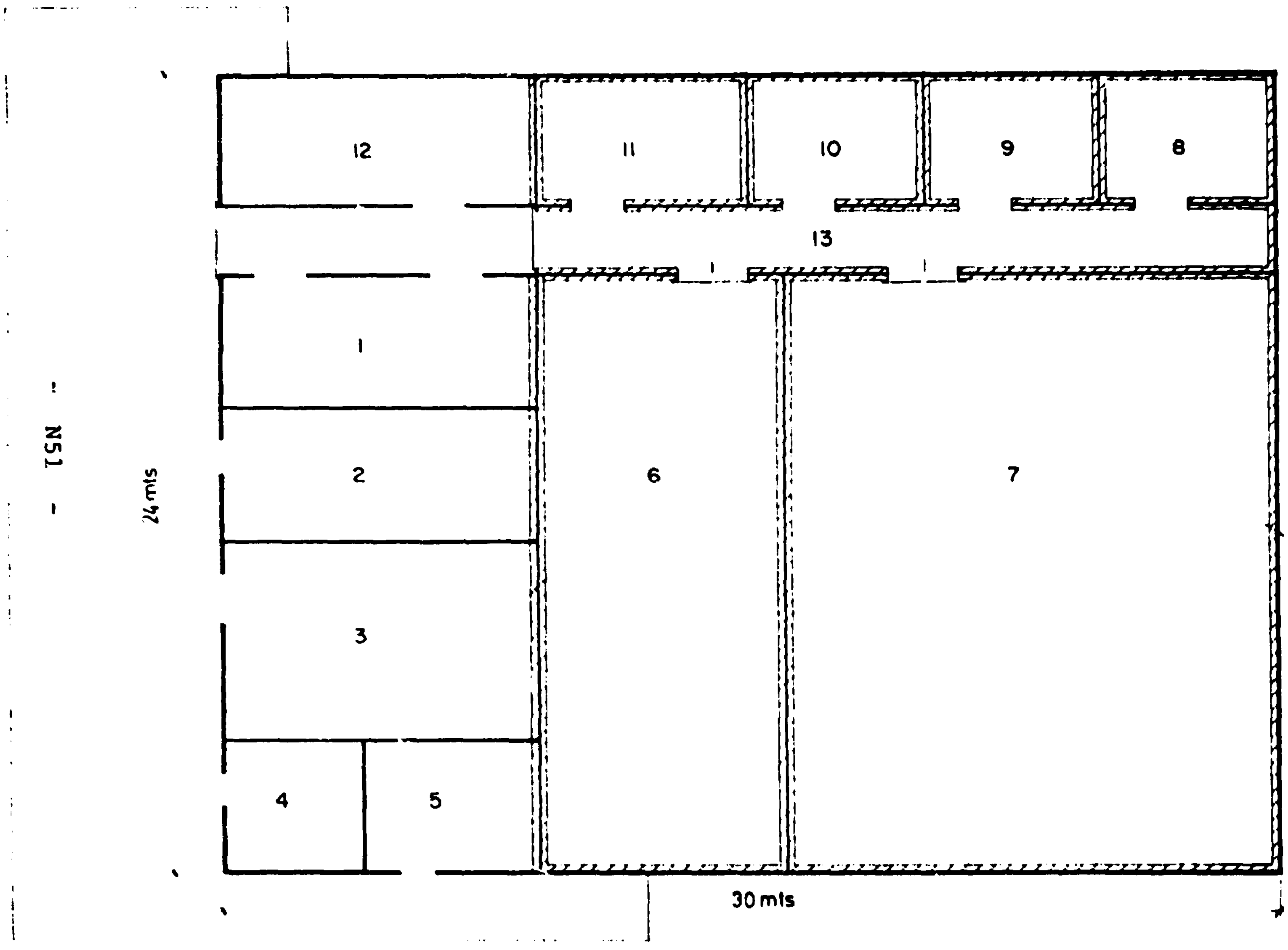

WC
STORE
1000
1800
4200
600
600
875
3925
N50
CHILL ROOM (PACKED MEAT)
COLD STORE (FISH)
OFFICE
MACHINE ROOM
Cold Store (Frozen Meat)
Cold Store (Frozen Meat)
Cold Store (Frozen Meat)
CHILL ROOM (FISH)
FREEZER
ICE STORE ROOM
ICE MAKING ROOM
SPARE PARTS STORE
WORKSHOP
INDUSTRIAL PROJECTS SERVICE
PROJECT
CLIENT

FIGURE VI

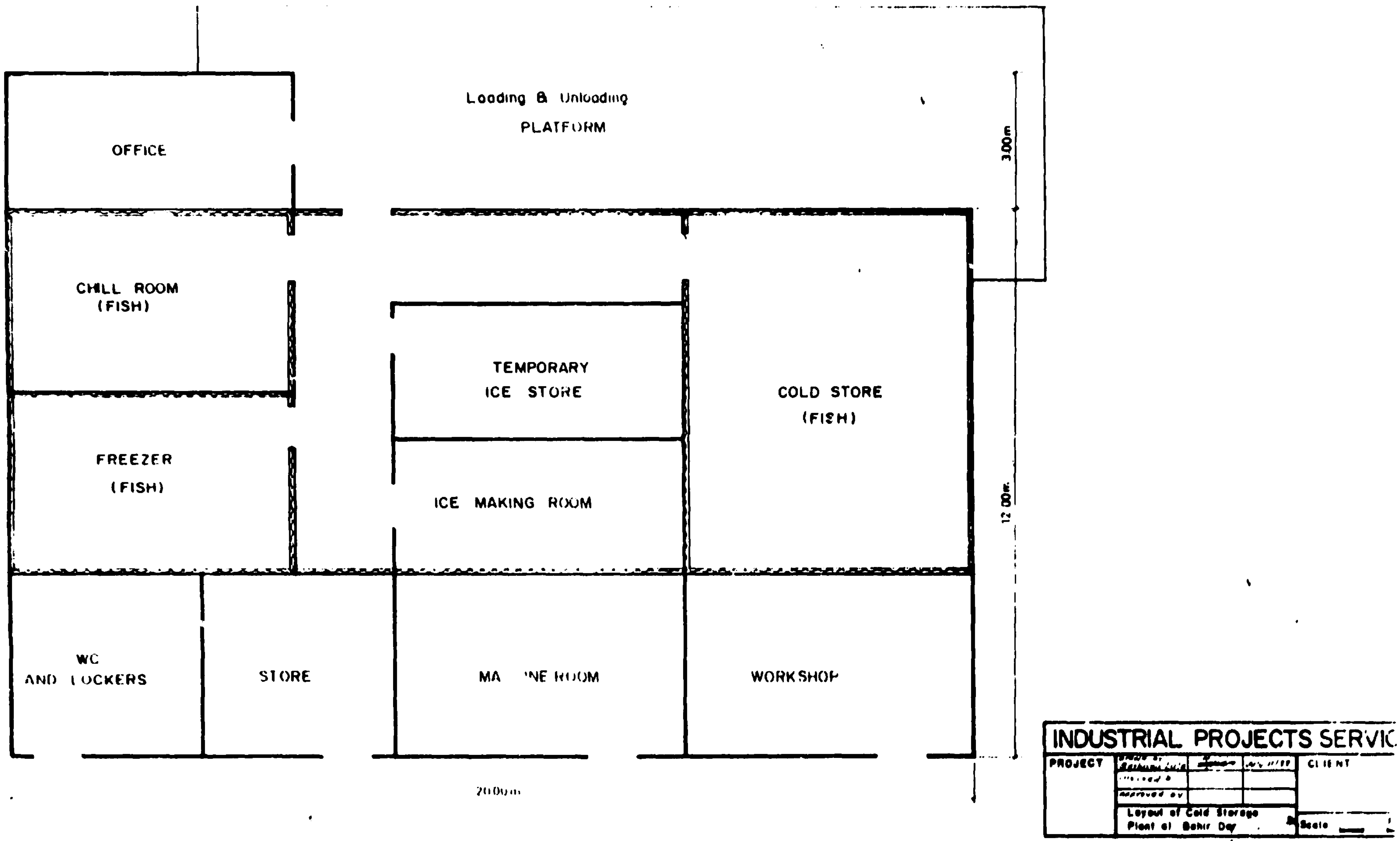


LEGEND

1- Office
2- Workshop
3- Machine Room
4- Store
5- WC & Lockers
6- Chill Room (Packed Meat)
7- Cold Store (Frozen Meat)
8- Cold Store (Fish)
9- Chill Room (Fish)
10- Freezer
11 Ice Store
12 Ice Making Shop
13 Aisle
14 Loading & Unloading Area

INDUSTRIAL PROJECTS SERVICE			
PROJECT	Drawn by		CLIENT
	Checked by		
	Approved by		
	Lay Out of a Cold Storage Plant at Massawa		Scale- 0 ... 2 mts

FIGURE VII



N52

TABLE XIII

COLD STORE SPACE REQUIREMENT

Description	Space Requirement (M²)		
	Bahr Dar	Massawa	Assab
Office	18	36	80
Cold store (fish)	48	20	60
Chill room (fish	24	20	48
Cold store (frozen meat)	-	252	1,584
Chill room (packed meat)	-	126	396
Temporary ice store	18	24	72
Ice making room	18	36	72
Freezer (fish)	24	20	24
Machine room	24	54	200
Workshop	24	36	98
Spare parts store	-	-	56
Store for miscellaneous items	16	20	108
W.C. and lockers	16	16	48
Aisle	28	60	178
Total Building space	258	720	3,024
Open space for parking and expansion	542	1,680	2,976
Total space required (Plot Size)	800 (20 x 40)	2,400 (40 x 60)	6,000 (60 x 100)

TABLE XIV

TOTAL FIXED INVESTMENT COST

Description	Cost ('000 Birr)		
	F.C.	L.C	Total
A. MACHINERY AND EQUIPMENT:			
1. Cold and chill rooms	1,138.5	-	1,138.5
2. Refrigeration	517.5	-	517.5
3. Fork lift trucks	186.3		186.3
4. Pallets and trolleys	103.5	-	103.5
5. Fittings, room equipment and spares	207.0	-	207.0
6. Foundation, insulation and heating	41.40	-	41.40
Total plant cost	2,194.20		2,194.20
Freight (10% FOB)		219.42	219.42
Total Machinery Cost (C&F)	2,194.20	219.42	2,413.62
Local Cost (12.5% C&F)	-	301.7	301.7
Total Cost of machinery and equipment (Incl.10% contingency)	2,413.62	573.23	2,986.85
B. BUILDINGS AND CIVIL WORKS:			
1. Building Cost	997.92	2,328.48	3,326.40
2. Civil works (12% of bld. cost)		399.17	399.17
Total building and civil works (incl. 10% contingency)	1,097.71	3,000.42	4,098.13
C. SERVICE EQUIPMENT:			
Office furniture and equipment	20.00	30.00	50.00
D. VEHICLES:			
Pick-up 4WD(1) (Incl. 10% contingency)	12.38	15.88	28.26
GRAND TOTAL	3,543.71	3,619.53	7,163.24

VII. ORGANIZATION AND MANPOWER

A. ORGANIZATION

The main activity of a cold storage unit is material handling, i.e. receiving incoming products to be cold stored, storing them for a period of time under prescribed temperatures and then despatching them out whenever they are required. To guide, control and supervise these activities, a plant manager with adequate experience and exposure to cold storage technology is very essential. He should also be responsible for the overall administration of the cold storage plant. Handling of goods within the stores, repair and maintenance activities are directly handled by the store's head and the refrigeration engineer and fitters, respectively.

B. MANPOWER AND TRAINING

The manpower requirement of the three cold storage plants is given in Table XV. A significant number of manual labourers should be required for loading and unloading of cold stored products, movement of these products to the various parts of the store and for stacking. Depending on the quantity and frequency of goods to be handled, labourers could be employed only when required. This way the expense on manpower can be reduced considerably. The store helpers indicated in Table XV are supposed to be permanent employees.

TABLE XV

MANPOWER REQUIREMENT

JOB DESCRIPTION	Monthly* Salary (Birr)	QUANTITY		
		Bahr Dar	Massawa	Assab
Plant Manager	1200	1	1	1
Secretary	450	1	1	1
Accountant	650	1	1	1
Clerk	300	-	1	1
Refrigeration Engineer	750	1	1	1
Refrigeration Fitters (Mechanics)	550	1	1	2
Workshop Assistants	280	1	1	2
Stores Head	450	1	1	1
Stores Helpers (Handling)	180	2	3	6
Fork-lift Operators	300	-	-	2
Driver	200	-	1	1
Guards	75	4	4	4
Sub-total	-	13	16	23
Total Annual Labour Cost* including 25% benefits	-	74,850	119,070	160,440

* For Massawa and Assab, monthly salaries are raised by 40%.

The refrigeration engineer, the fitters and workshop assistants should be responsible for the overall repair and maintenance of the cold storage units.

The store's head is required to keep up-to date records on the types and quantities of goods cold stored, including incoming and outgoing dates and storage temperatures.

The plant manager and the refrigeration engineer would have to be skilled personnel with an adequate theoretical and practical background on refrigeration technology in general and cold storage plants in particular. They need to be sent overseas for a three-month training. Some theoretical knowledge and work experience in food technology is also an essential qualification for the plant manager and refrigeration engineer.

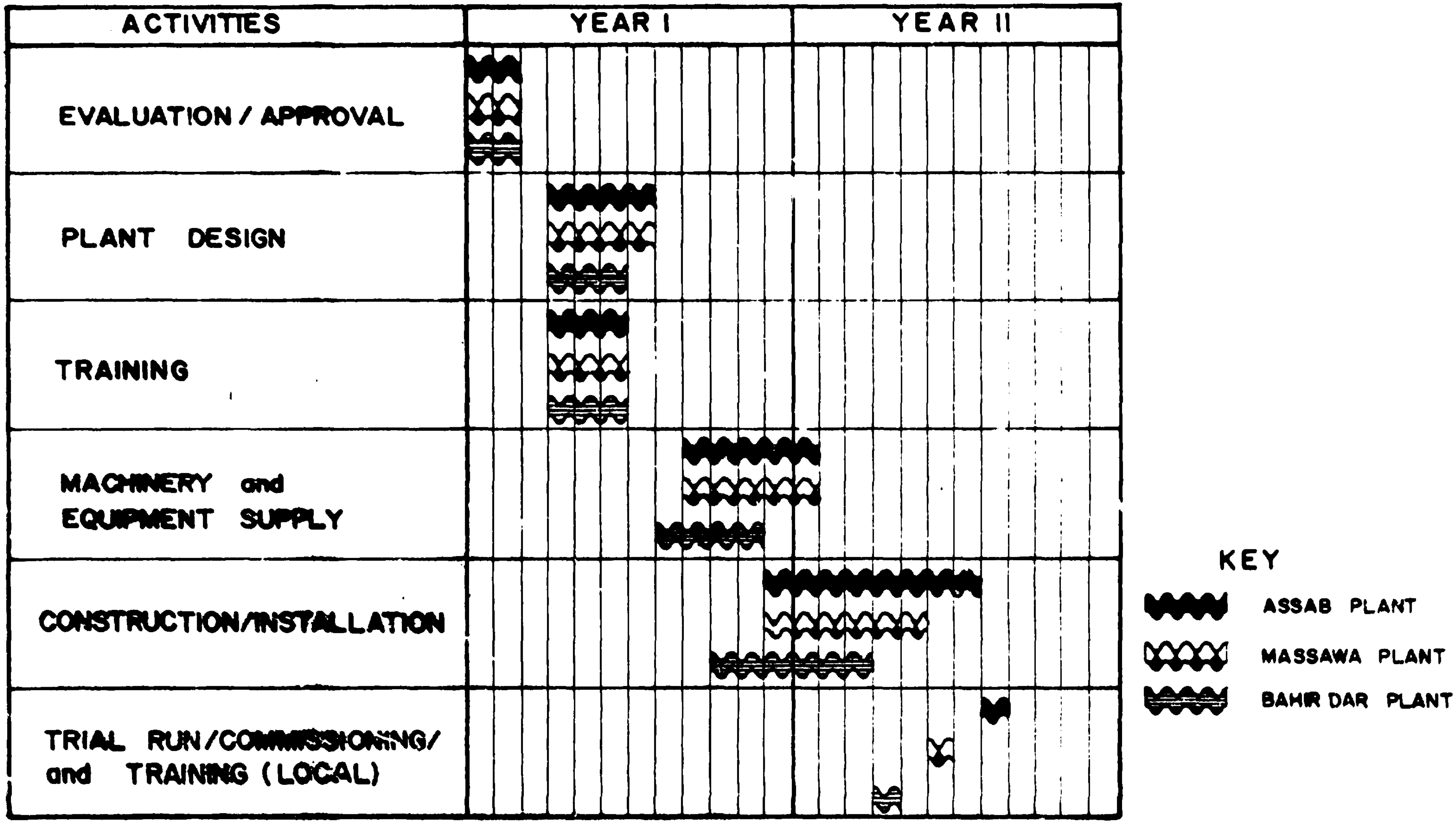
The fitters have to be all-round electrical and mechanical fitters with adequate work experience. Together with the stores head, they would require an intensive on the-job training for about three months by the experts taking part in the installation of the cold storage units.

VIII. IMPLEMENTATION

The implementation schedule of the cold storage plants at Assab, Massawa and Bahr Dar is shown in Figure VIII. The Assab plant will require about 20 months, the Massawa plant 18 and the Bahr Dar 16 for implementation. The time requirement for each activity, with the exception of the construction/installation activity, is more or less the same for all the three plants. The construction/installation of the Assab, and Massawa plants can be carried out within 8 and 6 months. respectively.

Recruitment of plant personnel should be carried out before the trial run and commissioning. On-the-job training should be given during the trial-run. The oversease training of the plant managers and the refrigeration engineers, if required, should be organized before arranging for machinery and equipment supply.

FIGURE VIII
IMPLEMENTATION SCHEDULE



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost of the cold storage facilities at Assab is shown in Table XVI.

TABLE XVI

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Building and civil works	1097.71	3000.42	4098.13
Plant machinery and equipment	2413.62	573.23	2986.85
Office furniture and equipment	20.00	30.00	50.00
Vehicles	12.38	15.88	28.26
Pre-production expenditure	256.05	403.61	659.66
Total	3799.76	4023.14	7822.90

The foreign currency component of the total initial investment cost will be about 49%. About 64% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the working capital requirements of the cold storage facility at Assab.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	0.5
3. Raw materials - Foreign	3.0
4. Raw Materials - Local	1.0
5. Accounts payable	1.0

The net working capital requirement at full capacity will be about Birr 0.02 million.

3. Production Costs

The detailed production cost estimation is given togehter with other required financial statements. The operating cost at full capacity amounts to Birr 1.94 million, out of which about 37% is in foreign currency.

4. Internal Rate of Return (IRR)

Only the internal rate of return of the cold storage facility at Assab was worked out since the Bahr Dar and Massawa cold storage facilities were not economical. Accordingly the cold storage facility at Assab was not found to be financially viable. The calculated internal rate of return was 6.73% with a net present value of Birr -1.46 million discounted at 10% p.a. The viability of this project largely depends on whether it has real demand or not.

5. Breakeven Analysis

Expressed in terms of sales revenues, the proejct breakseven at Birr 1.69 million, in terms of physical output at 6004 tons of storage facility, or at a capacity utilization of 68%.

B. ECONOMIC ANALYSIS

The economic rate of return of the project amounted to be 7.86% with a net present value of Birr -0.89 million discounted at 10% p.a.

The project will create employment for about 23 people when operating at full capacity.

APPENDIX A

COLD STORAGE BUILDING REQUIREMENTS

1. Floors

Frost-susceptible soils should be replaced with porous, low-capillarity fills whenever possible. Freezer floors classed as slab-on-fill or slab-on ground should be provided with a source of controllable heating for the entire floor. The heat source may be warm air installed in tile ducts or by electric heating cable. Freezer floor slabs on piers should be well ventillated.

2. Ceilings

Ceilings of cold rooms should be suspended beneath the roof deck. The space between the roof deck and the dropped insulated ceiling should be well ventillated to prevent condensation. A positive vapour seal and barrier to protect the insulation from moisture is essential.

3. Doors

Refrigerated doors are a universal source of complaint. Freezing, sagging and rotting of wooden members and physical abuse are repeatedly mentioned problems. Electrically operated doors are much more preferred eventhough few users are satisfied with air-operated ones.

Infitting doors are acceptable above 32°F. These should have double seal gaskets. Below 20°F, overlapping doors should be used. If infitting doors are used from 32°F to 20°F, controlled electric heating cables should be installed in the door frames. All freezer doors should have vestibules if possible.

4. Roofs

All cold storage roofs should be leak-proof, preferably white to reflect solar heat and with ample roof pitch to drain readily.

5. Walls

Penetration by metallic or other highly conductive materials through insulation should not be permitted unless completely insulated. The wall insulation should be installed in accordance with the recommendation of the manufacturer. Vapour barriers are an absolute necessity for refrigerated spaces regardless of whether the insulation is permeable or impermeable. The design engineer should specify the vapor seal requirements.

Steel reinforced columns penetrating to other floors should be insulated and then protected with 1/8 in galvanized sheet or stainless steel for a height of 6 to 8 ft.

6. Grading and Site Drainage

All grading should be well compacted to ensure no settlement. On bentonitic and similar volcanic clays, the footings should penetrate to a solid foundation or the entire structure should be erected on a strongly reinforced slab-on-fill to "ride the waves" of alternate ground expansion and contraction as affected by excessive moisture.

Footings and floors should be above the highest flood or water table on record. All building run-offs should be carried away from all walls, floors and footings. All floor slabs-on-fills should be one foot above grade to protect against flash flooding.

7. Heating and Air Conditioning

The heating and air conditioning of the administrative offices, control and machine rooms should not be overlooked. A central unit of sufficient capacity must be installed.

8. Sanitation

Freezing and cold storage rooms are very likely to have odors that come from the stored product when it was originally placed in the store. These odors should be removed or modified through the use of absorbers (carbon filters) or air-purifiers (germicidal ultraviolet light lamps).

APPENDIX B

USEFUL (NET) STORAGE DENSITIES OF VARIOUS COLD STORED FOOD PRODUCTS

Item No.	Cold Stored Products	Storage density Kg/m^3
A	VEGETABLES AND FRUITS	
	Apples	314 - 450
	Oranges and lemons	370 -619
	Beans (Green)	572
	Brocoli	343
	Peas	441
	Tomatoes	502 - 627
B	MEATS AND FOWL	
	Beef, boneless in cartons	1,296
	Fores and hinds (loose)	360
	Boneless lamb in box	988
	Poultry fryers, whole	411
	Poultry fryers, parts	630
	Turkeys in cartons	326 - 405
C	FISH AND FISH PRODUCTS	
	Blocks in cartons	891
	Filets in cartons	692 - 804
	Portions in cartons	470 - 535
	Round halibut loose in boxes	486 - 567

SOURCE * Summerised and modified from the Handbook of the American Society of Heating, Refrigeration and Air Conditioning Engineers.

APPENDIX C

TABLES OF FINANCIAL AND ECONOMIC

ANALYSES

Cold Storage Plant at Assab
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates.
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	7892.72	49.685 % foreign
current assets:	0.00	0.000 % foreign
total assets:	7892.72	49.685 % foreign

Source of funds during construction phase

equity & grants:	7892.72	49.685 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	7892.72	49.685 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	1276.80	1276.80	1276.80
depreciation :	660.14	660.14	660.14
interest :	0.00	0.00	0.00
production costs	1936.94	1936.94	1936.94
thereof foreign	36.73 %	36.73 %	36.73 %
total sales :	2472.80	2472.80	2472.80
gross income :	535.86	535.86	535.86
net income :	267.93	267.93	267.93
cash balance :	908.70	928.07	928.07
net cashflow :	908.70	928.07	928.07

Net Present Value at: 10.00 % = -1458.53
Internal Rate of Return: 6.73 %
Return on equity1: -3.68 %
Return on equity2: 6.73 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

COMFAR (c)

TABLE C.2 COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	2049.07	2049.06
Auxiliary and service facilities	28.26	69.82
Incorporated fixed assets	25.00	25.00
Plant machinery and equipment	1689.53	1297.32
Total fixed investment costs	3791.86	3441.20
Pre-production capital expenditures	411.38	248.28
Net working capital	0.00	0.00
Total initial investment costs	4203.24	3689.48
Of it foreign, in %	61.32	36.43

Cold Storage Plant at Assab --- Financial Analysis - July 1988

COMFAR (c)

TABLE C.3

Total Production Costs in '000 Birr

Year	3- 7	8	9	10-12	13-17
% of nom. capacity (single product).	100.00	100.00	100.00	100.00	100.00
Raw material 1	0.00	0.00	0.00	0.00	0.00
Other raw materials	268.07	268.07	268.07	268.07	268.07
Utilities	539.16	539.16	539.16	539.16	539.16
Energy	20.00	20.00	20.00	20.00	20.00
Labour, direct	160.44	160.44	160.44	160.44	160.44
Repair, maintenance	234.13	234.13	234.13	234.13	234.13
Spares	0.00	0.00	0.00	0.00	0.00
Factory overheads	30.00	30.00	30.00	30.00	30.00
Factory costs	1251.80	1251.80	1251.80	1251.80	1251.80
Administrative overheads	25.00	25.00	25.00	25.00	25.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00
Depreciation	660.14	508.59	514.24	528.21	224.52
Financial costs	0.00	0.00	0.00	0.00	0.00
Total production costs	1936.94	1785.39	1791.04	1805.01	1501.32
Costs per unit (single product)	0.22	0.20	0.20	0.21	0.17
Of it foreign, %	36.73	36.84	36.80	36.57	27.83
Of it variable,%	40.60	44.04	43.90	43.56	52.37
Total labour	160.44	160.44	160.44	160.44	160.44

Net Working Capital in '000 Birr

Year	adc	coto	3	4-17
Coverage	adc	coto		
Current assets &				
Accounts receivable	15	24.0	53.20	53.20
Inventory and materials	90	4.0	51.75	51.75
Energy	0	---	0.00	0.00
Spares	0	---	0.00	0.00
Work in progress	0	---	0.00	0.00
Finished products	0	---	0.00	0.00
Cash in hand	15	24.0	18.73	18.73
Total current assets			123.68	123.68
Current liabilities and Accounts payable	30	12.0	104.32	104.32
Net working capital			19.37	19.37
Increase in working capital			19.37	0.00
Net working capital, local			-23.63	-23.63
Net working capital, foreign			43.00	43.00

Note: adc = minimum days of coverage ; coto = coefficient of turnover .

- N72 -

COMFAR

TABLE C.5

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	4203.24	3689.48
Financial resources	4203.24	3689.48
Sales, net of tax	0.00	0.00
Total cash outflow	4203.24	3689.48
Total assets	4203.24	3689.48
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1625.74	2345.49
Outflow, local	1625.74	2345.49
Surplus (deficit)	0.00	0.00
Inflow, foreign	2577.50	1343.99
Outflow, foreign	2577.50	1343.99
Surplus (deficit)	0.00	0.00
Net cashflow	-4203.24	-3689.48
Cumulated net cashflow	-4203.24	-7892.72

TABLE C.5 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	2577.12	2472.80	2472.80	2472.80	2472.80	2472.80
Financial resources	104.32	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	2472.80	2472.80	2472.80	2472.80	2472.80	2472.80
Total cash outflow	1668.41	1544.73	1544.73	1544.73	1544.73	1648.76
Total assets	123.68	0.00	0.00	0.00	0.00	28.26
Operating costs	1276.80	1276.80	1276.80	1276.80	1276.80	1276.80
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	267.93	267.93	267.93	267.93	267.93	343.70
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	908.70	928.07	928.07	928.07	928.07	824.04
Cumulated cash balance	908.70	1836.77	2764.84	3692.91	4620.[illegible]	5445.02
Inflow, local	2547.63	2472.80	2472.80	2472.80	2472.80	2472.80
Outflow, local	1242.05	1190.86	1190.86	1190.86	1190.86	1282.51
Surplus (deficit)	1305.57	1281.94	1281.94	1281.94	1281.94	1190.29
Inflow, foreign	29.49	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	426.36	353.87	353.87	353.87	353.87	366.25
Surplus (deficit)	-396.87	-353.87	-353.87	-353.87	-353.87	-366.25
Net cashflow	908.70	928.07	928.07	928.07	928.07	824.04
Cumulated net cashflow	-6984.02	-6055.95	-5127.88	-4199.81	-3271.74	-2447.70

TABLE C.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	2472.80	2472.80	2472.80	2472.80	2472.80	2472.80
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	2472.80	2472.80	2472.80	2472.80	2472.80	2472.80
Total cash outflow	1687.50	1610.70	1610.70	1610.70	1790.80	1832.36
Total assets	69.82	0.00	0.00	0.00	28.26	69.82
Operating costs	1276.80	1276.80	1276.80	1276.80	1276.80	1276.80
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	340.88	333.90	333.90	333.90	485.74	485.74
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	785.30	862.10	862.10	862.10	682.00	640.44
Cumulated cash balance	6230.32	7092.42	7954.52	8816.63	9498.63	10139.07
Inflow, local	2472.80	2472.80	2472.80	2472.80	2472.80	2472.80
Outflow, local	1333.63	1256.83	1256.83	1256.83	1424.55	1478.49
Surplus (deficit)	1139.17	1215.97	1215.97	1215.97	1048.25	994.31
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	353.87	353.87	353.87	353.87	366.25	353.87
Surplus (deficit)	-353.87	-353.87	-353.87	-353.87	-366.25	-353.87
Net cashflow	785.30	862.10	862.10	862.10	682.00	640.44
Cumulated net cashflow	-1662.40	-800.30	61.80	923.91	1605.91	2246.35

TABLE C.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	2472.80	2472.80	2472.80
Financial resources	0.00	0.00	0.00
Sales, net of tax	2472.80	2472.80	2472.80
Total cash outflow	1762.54	1762.54	1762.54
Total assets	0.00	0.00	0.00
Operating costs	1276.80	1276.80	1276.80
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	485.74	485.74	485.74
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	710.26	710.26	710.26
Cumulated cash balance	10849.33	11559.59	12269.86
Inflow, local	2472.80	2472.80	2472.80
Outflow, local	1408.67	1408.67	1408.67
Surplus (deficit)	1064.13	1064.13	1064.13
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	353.87	353.87	353.87
Surplus (deficit)	-353.87	-353.87	-353.87
Net cashflow	710.26	710.26	710.26
Cumulated net cashflow	2956.61	3666.87	4377.13

- N76 -

TABLE C.5 (Cont'd)

COMFAR

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-5265.84	at	10.00 %
Internal Rate of Return (IRRE1) ..	-3.68 %		

b) Net Worth versus Net cash return:

Net present value	-1458.53	at	10.00 %
Internal Rate of Return (IRRE2) ..	6.73 %		

c) Internal Rate of Return on total investment:

Net present value	-1458.53	at	10.00 %
Internal Rate of Return (IRR) ..	6.73 %		

Net Worth : Equity paid plus reserves

COMFAR (c)

TABLE C.6

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	2472.80	2472.80	2472.80	2472.80	2472.80
Less: variable costs, incl. sales tax.	786.31	786.31	786.31	786.31	786.31
Variable margin	1686.49	1686.49	1686.49	1686.49	1686.49
As % of total sales	68.20	68.20	68.20	68.20	68.20
Non-variable costs, incl. depreciation	1150.63	1150.63	1150.63	1150.63	1150.63
Operational margin	535.86	535.86	535.86	535.86	535.86
As % of total sales	21.67	21.67	21.67	21.67	21.67
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	535.86	535.86	535.86	535.86	535.86
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	535.86	535.86	535.86	535.86	535.86
Tax	267.93	267.93	267.93	267.93	267.93
Net profit	267.93	267.93	267.93	267.93	267.93
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	267.93	267.93	267.93	267.93	267.93
Accumulated undistributed profit	267.93	535.86	803.79	1071.72	1339.65
Gross profit, % of total sales	21.67	21.67	21.67	21.67	21.67
Net profit, % of total sales	10.84	10.84	10.84	10.84	10.84
ROE, Net profit, % of equity	3.39	3.39	3.39	3.39	3.39
ROI, Net profit+interest, % of invest.	3.39	3.39	3.39	3.39	3.39

TABLE C.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	2472.80	2472.80	2472.80	2472.80	2472.80
Less: variable costs, incl. sales tax.	786.31	786.31	786.31	786.31	786.31
Variable margin	1686.49	1686.49	1686.49	1686.49	1686.49
As % of total sales	68.20	68.20	68.20	68.20	68.20
Non-variable costs, incl. depreciation	999.08	1004.73	1018.69	1018.69	1018.69
Operational margin	687.41	681.76	667.79	667.79	667.79
As % of total sales	27.80	27.57	27.01	27.01	27.01
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	687.41	681.76	667.79	667.79	667.79
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	687.41	681.76	667.79	667.79	667.79
Tax	343.70	340.88	333.90	333.90	333.90
Net profit	343.70	340.88	333.90	333.90	333.90
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	343.70	340.88	333.90	333.90	333.90
Accumulated undistributed profit	1683.36	2024.23	2358.13	2692.03	3025.92
Gross profit, % of total sales	27.80	27.57	27.01	27.01	27.01
Net profit, % of total sales	13.90	13.79	13.50	13.50	13.50
ROE, Net profit, % of equity	4.35	4.32	4.23	4.23	4.23
ROI, Net profit+interest, % of invest.	4.33	4.26	4.17	4.17	4.17

TABLE C.6 (Cont'd)

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	2472.80	2472.80	2472.80	2472.80	2472.80
Less: variable costs, incl. sales tax.	786.31	786.31	786.31	786.31	786.31
Variable margin	1686.49	1686.49	1686.49	1686.49	1686.49
As % of total sales	68.20	68.20	68.20	68.20	68.20
Non-variable costs, incl. depreciation	715.01	715.01	715.01	715.01	715.02
Operational margin	971.48	971.48	971.48	971.48	971.47
As % of total sales	39.29	39.29	39.29	39.29	39.29
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	971.48	971.48	971.48	971.48	971.47
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	971.48	971.48	971.48	971.48	971.47
Tax	485.74	485.74	485.74	485.74	485.74
Net profit	485.74	485.74	485.74	485.74	485.74
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	485.74	485.74	485.74	485.74	485.74
Accumulated undistributed profit	3511.66	3997.40	4483.14	4968.88	5454.61
Gross profit, % of total sales	39.29	39.29	39.29	39.29	39.29
Net profit, % of total sales	19.64	19.64	19.64	19.64	19.64
ROE, Net profit, % of equity	6.15	6.15	6.15	6.15	6.15
ROI, Net profit+interest, % of invest.	6.04	5.99	5.99	5.99	5.99

TABLE C.7

- N80 -

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	4203.24	7892.72
Fixed assets, net of depreciation	0.00	4203.24
Construction in progress	4203.24	3689.48
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	4203.24	7892.72
Equity capital	4203.24	7892.72
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE C.7 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	8264.97	8532.90	8800.83	9068.76	9336.69	9680.39
Fixed assets, net of depreciation	7232.58	6572.44	5912.30	5252.16	4592.02	4083.43
Construction in progress	0.00	0.00	0.00	0.00	0.00	28.26
Current assets	104.95	104.95	104.95	104.95	104.95	104.95
Cash, bank	18.73	18.73	18.73	18.73	18.73	18.73
Cash surplus, finance available	908.70	1836.77	2764.84	3692.91	4620.98	5445.02
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	8264.97	8532.90	8800.83	9068.76	9336.69	9680.39
Equity capital	7892.72	7892.72	7892.72	7892.72	7892.72	7892.72
Reserves, retained profit	0.00	267.93	535.86	803.79	1071.72	1339.65
Profit	267.93	267.93	267.93	267.93	267.93	343.70
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	104.32	104.32	104.32	104.32	104.32	104.32
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	104.32	104.32	104.32	104.32	104.32	104.32
Equity, % of liabilities	95.50	92.50	89.68	87.03	84.53	81.53

TABLE C.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	10021.27	10355.17	10689.06	11022.96	11508.70	11994.44
Fixed assets, net of depreciation	3597.45	3139.06	2610.86	2082.65	1858.13	1661.87
Construction in progress	69.82	0.00	0.00	0.00	28.26	69.82
Current assets	104.95	104.95	104.95	104 95	104.95	104.95
Cash, bank	18.73	18.73	18.73	18.73	18.73	18.73
Cash surplus, finance available	6230.32	7092.42	7954.53	8816.63	9498.63	10139.07
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	10021.27	10355.17	10689.06	11022.96	11508.70	11994.44
Equity capital	7892.72	7892.72	7892.72	7892.72	7892.72	7892.72
Reserves, retained profit	1683.36	2024.23	2358.13	2692.03	3025.92	3511.66
Profit	340.88	333.90	333.90	333.90	485.74	485.74
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	104.32	104.32	104.32	104.32	104.32	104.32
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	104.32	104.32	104.32	104.32	104.32	104.32
Equity, % of liabilities	78.76	76.22	73.84	71.60	68.58	65.80

TABLE C.7 (Cont'd)

- N83 -

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	12480.18	12965.92	13451.65
Fixed assets, net of depreciation	1507.16	1282.64	1058.11
Construction in progress	0.00	0.00	0.00
Current assets	104.95	104.95	104.95
Cash, bank	18.73	18.73	18.73
Cash surplus, finance available	10849.33	11559.59	12269.86
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	12480.18	12965.92	13451.65
Equity capital	7892.72	7892.72	7892.72
Reserves, retained profit	3997.40	4483.14	4968.88
Profit	485.74	485.74	485.74
Long and medium term debt	0.00	0.00	0.00
Current liabilities	104.32	104.32	104.32
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	104.32	104.32	104.32
Equity, % of liabilities	63.24	60.87	58.67

COMFAR 2.1

TABLE C.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	3795.80	3126.82
Financial resources	3795.80	3126.82
Sales, net of tax	0.00	0.00
Total cash outflow	3795.80	3126.82
Total assets	3795.80	3126.82
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	1218.30	1782.83
Outflow, local	1218.30	1782.83
Surplus (deficit)	0.00	0.00
Inflow, foreign	2577.50	1343.99
Outflow, foreign	2577.50	1343.99
Surplus (deficit)	0.00	0.00
Net cashflow	-3795.80	-3126.82
Cumulated net cashflow	-3795.80	-6922.62

TABLE C.8 (Cont'd)

Cashflow tables, production in 000 Birr

Year	3	4	5	6	7	8
Total cash inflow	1941.74	1856.80	1856.80	1856.80	1856.80	1856.80
Financial resources	84.94	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	1856.80	1856.80	1856.80	1856.80	1856.80	1856.80
Total cash outflow	1148.27	1038.05	1038.05	1038.05	1038.05	1057.58
Total assets	110.22	0.00	0.00	0.00	0.00	19.53
Operating costs	1038.05	1038.05	1038.05	1038.05	1038.05	1038.05
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	793.48	818.75	818.75	818.75	818.75	799.22
Cumulated cash balance	793.48	1612.23	2430.97	3249.72	4068.47	4867.69
Inflow, local	1912.25	1856.80	1856.80	1856.80	1856.80	1856.80
Outflow, local	721.91	684.18	684.18	684.18	684.18	691.33
Surplus (deficit)	1190.35	1172.62	1172.62	1172.62	1172.62	1165.47
Inflow, foreign	29.49	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	426.36	353.87	353.87	353.87	353.87	366.25
Surplus (deficit)	-396.87	-353.87	-353.87	-353.87	-353.87	-366.25
Net cashflow	793.48	818.75	818.75	818.75	818.75	799.22
Cumulated net cashflow	-6129.14	-5310.40	-4491.65	-3672.90	-2854.15	-2054.93

TABLE C.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	1856.80	1856.80	1856.80	1856.80	1856.80	1856.80
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	1856.80	1856.80	1856.80	1856.80	1856.80	1856.80
Total cash outflow	1107.87	1038.05	1038.05	1038.05	1057.58	1107.87
Total assets	69.82	0.00	0.00	0.00	19.53	69.82
Operating costs	1038.05	1038.05	1038.05	1038.05	1038.05	1038.05
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	748.93	818.75	818.75	818.75	799.22	748.93
Cumulated cash balance	5616.62	6435.37	7254.12	8072.87	8872.09	9621.02
Inflow, local	1856.80	1856.80	1856.80	1856.80	1856.80	1856.80
Outflow, local	754.00	684.18	684.18	684.18	691.33	754.00
Surplus (deficit)	1102.80	1172.62	1172.62	1172.62	1165.47	1102.80
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	353.87	353.87	353.87	353.87	366.25	353.87
Surplus (deficit)	-353.87	-353.87	-353.87	-353.87	-366.25	-353.87
Net cashflow	748.93	818.75	818.75	818.75	799.22	748.93
Cumulated net cashflow	-1306.00	-487.25	331.50	1150.25	1949.47	2698.40

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	1856.80	1856.80	1856.80
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	1856.80	1856.80	1856.80
Total cash outflow . .	1038.05	1038.05	1038.05
Total assets	0.00	0.00	0.00
Operating costs . . .	1038.05	1038.05	1038.05
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	818.75	818.75	818.75
Cumulated cash balance	10439.77	11258.52	12077.27
Inflow, local	1856.80	1856.80	1856.80
Outflow, local	684.18	684.18	684.18
Surplus (deficit) .	1172.62	1172.62	1172.62
Inflow, foreign . . .	0.00	0.00	0.00
Outflow, foreign . . .	353.87	353.87	353.87
Surplus (deficit) .	-353.87	-353.87	-353.87
Net cashflow	818.75	818.75	818.75
Cumulated net cashflow	3517.15	4335.90	5154.65

TABLE C.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-4255.24	at	10.00 %
Internal Rate of Return (IRRE1) ..	-1.29 %		

b) Net Worth versus Net cash return:

Net present value	-888.92	at	10.00 %
Internal Rate of Return (IRRE2) ..	7.86 %		

c) Internal Rate of Return on total investment:

Net present value	-888.92	at	10.00 %
Internal Rate of Return (IRR) ..	7.86 %		

Net Worth - Equity paid plus reserves

- 0 -

DETERGENTS

TABLE OF CONTENTS

I. SUMMARY

The current demand for soap and detergents is estimated at about 43,000 tons, growing to over 114,000 tons in fifteen years time. About 90% of the demand costitute demand for bar soap - common bar soap and detergent bar. The unsatisfied demand for the products is anticipated to grow from the current level of about 18,000 tons to 90,000 tons by the end of the forecast period (1987 - 2003).

Since consumer acceptability of detergent bars in the Ethiopian market has not yet been adequately tested, it has been recommended to start with a minimum economic size plant of about 2400 tons per year.

The main raw material, linear alkyl sulfonate (LAS), needs to be imported. Other material such as soda ash, sodium silicate, sodium chloride and sodium hydroxide are expected to be obtainable locally from existing plants and from those planned to be installed in the near future.

The recommended size of plant is estimated to cost Birr 1.5 million; the foreign portion being about 62%. The annual production cost at full capacity is estimated at Birr 2.97 million with a foreign currency component of about 81%.

The financial and economic analyses indicate the project to be worthy of further consideration. The rates of return turned out to be about 55% and 180%, respectively.

The plant will also create employment for about 35 people.

II. INTRODUCTION

Soap and detergents are basic products whose demand has to be met even at the lowest level of a country's development. Presently there are three detergent manufacturing and a number of common bar soap producing plants in Ethiopia. However, their aggregate supply volume falls much short of the demand for the products necessitating a substantial quantity of imports - on an average about 10,000 tons per year.

To meet the deficiency in supply it has been envisaged in the Ten Year Perspective Plan to increase the production capacity in the country from the present level of about 30,000 tons per year to about 130,000 tons. To achieve such a level of growth the plan presupposes the establishment of a number of soap and detergent plants during the plan period.

The production of detergent bars proposed in this project profile largely uses imported chemicals as its input requires a continuous outflow of foreign exchange for its operation. On the other hand the value added that may accrue from its domestic production could make it preferable to importing in its finished form. Thus the project requires a closer look in the next phase of the project study.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Soap and detergents are broadly used interchangeably to mean any surface active agents. In more specific terms, however, detergents refer to synthetic detergents commonly known as syndets, which are made from petro-chemicals. Soap, on the other hand, means common sodium soap made from natural fat and oil. Both soap and detergents are used mainly for household purposes for cleaning and washing. They also have industrial and other special, such as medical applications, but the quantity involved is not large.

Cleaning of soild surface with detergents and soap involves the following steps.

- Moistening of the surface of the object to be cleaned by water containing soap or detergents. In the case of textiles it involves also penetration of the fiber structure;

- Separating the dirt from the surface of the object and absorbing again the dirt by the detergents;

- Dispersion of the dirt from the fibre or other object into the wash water, and

- Preventing the dirt from being redeposited to the cleaned surface.

The above processes apply for any types of soap or detergents. But how effectivety and efficiently a type or a brand of soap or detergent performs the above functions determines its acceptability in the market.

Detergents have some advantages over soap, making them more preferable. First of all, soap forms a scum in hard water, leaving a ring or a residue on or around a bath tub, wash basin and glass ware. Soap also forms a precipitate by reacting with traces of acid compounds. Detergents do not create such problems. Other advantages of detergents are solubility in cold water and flexibility in formulation which enables their production to fit local washing conditions. Detergents can also be packed in any size and form, another advantage over common soap.

Detergents are classed as anionic, cationic, non-ionic or ampholythic, depending on their mode of chemical action. Detergents can be produced in solid (bar) or liquid or powder form.

2. Past and Present Supply and Demand

To some extent detergents and soap are substitute products and the supply of one affects the demand for the other, particularly detergent bars and common soap, since both have the same applications. Hence, the demand for detergents and soap is considered concurrently in this profile.

a. Demand for Common Soap

The apparent consumption of soap in Ethiopia from 1978/79 - 1985/86 is shown in Table I. During this period the total annual apparent consumption ranged from 14,000 tons (1984/85) to 25,600 tons (1982/83) with an overall annual average of about 21,000 tons. Imports accounted for an average of 51% (10,700 tons) of the total supply while the remaining 49% (10,300 tons) came from the domestic production. The highest apparent per capita consumption during this period was 0.63 kgs (1981/82) and the lowest was 0.32 kg (1984/85). These consumption levels are very low even by standards of other low income developing countries (See table II).

The average per capita apparent consumption of these countries shown in the table was about 1.77 kgs. which is 2.8 times greater than the highest per capita consumption figure recorded for Ethiopia (See Table I). It should be, however, noted that the consumption figures for Ethiopia do not reflect the actual demand level, for the product has been in short supply. In the last few years, the shortage was so acute that it had to be rationed.

b. Detergents

The apparent consumption of this group of products in Ethiopia from 1978/79 to 1985/86 ranged from 2200 tons in 1979/80 to 3400 tons in 1984/85. (See Table III). Unlike common soap, the import accounted for a very small share of the total supply. Except for 1971 and 1972, when the import represented 15% and 9% of the total supply, respectivley, almost all the volume consumed in the country in the other years was from the domestic production. Until the 1978 production of detergent bars, the share of detergent powder was about 90%. In 1978, however, detergent bar represented 30% of the total production.

TABLE I

APPARENT CONSUMPTION OF SOAP

(TONS)

Year	Domestic Production	Imports	Total Apparent Consumption	Per capita Consumption (Kgs)
1978/79	10050	9507	19557	0.534
1979/80	7904	10296	18200	0.483
1980/81	8738	11425	20163	0.520
1981/82	10007	15173	25180	0.631
1982/83	10714	14887	25601	0.624
1983/84	11172	10602	21774	0.516
1984/85	10988	3050	14038	0.324
1985/86	13139	10740	23879	0.535

SOURCE: National Chemicals Corporation, Ethiopian Food Corporation, ETIMEX and External Trade Statistics.

TABLE II

PER CAPITA APPARENT CONSUMPTION OF SOAP FOR SELECTED LOW INCOME DEVELOPING COUNTRIES

(1979 - 1981)

Country	Per Capita Income (US$)	Per Capita Consumption (KG)
Burma	192	1.23
Cameroon	880	1.83
Egypt	651	6.54
Guyana	723	2.55
Haiti	297	2.19
Indonesia	527	0.42
Kenya	419	0.95
Madagascar	359	1.84
Mali	195	0.50
Mozambique	359	1.71
Nepal	151	0.23
Niger	331	0.83
Philippines	787	1.00
Rwanda	251	1.05
Senegal	431	6.13
Sierra Leone	319	0.49
Sudan	384	2.80
Thailand	769	0.48
Burkina Faso	236	1.30
Zaire	211	1.66
Zambia	597	1.37

SOURCE: World Bank, World Tables; UNIDO, Hand Book of Industrial Statistics.

In the three years plan period, i.e. from 1986/87 to 88/89 the production of detergent bar was envisaged to be 25% of the total planned production of the detergent plants in the country. This change in the product mix is a reflection of the National Chemicals Corporation's belief that bar soap (detergent as well as common soap) is far more preferred to detergent powder.

The per capita consumption of all types of detergents in Ethiopia ranged from 57 grams in 1979/80 to 78 grams in 1984/85 with an average of 66 grams for the period (See Table III). Compared with other low income developing countries, the per capita consumption of Ethiopia appears to be on the low side (See Table IV). The lowest recorded per capita consumption is 120 grams in Afghanistan. The low consumption level in Ethiopia is partly due to supply shortage. The most important reason, however, is the low economic development level of the country as reflected by its per capita income.

TABLE III

APPARENT CONSUMPTION OF DETERGENT

(TONS)

Year	Sales of Domestic Production	Imports	Total Apparent Consumption	Per Capita Consumption (Kgs)
1978/79	2084	314	2398	0.066
1979/80	1977	179	2156	0.057
1980/81	2403	2	2405	0.062
1981/82	2340	15	2345	0.059
1982/83	2622	67	2689	0.066
1983/84	3023	38	3061	0.073
1984/85	3342	38[1]	3380	0.078
1985/86	2819	38[1]	2857	0.064

The imports are assumed to be the same as the preceding year

SOURCE: National Chemicals Corporation, External Trade Statistics

TABLE IV

PER CAPITA APPARENT CONSUMPTION OF WASHING POWDER AND DETERGENT IN SELECTED LOW INCOME DEVELOPING COUNTRIES (1979 - 1981)

Country	Per Capita Income (US$)	Per Capita Consumption (Kg.)
Afghanistan	221	0.12
Haiti	297	0.15
India	256	0.20
Gambia	368	0.21
Cape Verde	342	0.32
Indonesia	527	0.46
Egypt	651	0.86
Thailand	769	1.65
Zambia	597	2.20
Philippines	787	2.87

SOURCE: UNIDO Handbook of Industrial Statistics and World Bank World Tables.

The per capita GNP of Ethiopia was reported in the Ten Years Perspective Plan to be US $136 in 1983/84, which is much lower than those listed in Table IV. The general observed tendency in the per capita consumption of detergent is an increase with an increase in the standard of living as reflected in the per capita GNP. At a hihger level of development the increase in the per capita consumption of detergents is mainly due to a shift in the consumption pattern of the population, that is, a shift from the consumption of common soap to detergent powder. In fact, in most devleoped countries the substitution has virtually been completed in that only detergent powder is used for laundry. But in the case of countries, such as Ethiopia, whose development level is very low the demand for both products is expected to grow.

As indicated in Table V the installed capacity of the existing plants in Ethiopia could supply detergents substantially greater than the volume currently produced. The envisaged output in 1986/87 can be produced by 40% of the existing installed capacity. The reasons for the low level of the capacity utilization are lack of raw material, production bottlenecks, quality of the product, distribution problems, etc.

3. Demand Projection

Three approaches were considered to project the demand for soap and detergents:

- Time trend extrapolation,
- Cross-sectional regressions, and
- Judgemental

TABLE V

PRODUCTION AND PRODUCTION CAPACITY OF DETERGENT MANUFACTURING PLANTS IN ETHIOPIA

Plant	Product Type	Production (Ton)				Installed Capacity (Tons/Yr)
		1983/84	1984/85	1985/86	1986/87 Target	
Reppi	Powder detergent	1150	780	830	1000	2500
	Liquid detergent	-	20	75	100	500
	Detergent bar	-	200	525	600	1000
	Sub-Total	1150	1000	1430	1700	4000
Red Sea	Powder detergent	1340	1150	820	1200	3000
Asmara Soap F.	Powder detergent	280	380	200	500	500
	Detergent bar	290	170	240	300	500
	Total	3060	2700	2690	3700	8000

SOURCE: National Chemicals Corporation.

a. Time Trend Extrapolation

Under this method it is basically assumed that a balanced demand and supply condition has existed during a few years. Furthermore the relative influence of the factors affecting the demand are assumed to continue in the future. The latter assumption may be valid, to a certain extent, with respect to the demand for detergents and soap in Ethiopia. The former assumption however, does not hold true since the consumption of these products in Ethiopia was constrained by a limited supply, and in particular the import of detergents was completely curtailed for lack of foreign exchange. Thus, a time trend extrapolation method cannot be used to project the demand for soap and detergents.

b. Cross-Sectional Regression

A cross-sectional regression method based on the consumption and income data of a number of countries which are at a comparable level of development as Ethiopia, would have been a plausible approach for the demand projection of detergent, particularly for detergent powder, for it has been established that the per capita consumption of the product is closely related with the per capita GNP of a country. An analysis of the consumption and income based on data for countries reported in the UNIDO Handbook of Industrial Statistics, 1984, shows a correlation coefficient of 0.90, indicating a close relationship between them. This projection approach, however, could not be used because first of all the countries with the required data have a substantially higher per capita GNP than Ethiopia, thereby distorting the result of the cross-section regression. Secondly, the approach requires a projected data on the per capita GNP for a number of years in the future which is not available for Ethiopia for the projection period.

c. Judgemental

Since the quantitative methods of projection are not applicable in this particular case, due to the unreliability or lack of the data, the projection had to be based on a well considered judgement. The basic assumptions made to project the demand for soap and detergents were:

- The per capita consumption of detergent powder will be 120 grams by 1994 and this would increase at an annual growth rate of about 6% to 200 grams by 2003. This is based on the assumption that Ethiopia might attain by 1994 the lowest per capita income and consumption level shown in Table IV, namely, that of Afghanistan reported to be US $221 and 120 grams, respectively, from 1979 to 1981. A 6% annual growth rate was adopted from the average growth rate computed for the per capita consumption of detergent powder. The exact rate computed for some developing countries with incomes below US $400 was 6.7% from 1972 to 1981[1].

- In the case of bar soaps, including detergent bar, the per capita consumption was assumed to reach 1.25 kgs by 2000. This consumption level is about equal to the average per capita consumption of selected developing countries, excluding Egypt and Senegal, which have reported exceptionally very high consumption levels, shown in Table II. An annual growth rate of 3% was assumed to derive the demand volume for the remaining years of the projection period.

---

[1] UNIDO Handbook on Industrial Statistics, 1984

The assumed consumption level appears conservative compared with that adopted in the Ten Year Perspective Plan. In the plan, it was envisaged that the per capita consumption of soap would reach 3 kgs by 1994. This, however, seems highly optimistic estimate by any standard. Such a consumption level was attained by only those developing countries which have more than US $600 per capita income, higher than that estimated for Ethiopia.

On the basis of the final demand forecast (See Table VI) there will be no supply shortage of washing powder until 1997, by then, however, the supply will be short by 600 tons, increasing to about 6600 tons by 2003. In the case of bar soap, the unsatisfied demand, assuming only a supply from the domestic production, will be about 42,000 tons in 1994, reaching to about 83,000 tons by 2003.

It should be noted at this juncture that the demand for detergent bar is considered to have been included in the demand estimates for bar soap since its application is similar to common bar soap rather than detergent powder.

4. Pricing and Distribution

The quantity of detergent bars sold in 1985/86 was 765 tons. The ex-factory selling price, including turnover and transaction taxes, in 1987 was Birr 3210.00 and Birr 8606.00 per ton at the Repi Soap Factory and Asmara Soap Factory, respectivley. The selling prices of common bar soaps on the other hand, ranged from Birr 2400 to Birr 2650 per ton during the same period (See Table VII for the complete ex-factory selling prices by each of the factories under the National Chemicals Corporation. The average CIF price per ton of imported common bar soap from 1982/83 to 1985/86 was as follows:

TABLE VI

TOTAL AND UNSATISFIED DEMAND OF SOAP AND DETERGENTS

(TONS)

Year	WASHING POWDER			BAR SOAP			Total
	Per Capita Consumption	Demand	Unsatisfied Demand	Per Capita Consumption	Demand	Unsatisfied Demand	Unsatisfied Demand
1987	0.08	3,700	(4,300)	0.85	39,100	22,100	17,800
1988	0.08	3,800	(4,200)	0.88	41,600	24,600	20,400
1989	0.09	4,400	(3,600)	0.90	43,800	26,800	23,200
1990	0.10	5,000	(3,000)	0.93	46,600	29,600	26,600
1991	0.10	5,200	(2,800)	0.96	49,500	32,500	29,700
1992	0.11	5,800	(2,200)	0.99	52,500	35,500	33,300
1993	0.11	6,000	(2,000)	1.02	55,700	38,700	36,700
1994	0.12	6,800	(1,200)	1.05	59,200	42,200	41,000
1995	0.13	7,500	(500)	1.08	62,600	45,600	45,100
1996	0.13	7,800	(200)	1.11	66,300	49,300	49,100
1997	0.14	8,600	600	1.15	70,600	53,600	54,200
1998	0.15	9,500	1,300	1.18	74,600	57,600	58,900
1999	0.16	10,400	2,400	1.22	79,300	62,300	64,700
2000	0.17	11,400	3,400	1.25	83,600	66,600	70,000
2001	0.18	12,400	4,400	1.29	88,900	71,900	76,300
2002	0.19	13,500	5,500	1.33	94,300	77,300	82,800
2003	0.20	14,600	6,600	1.37	99,900	82,900	89,500

1982/83	:	Birr 1115.35
1983/94	:	Birr 1333.88
1984/85	:	Birr 1150.33
1985/86	:	Birr 766.74

It is clear from the above figures that the locally produced soaps are more expensive than the imported ones. In any case the selling price of a detergent bar should be comparable with that of a common bar soap since they serve the same purpose and one can substitute the other. Considering the present selling prices of the locally produced bar soaps and detergent bars, it would be reasonable to adopt a price within a range of Birr 2400.00 to Birr 3000.00 per ton.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

To determine the capacity of the proposed detergent bar manufacturing plant, two major factors were taken into consideration, namely, the consumer acceptability of detergent bars and the minimum economic and technical size plant.

As indicated in the market study, the demand for detergent bars is included in the demand estimates for bar soap since its application is similar with common soap rather than detergent powder. However, there may be consumer acceptability problems for detergent bars as these, unlike natural soap laundry bars, cannot be used for personal hygiene. It was thus considered appropriate to consider a minimum economic scale for detergent bar production.

TABLE VII

PRICES OF SOAP AND DETERGENTS PRODUCED BY PLANTS UNDER NATIONAL CHEMICALS CORPORATION

(FEBRUARY 1987)

DETERGENTS			S O A P		
Factory/Item	Unit	Gross Sales* (Birr)	Factory/Item	Unit	Gross Sales* (Birr)
Repi Soap Factory	Tons		Gullele Soap Factory		
Roll junior	"	5527.70	Anbassa Soap	Tons	2476.33
" medium	"	5005.51	Nazareth Soap Factory		
" large	"	4314.37	Laundry Soap	"	2466.67
" very large	"	4314.37	Asmara Soap Factory		
" in paper bags	"	4192.06	Laundry Soap	"	2642.86
Essex	"	5140.00	Toilet Soap	"	3562.86
Detergent Bar	"	3210.00			
Red Sea Soap Factory	"		Red Sea Soap Factory		
Omo large	"	4386.63	Lux large	"	6891.33
" medium	"	4510.32	" medium	"	6237.50
" junior	"	5767.90	" junior	"	7584.68
" satchet	"	6178.78	Lifeboy	"	4383.16
Asmara Soap Factory			Astral	"	8823.34
Clue Bars	"	2605.66	Laundry Soap	"	2642.47
" Blue	"	2077.00			
C - 21	"	2077.00			
C - 77	"	2495.20			

* Gross sales includes T.O.T. and sales tax

SOURCE: National Chemicals Corporation.

This is 1 ton per hour. Thus, based on a single shift of 8 hours and 300 working days, such a plant could produce 2400 tonnes of bar a year. This seems to be an appropriate size given the demand forecasts and the ability to expand the production through an increase in shifts.

2. Production Programme

Assuming that the proposed plant could start production in 1994, the capacity utilization of the plant would be 70% in the first year. The capacity utilization of the plant is expected to reach 80% during the second year and 100% starting in the third year.

IV. MATERIALS AND INPUTS

A. RAW MATERIALS

The raw materials used in the manufacture of detergents are quite numerous depending on the type and use of the finished product. The major raw materials and the auxiliaries to produce the various types of detergents are discussed briefly below.

1. Surfactants (Surface - Active Agents)

a. Linear Alkyl Sulfonate (LAS)

LAS are straight chain compounds having ten or more carbon atoms in the chain. They have largely replaced the alkyl benzene sulfonates (ABS) because of the water pollution. Linear alkyl sulfonates are produced by the neutralization of sulfonic acid (obtained by the reaction of linear alkylbenzene with sulfur dioxide) with an alkali. LAS are used as the main active ingredients or surfactants of the powder type detergent as well as liquid detergent and constitute more than 30% of the various detergents. Linear alkyl benzene sulfonates are products of the petroleum processing industry and have to be imported.

2. Builders

a. Soda Ash

This is also a major raw material in the production of detergents which acts as a filler with some building action.

Soda ash is known to exist in sufficient quantities (more than 50 millions of tons) in the Rift Valley Lakes of Shala, Abiyata and Chitu. At present a project is underway to produce soda ash from Lake Abiyata with an annual capacity of about 20,000 tons.

b. Sodium Sulfate

This is another raw material to be produced in the envisaged sulfuric acid complex. The production of sodium sulfate is expected to meet the domestic demand for the detergent, glass and textile plants. The envisaged capacity of the plant is about 8000 tpa, although the actual demand is expected to be not more than 3000 tpa. Sodium sulfate is a filler with building action in soft water.

c. Sodium Tripolyphosphate (STPP)

Sodium tripolyphosphate is used to remove the earth alkaline ions and thus impart water softening characteristics. However, due to the formation of "phosphate fertilizer" which enhances the growth of algae in the waste water, its application has decreased significantly. The newest and seemingly most promising substitute for phosphates is the use of zeolites.[1]

3. Additives

a. Sodium Silicate

This raw material is produced in two plants under the National Chemicals Corporation. The combined capacity of

[1]Layman, Detergents Shift Focus of Zeolities Market, Chem. Eng. News 60 (39) 10 (1982)

the two plants is about 2000 tpa. Sodium silicate is used as corrosion inhibitor with slight building action. Other additives are carboxymethyl cellulose (as antiredeposition unit), fluorescent dye (as optical brightener), tarnish inhibitor (prevention of silverware tarnish), bluings (to improve the whiteness of fabrics by counteracting the natural yellowing tendency) etc.

Perfumes and sometimes dye or pigment are added to improve product characteristics. There is a rehabilitation project being undertaken to produce essential oils (citronella) for domestic detergent and soap plants. The envisaged capacity of the essential oils plant is about 10,000 kg/year.

4. Other Raw Materials

a. Sodium Hydroxide

Sodium Hydroxide (20%) is required for the neutralization reaction; it is now imported. A new plant with an annual capacity of 10,000 tons will commence production in the near future.

b. Sodium Chloride

This raw material is used in special detergent formulations. The production of common salt is under the National Chemicals Corporation. The production capacity of the Saltworks is about 220,000 tons/year with an ongoing expansion at one Saltworks to increase the output by an additional 100,000 tons/year.

B. UTILITIES

The utility requirements of the detergent bar manufacturing plant will be as follows:

Electricity	:	187,200 kWh/year
Water	:	1,000 m^3/year (about 240 m^3 are required for binding the formulation)

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

The principal ingredient is the surfactant which would be an alkylbenzenesulphonate acid (e.g. DDBS). Another major ingredient is the builder which has the purpose of keeping the detached soil in the wash liquor. Sodium phosphate is regarded as the most effective builder in detergent bars, although other materials, such as silicates, can be used.

The bulk of the detergent bar is a filler, usually a carbonate. The material that binds the formulation together is water. Colour and perfume can be added.

For the proposed production of 2400 tons of detergent bars per year, the following raw materials will be required.

DDBS	:	480 tonnes/year
Sodium phosphate	:	600 tonnes/year
Carbonate	:	840 tonnes/year
Water	:	240 m^3/year
Other materials	:	240 tonnes/year

The annual supply programme of the raw materials is given in Table VIII. This has been worked out taking into consideration the planned production programme.

TABLE VIII

ANNUAL RAW MATERIALS SUPPLY PROGRAMME

INPUT	UNIT	Year 1	Year 2	Year 3
DDBS	Ton	336	384	480
Sodium phosphate	"	420	480	600
Carbonate	"	588	672	840
Other materials	"	168	192	240

D. MATERIALS AND INPUT COSTS

1. Cost of Raw Materials

The total annual cost for the imported raw materials will be Birr 2.484 million.

2. Cost of Utilities

Electricity

The cost of electricity will be Birr 0.22/kWh.

Water

Water for process and potable uses will cost Birr $0.5/m^3$.

3. Other Costs

Fuel for Vehicles

The total annual fuel cost for vehicles is estimated to be Birr 10,000.

Packing Materials

The cost of wrapping and packing materials will be about Birr 120,000/year.

V. LOCATION

The best location, would be as an attachment to existing factories, where sharing common services would make the project more attractive. The alternative locations will be Addis Ababa and Asmara. Because of the market advantage of Addis Ababa over Asmara, the best location would be Addis Ababa, especially at the Reppi Soap Factory. However, the proposed integration of the envisaged plant at the Reppi Soap Factory will require further indepth evaluation. For the purpose of financial analysis, the detergent bars manufacturing plant was assumed to be an independent unit.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Alternative Technologies of Detergent Production

The manufacture of detergents varies with the form of the final product, that is, powder, liquid or bar. Each requires a different manufacturing process and different raw materials, and the various manufacturing processes are discussed briefly below:

a. Powder Detergents

The most conventional process of production is spray drying, the process used in all the three detergent units in Ethiopia for the production of household and general purpose powder detergents. To scour the powder, the detergent fines from the cyclones of the spray drying system, are dry blended with fillers.

b. Liquid Detergents

Liquid detergents are produced by a neutralization of acids, such as dodecyl benzene sulfonic acid, with caustic soda so as the detergent is 10% - 14% of the formulation, and by adding a [illegible]otrope, a chemical which has the property of increasing the aqueous solubility of various slightly soluble organic chemicals such as urea and water. The water is about 83% - 8[illegible] of the formulation. Liquid detergents for various applications can be prepared by simple alterations of the inputs using the same facility. Sodium nypochlorite can be used as a cleansing agent.

c. Detergent Bars

For all practical purposes, the constituent of detergent bars (cakes) are almost the same as powder detergents. The paste (spray dried powder) is blended with builders and fillers in a blender, milled in a roll mill for homogenization, extruded and then cut into bars (cakes).

In Ethiopia, detergent bars are preferred for the following main reasons:

- The production of detergent bars does not require fuel for the hot air generation and its steam requirement is only for lowering the viscosity of the acid for the paste preparation;

- The production process is relatively simple both in the operation and maintenance of machinery;

- The product would have wide acceptance because of the traditional way of washing cloth using running river water where the application of powder detergent and liquid detergent would be inconvenient and uneconomical.

- The cost of production per unit of output is lower than that of detergent powder (in terms of fuel savings alone).

2. <u>Manufacturing Process</u>

NSD (non-soap-detergent) bars, as they are commonly called, are made from a very viscous mixture consisting of various anhydrous sodium salts together with an acid detergent base, fillers, binders and water. Colour and perfume may be added, if required.

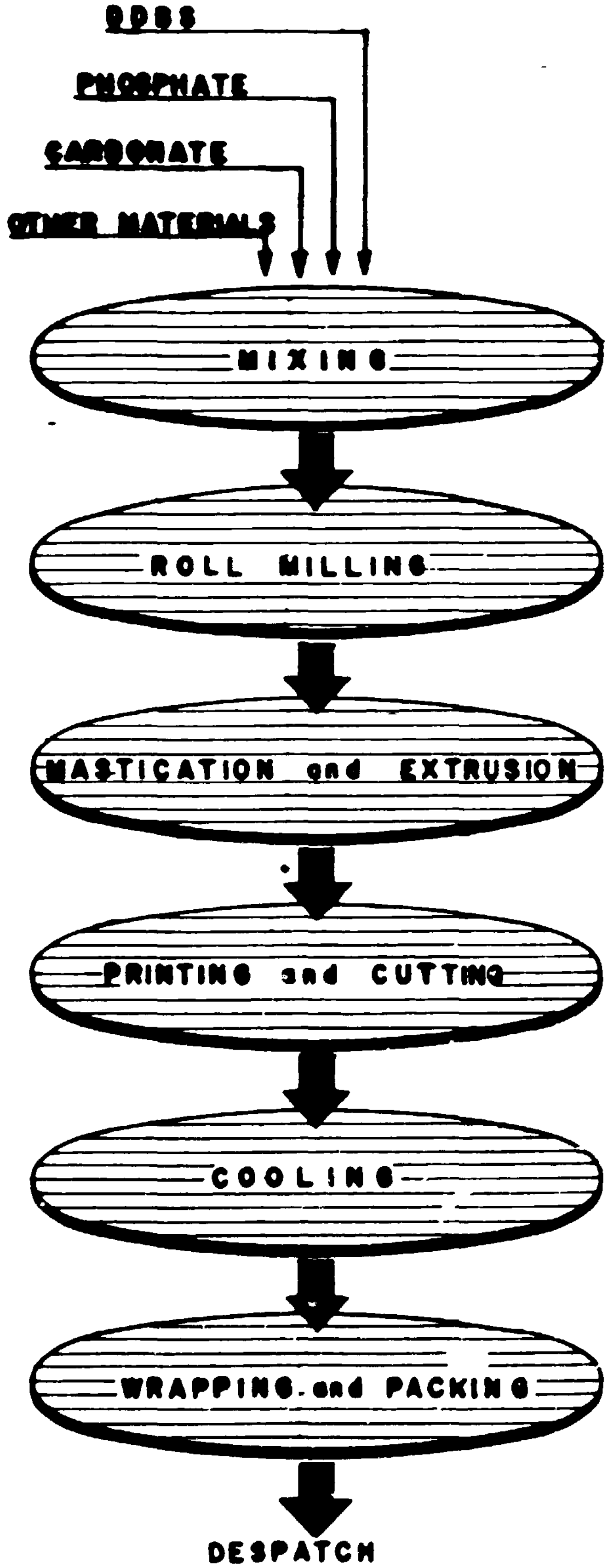
The complex mixture is amalgamated rapidly in a particular order and over a very exact time period on the basis of the formulation. A special multiscrew conveyor transfers the mixture to a roll mill while simultaneously breaking up the larger pieces. The five-roll mill completely removes all lumps and emits an almost homogeneous ribbon to the plodder or compacter. The twin screw plodder uses especially cast variable flight screws rotating at a slow speed to finish the mastication process. The final compaction is under vacuum so that all entrapped air is removed before the mass is extruded as a single or multiple bar of densified synthetic soap.

The extruded bar passes through a roller printer which stamps the trade mark and name of the manufacturing company/ factory on to it. Then the bar is cut automatically by an adjustable cutting machine. The cut tablets finally are refrigerated in a cooling tunnel before wrapping and packing.

From mixing to leaving the cooling tunnel, the process is about 20 minutes. If there is a mechanical breakdown or power failure, it is important to remove the mixture from the production line before it sets and turns into a concrete-like mass. The process flow chart for the manufacturing of detergent bars is given in Figure I.

FIGURE I

PROCESS FLOW CHART OF DETERGENT BARS PRODUCTION



3. Source of Technology

The process technology is quite simple and is readily available from plant suppliers such as:

Britannia Soap Machinery,
Battle Road,
Heathfield,
Newton Abbot T212 6XT,
UK.
Telex 42577

The product formulation has to be obtained from one of the international detergent manufacturers such as Unilever, Procter & Gamble and Henkel.

B. ENGINEERING

1. Machinery and Equipment

The machinery and equipment is made from high grade stainless steel. The list of the required machinery and equipment and their costs are given in Table IX.

2. Plant Layout

The factory size will be about 375 m^2 and should be located on a site at least 500 m^2. The actual production area will be about 115 m^2.

The plant layout is shown in Figure II.

TABLE IX
TOTAL FIXED INVESTMENT COST

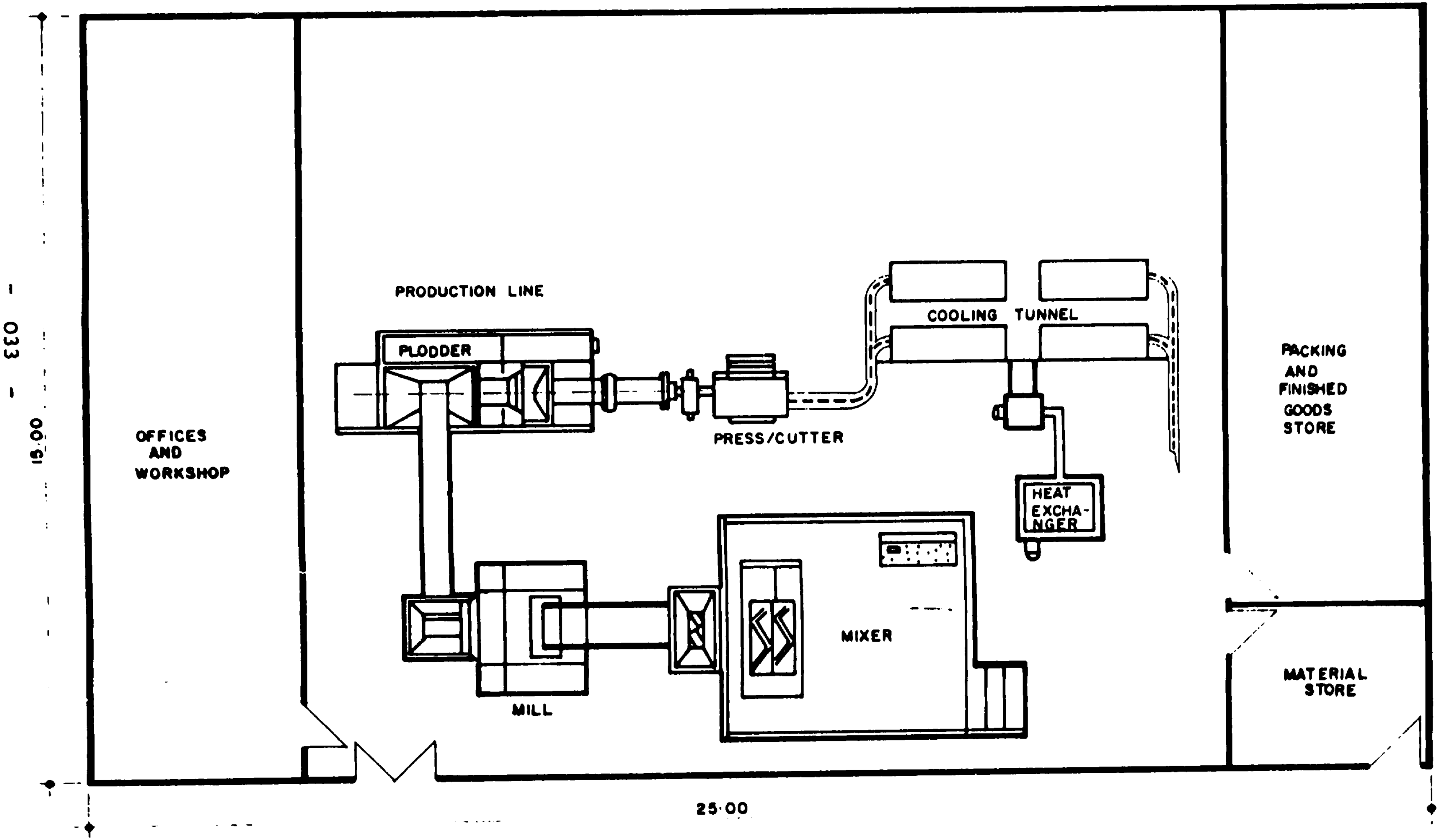
Description	COST ('000 BIRR)		
	F.C	L.C	TOTAL
A. MACHINERY AND EQUIPMENT			
Mixer (tilting type)			
Roll mill (5 roller)			
Plodder			
Stamping Press			
Cutter			
Cooling Tunnel			
Total Detergent Plant and Equipment Cost	621		621
Spare Parts	62.1	-	62.1
Total Equipment Cost	683.1	-	683.1
Freight		62.1	62.1
Total Machinery Cost (C & F)	683.1	62.1	745.2
Local Cost (12.5% of C & F)		93	93
Erection	18	8	26
Total cost of machinery and equipment (Incl. 10% contingency)	771	179	950

TABLE IX (Cont'd)

Description	COST ('000 BIRR)		
	F.C	L.C	TOTAL
B. <u>BUILDING AND CIVIL WORKS</u>			
Building cost	101	237	338
Site Development (2% of building cost)		7	7
Outdoor Works (Sewage, drainage piping, etc., 10% of building cost)		34	34
Total Building and Civil Works Cost (Incl. 10% contingency)	111	306	417
C. <u>SERVICE EQUIPMENT</u>			
Office Furniture and Equipment	7	16	23
D. <u>VEHICLES</u>			
Pick-up (one)	28	12	40
Service Car (one)	17	8	25
Total Vehicle Cost (Incl. 10% contingency)	50	22	72

FIGURE II

LAYOUT FOR DETERGENT BAR PRODUCTION



SCALE 1:100

VII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organization chart of the proposed plant is given in Figure III. The detergent bar manufacturing plant will be headed by a plant manager, who should be qualified in synthetic chemistry. He will report directly to the National Chemicals Corporation (NCC), which has three detergent manufacturing plants under its management.

B. MANPOWER

An estimate of the manpower resources required to operate the plant is given in Table X. Since there is sufficient experience in the manufacture of detergents, it will not be necessary to train the key personnel abroad. Training in product formulation and controlling of the manufacturing process could be undertaken during the plant commissioning.

FIGURE III

ORGANIZATION CHART OF DETERGENT BAR PLANT

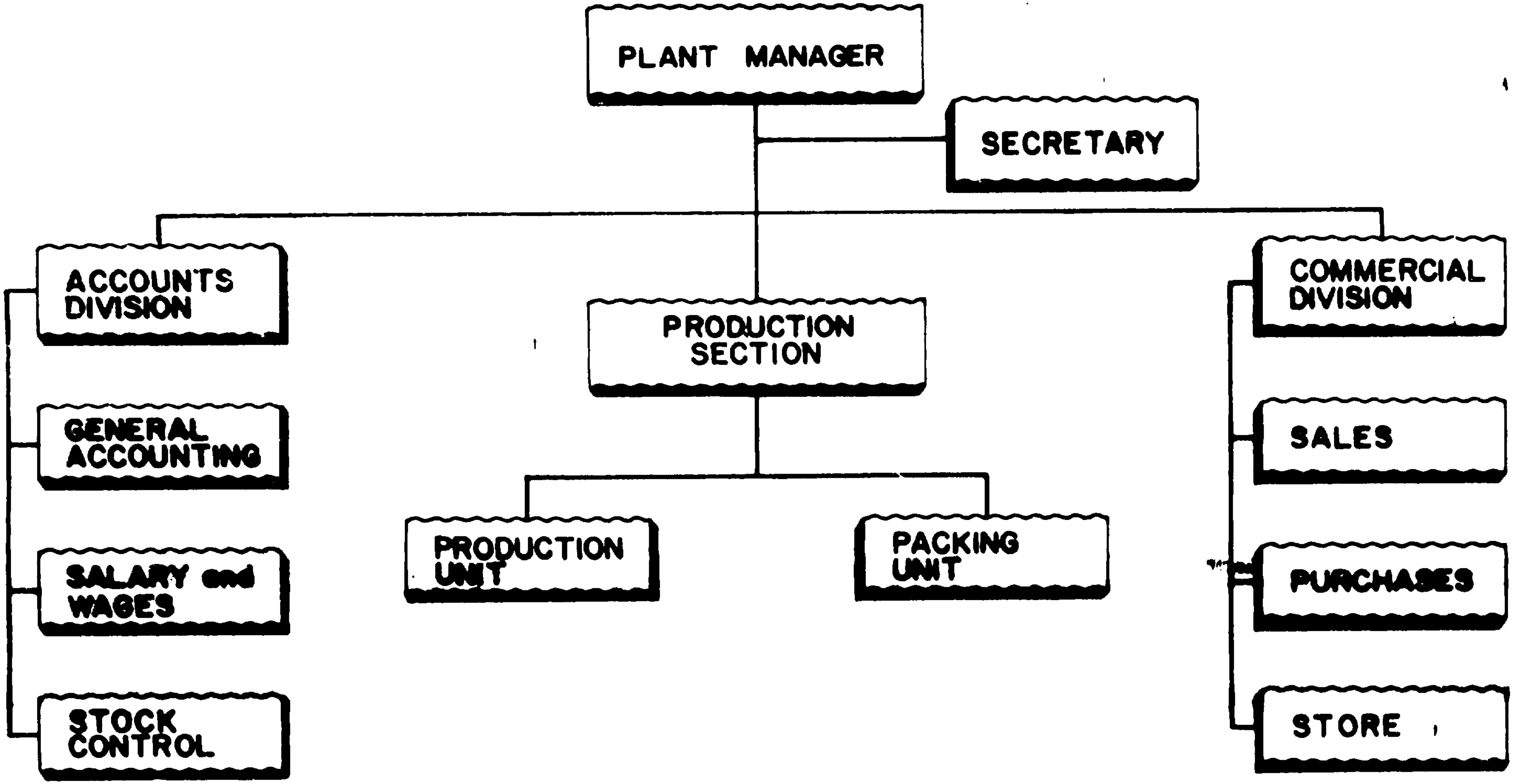


TABLE X
MANPOWER REQUIREMENT AND SALARIES

Personnel	No. Employed	Skill Level	Monthly Salary/ Person (Birr)	Total Annual Salary (Birr)
Plant Manager	1	Professional/tech.	1200	14,400
Secretary	1	Skilled	350	4,200
Accountant (Chief)	1	"	700	8,400
Accountant	1	"	450	5,400
Clerk	2	"	250	6,000
Administrator	1	"	600	7,200
General Service	1	"	350	4,200
Commercial, Head	1	"	600	7,200
Sales	1	"	450	5,400
Purchaser	1	"	450	5,400
Storekeeper	2	"	250	6,000
Production Supervisor	1	"	500	6,000
Material Handler	2	Semi-skilled	200	4,800
Operator	2	" "	150	3,600
Packer	6	Unskilled	90	6,480
Driver	2	Skilled	250	6,000
Guard	6	Unskilled	90	6,480
Messenger	1	"	70	840
Cleaner	2	"	70	1,680
Total (incl. 25% employment benefits)	35			78,750

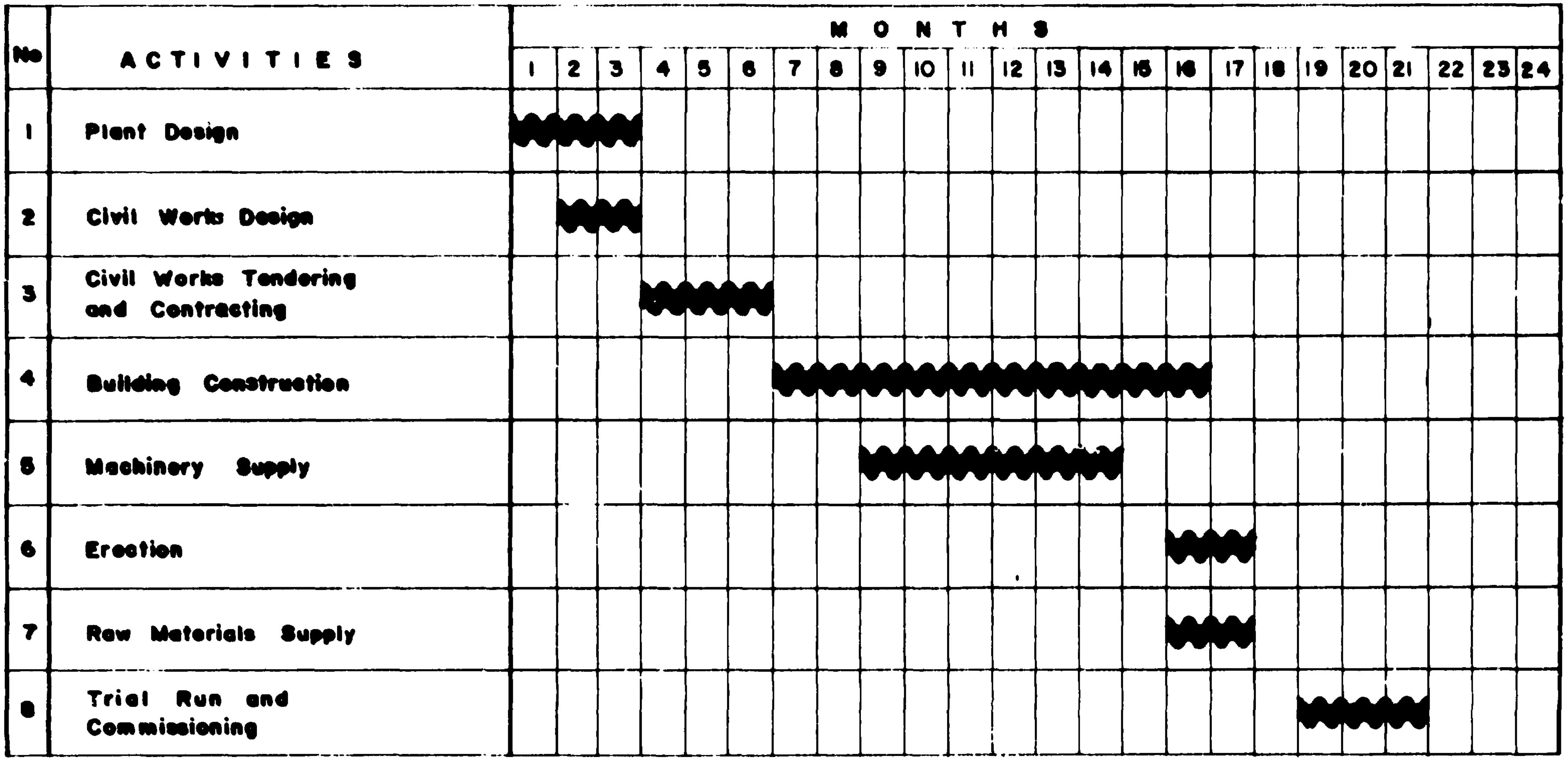
Skill distribution		%
Professional/technical	1	2.8
Skilled	15	42.8
Semi-skilled	4	11.4
Unskilled	15	42.8
Total	35	100

VIII. IMPLEMENTATION SCHEDULE

A general schedule for the project implementation has been worked out and is given in Figure IV. About 21 months will be required for plant design and construction. It must be noted however that if the plant is to be integrated with the Reppi Soap Factory after a through analysis and evaluation of the existing conditions there, then the establishment of the proposed detergent bar manufacturing plant could be undertaken in a shorter time.

FIGURE IV

IMPLEMENTATION SCHEDULE OF DETERGENTS BARS PRODUCTION PLANT



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS - DETERGENTS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table XI.

TABLE XI

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Buildings and Civil Works	74.00	203.00	277.00
Plant Machinery and equipment	771.00	179.00	950.00
Office furniture and equipment	7.00	16.00	23.00
Vehicles	50.00	22.00	72.00
Pre-production Expenditure	17.52	157.68	175.20
Total	919.52	577.68	1497.20

The foreign currency component of the total initial investment cost will be about 62%. About 84% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the working capital requirements of the detergent bars plant.

Items	Months of Coverage
1. Cash - in hand	0.5
2. Accounts Receivable	2.0
3. Raw Materials - Foreign	6.0
4. Raw Materials - Local	0.3
5. Work in progress	0.07
6. Finished Products	2.0
7. Accounts Payable	1.0

The net working capital requirement will be Birr 1.85 million, of which Birr 1.69 million will be required in foreign currency.

3. Production Costs

The detailed production cost estimation is given together with other required financial statements. The production cost at full capacity amounts to Birr 2.97 million, out of which about 81% is in foreign currency.

4. Internal Rate of Return (IRR)

The detergent bars plant will be financially viable with an internal rate of return of 55.44% and a net present value of Birr 9.79 million discounted at 10% P.a. The average selling price assumed was Birr 2700 per tonne. More attention should be given to consumer acceptability of detergent bars. Moreover, the project seems sensitive to raw material costs, especially the surfactant. Therefore, the viability of this project depends both on the market for detergent bars and also a reliable and inexpensive source of the raw materials.

5. Breakeven Analysis

The breakeven point would be reached at a production of 200 tonnes of detergent bars. The total revenue generated at the breakeven point would be Birr 0.54 million.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 180.7%, with a net present value of Birr 45.1 million discounted at 10% P.a. This was arrived at by taking a considered ex-factory price for 100 gram bars amounting to US $2 a kilo. This needs further refining during the feasibility stage since the quality of bars imported and those assumed to be produced locally are taken to be comparable. The market study should also be refined.

APPENDIX A

TABLE OF FINANCIAL AND ECONOMIC ANALYSES

TABLE A.1

COMFAR 21 UNIDO

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Detergent Bars Plant
October 1987
Opportunity Studies

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 000 Birr

Total initial investment during construction phase

fixed assets:	1497.20	61.416 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1497.20	61.416 % foreign

Source of funds during construction phase

equity & grants:	1497.20	61.416 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	1497.20	61.416 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	2012.56	2277.77	2808.21
depreciation :	160.59	160.59	160.59
interest :	0.00	0.00	0.00
production costs	2173.15	2438.36	2968.80
thereof foreign	78.84 %	79.48 %	80.42 %
total sales :	4536.00	5184.00	6480.00
gross income :	2362.85	2745.64	3511.20
net income :	1181.43	1372.82	1755.60
cash balance :	36.59	1353.52	1556.42
net cashflow :	36.59	1353.52	1556.42

Net Present Value at: 10.00 % = 9792.95
Internal Rate of Return: 55.44 %
Return on equity1: 70.65 %
Return on equity2: 55.44 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	156.00	111.00
Auxiliary and service facilities .	7.20	64.80
Incorporated fixed assets	2.30	20.70
Plant machinery and equipment . . .	475.00	475.00
Total fixed investment costs	65[illegible].50	671.50
Pre-production capital expenditures.	87.60	87.60
Net working capital	0.00	0.00
Total initial investment costs . . .	738.10	759.10
Of it foreign, in %	60.15	62.65

Detergent bars Plant -- October 1987

TABLE A.3

-- COMFAR 2.0 - Industrial Projects Service, Addis Ababa -----

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9	10-12
% of nom. capacity (single product).	70.00	80.00	100.00	100.00	100.00	100.00
Raw material 1	1738.80	1987.20	2484.00	2484.00	2484.00	2484.00
Other raw materials	84.00	96.00	120.00	120.00	120.00	120.00
Utilities	14.75	16.56	20.20	20.20	20.20	20.20
Energy	7.30	8.20	10.00	10.00	10.00	10.00
Labour, direct	76.75	78.75	78.75	78.75	78.75	78.75
Repair, maintenance	60.26	60.26	60.26	60.26	60.26	60.26
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	8.20	8.80	10.00	10.00	10.00	10.00
Factory costs	1992.06	2255.77	2783.21	2783.21	2783.21	2783.21
Administrative overheads	20.50	22.00	25.00	25.00	25.00	25.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	160.59	160.59	160.59	111.15	112.59	125.55
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	2173.15	2438.36	2968.80	2919.36	2920.80	2933.76
Costs per unit (single product) .	1.29	1.27	1.24	1.22	1.22	1.22
Of it foreign, %	78.84	79.48	80.42	81.32	81.32	81.27
Of it variable,%	85.43	87.02	89.34	90.85	90.80	90.40
Total labour	76.75	78.75	78.75	78.75	78.75	78.75

Detergent Bars Plant --- October 1987

TABLE A.3 (Cont'd)

-- COMFAR 2.0 - Industrial Projects Service, Addis Ababa -----

Total Production Costs in '000 Birr

Year	13-17
% of nom. capacity (single product).	100.00
Raw material 1	2484.00
Other raw materials	120.00
Utilities	20.20
Energy	10.00
Labour, direct	78.75
Repair, maintenance	60.26
Spares	0.00
Factory overheads	10.00
Factory costs	2783.21
Administrative overheads	25.00
Indir. costs, sales and distribution	0.00
Direct costs, sales and distribution	0.00
Depreciation	28.25
Financial costs	0.00
Total production costs	2836.46
Costs per unit (single product) .	1.18
Of it foreign, %	81.31
Of it variable,%	93.50
Total labour	78.75

TABLE A.4

COMFAR 2.0 Industrial Projects Service, Addis Ababa

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	60	6.0	335.43	379.63	468.04	468.04
Inventory and materials	157	2.3	793.59	906.96	1133.70	1133.70
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	0	---	0.00	0.00	0.00	0.00
Finished products	60	6.0	335.43	379.63	468.04	468.04
Cash in hand	15	24.0	6.99	7.08	7.25	7.25
Total current assets			1471.43	1673.29	2077.02	2077.02
Current liabilities and						
Accounts payable	30	12.0	166.00	187.98	231.93	231.93
Net working capital			1305.43	1485.31	1845.09	1845.09
Increase in working capital			1305.43	179.89	359.77	0.00
Net working capital, local			116.50	128.42	152.25	152.25
Net working capital, foreign			1188.93	1356.90	1692.84	1692.84

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

---------- COMFAR 2.0 - Industrial Projects Service, Addis Ababa -----

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	738.10	759.10
Financial resources .	738.10	759.10
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	738.10	759.10
Total assets	738.10	759.10
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	294.14	283.54
Outflow, local	294.14	283.54
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	443.96	475.56
Outflow, foreign . . .	443.96	475.56
Surplus (deficit) .	0.00	0.00
Net cashflow	-738.10	-759.10
Cumulated net cashflow	-738.10	-1497.20

Detergent Bars Plant --- October 1987

TABLE A.5 (Cont'd)

CONFAR 2.0 - Industrial Projects Service, Addis Ababa

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	4702.00	5205.98	6523.95	6480.00	6480.00	6480.00
Financial resources .	166.00	21.98	43.95	0.00	0.00	0.00
Sales, net of tax . .	4536.00	5184.00	6480.00	6480.00	6480.00	6480.00
Total cash outflow . .	4665.41	3852.46	4967.54	4563.81	4563.81	4595.73
Total assets	1471.43	201.86	403.73	0.00	0.00	7.20
Operating costs . . .	2012.56	2277.77	2808.21	2808.21	2808.21	2808.21
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	1181.43	1372.82	1755.60	1755.60	1755.60	1780.32
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	36.59	1353.52	1556.42	1916.19	1916.19	1884.27
Cumulated cash balance	36.59	1390.11	2946.53	4862.72	6778.91	8663.18
Inflow, local	4567.14	5187.25	6486.49	6480.00	6480.00	6480.00
Outflow, local	1723.26	1822.64	2301.50	2271.17	2271.17	2298.09
Surplus (deficit) .	2843.88	3364.61	4185.00	4208.83	4208.83	4181.91
Inflow, foreign . . .	134.86	18.73	37.46	0.00	0.00	0.00
Outflow, foreign . . .	2942.15	2029.82	2666.04	2292.64	2292.64	2297.64
Surplus (deficit) .	-2807.29	-2011.09	-2628.58	-2292.64	-2292.64	-2297.64
Net cashflow	36.59	1353.52	1556.42	1916.19	1916.19	1884.27
Cumulated net cashflow	-1460.61	-107.09	1449.33	3365.52	5281.71	7165.98

Detergent Bars Plant --- October 1987

TABLE A.5 (Cont'd)

-- COMFAR 2.0 - Industrial Projects Service, Addis Ababa -----

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	6480.00	6480.00	6480.00	6480.00	6480.00	6480.00
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	6480.00	6480.00	6480.00	6480.00	6480.00	6480.00
Total cash outflow . .	4652.61	4581.33	4581.33	4581.33	4637.18	4694.78
Total assets	64.80	0.00	0.00	0.00	7.20	64.80
Operating costs . . .	2808.21	2808.21	2808.21	2808.21	2808.21	2808.21
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	1779.60	1773.12	1773.12	1773.12	1821.77	1821.77
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	1827.39	1898.67	1898.67	1898.67	1842.82	1785.22
Cumulated cash balance	10490.57	12389.24	14287.91	16186.58	18029.40	19814.62
Inflow, local	6480.00	6480.00	6480.00	6480.00	6460.00	6480.00
Outflow, local	2314.97	2288.69	2288.69	2288.69	2339.54	2357.14
Surplus (deficit) .	4165.03	4191.31	4191.31	4191.31	4140.46	4122.86
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	2337.64	2292.64	2292.64	2292.64	2297.64	2337.64
Surplus (deficit) .	-2337.64	-2292.64	-2292.64	-2292.64	-2297.64	-2337.64
Net cashflow	1827.39	1898.67	1898.67	1898.67	1842.82	1785.22
Cumulated net cashflow	8993.37	10892.04	12790.71	14689.38	16532.20	18317.42

TABLE A.5 (Cont'd)

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	6480.00	6480.00	6480.00
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	6480.00	6480.00	6480.00
Total cash outflow . .	4629.98	4629.98	4629.98
Total assets	0.00	0.00	0.00
Operating costs . . .	2808.21	2808.21	2808.21
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	1821.77	1821.77	1821.77
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	1850.02	1850.02	1850.02
Cumulated cash balance	21664.64	23514.66	25364.68
Inflow, local	6480.00	6480.00	6480.00
Outflow, local	2337.34	2337.34	2337.34
Surplus (deficit) .	4142.66	4142.66	4142.66
Inflow, foreign . . .	0.00	0.00	0.00
Outflow, foreign . . .	2292.64	2292.64	2292.64
Surplus (deficit) .	-2292.64	-2292.64	-2292.64
Net cashflow	1850.02	1850.02	1850.02
Cumulated net cashflow	20167.44	22017.46	23867.48

- 052 -

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Return on Equity 1:

Net present value	10081.12	at	10.00 %
Internal Rate of Return (IRRE1) ..	70.65 %		

b) Return on Equity 2:

Net present value	9792.95	at	10.00 %
Internal Rate of Return (IRRE2) ..	55.44 %		

c) Internal Rate of Return on total investment:

Net present value	9792.95	at	10.00 %
Internal Rate of Return (IRR) ..	55.44 %		

Equity 1 = Total equity paid : Net income

Equity 2 = Initial equity paid : Net cash return

TABLE A.6

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	4536.00	5184.00	6480.00	6480.00	6480.00
Less: variable costs, incl. sales tax.	1856.53	2121.74	2652.18	2652.18	2652.18
Variable margin	2679.47	3062.26	3827.82	3827.82	3827.82
As % of total sales	59.07	59.07	59.07	59.07	59.07
Non-variable costs, incl. depreciation	316.62	316.62	316.62	316.62	316.62
Operational margin	2362.85	2745.64	3511.20	3511.20	3511.20
As % of total sales	52.09	52.96	54.19	54.19	54.19
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	2362.85	2745.64	3511.20	3511.20	3511.20
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	2362.85	2745.64	3511.20	3511.20	3511.20
Tax	1181.43	1372.82	1755.60	1755.60	1755.60
Net profit	1181.43	1372.82	1755.60	1755.60	1755.60
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1181.43	1372.82	1755.60	1755.60	1755.60
Accumulated undistributed profit	1181.43	2554.24	4309.84	6065.44	7821.04
Gross profit, % of total sales	52.09	52.96	54.19	54.19	54.19
Net profit, % of total sales	26.05	26.48	27.09	27.09	27.09
ROE, Net profit, % of equity	78.91	91.69	117.26	117.26	117.26
ROI, Net profit+interest, % of invest.	42.15	46.03	52.53	52.53	52.53

TABLE A.6 (Cont'd)

CONFAR 2.0 - Industrial Projects Service, Addis Ababa

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales ta	6480.00	6480.00	6480.00	6480.00	6480.00
Less: variable costs, incl. sales tax.	2652.18	2652.18	2652.18	2652.18	2652.18
Variable margin	3827.82	3827.82	3827.82	3827.82	3827.82
As % of total sales	59.07	59.07	59.07	59.07	59.07
Non-variable costs, incl. depreciation	267.18	268.62	281.58	281.58	281.58
Operational margin	3560.64	3559.20	3546.24	3546.24	3546.24
As % of total sales	54.95	54.93	54.73	54.73	54.73
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	3560.64	3559.20	3546.24	3546.24	3546.24
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	3560.64	3559.20	3546.24	3546.24	3546.24
Tax	1780.32	1779.60	1773.12	1773.12	1773.12
Net profit	1780.32	1779.60	1773.12	1773.12	1773.12
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1780.32	1779.60	1773.12	1773.12	1773.12
Accumulated undistributed profit	9601.37	11380.96	13154.06	14927.21	16700.32
Gross profit, % of total sales	54.95	54.93	54.73	54.73	54.73
Net profit, % of total sales	27.47	27.46	27.36	27.36	27.36
ROE, Net profit, % of equity	118.91	118.86	118.43	118.43	118.43
ROI, Net profit+interest, % of invest.	53.15	52.12	51.93	51.93	51.93

Detergent Bars Plant --- October 1987

TABLE A.6 (Cont'd)

Net Income Statement in 000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	6480.00	6480.00	6480.00	6480.00	6480.00
Less: variable costs, incl. sales tax.	2652.18	2652.18	2652.18	2652.18	2652.18
Variable margin	3827.82	3827.82	3827.82	3827.82	3827.82
As % of total sales	59.07	59.07	59.07	59.07	59.07
Non variable costs, incl. depreciation	184.28	184.28	184.28	184.28	184.28
Operational margin	3643.54	3643.54	3643.54	3643.54	3643.54
As % of total sales	56.23	56.23	56.23	56.23	56.23
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	3643.54	3643.54	3643.54	3643.54	3643.54
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	3643.54	3643.54	3643.54	3643.54	3643.54
Tax	1821.77	1821.77	1821.77	1821.77	1821.77
Net profit	1821.77	1821.77	1821.77	1821.77	1821.77
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1821.77	1821.77	1821.77	1821.77	1821.77
Accumulated undistributed profit	18522.09	20343.86	22165.63	23987.40	25809.17
Gross profit, % of total sales	56.23	56.23	56.23	56.23	56.23
Net profit, % of total sales	28.11	28.11	28.11	28.11	28.11
ROE, Net profit, % of equity	121.68	121.68	121.68	121.68	121.68
ROI, Net profit+interest, % of invest.	[illegible]	52.26	52.26	52.26	52.26

TABLE A.7

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	738.10	1497.20
Fixed assets, net of depreciation	0.00	738.10
Construction in progress	738.10	759.10
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	738.10	1497.20
Equity capital	738.10	1497.20
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required.	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

Detergent Bars Plant --- October 1987

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 birr

Year	3	4	5	6	7	8
Total assets	2844.63	4239.43	6038.98	7794.58	9550.18	11330.50
Fixed assets, net of depreciation	1336.61	1176.02	1015.43	854.84	694.25	583.10
Construction in progress	0.00	0.00	0.00	0.00	0.00	7.20
Current assets	1464.44	1666.22	2069.77	2069.77	2069.77	2069.77
Cash, bank	6.99	7.06	7.25	7.25	7.25	7.25
Cash surplus, finance available	36.59	1390.11	2946.53	4862.72	6778.91	8663.18
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	2844.63	4239.43	6038.98	7794.58	9550.18	11330.50
Equity capital	1497.20	1497.20	1497.20	1497.20	1497.20	1497.20
Reserves, retained profit	0.00	1181.43	2554.24	4309.84	6065.44	7821.04
Profit	1181.43	1372.82	1755.60	1755.60	1755.60	1780.32
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	166.00	187.98	231.93	231.93	231.93	231.93
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	166.00	187.98	231.93	231.93	231.93	231.93
Equity, % of liabilities	52.6	35.32	24.79	19.21	15.68	13.21

TABLE A.7 (Cont'd)

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	13110.10	14883.22	16656.34	18429.46	20251.23	22073.00
Fixed assets, net of depreciation	477.71	416.96	291.41	165.86	137.61	116.56
Construction in progress	64.80	0.00	0.00	0.00	7.20	64.80
Current assets	2069.77	2069.77	2069.77	2069.77	2069.77	2069.77
Cash, bank	7.25	7.25	7.25	7.25	7.25	7.25
Cash surplus, finance available	10490.57	12389.24	14287.91	16186.58	18029.40	19814.62
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	13110.10	14883.22	16656.34	18429.46	20251.23	22073.00
Equity capital	1497.20	1497.20	1497.20	1497.20	1497.20	1497.20
Reserves, retained profit	9601.37	11380.96	13154.08	14927.21	16700.32	18522.09
Profit	1779.60	1773.12	1773.12	1773.12	1821.77	1821.77
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	231.93	231.93	231.93	231.93	231.93	231.93
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	231.93	231.93	231.93	231.93	231.93	231.93
Equity, % of liabilities	11.42	10.06	8.99	8.12	7.39	6.78

Detergent Bars Plant --- October 1987

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in 000 Birr

Year	15	16	17
Total assets	23894.77	25716.54	27538.30
Fixed assets, net of depreciation	153.11	124.86	96.61
Construction in progress	0.00	0.00	0.00
Current assets	2069.77	2069.77	2069.77
Cash, bank	7.25	7.25	7.25
Cash surplus, finance available	21664.63	23514.65	25364.67
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	23894.77	25716.54	27538.30
Equity capital	1497.20	1497.20	1497.20
Reserves, retained profit	20343.86	22165.63	23987.40
Profit	1821.77	1821.77	1821.77
Long and medium term debt	0.00	0.00	0.00
Current liabilities	231.93	231.93	231.93
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	231.93	231.93	231.93
Equity, % of liabilities	6.27	5.82	5.44

TABLE A.8

ECONOMIC ANALYSIS

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	663.91	682.28
Financial resources	663.91	682.28
Sales, net of tax	0.00	0.00
Total cash outflow	663.91	682.28
Total assets	663.91	682.28
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	219.95	206.72
Outflow, local	219.95	206.72
Surplus (deficit)	0.00	0.00
Inflow, foreign	443.96	475.56
Outflow, foreign	443.96	475.56
Surplus (deficit)	0.00	0.00
Net cashflow	-663.91	-682.28
Cumulated net cashflow	-663.91	-1346.19

Detergent Bars Plant --- October 1987

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	7113.42	7969.96	9978.33	9936.00	9936.00	9936.00
Financial resources .	158.22	21.16	42.33	0.00	0.00	0.00
Sales, net of tax . .	6955.20	7948.80	9936.00	9936.00	9936.00	9936.00
Total cash outflow . .	3348.53	2367.19	3075.47	2679.32	2679.32	2685.31
Total assets	1434.52	198.07	396.15	0.00	0.00	5.99
Operating costs . . .	1914.01	2169.11	2679.32	2679.32	2679.32	2679.32
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	3764.89	5602.78	6902.87	7256.68	7256.68	7250.69
Cumulated cash balance	3764.89	9367.67	16270.53	23527.21	30783.89	38034.58
Inflow, local	6978.56	7951.23	9940.87	9936.00	9936.00	9936.00
Outflow, local	406.38	337.37	409.42	386.68	386.68	387.67
Surplus (deficit) .	6572.18	7613.87	9531.45	9549.32	9549.32	9548.33
Inflow, foreign . . .	134.86	18.73	37.46	0.00	0.00	0.00
Outflow, foreign . . .	2942.15	2029.82	2666.04	2292.64	2292.64	2297.64
Surplus (deficit) .	-2807.29	-2011.09	-2628.58	-2292.64	-2292.64	-2297.64
Net cashflow	3764.89	5602.78	6902.86	7256.68	7256.68	7250.69
Cumulated net cashflow	2418.70	8021.48	14924.34	22181.02	29437.70	36688.39

TABLE A.8 (Cont'd)

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	9936.00	9936.00	9936.00	9936.00	9936.00	9936.00
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	9936.00	9936.00	9936.00	9936.00	9936.00	9936.00
Total cash outflow	2733.23	2679.32	2679.32	2679.32	2685.31	2733.23
Total assets	53.91	0.00	0.00	0.00	5.99	53.91
Operating costs	2679.32	2679.32	2679.32	2679.32	2679.32	2679.32
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	7202.77	7256.68	7256.68	7256.68	7250.69	7202.77
Cumulated cash balance	45237.35	52494.03	59750.71	67007.39	74258.08	81460.85
Inflow, local	9936.00	9936.00	9936.00	9936.00	9936.00	9936.00
Outflow, local	395.59	386.68	386.68	386.68	387.67	395.59
Surplus (deficit)	9540.41	9549.32	9549.32	9549.32	9548.33	9540.41
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	2337.64	2292.64	2292.64	2292.64	2297.64	2337.64
Surplus (deficit)	-2337.64	-2292.64	-2292.64	-2292.64	-2297.64	-2337.64
Net cashflow	7202.77	7256.68	7256.68	7256.68	7250.69	7202.77
Cumulated net cashflow	43891.16	51147.84	58404.52	65661.20	72911.89	80114.66

Detergent Bars Plant --- October 1987

TABLE A.8 (Cont'd)

COMFAR 2.0 - Industrial Projects Service, Addis Ababa

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	9936.00	9936.00	9936.00
Financial resources	0.00	0.00	0.00
Sales, net of tax	9936.00	9936.00	9936.00
Total cash outflow	2679.32	2679.32	2679.32
Total assets	0.00	0.00	0.00
Operating costs	2679.32	2679.32	2679.32
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	7256.68	7256.68	7256.68
Cumulated cash balance	88717.53	95974.21	103230.90
Inflow, local	9936.00	9936.00	9936.00
Outflow, local	386.68	386.68	386.68
Surplus (deficit)	9549.32	9549.32	9549.32
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	2292.64	2292.64	2292.64
Surplus (deficit)	-2292.64	-2292.64	-2292.64
Net cashflow	7256.68	7256.68	7256.68
Cumulated net cashflow	87371.34	94628.02	101884.70

Detergent Bars Plant --- October 1987

TABLE A.8 (Cont'd)

Cashflow Discounting:

```
a) Return on Equity 1:
        Net  present  value .. ...........  45926.97  at     10.00 %
        Internal Rate of Return  (IRRE1) ..   202.46 %
b) Return on Equity 2:
        Net  present  value ....... ......  45104.97  at     10.00 %
        Internal Rate of Return  (IRRE2) ..   180.70 %
c) Internal Rate of Return on total investment:
        Net  present  value ..............  45104.97  at     10.00 %
        Internal Rate of Return  ( IRR ) ..   180.70 %
Equity 1 = Total equity paid : Net income
Equity 2 = Initial equity paid : Net cash return
```

- P -

AMMONIUM CHLORIDE

TABLE OF CONTENTS

I. SUMMARY

The plant is intended to produce ammonium chloride mainly used by dry cell battery as an electrolyte. The projected market demand is 113 tons in 1988, reaching 228 tons in 2003. The minimum economic scale is about 300 tons per annum.

The major raw materials used are sodium chloride (common salt), limestone, ammonia, and ammonium sulphate. As the latter two are not locally available, they will have to be imported.

The initial fixed investment cost is estimated to be 1.15 million Birr, of which 46% is in foriegn currency. The products are totally envisaged for domestic consumption.

The plant can generate employment for 42 persons.

The space required for the building is 250 m^2.

The project has a heavy foreign exchange component and is not financially and economically viable.

II. INTRODUCTION

The profile describes a new chemical for producing ammonium chloride to be used mainly in the manufacture of dry cells, via the ammonium sulphate/sodium chloride route.

Pure ammonium chloride is generally available in the form of white crystals. It is somewhat hygroscopic, soluble in water and glycerol, slightly soluble in alcohol. It sublimes at 350°C and has a specific gravity of 1.54. Ammonium chloride is toxic by inhalation (tolerance fume 10 mg/m^3 of air). It is mainly used in the manufacture of dry cells, as a flux in tinning and galvanising and in pharmaceuticals. It is also used as a good fertilizer for rice and sugar cane, for snow treatment, resins and adhesive of urea formaldehyde and in the food industry.

The by-product of the ammonium sulphate/sodium chloride process route is sodium sulphate which has many uses such as:

- in production of kraft and sulphate paper, helps to digest wood chips;

- in glass manufacture, speeds up melting process, improves boiling and working properties of high silica glass (although there are associated air pollution and refactory corrosion problems), and

- an ingredient in household laundry detergent.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Ammonium chloride, also referred to as salt ammoniac, is salt of ammonia and hydrogen chloride. Its principal use is as an electrolyte in dry cells; it is also extensively used as a constituent for galvanizing, tinning, and soldering fluxes to remove oxide coatings from metals and thereby improve the adhesive of the solders. Additionally, it is a component of many proprietory cold and cough remedies.

Ammonium chloride (NH_4Cl), is a white crystalline volatile salt that occurs naturally, especially as a product of volcanic action or is manufactured using different production techniques. Ammonium chloride is a substance that is very soluble in water forming a slightly acidic solution. It vaporizes without melting at 340°C to form an equal volume of ammonia and hydrogen chloride.

The chemical is also used in the manufacture of numerous ammonia compounds, fertilizer, washing powders, resins and adhesive of urea - formaldehyde and in the food industry.

The fertilizer grade ammonium chloride could be more effective where potassium (K) is deficient in soils. However, the Ethiopian soil is sufficient in potassium and does not respond to it. Moreover, ammonium chloride has low nitrogen content compared with urea, which is widely used in the country. The other user industries mentioned above are not developed yet.

Thus, the application of ammonium chloride is chiefly limited to the production of dry cell battery. As a result of this reason, the future demand for this compound was, therefore, assessed by taking the planned local production of dry cell battery during the coming ten years.

The by-product of the ammonium sulfate/sodium chloride process route is sodium sulfate which has many uses. Sodium sulfate is a white, crystalline solid or powder used in the manufacture of kraft paper, paper board, glass, household laundry detergents, and in dyeing and printing - textiles. Its chemical formula is Na_2SO_4. It is marketed as salt cake or purified by crystallization.

The import of sodium sulphate between 1977 and 1984 was, on the average, 569 tons valued at Birr 377,652.

Thus the amount of sodium sulfate which will be produced as by-product in the process of manufacturing ammonium chloride, could be easily sold in the local market, improving the financial viability of the ammonium chloride project, and at the same time saving foreign exchange.

2. Past and Future Demand Analysis

Dry cell batteries are supplied locally and imported. The local supply of dry cell batteries between 1976 and 1986 grew from 2.009 million to 9.38 million. But the import of dry cell batteries during the same period shows significant variations. (See Table I).

TABLE I

SUPPLY OF DRY CELL BATTERIES

('000 pcs)

Year	Local Production[1]	Import	Total Supply
1976	2,009	35,000	39,009
1977	1,215	12,466	13,681
1978	5,804	16,693	22,497
1979	8,204	26,503	34,707
1980	15,287	20,877	36,264
1981	10,577	23,507	34,084
1982	13,244	5,932	19,181
1983	9,844	15,053	34,084
1984	11,193	16,549	27,772
1985	8,472	26,686	35,158
1986	9,380	13,411	22,791

According to the United Abilities Factory, the amount of ammonium chloride required for each dry cell battery is 7.61 grams. On the basis of this consumption coefficient, the past requirement of ammonium chloride by the factory was calculated and is shown in Table II.

---

[1] Refers to the production of the United Abilities Factory.

TABLE II

DRY CELL BATTERY PRODUCTION AND AMMONIUM CHLORIDE CONSUMPTION

Year	Dry cell Battery Production ('000 pcs)	Ammonium chloride consumption (tons)
1976	2,009	15.29
1977	1,215	9.25
1978	5,804	44.17
1979	8,204	62.43
1980	15,287	117.09
1981	10,577	80.49
1982	13,244	100.79
1983	9,344	74.91
1984	11,193	85.18
1985	8,472	64.47
1986	9,380	71.38
1987	14,851[1]	113.01
1988	14,850[1]	113.01
1989	14,850[1]	113.01

1 Production plan

As shown in Table II, the highest amount of ammonium chloride consumed was in 1980, when the local production of dry cell batteries amounted to about 15.3 million, and the ammonium chloride used was 117.09 tons.

The production plan of dry cell batteries shown in Table II is assumed to remain at 14.65 million during the coming three years. The requirement of ammonium chloride at the above consumption coefficient will, therefore, amount to 113.01 tons per year.

On the basis of the past production figures, the attainment of the three-year production plan does not appear to pose a serious problem.

Further, the United Abilities Factory is planning to expand its current production capacity to 30.0 million in the future. The local market can definitely absorb more than what the factory is planning to produce. This expansion programme is assumed to be effected in 1993. At this production level, the ammonium chloride requirement will, therefore, amount to 228.3 tons per year. (See Table III).

TABLE III

DEMAND PROJECTION FOR AMMONIUM CHLORIDE

(TONS)

Year	Dry Cell Battery Production ('000)	Ammonium chloride Requirement
1988	14850	113.01
1989	14850	113.01
1990	14850	113.01
1991	14850	113.01
1992	14850	113.01
1993	30000	113.01
1994	30000	228.30
1995	30000	228.30
1996	30000	228.30
1997	30000	228.30
1998	30000	228.30
1999	30000	228.30
2000	30000	228.30
2001	30000	228.30
2002	30000	228.30
2003	30000	228.30

3. Pricing

The current F.O.B. price of ammonium chloride stands at US $450 per ton and that of sodium sulphate is US$90 per ton.

C. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

Ammonium chloride is not commonly manufactured via the ammonium sulphate/sodium chloride route. The large producers su. as ICI, BASF and the Chinese obtain ammonium chloride as a .. product in the ammonia-soda (Solvay) process which produces sodium carbonate. However, it is possible to scale the plant at a ton/day of ammonium chloride using the ammonium sulphate/sodium chloride route. Based on a single shift of 8 hours and 275 working days, the plant could produce 275 tons of ammonium chloride a year.

2. Production Programme

The plant is assumed to start production with a capacity utilization of 60% during its first year of operation. The capacity utilization of the plant is expected to reach 70% during the second year, reaching 85% after the third year, thus producing about 230 tpa of ammonium chloride; and about 290 tons of sodium sulphate is also produced as a co-product.

IV. MATERIALS AND INPUTS

A. RAW MATERIALS

The type of raw materials to be used depends on the process technology selected. The following are the major raw materials to be considered:

1. Sodium Chloride (common salt)

Common salt is produced at the two sea ports of Ethiopia, viz, Assab and Massawa. Marine salt of acceptable industrial quality in sufficient quantities is available. The total production capacity of the salt works is more than 220,000 tpa with an on-going expansion project to increase the output by an additional 100,000 tpa. There are also private producers whose production amounts to 40,000 - 50,000 tpa. The requirement of the ammonium chloride plant could be met from the Assab Salt Works.

2. Limestone

Limestone is available in sufficient quantities and quality in various parts of the country such as Harerrghe, Bale, Tigray, Shewa,Wollo, and Arsi.

3. Ammonia

Ammonia is not produced locally and it has to be imported until either a mini-hydro based electrolysis plant or natural gas based ammonia are available for fertilizer production.

4. Ammonium Sulphate

Ammonium sulphate is to be imported. Based on the selected tec iology, i.e. via the ammonium sulphate sodium chloride route, th raw materials required are sodium chloride, ammonium sulphate and ammonia water.

B. UTILITIES

The utility requirements of the ammonium chloride plant will be as follows:-

Electricity: 110,000 kwh/year
Water: 1800m^3/year

Other auxiliary materials required will be pp woven and PE lined sacks (a project to produce PP woven and PE lined sacks is to be promoted by the National Chemicals Corporation) and factory supplies such as lubricant oils. Ammonium chloride could also be packed in barrels and multiply paper sacks.

C. RAW MATERIAL REQUIREMENTS AND SUPPLY PROGRAMME

Based on the selected technology, i.e. reaction of ammonium sulphate and sodium chloride solutions, the raw materials requirements will be as follows:-

1.46 tons of ammonium sulphate	per	ton	of	ammonium	chloride	
1.04 tons of common salt	"	"	"	"	"	
6 kg of ammonia water (23%)	"	"	"	"	"	

The annual raw material supply programme was worked out and is given in Table IV.

TABLE IV

ANNUAL RAW MATERIAL SUPPLY PROGRAMME

Raw Material	Unit	Year 1	Year 2	Year 3
Ammonium Sulphate	ton	241	281	341
Sodium chloride	"	172	200	243
Ammonia water, 23%	"	1	1.15	1.40

D. MATERIAL AND INPUT COST

1. Cost of Raw Materials

The unit costs of the locally available raw material, i.e. common salt and that of the imported raw materials (ammonium sulphate and ammonium hydroxide) divided into local and foreign components are given in Table V.

TABLE V

RAW MATERIAL UNIT COST

Raw Material	Unit Price (Birr/kg) Dry Weight F.C.	L.C	TOTAL
Sodium chloride	-	0.207	0.207
Ammonium sulphate	0.33	0.084	0.414
Ammonia water , 23%	0.046	0.018	0.064

2. Cost of Utilities

Electricity

The cost of the electric power will be Birr 0.22/KWh

Water

Water for potable and industrial use will cost Birr $0.5/m^3$

3. Other Costs

a. Fuel for Vehicles

The total annual fuel cost for vehicles is estimated to be Birr 8,000.

b. Packing Materials

Packing of ammonium chloride (230 tpa) and the co-product, sodium sulphate (290 tpa) in 50 kg. polypropylene (PP) woven and polyethylene lined (PE) sacks will cost Birr 65000 annually.

V. LOCATION

The choice of the most suitable location for the ammonium chloride plant was determined by two major factors, i.e. proximity to raw materials sources and the market for the finished product. Hence, Assab is one possible location where the plant would be close to the salt works and the imported ammonium sulphate. However, the market for ammonium chloride is in the Addis Ababa region where it will be used mainly in the manufacture of dry cells. Sodium sulphate, the co-product of the manufacturing process of ammonium chloride could also be used in the glass, textile and detergent plants located in Addis Ababa. In general both locations could be regarded as equally favourable from the technical and economic point of view. On the basis of regional distribution of industries and the future export potential of the product, it is recommended that the plant be located at Assab, close to the salt works.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Alternative Technologies for the Manufacture of Ammonium Chloride

Pure ammonium chloride can be produced by the following processes:

- Double decomposition method,
- Ammonia-soda process
- The reaction of ammonium sulphate and sodium chloride, and direct neutralization of hydrochloric acid with ammonia

a. Double Decomposition Method

In this process, anhydrous ammonia and pure sulphur dioxide are added to a sodium chloride solution. When the reaction reaches equilibrium, the sodium sulphite precipitates. The ammonium chloride remains in solution and is separated from the precipitate by either centrifugation or filtration. The ammonium chloride is concentrated, crystallized, dried and packed. This process is rejected in this study for it requires sulphur dioxide and ammonia, the transport and handling of which is difficult. Although the sulphur dioxide could be made available from the envisaged sulfuric acid complex, it would require a special diversion line from the sulfur burning furnace. The situation with ammonia is similar as the above mentioned process.

b. Ammonia-Soda (Modified Solvay) Process

This process is mainly used in the manufacture of soda ash from common salt and limestone, under which ammonium chloride is produced as an intermediate. it consists of the following steps:-

- Ammoniation of purified brine,
- Calcination of limestone,
- Carbonation of ammoniated brine,
- Formation of ammonium carbonate,
- Formation of ammonium bicarbonate,
- Reaction of ammonium bicarbonate with brine,
- Separation of sodium bicarbonate from an ammonium chloride solution by filtration,
- Concentration of ammonium chloride
- Crystallization of ammonium chloride,
- Centrifuging or filtering of ammonium chloride, and
- Washing, drying and packing of ammonium chloride

The ammonia-soda process cannot be recommended, for the productin process is complex even for soda ash manufacturing. Moreover, the calcium chloride by-product has to be disposed directly into a sea as the quality of river water will be significantly affected by the calcium chloride/sodium chloride solutions.

c. Ammonium Sulphate/Sodium Chloride Process

This is a process in which ammonium sulphate and sodium chloride are used as raw materials. The process is believed to be the most appropriate for Ethiopian conditions, in that the handling of the raw materials and the general production mechanism is simpler than the other processes.

d. Direct Neutralization of Hydrochloric Acid With Ammonia

This process utilizes the neutralization of commercial grade hydrochloric acid and ammonia. The acid and ammonia are reacted in an ammonium chloride solution recycled from the downstream stage. The ammonium chloride solution is concentrated, crystallized by cooling, filtered and dried after which it is immediately packed in moisture proof packing. The requirement for the handling of imported ammonia and hydrochloric acid, the degree of sophisticatic of the plant make this process less attractive than the ammonium sulphate/sodium chloride method. Only high grade laboratory quality ammonium chloride is produced by this method.

2. Manufacturing Process of Selected Technology

The manufacturing process of ammonium chloride via the ammonium sulphate/sodium chloride route may be divided into the following stages:-

- Mixing,
- Filtration,
- Crystallisation, and
- Finishing

These processing stages are discussed in detail below.

a. Mixing

Ammonium sulphate is introduced to sodium chloride (about 5% in excess) and the mixture is agitated vigorously while heating to about 100°C.

b. Filtration

The pasty slurry enters the path of the rotary vacuum drum filter and continues to be agitated and kept hot to avoid crust formation. The paste is vacuum sucked on to the drum. The sulphate is washed substantially free of ammonium chloride, the washings being collected and passed on to the nexc step in the process. With the vacuum pressure shut off, the filter cake is scraped off the drum.

c. Crystallisation

The ammonium chloride filtrate runs into crystallising pans where it is cooled and becomes concentrated.

d. Finishing

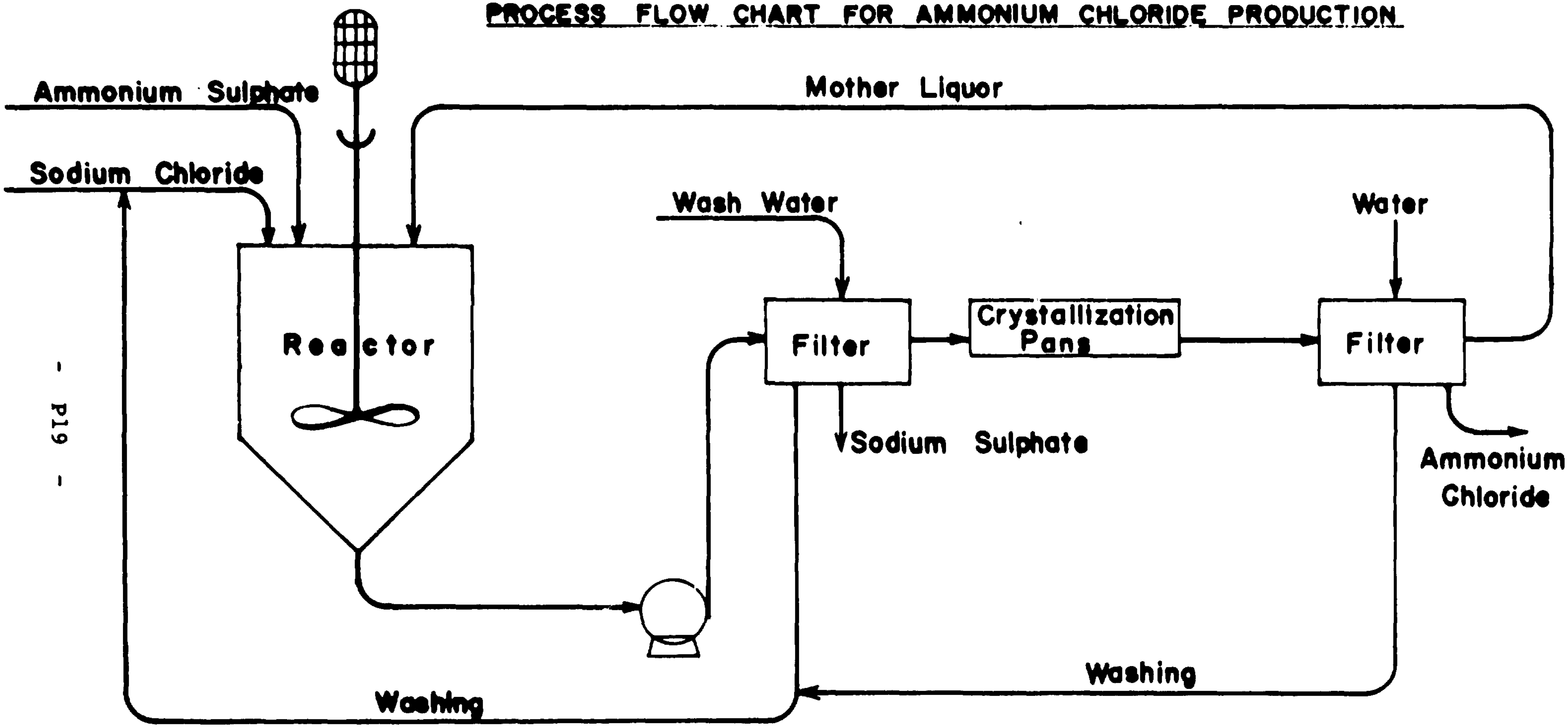
After crystallisation has taken place, the ammonium chloride is removed from the pans, washed free of any remaining sulphate, dried and treated with ammonia water to remove traces of any iron present. The process does not wait for complete crystallisation which could take a long time. The residual mother liquor is reused as a heel in the mixing tank. The ammonium chloride is packed in moisture proof packaging. The process flow chart for the manufacture of ammonium chloride is given in Figure I.

3. Source of Technology

The process technology requires collaboration by various suppliers. The main item of equipment, however, is the rotary vacuum drum filter. These are made by several plant manufacturers such as:-

Figure I

PROCESS FLOW CHART FOR AMMONIUM CHLORIDE PRODUCTION



1. Door-Oliver Inc.,
77 Havemeyer Lane,
Stamford,
Connecticut 06904,
USA

Stockdale Filtration Systems Ltd.,
Waters Green House,
Macclesfield,
Cheshire SK 11, 6LF,
UK

B. ENGINEERING

1. Machinery and Equipment

The list of the main production machinery and equipment as well as auxiliary facilities and their costs are given in Table VI.

2. Plant Layout

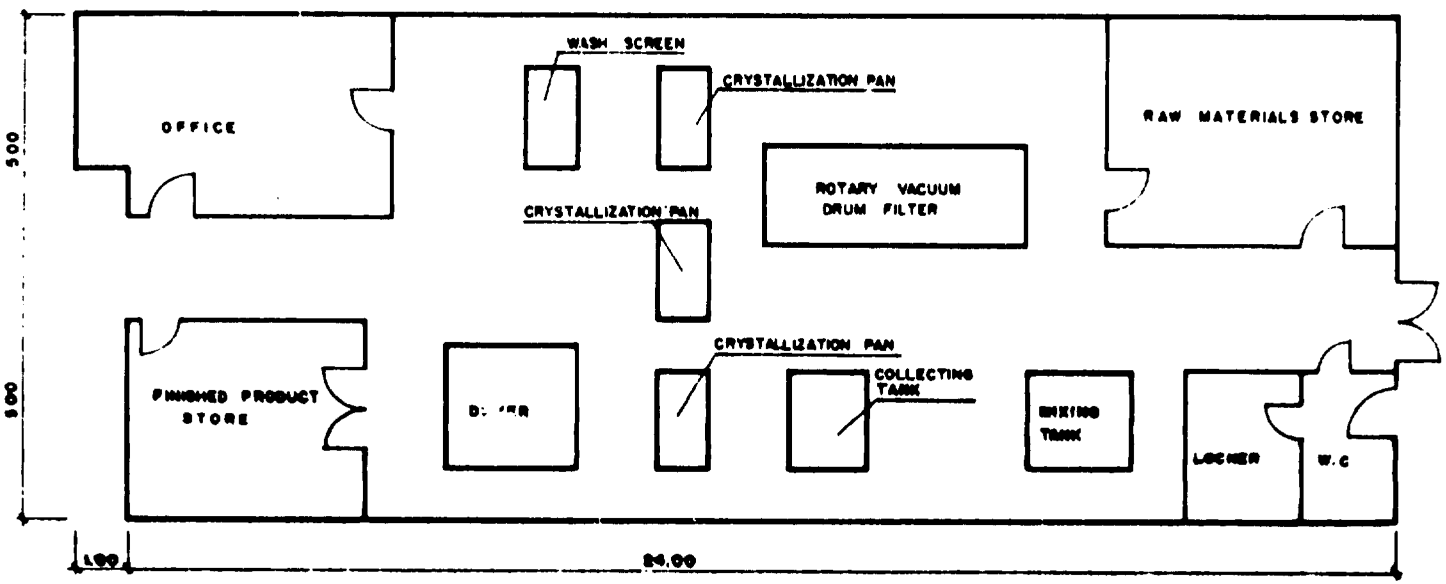
The plant layout for ammonium chloride production was worked out on the basis of the material flow and is given in Figure II. Although the operation could be carried out on a small scale, the crystallizing pans still require considerable floor space. Thus the total area required for the building will be 250 m^2 and the breakdown of the area requirement by each unit/section is given below.

	m^2
Material Store	25
Production area	183
Offices	24
Finished goods store	18

In addition to the main building, a 100 m^2 space will be required for the auxiliary facilities.

FIGURE II

PLANT LAYOUT FOR AMMONIUM CHLORIDE PRODUCTION



INDUSTRIAL PROJECTS SERVICE

PROJECT | Drawn by | Date | CLIENT
Checked by
Approved by

TABLE VI

TOTAL FIXED INVESTMENT COST

DESCRIPTION	COST ('000 BIRR) F.C.	L.C.	TOTAL
A. MACHINERY AND EQUIPMENT			
1. Mixing Tank	31	-	31
2. Rotary Vacuum Drum Filter (including accessories)	93	-	93
3. Dryer	62	-	62
4. Other Equipment* (pans, piping, screens, boiler compressors, pumps, storage tanks, spares, etc.)	83	-	83
Equipment Cost	269		269
Freight	-	27	27
Total Machinery Cost (C & F)	269	7	296
Technology fee	42		42
Local Cost (12.5% of C & F)	-	30	30
Total Cost of Machinery and Equipment (including 10% Contingency)	342	63	405

* The piping and crystallising pans have to be made from acid resistant material, (e.g. polypropylene)

TABLE V (CONT'D)

DESCRIPTION	COST('000 BIRR)		
	F.C.	L.C.	TOTAL
B. BUILDING AND CIVIL WORKS			
1. Building cost	95	220	315
2. Site Development (2% of building cost)	-	6.3	6.3
3. Outdoor works (sewage, water piping., etc.10% of building cost)	-	31.5	31.5
Total building and Civil works cost (including 10% contingency)	105	283.5	388.5
C. SERVICE EQUIPMENT			
1. Office Furniture and Equipment, including 10% Contingency	10	23	33
D. VEHICLES			
1. Pick-up (one)	28	12	40
2. Service Car (one)	17	8	25
10% Contingency	4.5	2	6.5
Sub-Total	49.5	22	71.5

VIII. PLANT ORGANIZATION AND MANPOWER

A. PLANT ORGANIZATION

The organizational structure of the proposed ammonium chloride manufacturing plant was worked out on the basis of key functional duties that need to be considered for the efficient operation of the plant.

The plant will be headed by a manager, who will report directly to the National Chemicals Corporation. It will have four divisions, namely, Administration, Production, Maintenance, Commercial and Accounts. For more details on the organizational structure see Figure III.

B. MANPOWER

The manpower requirement for a one-shift operation is given in Table VII. The plant would employ 42 people. The plant manager should be a qualified chemical engineer. He should attend a product training course for about a month. The production personnel would be trained on-the-job during the plant start-up.

Figure III

ORGANIZATION CHART OF AMMONIUM CHLORIDE PLANT

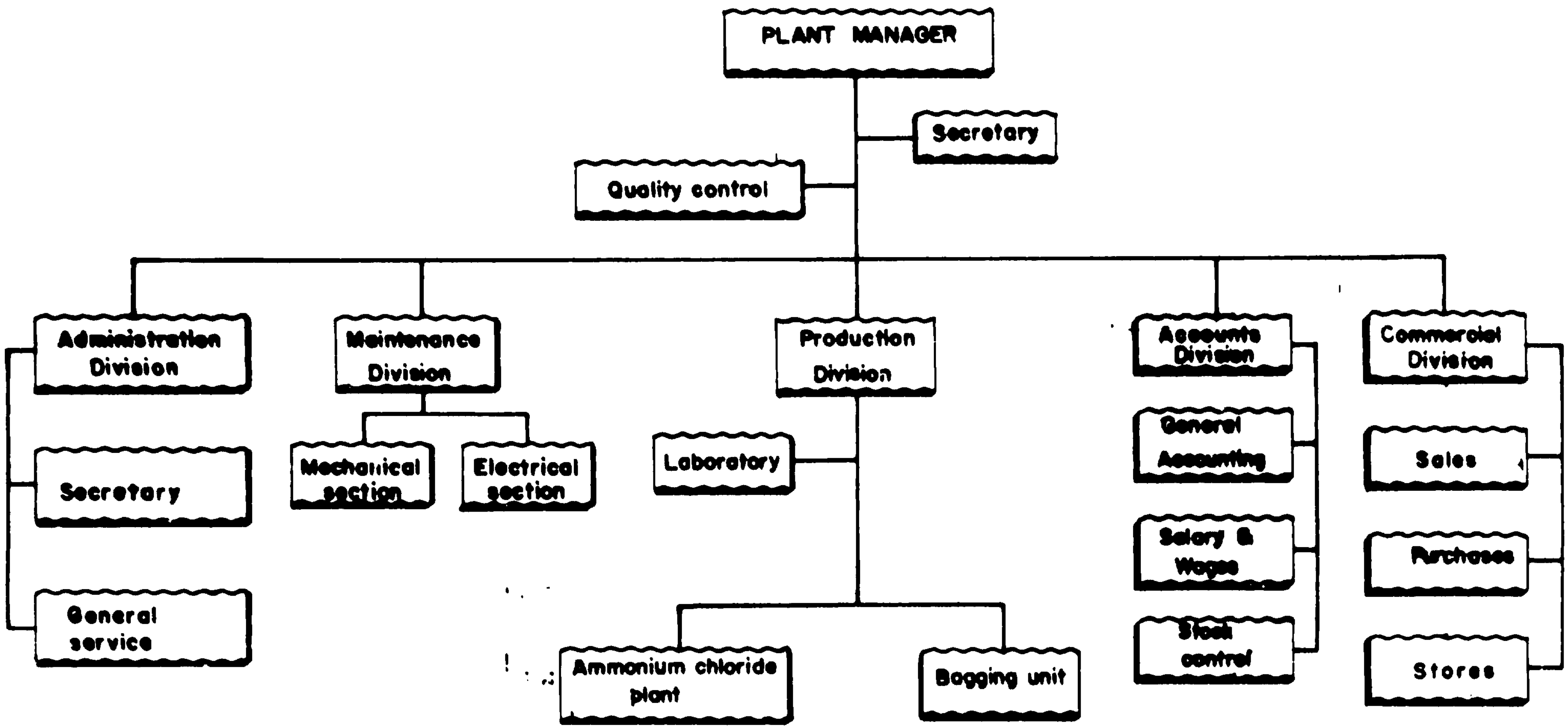


TABLE VII

MANPOWER REQUIREMENT AND SALARIES

Personnel	No. Employed	Skill Level	Monthly Salary/ Person (BIRR)	Total Annual Salary
Plant Manager	1	Professional/tech.	1400	16800
Secretary	1	Skilled	350	4200
Administrator	1	Skilled	600	7200
Chief Accountant	1	"	700	8400
Commercial Section	1	"	600	7200
Sales	1	"	400	4800
Purchaser	1	"	400	4800
Chemist	1	Professional/tech.	500	6000
Accountant	2	Skilled	350	8400
General Service	1	"	250	3000
Secretary	2	"	300	7200
Storekeeper	2	"	400	9600
Supervisor	1	"	450	5400
Maintenance Head	1	"	700	8400
Electrician	1	"	350	4200
Mechanic	1	"	350	4200
Operator	8	Semi-skilled	150	14400
Labourer	6	Unskilled	120	8640
Driver, General Serv.	1	Skilled	250	3000
Guard	6	Unskilled	120	8640
Cleaner	2	"	100	2400
Total (Including 25% benefits)	42		-	183,600

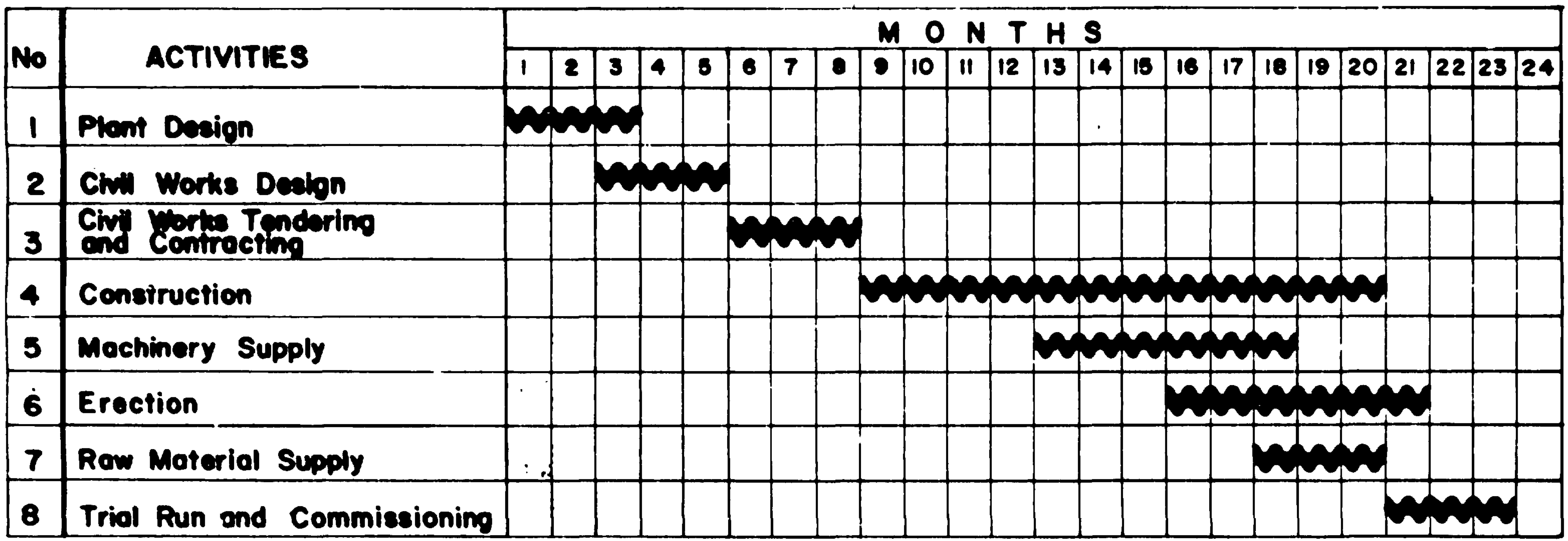
Skill distribution		%
Professional/tech.	2	5
Skilled	18	43
Semi-skilled	8	19
Unskilled	14	33
Total	42	100

VIII. IMPLEMENTATION SCHEDULE

It is not possible at this stage to draw up a timing schedule for the implementation of the project. However, a general timing of the activities is given in Figure IV, starting with the date of signing of the contract with the machinery supplier. About 24 months will be required for the establishment of the proposed plant.

Figure IV

Implementation Schedule of Ammonium Chloride Plant



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table VIII.

TABLE VIII

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

	Foreign	Local	Total
Building and civil works	105.00	283.50	388.50
Plant machinery and equipment	342.00	63.00	405.00
Office furniture and equipment	10.00	23.00	33.00
Vehicles	49.50	22.00	71.50
Pre-production expenditure	24.98	224.82	249.80
Total	531.50	616.30	1147.80

The foreign currency component of the total initial investment cost will be about 46%. About 64% of the total foreign currency requirement will be for machinery and equipment.

2. Working Capital Requirements

The following parameters were used to estimate the working capital rquirements of the ammonium chloride plant.

Items	Months of Coverage
1. Cash in hand	0.5
2. Accounts receivable	0.5
3. Raw materials - foreign	6.0
4. Raw materials - local	1.0
5. Finished products	1.5
6. Accounts payable	1.0

The net working capital requirement at full capacity will be Birr 0.11 million, of which Birr 0.074 million will be required in foreign currency.

3. Production Costs

The detailed production cost estimation is given together with other required financial statements. The production cost at full capacity amounts to Birr 0.61 million, out of which about 32% is in foreign currency.

4. Internal Rate of Return (IRR)

The ammonium chloride plant will not be financially viable since the internal rate of return is below zero. The net present value discounted at 10% p.a. amounted to Birr -2.04 million.

The selling price assumed in the financial analysis is Birr 1300 per ton for ammonium chloride and Birr 260 per ton for sodium sulphate.

5. Breakeven Analysis

The breakeven point would be reached if the plant generates a total revenue of Birr 1.05 million. This could be achieved provided the plant produces 1455 tons of ammonium chloride and sodium sulphate; 44% of the total tonnage being the share of ammonium chloride. In other words the plant would breakeven if it produces 641 tons of ammonium chloride and 814 tons of sodium sulphate. This production level is far more than the projected demand for the two products and the capacity of the proposed plant.

B. ECONOMIC ANALYSIS

The economic rate fo return turned out to be -10.55% with a net present value of Birr - 1.74 million.

The project will create employment for about 42 people when operating at full capacity.

APPENDIX A

TABLES OF FINANCIAL AND ECONOMIC ANALYSES

Ammonium Chloride Plant
Financial Analysis - July 1988
Opportunity Study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit : 1.0000 units accounting currency
local currency 1 unit : 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	1159.80	46.687 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1159.80	46.687 % foreign

Source of funds during construction phase

equity & grants:	1159.80	46.687 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	1159.80	46.687 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	383.69	407.81	444.00
depreciation :	128.58	128.58	128.58
interest :	0.00	0.00	0.00
production costs	512.27	536.40	572.59
thereof foreign	28.83 %	29.62 %	30.69 %
total sales :	223.31	260.53	316.37
gross income :	-288.96	-275.86	-256.22
net income :	-288.96	-275.86	-256.22
cash balance :	-233.50	-155.72	-140.30
net cashflow :	-233.50	-155.72	-140.30

Net Present Value at: 10.00 % = -2035.42
Internal Rate of Return: not found
Return on equity1: not found
Return on equity2: not found

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

TABLE A.2

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	233.00	157.50
Auxiliary and service facilities	44.70	26.80
Incorporated fixed assets	3.30	29.70
Plant machinery and equipment	132.00	283.00
Total fixed investment costs	413.00	497.00
Pre-production capital expenditures	133.10	116.70
Net working capital	0.00	0.00
Total initial investment costs	546.10	613.70
Of it foreign, in %	40.62	52.09

COMFAR

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5	6- 7	8	9
% of nom. capacity (single product).	0.00	0.00	0.00	0.00	0.00	0.00
Raw material 1	113.10	131.95	160.23	188.50	188.50	188.50
Other raw materials	4.50	5.25	6.38	7.50	7.50	7.50
Utilities	17.57	19.45	22.28	25.10	25.10	25.10
Energy	5.12	5.84	6.92	8.00	8.00	8.00
Labour, direct	183.60	183.60	183.60	183.60	183.60	183.60
Repair, maintenance	35.48	35.48	35.48	35.48	35.48	35.48
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	5.32	5.74	6.37	7.00	7.00	7.00
Factory costs	364.69	387.31	421.25	455.18	455.18	455.18
Administrative overheads	19.00	20.50	22.75	25.00	25.00	25.00
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	128.58	128.58	128.58	128.58	64.32	73.13
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	512.28	536.40	572.59	608.77	544.51	553.30
Costs per unit (single product)	0.00	0.00	0.00	0.00	0.00	0.00
Of it foreign, %	28.83	29.62	30.69	31.62	32.62	33.21
Of it variable,%	28.25	31.48	35.81	39.63	44.30	43.60
Total labour	183.60	183.60	183.60	183.60	183.60	183.60

COMFAR 2.1 UNIDO

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	10-12	13-17
% of nom. capacity (single product).	0.00	0.00
Raw material 1	188.50	188.50
Other raw materials	7.50	7.50
Utilities	25.10	25.10
Energy	8.00	8.00
Labour, direct	183.60	183.60
Repair, maintenance	35.48	35.48
Spares	0.00	0.00
Factory overheads	7.00	7.00
Factory costs	455.18	455.18
Administrative overheads	25.00	25.00
Indir. costs, sales and distribution	0.00	0.00
Direct costs, sales and distribution	0.00	0.00
Depreciation	78.49	33.69
Financial costs	0.00	0.00
Total production costs	558.66	513.86
Costs per unit (single product)	0.00	0.00
Of it foreign, %	33.54	29.42
Of it variable,%	43.18	46.94
Total labour	183.60	183.60

TABLE A.4

Net Working Capital in '000 Birr

Year	mdc	coto	3	4	5	6	7-17
Coverage	mdc	coto					
Current assets &							
Accounts receivable	15	24.0	15.99	16.99	18.50	20.01	20.01
Inventory and materials	116	3.1	37.80	44.10	53.55	63.00	63.00
Energy	0	---	0.00	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00	0.00
Work in progress	0	---	0.00	0.00	0.00	0.00	0.00
Finished products	38	9.4	39.59	42.53	46.95	51.36	51.36
Cash in hand	15	24.0	10.14	10.22	10.34	10.46	10.46
Total current assets			103.52	113.84	129.34	144.83	144.83
Current liabilities and							
Accounts payable	30	12.0	30.39	32.28	35.10	37.93	37.93
Net working capital			73.12	81.57	94.24	106.90	106.90
Increase in working capital			73.12	8.44	12.67	12.66	0.00
Net working capital, local			27.10	28.54	30.71	32.87	32.87
Net working capital, foreign			46.02	53.02	63.53	74.02	74.02

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

TABLE A.5

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	546.10	613.70
Financial resources	546.10	613.70
Sales, net of tax	0.00	0.00
Total cash outflow	546.10	613.70
Total assets	546.10	613.70
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	324.29	294.03
Outflow, local	324.29	294.03
Surplus (deficit)	0.00	0.00
Inflow, foreign	221.81	319.67
Outflow, foreign	221.81	319.67
Surplus (deficit)	0.00	0.00
Net cashflow	-546.10	-613.70
Cumulated net cashflow	-546.10	-1159.80

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	253.70	262.42	319.20	375.02	- 372.19	372.19
Financial resources .	30.39	1.89	2.83	2.83	0.00	0.00
Sales, net of tax . .	223.31	260.53	316.37	372.19	372.19	372.19
Total cash outflow . .	487.21	418.14	459.50	495.87	480.18	524.18
Total assets	103.52	10.33	15.50	15.49	0.00	44.00
Operating costs . . .	383.69	407.81	444.00	480.18	480.18	480.18
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-233.50	-155.72	-140.30	-120.65	-107.99	-151.99
Cumulated cash balance	-233.50	-389.22	-529.52	-650.18	-758.17	-910.16
Inflow, local	246.09	261.48	317.80	373.62	372.19	372.19
Outflow, local	342.22	307.66	328.24	347.62	344.03	357.23
Surplus (deficit) .	-96.13	-46.17	-10.45	26.00	28.16	14.96
Inflow, foreign . . .	7.61	0.93	1.40	1.40	0.00	0.00
Outflow, foreign . . .	144.99	110.48	131.25	148.05	136.15	166.95
Surplus (deficit) .	-137.37	-109.55	-129.85	-146.65	-136.15	-166.95
Net cashflow	-233.50	-155.72	-140.30	-120.65	-107.99	-151.99
Cumulated net cashflow	-1393.30	-1549.02	-1689.32	-1809.98	-1917.97	-2069.96

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow . .	372.19	372.19	372.19	372.19	372.19	372.19
Financial resources .	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax . .	372.19	372.19	372.19	372.19	372.19	372.19
Total cash outflow . .	506.98	480.18	480.18	480.18	524.18	506.98
Total assets	26.80	0.00	0.00	0.00	44.00	26.80
Operating costs . . .	480.18	480.18	480.18	480.18	480.18	480.18
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	-134.79	-107.99	-107.99	-107.99	-151.99	-134.79
Cumulated cash balance	-1044.95	-1152.94	-1260.93	-1368.92	-1520.91	-1655.70
Inflow, local	372.19	372.19	372.19	372.19	372.19	372.19
Outflow, local	352.83	344.03	344.03	344.03	357.23	352.83
Surplus (deficit) .	19.36	28.16	28.16	28.16	14.96	19.36
Inflow, foreign . . .	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign . . .	154.15	136.15	136.15	136.15	166.95	154.15
Surplus (deficit) .	-154.15	-136.15	-136.15	-136.15	-166.95	-154.15
Net cashflow	-134.79	-107.99	-107.99	-107.99	-151.99	-134.79
Cumulated net cashflow	-2204.75	-2312.74	-2420.73	-2528.72	-2680.71	-2815.50

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	372.19	372.19	372.19
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	372.19	372.19	372.19
Total cash outflow . .	480.18	480.18	480.18
Total assets	0.00	0.00	0.00
Operating costs . . .	480.18	480.18	480.18
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	-107.99	-107.99	-107.99
Cumulated cash balance	-1763.69	-1871.68	-1979.67
Inflow, local	372.19	372.19	372.19
Outflow, local	344.03	344.03	344.03
Surplus (deficit) .	28.16	28.16	28.16
Inflow, foreign . . .	0.00	0.00	0.00
Outflow, foreign . . .	136.15	136.15	136.15
Surplus (deficit) .	-136.15	-136.15	-136.15
Net cashflow	-107.99	-107.99	-107.99
Cumulated net cashflow	-2923.49	-3031.48	-3139.47

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:
  Net present value .... -2583.00 at 10.00 %
  Internal Rate of Return (IRRE1) .. not found

b) Net Worth versus Net cash return:
  Net present value .... -2035.42 at 10.00 %
  Internal Rate of Return (IRRE2) .. not found

c) Internal Rate of Return on total investment:
  Net present value .... -2035.42 at 10.00 %
  Internal Rate of Return (IRR) .. not found

Net Worth = Equity paid plus reserves

TABLE A.6

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	223.31	260.53	316.37	372.19	372.19
Less: variable costs, incl. sales tax.	144.73	168.86	205.05	241.22	241.22
Variable margin	78.58	91.68	111.32	130.96	130.96
As % of total sales	35.19	35.19	35.19	35.19	35.19
Non-variable costs, incl. depreciation	367.54	367.54	367.54	367.54	367.54
Operational margin	-288.96	-275.86	-256.22	-236.58	-236.58
As % of total sales	-129.40	-105.88	-80.99	-63.56	-63.56
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-288.96	-275.86	-256.22	-236.58	-236.58
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-288.96	-275.86	-256.22	-236.58	-236.58
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-288.96	-275.86	-256.22	-236.58	-236.58
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-288.96	-275.86	-256.22	-236.58	-236.58
Accumulated undistributed profit	-288.96	-564.83	-821.04	-1057.62	-1294.19
Gross profit, % of total sales	-129.40	-105.88	-80.99	-63.56	-63.56
Net profit, % of total sales	-129.40	-105.88	-80.99	-63.56	-63.56
ROE, Net profit, % of equity	-24.91	-23.79	-22.09	-20.40	-20.40
ROI, Net profit+interest, % of invest.	-23.44	-22.22	-20.43	-18.68	-18.68

TABLE A.6 (Cont'd)

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	372.19	372.19	372.19	372.19	372.19
Less: variable costs, incl. sales tax.	241.22	241.22	241.22	241.22	241.22
Variable margin	130.96	130.96	130.96	130.96	130.96
As % of total sales	35.19	35.19	35.19	35.19	35.19
Non-variable costs, incl. depreciation	303.28	312.08	317.44	317.44	317.44
Operational margin	-172.32	-181.12	-186.48	-186.48	-186.48
As % of total sales	-46.30	-48.66	-50.10	-50.10	-50.10
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-172.32	-181.12	-186.48	-186.48	-186.48
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-172.32	-181.12	-186.48	-186.48	-186.48
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-172.32	-181.12	-186.48	-186.48	-186.48
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-172.32	-181.12	-186.48	-186.48	-186.48
Accumulated undistributed profit	-1466.51	-1647.62	1834.10	-2020.57	-2207.05
Gross profit, % of total sales	-46.30	-48.66	-50.10	-50.10	-50.10
Net profit, % of total sales	-46.30	-48.66	-50.10	-50.10	-50.10
ROE, Net profit, % of equity	-14.86	-15.62	-16.08	-16.08	-16.08
ROI, Net profit+interest, % of invest.	-13.15	-13.54	-13.94	-13.94	-13.94

COMFAR

TABLE A.6 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	372.19	372.19	372.19	372.19	372.19
Less: variable costs, incl. sales tax.	241.22	241.22	241.22	241.22	241.22
Variable margin	130.96	130.96	130.96	130.96	130.96
As % of total sales	35.19	35.19	35.19	35.19	35.19
Non-variable costs, incl. depreciation	272.64	272.64	272.64	272.64	272.64
Operational margin	-141.68	-141.68	-141.68	-141.68	-141.68
As % of total sales	-38.07	-38.07	-38.07	-38.07	-38.07
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-141.68	-141.68	-141.68	-141.68	-141.68
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-141.68	-141.68	-141.68	-141.68	-141.68
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-141.68	-141.68	-141.68	-141.68	-141.68
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-141.68	-141.68	-141.68	-141.68	-141.68
Accumulated undistributed profit	-2348.72	-2490.40	-2632.07	-2773.75	-2915.42
Gross profit, % of total sales	-38.07	-38.07	-38.07	-38.07	-38.07
Net profit, % of total sales	-38.07	-38.07	-38.07	-38.07	-38.07
ROE, Net profit, % of equity	-12.22	-12.22	-12.22	-12.22	-12.22
ROI, Net profit+interest, % of invest.	-10.26	-10.06	-10.06	-10.06	-10.06

TABLE A.7

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	546.10	1159.80
Fixed assets, net of depreciation	0.00	546.10
Construction in progress	546.10	613.70
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	546.10	1159.80
Equity capital	546.10	1159.80
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	1423.69	1581.30	1724.43	1847.91	1955.90	2107.89
Fixed assets, net of depreciation	1031.22	902.63	774.05	645.46	516.88	452.55
Construction in progress	0.00	0.00	0.00	0.00	0.00	44.00
Current assets	93.37	103.62	119.00	134.37	134.37	134.37
Cash, bank	10.14	10.22	10.34	10.46	10.46	10.46
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	0.00	288.96	564.83	821.04	1057.62	1294.19
Loss	288.96	275.86	256.22	236.58	236.58	172.32
Total liabilities	1423.69	1581.30	1724.43	1847.91	1955.90	2107.89
Equity capital	1159.80	1159.80	1159.80	1159.80	1159.80	1159.80
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	30.39	32.28	35.10	37.93	37.93	37.93
Bank overdraft, finance required.	233.50	389.22	529.52	650.18	758.17	910.16
Total debt	263.89	421.50	564.63	688.11	796.10	948.09
Equity, % of liabilities	81.46	73.34	67 26	62.76	59.30	55.02

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	2242.68	2350.67	2458.66	2566.65	2718.64	2853.43
Fixed assets, net of depreciation	423.43	371.74	293.26	214.77	181.09	191.40
Construction in progress	26.80	0.00	0.00	0.00	44.00	26.80
Current assets	134.37	134.37	134.37	134.37	134.37	134.37
Cash, bank	10.46	10.46	10.46	10.46	10.46	10.46
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00	0.00
Loss carried forward	1466.51	1647.62	1834.10	2020.57	2207.05	2348.72
Loss	181.12	186.48	186.48	186.48	141.68	141.68
Total liabilities	2242.68	2350.67	2458.66	2566.65	2718.64	2853.43
Equity capital	1159.80	1159.80	1159.80	1159.80	1159.80	1159.80
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	37.93	37.93	37.93	37.93	37.93	37.93
Bank overdraft, finance required.	1044.95	1152.94	1260.93	1368.92	1520.91	1655.70
Total debt	1082.88	1190.87	1298.86	1406.85	1558.84	1693.63
Equity, % of liabilities	51.71	49.34	47.17	45.19	42.66	40.65

COMFAR

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	2961.42	3069.41	3177.40
Fixed assets, net of depreciation	184.52	150.83	117.15
Construction in progress	0.00	0.00	0.00
Current assets	134.37	134.37	134.37
Cash, bank	10.46	10.46	10.46
Cash surplus, finance available	0.00	0.00	0.00
Loss carried forward	2490.40	2632.07	2773.75
Loss	141.68	141.68	141.68
Total liabilities	2961.42	3069.41	3177.40
Equity capital	1159.80	1159.80	1159.80
Reserves, retained profit	0.00	0.00	0.00
Profit	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00
Current liabilities	37.93	37.93	37.93
Bank overdraft, finance required	1763.69	1871.68	1979.67
Total debt	1801.62	1909.61	2017.60
Equity, % of liabilities	39.16	37.79	36.50

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	451.12	536.07
Financial resources .	451.12	536.07
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	451.12	536.07
Total assets	451.12	536.07
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	239.31	216.40
Outflow, local	239.31	216.40
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	211.81	319.67
Outflow, foreign . . .	211.81	319.67
Surplus (deficit) .	0.00	0.00
Net cashflow	-451.12	-536.07
Cumulated net cashflow	-451.12	-987.19

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	184.78	188.91	229.88	269.99	267.42	267.42
Financial resources	24.32	1.71	2.57	2.57	0.00	0.00
Sales, net of tax	160.45	187.19	227.31	267.42	267.42	267.42
Total cash outflow	396.64	337.71	375.19	407.70	392.86	429.60
Total assets	90.50	9.89	14.84	14.84	0.00	36.74
Operating costs	306.14	327.82	360.34	392.86	392.86	392.86
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-211.86	-148.81	-145.31	-137.71	-125.44	-162.18
Cumulated cash balance	-211.86	-360.67	-505.98	-643.69	-769.13	-931.31
Inflow, local	177.16	187.97	228.48	268.59	267.42	267.42
Outflow, local	251.65	227.23	243.93	259.65	256.71	262.65
Surplus (deficit)	-74.49	-39.26	-15.45	8.94	10.71	4.77
Inflow, foreign	7.61	0.93	1.40	1.40	0.00	0.00
Outflow, foreign	144.99	110.48	131.25	148.05	136.15	166.95
Surplus (deficit)	-137.37	-109.55	-129.85	-146.65	-136.15	-166.95
Net cashflow	-211.86	-148.81	-145.31	-137.71	-125.44	-162.18
Cumulated net cashflow	-1199.05	-1347.86	-1493.17	-1630.88	-1756.32	-1918.50

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	267.42	267.42	267.42	267.42	267.42	267.42
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	267.42	267.42	267.42	267.42	267.42	267.42
Total cash outflow	414.86	392.86	392.86	392.86	429.60	414.86
Total assets	22.00	0.00	0.00	0.00	36.74	22.00
Operating costs	392.86	392.86	392.86	392.86	392.86	392.86
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	-147.44	-125.44	-125.44	-125.44	-162.18	-147.44
Cumulated cash balance	-1078.75	-1204.19	-1329.63	-1455.07	-1617.25	-1764.70
Inflow, local	267.42	267.42	267.42	267.42	267.42	267.42
Outflow, local	260.71	256.71	256.71	256.71	262.65	260.71
Surplus (deficit)	6.71	10.71	10.71	10.71	4.77	6.71
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	154.15	136.15	136.15	136.15	166.95	154.15
Surplus (deficit)	-154.15	-136.15	[illegible]6.15	-136.15	-166.95	-154.15
Net cashflow	-147.44	-125.44	[illegible]44	-125.44	-162.18	-147.44
Cumulated net cashflow	-2065.94	-2191.38	[illegible]82	-2442.26	-2604.44	-2751.88

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	267.42	267.42	267.42
Financial resources	0.00	0.00	0.00
Sales, net of tax	267.42	267.42	267.42
Total cash outflow	392.86	392.86	392.86
Total assets	0.00	0.00	0.00
Operating costs	392.86	392.86	392.86
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	-125.44	-125.44	-125.44
Cumulated cash balance	-1890.14	-2015.58	-2141.02
Inflow, local	267.42	267.42	267.42
Outflow, local	256.71	256.71	256.71
Surplus (deficit)	10.71	10.71	10.71
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	136.15	136.15	136.15
Surplus (deficit)	-136.15	-136.15	-136.15
Net cashflow	-125.44	-125.44	-125.44
Cumulated net cashflow	-2877.33	-3002.77	-3128.21

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:
  Net present value .... -1839.16 at 10.00 %
  Internal Rate of Return (IRRE1) .. not found

b) Net Worth versus Net cash return:
  Net present value .... -1744.38 at 10.00 %
  Internal Rate of Return (IRRE2) .. -10.55 %

c) Internal Rate of Return on total investment:
  Net present value .... -1744.38 at 10.00 %
  Internal Rate of Return (IRR) .. -10.55 %

Net Worth = Equity paid plus reserves

- Q -

S T R A W B O A R D

F O R

BUILDING CONSTRUCTION

1. SUMMARY

The biggest potential use of straw is for making strawboard as a chipboard type of construction product. Because of its tightly compressed characteristic, it offers considerable resistance to fire. Moreover, it has a sound insulating property and can be used in varying climates.

The total future demand for strawboard/chipboard in the building construction sub-sector will be in the range of 7200m^3 and 19700m^3 in 1988 and 2002, respectively. The existing chipboard plant will cover about 22-60% of the market over the period under review. The unsatisfied demand will thus vary between 2900m^2 in 1988 and 15,400 m^2 by the year 2002.

It is suggested that the project should consider the establishment of a plant with a capacity equivalent to the available minimum scale of operation (150,000 m^2 p.a.). It will operate in three shifts.

The product is produced on a semi-automatic machine in a continuous board. The basic raw material is subjected to heat and pressure during its progression through the machine and the resultant slab shape is covered with a smooth liner, such as stiff paper, which is automatically glued to all surfaces.

The initial investment cost of the plant is estimated to be Birr 9.47 million. The foreign currency component amounted to Birr 5.35 million, of which about 68% will be for the purchase of machinery and equipment.

The project is financially and economically viable. The corresponding rate of returns turned out to be 16.54% and 19.79%, respectivley, with net present value of Birr 4.36 million and Birr 7.06 million discounted at 10% p.a.

II. INTRODUCTION

Most developing countries are currently facing serious shortages of building materials, mainly, due to the critical shortage of wood, which is the principal traditional building material, resulting from improper exploitation of forests. In order to alleviate the problem, the development of substitute products, such as strawboard, has gained wide acceptance in most developing countries. This study is thus intended to investigate the commercial and technical viability of strawboard manufacturing in Ethiopia.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Product Description and Application

Straw has also a great potential in the building industry because of its chemical and physical consistency. In a world with mass demand for building materials, and where the poorest nations have the greatest demand, the materials need to be indigenously available, plentiful in supply, stable in raw material costs, be cheap in conversion, multi-functional, time saving in their use, low in energy consumption, insulating in performance and long lasting. Strawboard is a building material which possesses most of these properties.

The technology of converting straw into sturdy building board was developed about forty years ago. The boards, which can vary in thickness between 35 mm and 75 mm, can be used for roofing, flooring, doors, partitions, shattering, packaging, furniture, pallets, display boards, office screens and prefabricated housing.[1] It is a rigid building type panel produced from clean, dry unpulped straw or similar fibrous raw materials. The inherent chemicals in the straw provide the set. No binder or cement is required for the straw core. This provides its advantage over other chipboard products which require substantial quantities of resin.

Strawboard, because of its tightly compressed characteristic, offers considerable resistance to fire. Moreover, it has a sound insulating property and can be used in varying climates.

---

[1] Stramit International, the Processing and use of Waste Straw as a construction Material.

[illegible]

(a) Past and Present Demand Assessment

As stated earlier, the biggest potential use of straw is for making strawboard as a chipboard type of construction product. Therefore, the demand for the former is investigated in relation to the demand generated for the latter by the building construction sub-sector. The furniture industry, which also uses a substantial quantity of chipboards, is not, however, considered to be a possible market for the type of strawboard that this project envisages to produce.

The present supply of chipboard for roofing, partitions etc. is far from satisfying the current demand level. Thus, this exercise involves in determining the total unsatisfeid demand for chipboard in the building construction sub-sector. Subsequently, the estimated demand gap is assumed to be filled up with a strawboard of the type envisaged in this project.

The market is supplied by the Ethiopian Chipboard and Furniture Company which has a production capacity of 6000m^3 of chipboard per year. The plant has no excess capacity to augument the supply nor has immediate plans to expand and/or establish a new plant. It supplies currently about 5400 m^3 of chipboard per year, of which about 80% is absorbed in the building construction sub-sector.

According to the available information, the supply of chipboard to the market is considerably lower than what the market demands. For example, in 1986 the supply destined for the building construction sub-sector alone resulted in a short fall of about 30%.

2. Demand Analysis

(a) Past and Present Demand Assessment

As stated earlier, the biggest potential use of straw is for making strawboard as a chipboard type of construction product. Therefore, the demand for the former is investigated in relation to the demand generated for the latter by the building construction sub-sector. The furniture industry, which also uses a substantial quantity of chipboards, is not, however, considered to be a possible market for the type of strawboard that this project envisages to produce.

The present supply of chipboard for roofing, partitions etc. is far from satisfying the current demand level. Thus, this exercise involves in determining the total unsatisfeid demand for chipboard in the building construction sub-sector. Subsequently, the estimated demand gap is assumed to be filled up with a strawboard of the type envisaged in this project.

The market is supplied by the Ethiopian Chipboard and Furniture Company which has a production capacity of $6000m^3$ of chipboard per year. The plant has no excess capacity to augument the supply nor has immediate plans to expand and/or establish a new plant. It supplies currently about 5400 m^3 of chipboard per year, of which about 80% is absorbed in the building construction sub-sector.

According to the available information, the supply of chipboard to the market is considerably lower than what the market demands. For example, in 1986 the supply destined for the building construction sub-sector alone resulted in a short fall of about 30%.

Demand Projection

An end-use method is adopted to estimate the future demand for strawboard. The end-user, as indicated earlier, is the building construction sub-sector. It is further assumed that any anticipated increase in the building construction investment will bring about a pro-rata increase in the demand for strawboard.

In the Ten Year Perspective Plan, the building construction sub-sector is anticipated to grow at a rate of 15% annually, starting from an optimistic base figure. The past three years of the Ten Year Perspective Plan witnessed an average accomplishment of only 50%. Thus, for the purpose of this study, the building construction sub-sector is assumed to grow at an average annual growth rate of 7.5%. This rate of growth is thus assumed to be more realistic in reflecting the anticipated growth of demand for strawboard.

The demand in the base year (1986) was estimated to be 6200 m^3. Applying the assumed rate of growth to the base figure, the total future demand for strawboard in the building construction sub-sector will be in the range of 7200 m^3 and 19700 m^3 in 1988 and 2002, respectively. The unsatisfied demand, which is this estimated demand less the supply from the plant mentioned earlier, will vary between 2900 m^3 in 1988 and 15400m^3 by the year 2002. For details see Table I.

TABLE [illegible]

DEMAND FORECAST FOR STRAWBOARD IN THE BUILDING CONSTRUCTION SUB-SECTOR

(M^3)

Year	Estimated Total Demand	Existing Supply	Unsatisfied Demand
1988	7200	4300	2900
1989	7700	4300	3400
1990	8300	4300	4000
1991	8900	4300	4600
1992	9600	4300	5300
1993	10300	4300	6000
1994	11100	4300	6800
1995	11900	4300	7600
1996	12800	4300	8500
1997	13700	4300	9400
1998	14800	4300	10500
1999	15900	4300	11600
2000	17100	4300	12800
2001	18300	4300	14000
2002	19700	4300	15400

[illegible] Pricing

The selling price for chipboard of thickness 16 mm is Birr 12.35 per m^2. The selling price of strawboard could be possibly cheaper as its unit production cost is expected to be lower than the cost of chipboard. However, for the purpose of the financial analysis the selling price of chipboard is adopted.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The available minimum scale of operation is 150,000m^2 per year. The expected market demand, however, is far in excess. It is expected to range, interms of metre square[1], from 181300 m^2 in 1988 to 962500 m^2 by the year 2002. The plant can operate in three shifts, covering about 47% of the demand that will prevail in the year 2002. In view of the fact that the product is a new venture as against chipboard, it is recommended that production starts at the available minimum scale of operation.

2. Production Programme

The expected market demand is far in excess of the minimum scale of operation. Thus the plant should start-up in a three shift operation in order to fill-up the expected demand gap. If the plant is assumed to start operation in 1993, it will soon fail to meet all the expected demand gap. Thus the establishment of another plant of equivalent capacity should be considered in 1998. For detail production programme see Table II.

---

[1]The conversion from cubic metre into square metre was made by dividing the former by 0.016 m, which is the average thickness of Ethiopian Chipboard.

TABLE II

PRODUCTION PROGRAMME FOR STRAWBOARD

PRODUCTION PLANT

Year	Estimated Demand Gap (m^2)	Production Programme (m^2)	Capacity Utilization (%)	Demand Coverage (%)
1993	375000	315000	70	84
1994	425000	382500	85	90
1995	475000	450000	100	95
1996	531300	450000	100	85
1997	587500	450000	100	77
1998	656300	450000	100	69
1999	725000	450000	100	62
2000	800000	450000	100	56
2001	875000	450000	100	51
2002	962500	450000	100	47

[illegible]. MATERIALS AND INPUTS

A. RAW MATERIALS

1. Straw Availability

The project is planned to process straw from wheat and barley, which are abundantly grown in the country .

The peasant farming sector, the dominant source of the country's agricultural produces, uses an average of 1.23 million hectares of land annually for growing wheat and barley only (See Table III). However, it will be difficult to collect straw commercially from the peasant sector, since the farms are scattered and the farmers use the straw, among others, to feed their cattle. An exception is the mechanized peasant cooperative farms, which are increasing in number, as to be seen in the Arsi and Gojjam Administrative Regions.

With respect to the State Farms, the Southern Agricultural Development Corporation is the main, if not the only, producer of wheat and barley. The concerned state farm enterprises under the Corporation, and their respective wheat and barley farm lands and production are given in Table IV.

The actual quantity of the available straw depends on several factors, including seed variety, soil conditions, fertilisers, metrological conditions, harvesting techniques, etc. With the exception of about 1600 tons of straw per year presently collected by the Animal Feed Corporation from the Dixis State Farm for animal feed preparation, the state farms burn their straw at a cost to clear the farm for the next plantation and only a negligible amount is grazed by roaming herd.

It is generally believed that an average of [illegible].25 tons of straw per hectare can be mechanically recovered from the state farms, the unrecoverable part serves the purpose of enriching the soil for the next season. The recorded data from the Dixis State Farm puts the average net recovery as high as 2.1 tons/hectare. It must be noted, however, that the grain yield rate of the Dixis State Farm is also higher than the average; third among the state farms, exceeded by the Lole State Farm which has the highest yield rate and the Serufta State Farm standing second.

To be on the conservative side, an average recoverable rate of 1.2 tons of straw per hectare has been used in this study for all state farms. This gives a total of about 93,000 tons of mechanically recoverable wheat and barley straw from the state farms in the Arsi and Bale Administrative Regions only, 37,650 and 55,380 tons, respectively. Details for each farm are given in Table VI.

The Ministry of State Farms Development in conjunction with the Southern Agricultural Development Corporation are presently entertaining a project idea to produce about 5000 tons per year of straw briquets at the Dixis State Farm. This still leaves about 88,000 tons of straw per year available in the state farms for this project and the Straw Treatment and Pelletising project, being studied parallely. However, this quantity alone is not sufficient for the requirement of both projects, since the Straw Treatment and Pelletising Project requires a substantial quantity of straw. Hence, the mechanized peasant cooperative farms should be considered as a possible potential source of wheat and barley straw for the Straw Pelletising Project.

TABLE III

PEASANT SECTOR PRODUCTION OF WHEAT AND BARLEY

BY ADMINISTRATIVE REGIONS: 1982/83 and 1983/84 - MAIN SEASONS

Region	MAIN SEASON 1982/83				MAIN SEASON 1983/84			
	Barley		Wheat		Barley		Wheat	
	Area Ha	Production Qt	Area Ha	Production Qt	Area Ha	Production Qt	Area Ha	Production Qt
Total	693210	6014127	486580	4821120	748773	5067996	53267	420855[illegible]
Arssi	123073	1297816	129720	1728932	110654	1156110	134145	15689[illegible]
Bale	24005	220840	11565	105311	26854	179650	11176	93371
Gamogofa	15836	106022	3939	31604	22352	126168	4182	35276
Gojam	127197	919697	42448	415082	125704	673174	48379	352[illegible]
Gonder	95532	1300753	45382	491835	106642	915423	48608	386[illegible]
Hararghe	6630	52728	3149	26108	9071	59025	4274	2976[illegible]
Illubabor	3388	26154	774	7529	3518	24810	1151	12021
Kofa	8524	65168	3841	31284	6251	40967	4437	34501
Shoa	174072	1310769	184042	1563138	210671	1254647	187245	1221664
Sidamo	39842	278214	4341	43921	42742	225611	7987	58940
Wollaga	21109	150367	6707	57937	21343	130724	7105	57188
Wollo	55002	285599	50672	318439	62971	281687	73988	35[illegible]

SOURCE: General Agricultural Survey, Preliminary Report 1983/84, Vol. 1, Planning and Programme Dept., Ministry of Agriculture.

- 210 -

TABLE IV

SOUTHERN AGRICULTURAL DEVELOPMENT CORPORATION

PRODUCTION OF WHEAT AND BARLEY

1984/85 - 1986/87

State Farm Enterprise	Crop Type	1984/85 Area in Hectar	1984/85 Prod. in Quintals	1985/86 Area in Hectar	1985/86 Prod. in Quintals	1986/87 Area in Hectar	1986/87 Prod. in Quintals	Annual Average Area in Hectar	Annual Average Prod. in Quintals	Total Average Hectar Per Enterprise	Expected Straw in Tons	Distance From
ARSI												
Dixis	Wheat	8002	159282	7947	139198	7162	176048	7704	158176	7704	9245	Asella 92 km
Lola	Wheat	747	23277	1425	46319	1186	36168	1119	352	2680	3216	Asella 40 km
	Barley	1581	38150	1480	30714	1623	35017	1561	34627			
Adelle	Wheat	5721	98007	5563	114864	5490	102088	5491	104986	5491	6589	Asella 139 km
Garadella &	Wheat	8637	121872	8464	130832	8338	157861	8480	136855	11042	13250	Asella 132 km
Temella (1)	Barley	2409	12716	2574	36637	2704	44469	2562	31274			(near Asasa)
Goffer	Wheat	2927	30353	2367	38503	3114	71284	2803	46713	4460	15352	Asella 142 km
	Barley	1733	21857	2044	24557	1195	10515	1657	18974			(Shashemene 25 km)
Sub-Total	Both	31757		31864		30512		31377		31377	37652	
BALE												
Herero & Hunte (2)	Wheat	6956	10555	8748	154567	8154	190643	7953	118588	9869	11843	Shashemene 80 km
	Barley	2371	22852	1484	22754	1892	36266	1916	27291			
Sinanna	Wheat	8614	107453	9498	144306	9292	149587	9135	133782	10361	12433	Robe/Bale 14-40 km
	Barley			1144	18540	1307	32449	1226	25495			
Shenika	Wheat	3065(3)	13690(3)	6199	45561	6132	53110	6166	49336	6166	17399	Robe/Bale 78 km
Dinkiti	Wheat	6907	106386	6535	109505	7000	105404	6814	107098	6814	8177	Robe/Bale 90 km
Scrufta	Wheat	4048	93588	4865	122661	4295	111795	4403	109348	6803	8163	Robe/Bale 135 km
	Barley	2268	43396	2229	44334	2704	40640	2400	42790			
Gololcha	Wheat			4902(3)	7754(3)	6138	127439	6138	127439	6139	7366	Robe/Bale 130 km
Sub-Total	Both	34229		45604		46914		46151		46151	55381	
GRAND TOTAL	Both	65986		77468		77426		77528		77528	93033	

NOTE: (1) Garadella and Temella have been separated as two independent enterprises since 1985/86.
(2) Herero and Hunte have been separated as two independent enterprises since 1986/87.
(3) Figures excluded from the averages since they are unrepresentative.

SOURCE: Southern Agricultural Development Corporation, Addis Ababa.

The straw collection and delivery to this project can be carried out in a similar manner as is presently being done at Dixis State Farm. At present, all harvesting is carried out by combine harvesters. The recoverable straw is picked up and baled by mechanised square balers (John Deere 342 A) producing bales of about 15 kg with a dimension of 1.00 x 0.46 x 0.36 meters (0.166 m^3/bale). The bales are ejected from the baler as it moves and manually collected and placed in piles at the perimeter of the field. The bales are then manually loaded on trailers for delivery.

It will be necessary to replace the manual field collection of bales with wheel tractor driven trailers as the consignment is going to be much higher than the present one.

It must be noted that harvesting starts at the end of October or early November and is generally completed by early January. The straw collection has to take place simultaneously for technical reasons and for the fields have to be cleared for preparation for the next plantation which starts shortly then after. This leaves a net collection period of about three months and the capacity of the collection facilities (balers, trailers, wheel tractors, labour, etc.) has to take this fact into account.

The storage facility at the project site should also consider the seasonal supply of straw. Considering the high volume of the storage requirement, it will be preferable to use open storage, where the straw is covered with light weight tarpaulins only. Enough space should be left between the bale piles (about 5m) to create a fire break. Taking this into account, a straw volume (in tons) to the storage space area (in m^2) of about 1:2 can be used to estimate the open space requirement.

B. OTHER INPUTS AND UTILITIES

Other than straw, the project requires low quality (e.g. recycled) paper of about 410 gms/m^2 and glue. The power load requirement for the given plant capacity is about 240 kw. No water is required for the process.

C. MATERIALS AND INPUTS COSTS

The consumption rates and estimated prices of all raw materials and inputs are given in Table V.

It is assumed that the concerned farms take over the straw collection activity, as this is closely interlinked with their normal farm operations and supply the proejct. The farms can either buy the required trailers balers, trucks etc. by themselves or lease them from the project. At present, Dixis farm charges 0.10 Birr/Bale (6.70 Birr/ton) for straw only. Rough estimations under normal conditions indicate a price of about 20 Birr/ton of baled and collected straw at farm site (including collection and over head costs and some margin). Transportation to project site will be a considerable additional cost depending on the distance.

In this study an international price of 50 Birr/ton delivered at project site, as practiced in the UK, has been taken.

The straw requirement given in Table V assumes a maximum of 16% moisture content of the delivery and 5% loss in process.

TABLE V

RAW MATERIALS AND INPUTS CONSUMPTION AND COSTS

Item	Consumption Per m² of Board	unit Price	Annual Cost For 450,000 m² Board (Birr)		
			F.c.	L.C.	Total
Straw	20 kg	50 Birr/t	-	450,000	450,000
Paper (410gm/m²)	0.8 kg	1.60 Birr/kg	-	476,000	576,000
Glue	0.5 kg	1.00 Birr/kg	225,000	56,250	281,250
Electricity	2 kwh	0.22 Birr/kWh	-	198,000	198,000
		Total	225,000	1,280,250	1,505,250

V. LOCATION

As straw, the principal raw material, is very bulky to transport, the factory should normally be located such that the source of straw supply should be within a 50 km radius of the factory.

Furthermore, since the project has to rely on a licence for the technology and requires skilled manpower, the location should provide enough infrastructural and social facilities to reasonably attract both the staff of the licensor and the skilled labour force. The required electric power should also be available.

Taking the above into consideration, it is proposed that the project be located at Asella town which is only 175 km from Addis Ababa, a major market centre. Asella is the capital of Arsi Administrative Region and provides the required infrastructural and social facilities.

If located at Asella, over one-third of the straw requirement of the project can be supplied from Lole State Farm, 40 km from Asella. The remaining two-third can easily be obtained from the mechanised peasant co-operative farms at Lole and/or Etteya (the latter only 23 km from Asella). Each of these cooperative farms is much bigger than the Lole State Farm.

VI. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

This profile considers the manufacture of strawboard as a chipboard type of construction product. The process described below is one patented by Stramit which can capitalise on a ready availability of straw and manufacture it into building boards.

The boards, which can vary in thickness between 35 mm and 75 mm, can be used, for example, for roofing, flooring, doors, partitions, shuttering, packaging, furniture, pallets, display boards, office screens and prefabricated housing. Made to its own British Standard BS 4046, a board would typically measure 1.2 metres wide, 50 mm thick and be cut in 2-4 metre lengths. The optimum density is 19 kg/m^2. The insulating value is equivalent to an eleven inch cavity wall, a sound reduction of approximately 30 decibels at 100/32000 c/s. Further, the boards do not support fire having been subjected successfully to every available test at the fire research station at Borehamwood in the UK.

The product itself is a rigid building type panel produced from clean, dry unpulped straw or similar fibrous raw materials. The inherent chemicals in the straw provide the set. No binder glue or cement is required for the straw core. This provides its advantage over other chipboard products which require substantial quantities of resin.

The product is produced on a semi-automatic machine in a continuous board. The basic raw material is subjected to heat and pressure during its progression through the machine and the resultant slab shape is covered with a smooth liner, such as stiff paper, which is automatically glued to all surfaces.

[illegible] thicknesses, 38 mm and 58 mm, are made.

1. Process and Technology

a. Process

The principal operations in producing strawboard are as follows:

. feeding bales
. bale opening
. separating waste from straw
. feeding straw into hopper
. slab forming process
. paper lining
. cut off and end sealing.

(1) Feeding Bales

Straw would normally be baled in the fields for ease of transportation and brought to the plant. Bales are then loaded onto the accumulative bale conveyor, two abreast, whee the string or wire is cut and removed before the bales move onto the straw bale conveyor.

(2) Bale Opening

At the end of the conveyor the bale opener loosens and spreads out the straw in an even mat. Provision is made for dust extraction at this point before the straw is passed at a controlled volume to a straw walker/separater unit, where it is cleaned and graded.

(3) Separating Waste From Straw

The straw walkers consist of a series of stepped paddles, inclined upwards and moving longitudinally in a reciprocating action. This passes the straw forward while allowing the chaff, stones, grain and short straw to fall onto a waste conveyor. The straw is ejected from the straw walker system and falls onto an inclined loose straw conveyor which carries it to the top of the straw feed hopper. Here the straw is fed into the reciprocating ram of the slab forming section.

Grain and small stones are fed into different reject channels in the separater. The grain is bagged for subsequent resale while the stones are dropped into a container for removal. The reject short straw is normally ground in a separate grinding plant and sold as an animal food additive. In this way nothing is wasted.

(4) Slab Forming Process

The long straw is fed into a hopper, the level of which is maintained by means of photo-electric cells which actuate the starters of the drive motors of the bale conveyors, straw walkers and loose straw conveyors.

At he bottom of the hopper a set of mechannical fingers pull an equal amount of straw downwards for each stoke of the ram. With each stroke new straw is forced in between the top and bottom beds of the slab forming section, impacting it against the slab of straw already between the beds. When the friction between the straw and the beds, the tension of the paper liner and weight of the slab is overcome, the slab will move forward.

The straw passes through the back cold beds first, where it is compressed into its slab shape. It then moves into the back hot plates, which are heated by means of thermostatically controlled electrical elements, where it is set permanently into its compressed state. From here the slab of straw enters the front hot beds where the paper liner is applied.

(5) Paper Lining

The paper liner is introduced between the back and front hot beds. It is fed from two reels above and below the machine and passes through glue rollers. The pressure and heat from the bed plates bond the paper liner onto the straw slab.

(6) Cut Off and End Sealing

The slab, after leaving the front hot bed, moves onto the runout table at the end of which is an electrically driven automatic cross-cut saw unit - moving longitudinally with the slab to give a right angled cut. The saw unit is fitted with a device for autoamtic measuring of lengths to be cut.

b. Technology Source

The equipment, technical know-how and training can be obtained from:

Stramit International
Tomo House
Tomo Industrial Estate
Creeting Road
Stowmarket
Suffolk IP14 5AY
UK
Telephone 0449 613535

Stramit International has a policy which offers licensees a complete package which includes the licensor installing the machinery, commmissioning it and running the factory for an initial period. Technical production back-up, training and technical marketing back-up are also built into the package.

B. ENGINEERING

1. Machinery and equipment

The machinery as described above is available as a turnkey project for around US$1.5 million, depending on individual circumstances. There is a possibility of buying a second hand plant from Stramit for about half this price, but the time scale between start of project and operation would be considerably longer because the plant would need to be stripped down and refurbished before installation.

The plant has to be fitted with duct extraction equipment. Estimated cost of machinery and equipment and training are shown in Table VI.

TABLE VI

MACHINERY AND EQUIPMENT COST AND TECHNOLOGY (TRAINING FEES)

I T E M	F.C. (BIRR)	L.C (BIRR)	TOTAL (BIRR)
1. Plant and Spares (turnkey)	2,587,500	-	2,587,500
2. Extra Presshead for different board sizes	93,200	-	93,200
3. Forklift trucks (2)	103,500	-	103,500
Sub-Total (FOB)	2,784,200	-	2,784,200
4. Sea Freight (8%)	-	222,800	222,800
5. Inland transport, handling and service charges (12.5%)	-	348,100	348,100
6. Technology Fee & Training	517,500	-	517,500
7. Two pick-up vehicles	54,000	36,000	90,000
Sub-Total	3,355,700	606,900	3,962,600
8. Contingencies (10%)	335,600	60,700	396,300
TOTAL	3,691,300	667,600	4,358,900

[illegible] AND EQUIPM[illegible] TECH[illegible]OGY [illegible]

I T E M	F.C. (BIRR)	L.C (BIRR)	TOTAL (BIRR)
1. Plant and Spares (turnkey)	2,587,500	-	2,587,500
2. Extra Presshead for different board sizes	93,200	-	93,200
3. Forklift trucks (2)	103,500	-	103,500
Sub-Total (FOB)	2,784,200		2,784,200
4. Sea Freight (8%)	-	222,800	222,800
5. Inland transport, handling and service charges (12.5%)	-	348,100	348,100
6. Technology Fee & Training	517,500	-	517,500
7. Two pick-up vehicles	54,000	36,000	90,000
Sub-Total	3,355,700	606,900	3,962,600
8. Contingencies (10%)	335,600	60,700	396,300
TOTAL	3,691,300	667,600	4,358,900

?. Layout and Building

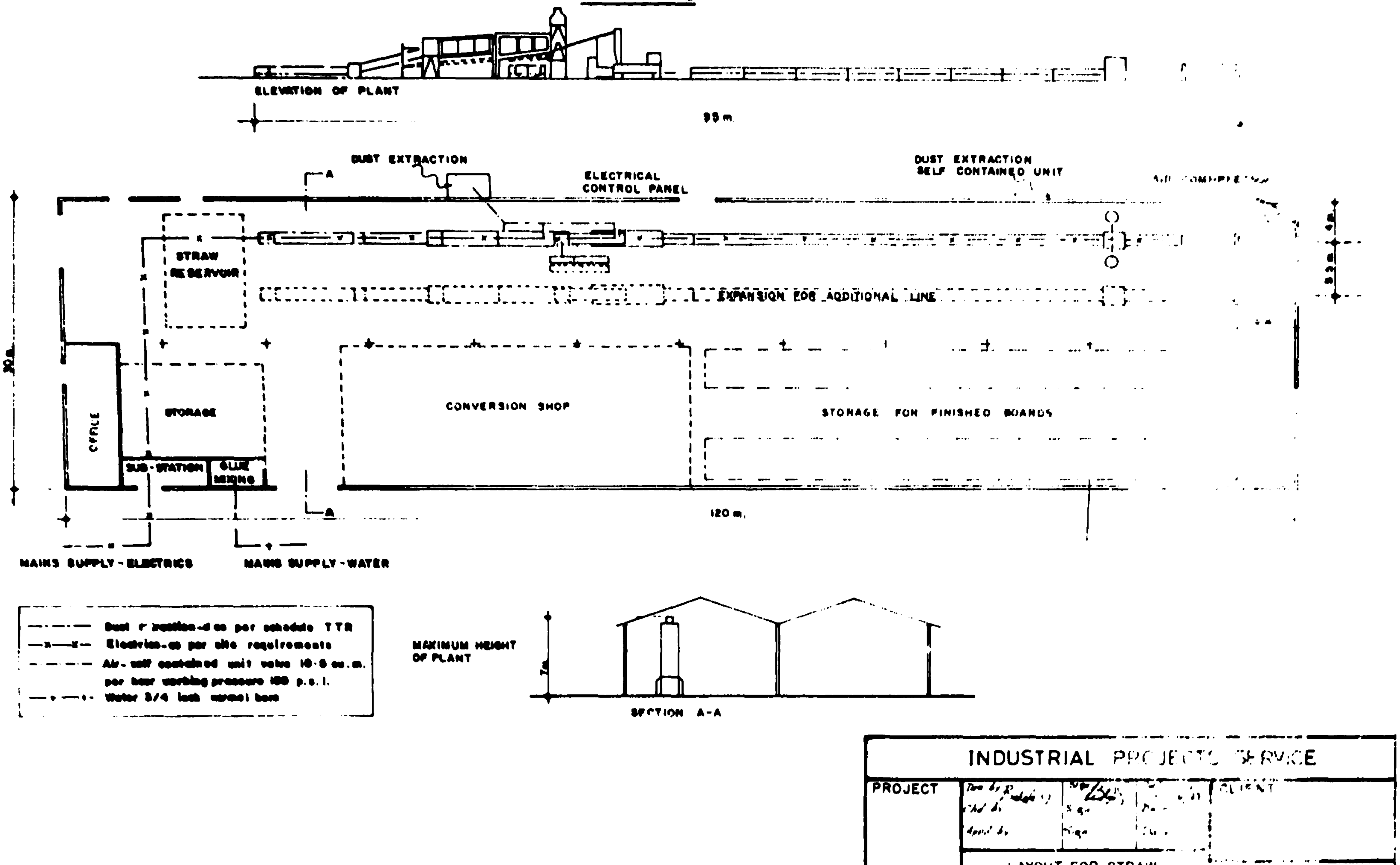
The layout for the straw manufacturing pl... is shown in Figure I. The building needs to have a covered area of 120m x 30m and a site area of 12,000 m².

No special demand are made on the building. Foundations need to be slightly reinforced at the slab forming section only

Investment cost on building and civil works is estimated as follows:

Building 3,600 m^2	- Birr	3,240,000
Land & Site Preparation(2%)	- "	64,800
Outdoor Works (10%)	- "	324,000
Sub-Total	Birr	3,628,800
Contigencies (10%)		362,900
Total Birr		3,991,700

FIGURE I


ELEVATION OF PLANT
95 m
DUST EXTRACTION
ELECTRICAL CONTROL PANEL
DUST EXTRACTION SELF CONTAINED UNIT
STRAW RESERVOIR
EXPANSION FOR ADDITIONAL LINE
STORAGE
OFFICE
SUB-STATION
GLUE MIXING
CONVERSION SHOP
STORAGE FOR FINISHED BOARDS
120 m.
MAINS SUPPLY - ELECTRICS
MAINS SUPPLY - WATER
MAXIMUM HEIGHT OF PLANT
SECTION A-A
INDUSTRIAL PROJECTS SERVICE
PROJECT
CLIENT

[illegible] PLANT ORGANIZATION AND MANPOWER

A. ORGANIZATION

Considering its unique manufacturing process and size, the project is to have its own management to run its operation under the supervision of a state organization. The proposed organization chart is shown in Figure II.

B. MANPOWER AND TRAINING

The total number of employees required to operate in three shifts is 96. The break down as well as monthly salaries/wages and qualifications are shown in Table VII.

The training of staff will be undertaken by a company such as Stramit International, who has a great deal of experience in setting up plants in devloping countries. The company envisages six months to train the skilled workers on site, followed by regular visits of two weeks each year to oversee and carry out maintenance work and make sure the licencee is making as much of the potential of his plant as possible. Further, the production/technical head requires a 6 months training abroad at one of the licensor's plants. All training costs, with the exception of the production/technical head's flight and lodging expenses, are included in the technology and training fee as turnkey proposal.

FIGURE II

ORGANIZATION CHART

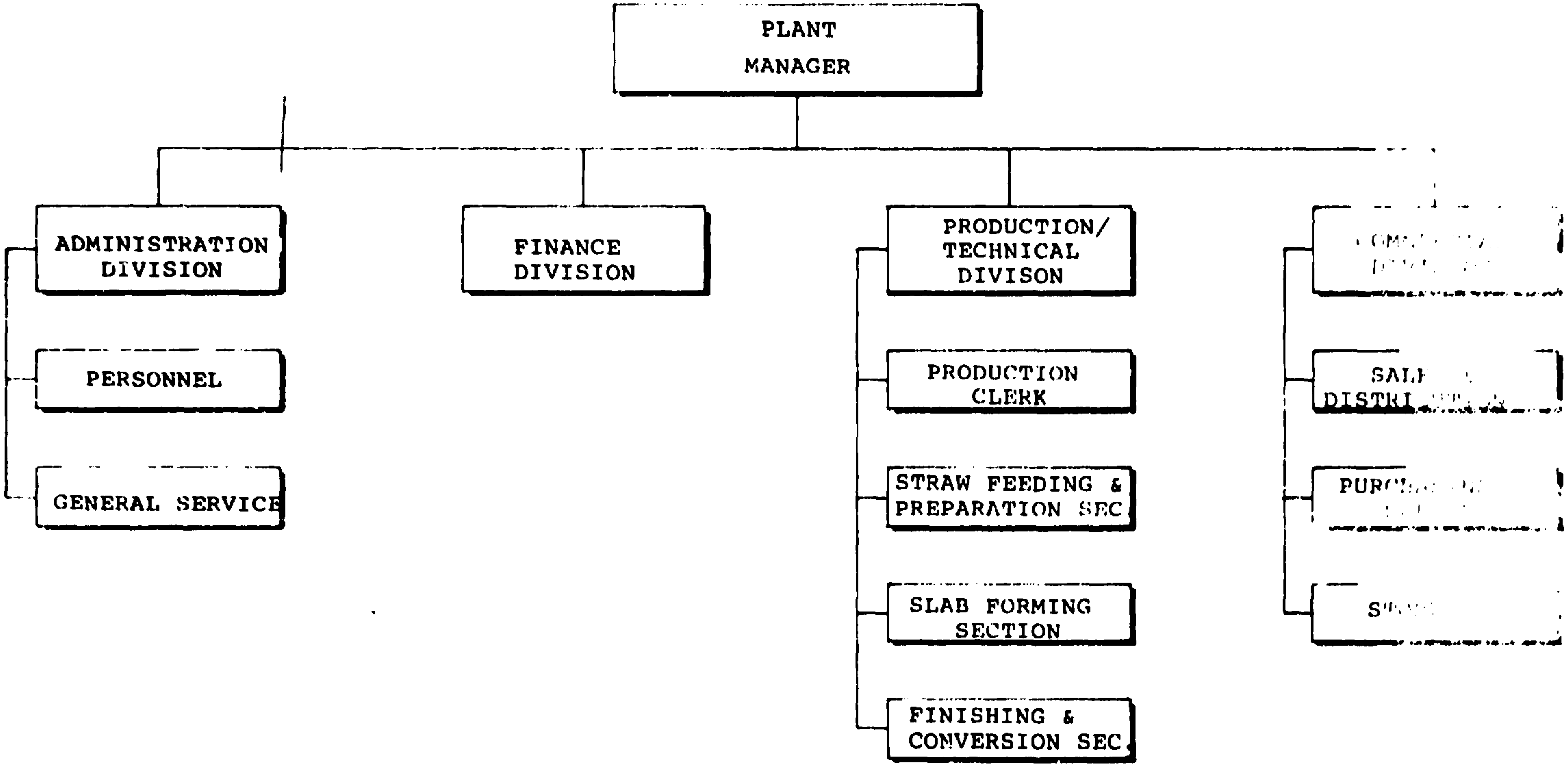


TABLE VII

MANPOWER REQUIREMENT FOR ONE SHIFT OPERATION

	Post	Persons Per Shift	Number of Shift	Total Persons	Monthly Salary Per Person	Total Monthly Salary	Qualificat[illegible] (Skill)
1	Plant Manager	1	1	1	1200	1200	
2	Secretary	1	1	1	450	450	Secretarial d[illegible]
3	Proudction/Technical Head	1	1	1	900	900	BSc. in enginee[illegible] specialised tra[illegible]
4	Shift Supervisor	1	3	3	400	1200	Technical school [illegible] with experience
5	Chief Mechanic	1	1	1	600	600	Poly graduate [illegible]
6	Mechanic	1	3	3	400	1200	Technical school [illegible]
7	Electrician	1	3	3	400	1200	" "
8	Production Clerk	1	1	1	300	300	Commercial sch[illegible]te
9	Forman	3	3	9	350	3150	Technical schoo[illegible]
10	Operators	6	3	18	200	3600	Skilled
11	Conversion shop	4	3	12	200	2400	Skilled
12	Fork lift operator	1	3	3	200	600	Skilled

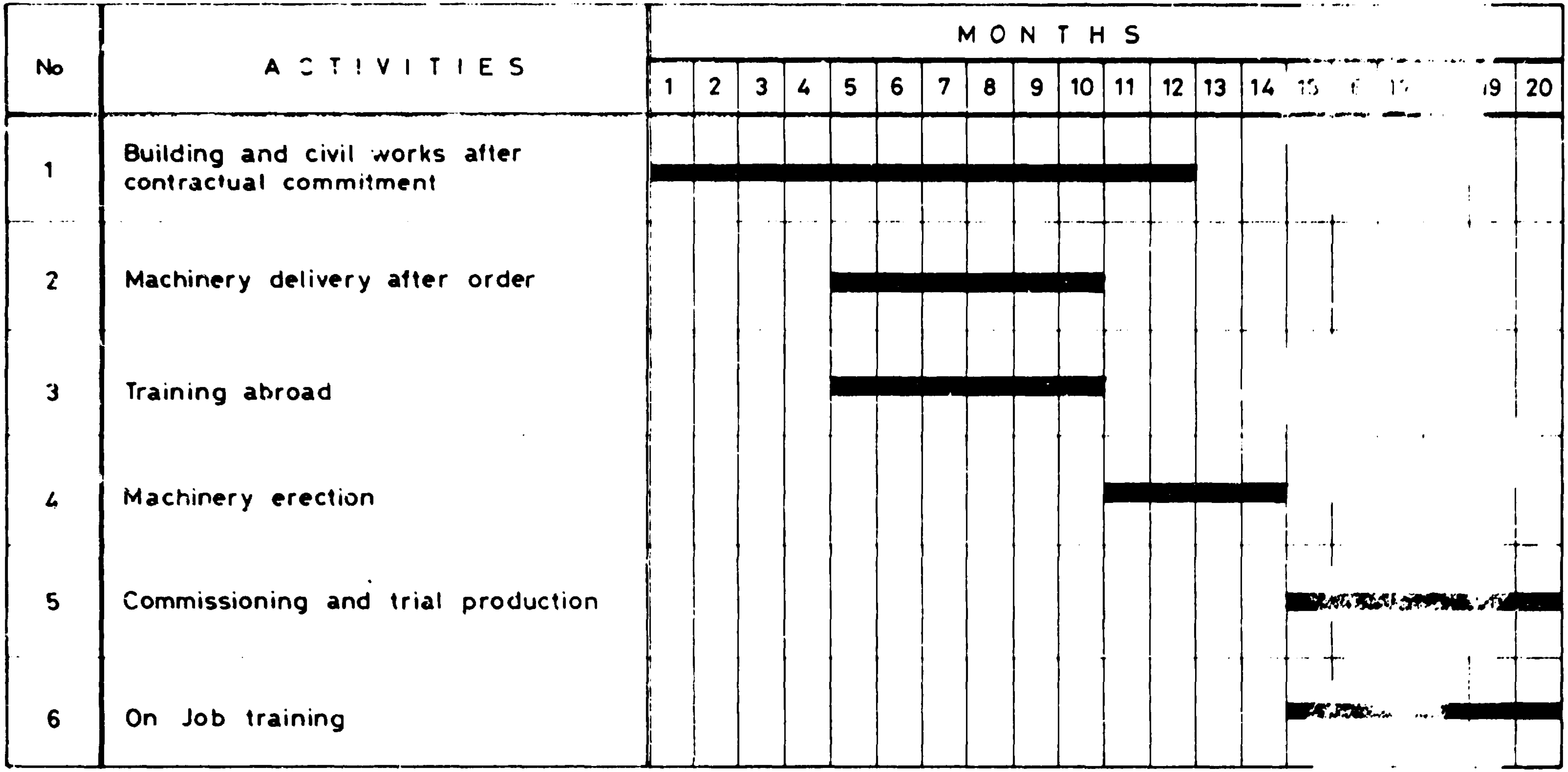
	Post	Persons Per Shift	Number of Shift	Total Persons	Monthly Salary Per Person	Total Monthly Salary	Qualification (Skill)
13	Labourers	6	3	18	60	1080	Unskilled
14	Administration Head	1	1	1	600	600	Diploma with experience or B.A. in administration
15	Personnel Clerk	1	1	1	300	300	Commercial school graduate
16	General Service Asst.	1	1	1	350	350	Technical school graduate
17	Drivers	2	1	2	200	400	3rd driving licence
18	Guards	2	4	8	60	480	Unskilled
19	Cleaner & Messenger	2	1	2	60	120	Unskilled
20	Financial Head	1	1	1	600	600	Accounting diploma with experience or degree in accounting
21	Accounting Clerks	2	1	2	300	600	Commercial school graduate
22	Commercial Head	1	1	1	600	600	Diploma in mgt. with experience or BA in mgt.
23	Sales and Distribution Officer	1	1	1	400	400	Commercial school graduate with experience
24	Purchase and Supply Officer	1	1	1	400	400	ditto
25	Store Keeper	1	1	1	300	300	Commercial school graduate
	Total	-	-	96	-	23,030	

VIII. IMPLEMENTATION SCHEDULE

Duration of the implementation after financial arrangements and contractual committment is estimated to be 20 months. Coarse breakdown is given in Figure III. Detail implementation schedule can be worked out first at feasibility study stage.

FIGURE III

IMPLEMENTATION SCHEDULE



IX. FINANCIAL AND ECONOMIC EVALUATION

A. FINANCIAL ANALYSIS

1. Total Initial Investment Cost

The major breakdown of the total initial investment cost is shown in Table VIII.

TABLE VIII

SUMMARY OF THE INITIAL INVESTMENT COST

('000 BIRR)

Cost Items	Currency		
	Foreign	Local	Total
Buildings and civil works	997.95	2993.75	3991.70
Plant machinery and equipment	3631.90	628.00	4259.90
Office furniture and equipment	19.50	33.00	52.50
Vehicles	59.40	39.60	99.00
Pre-production expenditure	640.06	425.44	1065.50
Total	5348.81	4119.79	9468.60

The strawboard plant requires an initial investment cost of Birr 9.47 million. The foreign currency component amounts to Birr 5.35 million which represents 56% of the total initial investment cost. The other 44% is required in local currency. About 68% of the total foreign currency requirement will be for machinery and equipment.

[illegible]

The following parameters were used to estimate the net working capital requirements of the strawboard plant.

Items		Months of Coverage
1.	Cash in hand	0.5
2.	Accounts receivable	1.0
3.	Raw materials - straw	9.0
	- glue	6.0
	- paper	2.0
4.	Work in progress	0.2
5.	Finished products	1.0
6.	Accounts payable	1.0

The net working capital requirement at full capacity amounted to Birr 0.77 million. About 22% of the total net working capital will be in foreign currency.

3. Production Costs

The detailed production cost schedule is given together with other required financial statements.

The total production cost at full capacity amounts to Birr 2.91 million, out of which about 35% is in foreign currency.

4. Internal Rate of Return (IRR)

The strawboard plant will be financially viable with an internal rate of return of 16.54% and a net present value of Birr 4.36 million calculated at 10% p.a. discount rate.

[illegible] selling price [illegible] .med [illegible] analysis was Birr 12 [illegible] m².

5. Breakeven Analysis

The breakeven point would be reached at a production of 147,775 m² of strawboards. The total revenue generated at the breakeven point would be Birr 1.83 million. This means the plant would breakeven if it uses about 33% of its capacity.

B. ECONOMIC ANALYSIS

The economic rate of return turned out to be 19.79%, with a net present value of Birr 7.06 million discounted at 10% p.a.

The project will create employment for about 96 people.

APPENDIX A

TABLE OF FINANCIAL AND ECONOMIC ANALYSES

Straw Panel Board
Financial Analysis - July 1988
Opportunity study - Final Report

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 Birr

Total initial investment during construction phase

fixed assets:	9468.60	56.490 % foreign
current assets:	0.00	0.000 % foreign
total assets:	9468.60	56.490 % foreign

Source of funds during construction phase

equity & grants:	9468.60	56.490 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	9468.60	56.490 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	1562.99	1805.87	2048.75
depreciation :	863.73	863.73	863.73
interest :	0.00	0.00	0.00
production costs	2426.72	2669.60	2912.48
thereof foreign	39.02 %	36.92 %	35.17 %
total sales :	3890.25	4723.88	5557.50
gross income :	1463.53	2054.28	2645.02
net income :	731.77	1027.14	1322.51
cash balance :	1035.92	1783.95	2079.32
net cashflow :	1035.92	1783.95	2079.32

Net Present Value at: 10.00 % = 4365.50
Internal Rate of Return: 16.54 %
Return on equity1: 10.10 %
Return on equity2: 16.54 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

COMFAR

TABLE A.2

Total Initial Investment in '000 Birr

Year	1	2
Fixed investment costs		
Land, site preparation, development	0.00	0.00
Buildings and civil works	1995.86	1995.84
Auxiliary and service facilities .	49.50	49.50
Incorporated fixed assets	5.25	47.25
Plant machinery and equipment . . .	2129.95	2129.95
Total fixed investment costs	4180.56	4222.54
Pre-production capital expenditures.	532.75	532.75
Net working capital	0.00	0.00
Total initial investment costs . . .	4713.31	4755.29
Of it foreign, in %	56.58	56.40

COMFAR (c)

TABLE A.3

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Total Production Costs in '000 Birr

Year	3	4	5- 7	8	9	10-12
% of nom. capacity (single product).	70.00	85.00	100.00	100.00	100.00	100.00
Raw material 1	315.00	382.50	450.00	450.00	450.00	450.00
Other raw materials	600.07	72[illegible].[illegible]6	857.25	857.25	857.25	857.25
Utilities	144.76	171.53	198.30	198.30	198.30	198.30
Energy	108.26	128.28	148.30	148.30	148.30	148.30
Labour, direct	28.79	28.79	28.79	28.79	28.79	28.79
Repair, maintenance	302.75	302.75	302.75	302.75	302.75	302.75
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	28.80	28.80	28.80	28.80	28.80	28.80
Factory costs	1528.43	1771.31	2014.19	2014.19	2014.19	2014.19
Administrative overheads	34.56	34.56	34.56	34.56	34.56	34.56
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	863.73	863.73	863.73	630.83	640.73	650.63
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	2426.72	2669.60	2912.48	2679.58	2689.48	2699.38
Costs per unit (single product)	0.62	0.57	0.52	0.48	0.48	0.49
Of it foreign, %	39.02	36.92	35.17	33.01	33.11	33.21
Of it variable,%	46.71	51.56	55.59	60.43	60.20	59.98
Total labour	28.79	28.79	28.79	28.79	28.79	28.79

- 938 -

COMFAR

TABLE A.3 (Cont'd)

Total Production Costs in '000 Birr

Year	13-16	17
% of nom. capacity (single product).	100.00	100.00
Raw material 1	450.00	450.00
Other raw materials	857.25	857.25
Utilities	198.30	198.30
Energy	148.30	148.30
Labour, direct	28.79	28.79
Repair, maintenance	302.75	302.75
Spares	0.00	0.00
Factory overheads	28.80	28.80
Factory costs	2014.19	2014.19
Administrative overheads	34.56	34.56
Indir. costs, sales and distribution	0.00	0.00
Direct costs, sales and distribution	0.00	0.00
Depreciation	219.39	219.37
Financial costs	0.00	0.00
Total production costs	2268.14	2268.12
Costs per unit (single product)	0.41	0.41
Of it foreign, %	23.42	23.42
Of it variable,%	71.39	71.39
Total labour	28.79	28.79

COMFAR 2.1 UNIDO

TABLE A.4

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Working Capital in '000 Birr

Year			3	4	5	6-17
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	130.25	150.49	170.73	170.73
Inventory and materials	153	2.4	388.76	472.07	555.38	555.38
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	5	72.0	21.23	24.60	27.97	27.97
Finished products	30	12.0	130.25	150.49	170.73	170.73
Cash in hand	15	24.0	16.45	16.45	16.45	16.45
Total current assets			686.94	814.10	941.26	941.26
Current liabilities and						
Accounts payable	30	12.0	127.37	147.61	167.85	167.85
Net working capital			559.57	666.49	773.41	773.41
Increase in working capital			559.57	106.92	106.92	0.00
Net working capital, local			434.07	520.34	606.62	606.62
Net working capital, foreign			125.51	146.15	166.79	166.79

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

- Q40 -

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow . .	4713.31	4755.29
Financial resources .	4713.31	4755.29
Sales, net of tax . .	0.00	0.00
Total cash outflow . .	4713.31	4755.29
Total assets	4713.31	4755.29
Operating costs . . .	0.00	0.00
Cost of finance . . .	0.00	0.00
Repayment	0.00	0.00
Corporate tax . . .	0.00	0.00
Dividends paid . . .	0.00	0.00
Surplus (deficit) .	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	2046.70	2073.09
Outflow, local	2046.70	2073.09
Surplus (deficit) .	0.00	0.00
Inflow, foreign . . .	2666.61	2682.20
Outflow, foreign . . .	2666.61	2682.20
Surplus (deficit) .	0.00	0.00
Net cashflow	-4713.31	-4755.29
Cumulated net cashflow	-4713.31	-9468.60

- 241 -

COMFAR

TABLE A.5 (Cont'd)

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow	4017.62	4744.12	5577.74	5557.50	5557.50	5557.50
Financial resources	127.37	20.24	20.24	0.00	0.00	0.00
Sales, net of tax	3890.25	4723.88	5557.50	5557.50	5557.50	5557.50
Total cash outflow	2981.70	2960.17	3498.42	3371.26	3371.26	3537.21
Total assets	686.94	127.16	127.16	0.00	0.00	49.50
Operating costs	1562.99	1805.87	2048.75	2048.75	2048.75	2048.75
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	731.77	1027.14	1322.51	1322.51	1322.51	1438.96
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	1035.92	1783.95	2079.32	2186.24	2186.24	2020.29
Cumulated cash balance	1035.92	2819.86	4899.18	7085.42	9271.66	11291.95
Inflow, local	3984.95	4740.89	5574.51	5557.50	5557.50	5557.50
Outflow, local	2431.51	2505.53	3005.02	2901.73	2901.73	3037.98
Surplus (deficit)	1553.44	2235.36	2569.49	2655.77	2655.77	2519.52
Inflow, foreign	32.67	3.23	3.23	0.00	0.00	0.00
Outflow, foreign	550.19	454.65	493.40	469.53	469.53	499.23
Surplus (deficit)	-517.53	-451.42	-490.17	-469.53	-469.53	-499.23
Net cashflow	1035.92	1783.95	2079.32	2186.24	2186.24	2020.29
Cumulated net cashflow	-8432.68	-6648.74	-4569.42	-2383.18	-196.94	1823.35

TABLE A.5 (Cont'd) COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	5557.50	5557.50	5557.50	5557.50	5557.50	5557.50
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	5557.50	5557.50	5557.50	5557.50	5557.50	5557.50
Total cash outflow	3532.26	3477.81	3477.81	3477.81	3742.93	3742.93
Total assets	49.50	0.00	0.00	0.00	49.50	49.50
Operating costs	2048.75	2048.75	2048.75	2048.75	2048.75	2048.75
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	1434.01	1429.06	1429.06	1429.06	1644.68	1644.68
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	2025.24	2079.69	2079.69	2079.69	1814.57	1814.57
Cumulated cash balance	13317.19	15396.88	17476.56	19556.25	21370.82	23185.39
Inflow, local	5557.50	5557.50	5557.50	5557.50	5557.50	5557.50
Outflow, local	3033.03	3008.28	3008.28	3008.28	3243.70	3243.70
Surplus (deficit)	2524.47	2549.22	2549.22	2549.22	2313.80	2313.80
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	499.23	469.53	469.53	469.53	499.23	499.23
Surplus (deficit)	-499.23	-469.53	-469.53	-469.53	-499.23	-499.23
Net cashflow	2025.24	2079.69	2079.69	2079.69	1814.57	1814.57
Cumulated net cashflow	3848.59	5928.27	8007.96	10087.65	11902.22	13716.79

Straw Panel Board --- Financial Analysis - July 1988

COMFAR

TABLE A.5 (Cont'd) COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow . .	5557.50	5557.50	5557.50
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	5557.50	5557.50	5557.50
Total cash outflow . .	3693.43	3693.43	3693.44
Total assets	0.00	0.00	0.00
Operating costs . . .	2048.75	2048.75	2048.75
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	1644.68	1644.68	1644.69
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	1864.07	1864.07	1864.06
Cumulated cash balance	25049.46	26913.52	28777.58
Inflow, local	5557.50	5557.50	5557.50
Outflow, local	3223.90	3223.90	3223.91
Surplus (deficit) .	2333.60	2333.60	2333.59
Inflow, foreign . . .	0.00	0.00	0.00
Outflow, foreign . . .	469.53	469.53	469.53
Surplus (deficit) .	-469.53	-469.53	-469.53
Net cashflow	1864.07	1864.07	1864.06
Cumulated net cashflow	15580.86	17444.93	19308.99

TABLE A.5 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	61.66	at	10.00 %
Internal Rate of Return (IRRE1) ..	10.10 %		

b) Net Worth versus Net cash return:

Net present value	4365.50	at	10.00 %
Internal Rate of Return (IRRE2) ..	16.54 %		

c) Internal Rate of Return on total investment:

Net present value	4365.50	at	10.00 %
Internal Rate of Return (IRR) ..	16.54 %		

Net Worth = Equity paid plus reserves

COMFAR

TABLE A.6

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Net Income Statement in '000 Birr

Year	3	4	5	6	7
Total sales, incl. sales tax	3890.25	4723.88	5557.50	5557.50	5557.50
Less: variable costs, incl. sales tax	1133.43	1376.31	1619.19	1619.19	1619.19
Variable margin	2756.82	3347.57	3938.31	3938.31	3938.31
As % of total sales	70.86	70.86	70.86	70.86	70.86
Non-variable costs, incl. depreciation	1293.29	1293.29	1293.29	1293.29	1293.29
Operational margin	1463.53	2054.28	2645.02	2645.02	2645.02
As % of total sales	37.62	43.49	47.59	47.59	47.59
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	1463.53	2054.28	2645.02	2645.02	2645.02
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	1463.53	2054.28	2645.02	2645.02	2645.02
Tax	731.77	1027.14	1322.51	1322.51	1322.51
Net profit	731.77	1027.14	1322.51	1322.51	1322.51
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	731.77	1027.14	1322.51	1322.51	1322.51
Accumulated undistributed profit	731.77	1758.91	3081.42	4403.93	5726.44
Gross profit, % of total sales	37.62	43.49	47.59	47.59	47.59
Net profit, % of total sales	18.81	21.74	23.80	23.80	23.80
ROE, Net profit, % of equity	7.73	10.85	13.97	13.97	13.97
ROI, Net profit+interest, % of invest.	7.30	10.13	12.91	12.91	12.91

Net Income Statement in '000 Birr

Year	8	9	10	11	12
Total sales, incl. sales tax	5557.50	5557.50	5557.50	5557.50	5557.50
Less: variable costs, incl. sales tax.	1619.19	1619.19	1619.19	1619.19	1619.19
Variable margin	3938.31	3938.31	3938.31	3938.31	3938.31
As % of total sales	70.86	70.86	70.86	70.86	70.86
Non-variable costs, incl. depreciation	1060.39	1070.29	1080.19	1080.19	1080.19
Operational margin	2877.92	2868.02	2858.12	2858.12	2858.12
As % of total sales	51.78	51.61	51.43	51.43	51.43
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	2877.92	2868.02	2858.12	2858.12	2858.12
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	2877.92	2868.02	2858.12	2858.12	2858.12
Tax	1438.96	1434.01	1429.06	1429.06	1429.06
Net profit	1438.96	1434.01	1429.06	1429.06	1429.06
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1438.96	1434.01	1429.06	1429.06	1429.06
Accumulated undistributed profit	7165.40	8599.42	10028.48	11457.54	12886.60
Gross profit, % of total sales	51.78	51.61	51.43	51.43	51.43
Net profit, % of total sales	25.89	25.80	25.71	25.71	25.71
ROE, Net profit, % of equity	15.20	15.14	15.09	15.09	15.09
ROI, Net profit+interest, % of invest.	13.98	13.87	13.82	13.82	13.82

Net Income Statement in '000 Birr

Year	13	14	15	16	17
Total sales, incl. sales tax	5557.50	5557.50	5557.50	5557.50	5557.50
Less: variable costs, incl. sales tax	1619.19	1619.19	1619.19	1619.19	1619.19
Variable margin	3938.31	3938.31	3938.31	3938.31	3938.31
As % of total sales	70.86	70.86	70.86	70.86	70.86
Non-variable costs, incl. depreciation	648.95	648.95	648.95	648.95	648.93
Operational margin	3289.36	3289.36	3289.36	3289.36	3289.38
As % of total sales	59.19	59.19	59.19	59.19	59.19
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	3289.36	3289.36	3289.36	3289.36	3289.38
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	3289.36	3289.36	3289.36	3289.36	3289.38
Tax	1644.68	1644.68	1644.68	1644.68	1644.69
Net profit	1644.68	1644.68	1644.68	1644.68	1644.69
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	1644.68	1644.68	1644.68	1644.68	1644.69
Accumulated undistributed profit	14531.28	16175.96	17820.64	19465.33	21110.02
Gross profit, % of total sales	59.19	59.19	59.19	59.19	59.19
Net profit, % of total sales	29.59	29.59	29.59	29.59	29.59
ROE, Net profit, % of equity	17.37	17.37	17.37	17.37	17.37
ROI, Net profit+interest, % of invest.	15.83	15.75	15.75	15.75	15.75

TABLE A.7 ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Projected Balance Sheets, construction in '000 Birr

Year	1	2
Total assets	4713.31	9468.60
Fixed assets, net of depreciation	0.00	4713.31
Construction in progress	4713.31	4755.29
Current assets	0.00	0.00
Cash, bank	0.00	0.00
Cash surplus, finance available	0.00	0.00
Loss carried forward	0.00	0.00
Loss	0.00	0.00
Total liabilities	4713.31	9468.60
Equity capital	4713.31	9468.60
Reserves, retained profit	0.00	0.00
Profit	0.00	0.00
Long and medium term debt	0.00	0.00
Current liabilities	0.00	0.00
Bank overdraft, finance required	0.00	0.00
Total debt	0.00	0.00
Equity, % of liabilities	100.00	100.00

- Q49 -

COMFAR

Projected Balance Sheets, Production in '000 Birr

Year	3	4	5	6	7	8
Total assets	10327.73	11375.12	12717.87	14040.38	15362.89	16801.85
Fixed assets, net of depreciation	8604.87	7741.15	6877.42	6013.70	5149.97	4519.14
Construction in progress	0.00	0.00	0.00	0.00	0.00	49.50
Current assets	670.49	797.65	924.81	924.81	924.81	924.81
Cash, bank	16.45	16.45	16.45	16.45	16.45	16.45
Cash surplus, finance available	1035.92	2819.86	4899.18	7085.42	9271.66	11291.95
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	10327.73	11375.12	12717.87	14040.38	15362.89	16801.85
Equity capital	9468.60	9468.60	9468.60	9468.60	9468.60	9468.60
Reserves, retained profit	0.00	731.77	1758.91	3081.42	4403.93	5726.44
Profit	731.77	1027.14	1322.51	1322.51	1322.51	1438.96
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	127.37	147.61	167.85	167.85	167.85	167.85
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	127.37	147.61	167.85	167.85	167.85	167.85
Equity, % of liabilities	91.68	83.24	74.45	67.44	61.63	56.35

TABLE A.7 (Cont'd)

Projected Balance Sheets, Production in '000 Birr

Year	9	10	11	12	13	14
Total assets	18235.86	19664.93	21093.99	22523.05	24167.73	[illegible]
Fixed assets, net of depreciation	3927.92	3326.79	2676.17	2025.54	1806.15	1636.27
Construction in progress	49.50	0.00	0.00	0.00	49.50	49.50
Current assets	924.81	924.81	924.81	924.81	924.81	924.81
Cash, bank	16.45	16.45	16.45	16.45	16.45	16.45
Cash surplus, finance available	13317.18	15396.87	17476.56	19556.25	21370.81	23185.38
Loss carried forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	18235.86	19664.93	21093.99	22523.05	24167.73	25812.41
Equity capital	9468.60	9468.60	9468.60	9468.60	9468.60	9468.60
Reserves, retained profit	7165.40	8599.42	10028.48	11457.54	12886.60	14531.2[illegible]
Profit	1434.01	1429.06	1429.06	1429.06	1644.68	1644.6[illegible]
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	167.85	167.85	167.85	167.85	167.85	167.85
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	167.85	167.85	167.85	167.85	167.85	167.[illegible]
Equity, % of liabilities	51.92	48.15	44.89	42.04	39.18	36.[illegible]

- 951 -

COMFAR

TABLE A.7 (Cont'd) ---------- COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA -----

Projected Balance Sheets, Production in '000 Birr

Year	15	16	17
Total assets	27457.09	29101.78	30746.46
Fixed assets, net of depreciation	1466.38	1247.00	1027.62
Construction in progress	0.00	0.00	0.00
Current assets	924.81	924.81	924.81
Cash, bank	16.45	16.45	16.45
Cash surplus, finance available	25049.45	26913.52	28777.58
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	27457.09	29101.78	30746.46
Equity capital	9468.60	9468.60	9468.60
Reserves, retained profit	16175.96	17820.64	19465.33
Profit	1644.68	1644.68	1644.69
Long and medium term debt	0.00	0.00	0.00
Current liabilities	167.85	167.85	167.85
Bank overdraft, finance required	0.00	0.00	0.00
Total debt	167.85	167.85	167.85
Equity, % of liabilities	34.49	32.54	30.80

- 052 -

TABLE A.8 - ECONOMIC ANALYSIS

Cashflow Tables, construction in '000 Birr

Year	1	2
Total cash inflow	4713.31	4755.29
Financial resources	4713.31	4755.29
Sales, net of tax	0.00	0.00
Total cash outflow	4713.31	4755.29
Total assets	4713.31	4755.29
Operating costs	0.00	0.00
Cost of finance	0.00	0.00
Repayment	0.00	0.00
Corporate tax	0.00	0.00
Dividends paid	0.00	0.00
Surplus (deficit)	0.00	0.00
Cumulated cash balance	0.00	0.00
Inflow, local	2046.70	2073.09
Outflow, local	2046.70	2073.09
Surplus (deficit)	0.00	0.00
Inflow, foreign	2666.61	2682.20
Outflow, foreign	2666.61	2682.20
Surplus (deficit)	0.00	0.00
Net cashflow	-4713.31	-4755.29
Cumulated net cashflow	-4713.31	-9468.60

COMFAR

TABLE A.8 (Cont'd) COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	3	4	5	6	7	8
Total cash inflow . .	3021.26	3558.90	4184.12	4168.13	4168.13	4168.13
Financial resources .	103.58	15.99	15.99	0.00	0.00	0.00
Sales, net of tax . .	2517.69	3542.91	4168.13	4168.13	4168.13	4168.13
Total cash outflow . .	1823.25	1562.01	1753.86	1652.52	1652.52	1702.02
Total assets	554.43	101.34	101.34	0.00	0.00	49.50
Operating costs . . .	1268.82	1460.67	1652.52	1652.52	1652.52	1652.52
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	1198.01	1996.89	2430.26	2515.61	2515.61	2466.11
Cumulated cash balance	1198.01	3194.90	5625.16	8140.77	10656.38	13122.49
Inflow, local	2988.60	3555.67	4180.89	4168.13	4168.13	4168.13
Outflow, local	1273.06	1107.36	1260.46	1182.99	1182.99	1202.79
Surplus (deficit) .	1715.54	2448.31	2920.43	2985.14	2985.14	2965.34
Inflow, foreign . . .	32.67	3.23	3.23	0.00	0.00	0.00
Outflow, foreign . . .	550.19	454.65	493.40	469.53	469.53	499.23
Surplus (deficit) .	-517.52	-451.42	-490.17	-469.53	-469.53	-499.23
Net cashflow	1198.01	1996.89	2430.26	2515.61	2515.61	2466.11
Cumulated net cashflow	-8270.59	-6273.70	-3843.44	-1327.83	1187.78	3653.89

- 954 -

COMFAR

TABLE A.8 (Cont'd)

COMFAR 2.1 - INDUSTRIAL PROJECTS SERVICE, ADDIS ABABA

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	4168.13	4168.13	4168.13	4168.13	4168.13	4168.13
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	4168.13	4168.13	4168.13	4168.13	4168.13	4168.13
Total cash outflow	1702.02	1652.52	1652.52	1652.52	1702.02	1702.02
Total assets	49.50	0.00	0.00	0.00	49.50	49.50
Operating costs	1652.52	1652.52	1652.52	1652.52	1652.52	1652.52
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	2466.11	2515.61	2515.61	2515.61	2466.11	2466.11
Cumulated cash balance	15588.60	18104.21	20619.81	23135.42	25601.53	28067.64
Inflow, local	4168.13	4168.13	4168.13	4168.13	4168.13	4168.13
Outflow, local	1202.79	1182.99	1182.99	1182.99	1202.79	1202 79
Surplus (deficit)	2965 34	2985.14	2985.14	2985.14	2965.34	2965.34
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	499.23	469.53	469.53	469.53	499.23	499.23
Surplus (deficit)	-499.23	-469.53	-469.53	-469.53	-499.23	-499.23
Net cashflow	2466.11	2515.61	2515.61	2515.61	2466.11	2466.11
Cumulated net cashflow	6120.00	8635.61	11151.22	13666.83	16132.94	18599.04

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	9	10	11	12	13	14
Total cash inflow	4188.13	4188.13	4188.13	4188.13	4188.13	4188.13
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	4188.13	4188.13	4188.13	4188.13	4188.13	4188.13
Total cash outflow	1702.02	1652.52	1652.52	1652.52	1702.02	1702.02
Total assets	49.50	0.00	0.00	0.00	49.50	49.50
Operating costs	1652.52	1652.52	1652.52	1652.52	1652.52	1652.52
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	2486.11	2515.61	2515.61	2515.61	2486.11	2486.11
Cumulated cash balance	15588.60	18104.21	20619.81	23135.42	25601.53	28067.64
Inflow, local	4188.13	4188.13	4188.13	4188.13	4188.13	4188.13
Outflow, local	1202.79	1182.99	1182.99	1182.99	1202.79	1202.79
Surplus (deficit)	2985.34	2985.14	2985.14	2985.14	2985.34	2985.34
Inflow, foreign	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, foreign	499.23	469.53	469.53	469.53	499.23	499.23
Surplus (deficit)	-499.23	-469.53	-469.53	-469.53	-499.23	-499.23
Net cashflow	2486.11	2515.61	2515.61	2515.61	2486.11	2486.11
Cumulated net cashflow	6120.00	8635.61	11151.22	13666.83	16132.94	18599.04

TABLE A.8 (Cont'd)

Cashflow tables, production in '000 Birr

Year	15	16	17
Total cash inflow	4168.13	4168.13	4168.13
Financial resources	0.00	0.00	0.00
Sales, net of tax	4168.13	4168.13	4168.13
Total cash outflow	1652.52	1652.52	1652.52
Total assets	0.00	0.00	0.00
Operating costs	1652.52	1652.52	1652.52
Cost of finance	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00
Surplus (deficit)	2515.61	2515.61	2515.61
Cumulated cash balance	30583.25	33098.86	35614.47
Inflow, local	4168.13	4168.13	4168.13
Outflow, local	1182.99	1182.99	1182.99
Surplus (deficit)	2985.14	2985.14	2985.14
Inflow, foreign	0.00	0.00	0.00
Outflow, foreign	469.53	469.53	469.53
Surplus (deficit)	-469.53	-469.53	-469.53
Net cashflow	2515.61	2515.61	2515.61
Cumulated net cashflow	21114.65	23630.26	26145.87

TABLE A.8 (Cont'd)

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	2670.80	at	10.00 %
Internal Rate of Return (IRRE1) ..	13.86 %		

b) Net Worth versus Net cash return:

Net present value	7065.38	at	10.00 %
Internal Rate of Return (IRRE2) ..	19.79 %		

c) Internal Rate of Return on total investment:

Net present value	7065.38	at	10.00 %
Internal Rate of Return (IRR) ..	19.79 %		

Net Worth = Equity paid plus reserves