## OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

## DISCLAIMER



## FAIR USE POLICY



## CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED

DP/ID/SER.A/67
17 November 1976
English

07345

# INDUSTRIAL SURVEY AND PROMOTION CENTRE, NAIROBI

DP/KEN/70/521

KENYA

Technical report:
Industrial priorities and planning with reference to the metallurgical industries

Prepared for the Government of Kenya by the United Nations Industrial Development Organization, executing agency for the United Nations Development Programme

United Nations Industrial Development Organization

id. 76-6868

United Nations Development Programme

# INDUSTRIAL SURVEY AND PROMOTION CENTRE, NAIROBI

DP/KEN/70/521

KENYA

## Technical report: Industrial prionities and planning with reference to the metallurgical industries

Prepared for the Government of Kenya by the
United Nations Industrial Development Organization
executing agency for the United Nations Development Programme

**Based on the work of S.S. Gill, industrial engineer (metal processing industries)**

United Nations Industrial Development Organization
Vienna, 1976

The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Mention of firm names and commercial products does not imply endorsement by the United Nations Industrial Development Organization (UNIDO).

This document has been reproduced without formal editing.

## ABSTRACT

Following an assignment as a short-term consultant (December 1975 to March 1976) under the project entitled "Industrial Survey and Promotion Centre, Nairobi" (DP/KEN/70/521) the author had the privilege of serving the Ministry of Commerce and Industry, Kenya, as a consultant for an additional four months from June to September 1976.

During these four months, the main stress has been on recommending essential core sector industries and the Agro-Industrial complex, besides some follow-up action on projects recommended in the previous report. An attempt has also been made to prepare a paper on Industrial Technology as desired by the Director, I.S.P.C. at the instance of the National Council for Science and Technology. A minor digression from the original job description could not be helped because of such requests from Government authorities.

Proper care has been taken to maintain entity of each project or scheme to facilitate its distribution to respective government departments or interested parties, even at the risk of slight repetition.

CONTENTS

# I. INTRODUCTION

The familiar pattern of industrial growth followed in any developing country begins with servicing and simple fabrication workshops, low degree of processing of local agricultural produce, import substitution of consumer goods as well as simpler types of intermediate and capital goods. A similar pattern has been followed in Kenya and the growth rate in the manufacturing sector has been impressive since Independance. It has now almost completed the first stage of import substitution of the simpler type and has reached a more difficult phase of industrialization, namely, import substitution of sophisticated items, manufacture of intermediate and capital goods and export-oriented manufactures involving higher degree of skills, managerial techniques and capital intensity. In the second phase of industrialization Kenya has to strike a balance between achieving faster industrial growth rate, greater employment potential, dispersal of industries, reduced dependence on imported technology and investments, greater degree of processing of local raw materials and much larger earnings from exports of local manufactures.

In the manufacturing sector foreign investments have played a predominant role for the past several years and this situation still continues. The main criteria for private investment so far has been the profit motive, and as a result manufacture of consumer goods received a preponderant weightage. It is now fairly well established that this pattern of import substitution has failed to improve the international trade balances, create additional employment commensurate with the magnitude of investments, generate a technological base for the adoption and adaptation of imported technology and innovative processes for better utilization of local resources. The Government assisted the import substitution type of industries by providing high degree of protection and cheap capital to such industries, thus assuring them of a sheltered market.

In order to facilitate a smooth transition to the second phase of industrialization, the Industrial Survey and Promotion Centre considered it useful to develop new project ideas in the non-traditional industrial sectors; to procure sources of technology, machinery and equipment to suit the Kenyan factor endowments, and, identify gaps in industrial infrastructural facilities like industrial Research Laboratory, testing facilities, tool room, foundry and forge shop etc. Another important gap was the absence of guidelines for an industrial technology plan for the country. This report is a modest attempt in bridging the gap from the easy import substitution type of industrial development to an outward looking export-led growth for the future.

Besides giving a brief summary of the follow-up-action taken for execution of the projects identified in the previous report, the present report mainly highlights the need for establishment of some basic industries including tool-room, forge shop and grey iron foundry and creation of infrastructural facilities - Industrial Research and Development Laboratory and Electronic Development Centre - essentially required for further growth of industries in general and engineering industries in particular. As most of these projects are either developmental schemes or are less remunerative than process/consumer industries, they need to be initiated, promoted and carefully nursed by the Government in collaboration with some foreign agencies. It is also envisaged that Government will now be in a position to avail of the foreign aid more effectively, which could not be done earlier due to lack of suitable industrial project ideas.

An effort has also been made to submit a proposal for establishment of an Agro-Industrial Complex with dual objective of offering a package deal for area development with concentration of subsistence farmers, and encouraging an export oriented industry. The proposal for manufacture of farm equipment is aimed at manufacture of suitably designed equipment to help improve the productive capacity of the subsistence farmer. The scheme for the manufacture and use of Bio-gas plants on a national basis, has been suggested for better utilization of animal waste, for production of fertilizer, provide better ammenities in the rural areas and economise the imported petroleum products to an appreciable extent.

It is hoped, that these proposals when implemented, will help in achieving technological self-reliance, national targets for industrial growth to an appreciable extent and orient the industrial pattern in the desired direction.

## II. FOLLOW-UP ACTION

During the first assignment as a short-term Consultant (December 1975 to March 1976) the author made an effort to identify few key Engineering Projects covering a wide range of engineering and metal products. Attempts were also made to identify new investment opportunities outside the metal product sector where conspicuous industrial and machine tool gaps were evident. Some of the major investment opportunities identified were (i) Integrated Steel, (ii) Machine Tools (iii) Diesel Engines and pumping sets (iv) Mini Sugar Plants (v) Cardboard from Agricultural Waste (vi) Reclaimed Rubber and (vii) Tin recovery from tin scrap.

The function of an adviser should not end with mere identification of projects. Time permitting, he should try to see it through till the stage of implementation, which normally includes locating appropriate sources of technology and equipment and motivation of local entrepreneurship for the same. Keeping in view the limited markets and scale of economy, availability of local sources and skills and the prevailing industrial policies of the Government, suitable sources of technology were located for these projects for the benefit of the local entrepreneur. Every effort was made to locate more than one source of technology and equipment to place the local entrepreneurs in a better bargaining position.

The main thrust in the second assignment as a short term Consultant (June-September 1976) was to carry forward the work done already for implementation of such projects in co-operation with local colleagues besides initiating work on other potential projects of national importance. It is rather encouraging to report that a number of foreign countries and investors have shown interest in the projects already identified. A few parties have already visited Kenya with the objectives of further developing the projects to the stage of investment. The progress so far made on various projects and other related activities is briefly mentioned below:

### 1. List of Consultants/Collaborators

During the first assignment, a tentative list of engineering industries, having scope for development in Kenya, was circulated to various consultants, collaborators and equipment suppliers in different countries through the respective Embassies and directly wherever possible. This was followed with supply of additional background information related to Government policies and other factors having an

important bearing on setting of new industries including local availability of skilled labour and its cost, cost of supply of services (water, electricity and fuel) climatic and soil data and cost of construction etc. A number of parties from industrialized and developing countries responded to this request, which was most encouraging. The entire information so received was processed and tabulated, giving therein alphabetical name of each party and its interest under ten major industrial heads. This register of consultants is now a basic document indicating the sources of technology and equipment for various potential projects. An attempt should be made to update it frequently as more and more parties in foreign countries evince interest for supply of technology and equipment to local entrepreneurs. The existing list of such consultants/collaborators is placed at Appendix I.

2. Mini Integrated Steel Plant

A proposal for manufacture of 250,000 tons of steel per annum based on imported pelleted iron ore and furnace oil from refineries at Mombasa - presently exported - was circulated to various consultants in different countries. The sponge iron technology recently developed and established in a number of developing countries was recommended to be adopted.

A number of consulting firms well versed in this unconventional technology for manufacture of steel showed interest. Two firms of international repute from developing countries even sent their experts to have an on the spot assessment for its technical and economic viability. Both the parties have confirmed the apparent viability of such a project. One of the firms have agreed to send the preliminary project report for approval of the project by the Government in principle. As the total cost of the project is likely to exceed K.Sh. 1000 million, it shall have to be financed by international agencies like World Bank. For this purpose the party has agreed to send a team of experts in the near future for making an indepth study of further details of marketing, product mix, technological aspect and cost of the project etc.

3. Machine Tools

The proposal for manufacture of general purpose low priced quality machine tools was widely acclaimed by a number of parties in U.K., West Germany, Italy, India and few other countries. Two of the parties of international repute from developed and developing countries sent their preliminary reports as well. This was followed by a visit of a team of

top executives from a developing country who further confirmed the economic viability of such a project after their assessment of local conditions and future demands. Besides offering technical collaboration for phased manufacture of such machine tools, they also offered their services for training of local technician in Machine Tool Technology and helping the Kenyan Government to establish a Tool Room Project so badly needed in this country. The prefeasibility report on the entire complex has already been recorded. It will be followed by a visit by their technical expert for preparation of detailed project report.

A paper justifying the need for a machine tool complex in Kenya, its overall objective and extent of financial implications was put up to Government for its approval in principle, copy placed at appendix II.

4. Diesel Engine and Pumping Sets

The manufacture of Diesel Engines, electric motors, water pumps and other allied machinery for irrigation, and post harvesting operation is considered to be of the most essential input for increased agricultural production and modern farming technology. The project for its manufacture related to local requirements was widely appreciated and few parties from developing countries have even offered technical and financial collaboration.

Considering the importance of all these items for the agricultural sector, some sporadic efforts were made in the past for their manufacture individually, which was found to be uneconomical due to low volume of production. In order to get over the problem of economy of scale, it was suggested in this proposal to club together all items, that could be manufactured with nearly similar type of equipment under one roof. This idea appealed to one of the collaborators, who sent one expert to Kenya for a month for on the spot assessment and collection of data for preparation of the project report. The report is expected to be received before the end of September 1976.

5. Leaf Spring, Hand Tools and Bakelite Electrical Accessories

These proposals have achieved the maximum degree of success. The local parties have negotiated with foreign collaborators. It is understood that in case of leaf springs more than one party is interested in putting up plants forits manufacture. It is anticipated at least one plant for each item will be on the ground by middle of 1977. The local assemblers of automobiles have also shown interest in the purchase of locally made springs.

## 6. Card Board, Reclaimed Rubber, Refining of Used Oil and Tin Recovery from Tinplate Scrap

All these proposals were based on utilization of Agricultural and Industrial wastes. The local parties interested in different projects have been put in touch with suitable collaborators and negotiations by different local parties are at different stages of implementation. With the present rate of progress these plants are anticipated to be in production by end of 1977.

## 7. Mini Sugar Plant

This proposal for manufacture of sugar on a small scale is a typical example of application of appropriate technology and has been most well received by the local entrepreneur. Besides being an important agro-industry, it has the potential of wide dispersal and creation of vast employment potential.

Over half a dozen of local entrepreneurs are having final negotiations with collaborators from a developing country. It is anticipated, that by the end of 1978, over 20 such plants may be in operation.

## III. INFRASTRUCTURAL FACILITIES

### A. INDUSTRIAL TECHNOLOGY PLAN

Industrial technology can be described as the systematic application of scientific and other organized knowledge to practical tasks. Scientific research is mostly done in laboratories while its application is done in the factory premises and shop-floors. Science teaches how something would work under controlled conditions in a laboratory while technology adapts scientific research to real life conditions. Industrial technology has advanced in those countries where there is a close co-ordination and linkage between scientific research and industrial innovation. In Kenya, both science and technology are in their infant stages, though it is established that Kenya has the third largest scientific and technical potential in Africa. Kenya therefore has the basic background to plan for a systematic build up of national scientific capability and its practical application to economic and social development of the nation.

#### Establishment of a National Council of Science and Technology

The Government is aware of the need for a centralised co-ordinating body to ensure that scientific research and its application is chanelled into those sectors which are crucial to the economic and social development of the country. With limited financial and man-power resources it is absolutely necessary to obtain practical results of research and experimental development as early as possible.

The Government has expressed a desire for the establishment of a national institution to formulate national science and technology policy and Plan with the following objectives:

i) Determine priorities for scientific and technological activities in Kenya in relation to economic and social policies within the framework of national policies;

ii) Formulate a national science and technology plan and its application to the development of Agricultural industry and social welfare and environments etc.

iii) Control importation of technology and suggest measures for strengthening the indigenous technological capacity for development of appropriate technology;

iv) Ensure output of scientific and technical man-power to suit local requirements;

v) Encourage applied scientific research and its application in different sectors of economy;

vi) Advise the government on the overall requirements for the implementation of the national science policy;

vii) Advise on suitable organisational arrangements for planning, managing and coordinating scientific activities at various levels including setting up of new committees.

The purpose of this paper is to highlight the importance of industrial technology in the over-all Science and Technology Programme for the country and to spell out the various aspects of a meaningful Industrial Technology Plan for Kenya.

## The Role of Industrial Technology

Industrial technology is the key element in the National Science Policy. The Lima Declaration and Plan of Action endoresed by the U.N. General Assembly calls for a major increase in the global share of industrial output by developing countries. If Kenya is to translate these recommendations into concrete plans of action our industrial growth rate will have to be at least 10 to 12 per cent per year to be sustained over a period of 25 years. This implies more than doubling the industrial growth rate achieved in 1974 and 1975. To achieve these targets of industrial growth the technological inputs may have to be increased by over 20 to 30 times the present level to be able to achieve the targets of industrial growth. These facts highlight the magnitude of national effort needed in building up national technological capability in the country.

The order of industrial growth envisaged in the Lima Declaration cannot be reached by concentrating on exports alone. There is a need to substantially increase domestic consumption of manufactured goods. But there is also a limit to which domestic consumption can be increased through imported raw materials, equipment and technologies. Indigenous resource-based industrial development, by the adoption of appropriate industrial technologies is our important way to achieving substantial increases in production and thus contribute to maximum economic growth. It is no exaggeration to say that no single branch of economic activity influences or gets influenced by technology more than industry. In the over-all economic development strategy of a country technological development would be a catalytic agent for industrial growth

and could become a major instrument in the growth and diversification of industry. Research based industrial development with indigenously developed technology would provide profitable outlets for agricultural development, irrigation, agrochemical and light engineering industries and so on, thus providing a spring board for inter-sectoral economic development.

Contents of a Technological Plan

To prepare a comprehensive national technological plan, it is necessary to make an assessment of the technological requirements included in the current Development Plan and also have a broad idea of the next two or three Development Plans. The crucial elements of technology are:

a. skilled man-power

b. local and imported machinery and equipment

c. local and imported raw materials, and

d. the likely job apportunities that need to be created in different Development Plans.

Based on the quantitative information on these elements, an internally consistent technological plan can be worked out and national policy measures recommended to facilitate the implementation of such a Plan. This planning procedure should apply to all aspects of technology including foreign investments, terms and conditions of joint ventures, repatriation of capital and profits, project evaluation, industrial property laws relating patents and trade names, transfer, adaptation and development of technology, research and development expenditure etc.

An important pre-requisite for an industrial technological plan is the assessment of the technological requirements of industrial development programmes including man-power, machinery and equipment. This should be compared with existing facilities with a view to determining additional requirements.

In the Development Plan (1974-78) it is indicated that various Government agencies will undertake periodic survey under the direction of the proposed National Council for Science and Technology. The Plan also proposes to undertake a review of the national research programmes to evaluate their relevance to the development targets set up in the Plan and to suggest a re-orientation necessary. A review of the

effectiveness of the machinery involved in technology innovation and technology transfer is also visualized. The Government has proposed to increase its expenditure on research and technological development from 0.91% in 1971 to 1% of the G.D.P. in 1978. This would work out to K£11 million in 1978 and an annual growth rate of 11.5% between 1971 and 1978. For Kenya to achieve the industrial targets corresponding to the Lima Plan of Action, it will be necessary to increase substantially the expenditure on industrial research and technology.

In Kenya, most of the development in the manufacturing sector, in the past has been confined to the process of industries or import substitution of consumer goods with substantial foreign investments in imported technology and little effort to develop local technological capacity. The same holds true in the case of extractive sectors including mining and forests. This asymetric dependance of technology has reflected in Kenya's ability to produce capital and intermediate goods thus aggravating the differences in technological capabilities. The sophistication acquired in the manufacture of capital goods makes an important contribution to the utilization and adaptation of capical equipment to suit local factor endowments.

The continued dependance on foreign technology has resulted in a heavy burden on the balance of payments, by way of direct foreign exchange transfers for the import of technology, repatriation of profits, interest payments of royalties and cost of expertise. To this must be added the likely burden of over-invoicing of imported machinery and equipment and intermediate products. It has led to a situation where the pattern of national industrialisation is overwhelmingly influenced by global strategy of profit maximisation followed by the multinational cooperations.

It therefore needs an aggressive scientific and technological effort to influence the pattern and direction of industrialization and natural resource development to achieve an accelerated balanced and sustained economic growth in the country.

Some of the measures that need to be taken to achieve a balanced technological development at the national level include:-

a) Restructuring of the rules and regulations for import of technology and the code of industrial property system related to patent and trade marks.

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

b) Devising adequate measures to strengthen the technological capacity of the country, thereby reducing the technological dependence.

A lot has been said and done at various international fora for the need to alter the existing international legal and juridical patterns in the area of transfer of technology to serve the interest of the developing world. A number of developing countries have already implemented these decisions and have set up institutions and evolved procedures for the development of technology to suit their local environments and to adapt imported technology in harmony with national priorities. The Government now proposes to take advantage from the achievements of modern science and technology for the acceleration of Kenya's economic and social progress by creating national capacities for the application of industrial technology. The national industrial technology plan would include the following important measures:-

a) Restriction on import of technology in fields, where indigenous technology is available;

b) Restriction on abuse of patent rights and trade marks;

c) The transfer of technology to be more effective and on reasonable terms and conditions;

d) Training of local personnel in key technical positions and easy access to technical documentation;

e) Strengthen machinery for screening, evaluating and assessment of imported technology for its direct and indirect cost;

f) Establishment of necessary infrastructure and supporting institution for development of indigenous technologies e.g.

- Research, development and testing laboratories
- Tool Room facilities
- Development of Engineering and design facilities

g) Encouragement of local engineering consultancy cells;

h) Standardisation of locally manufactured items and intermediate products with testing facilities;

i) Establishment of a technical information centre

j) Promotion of Research, development and testing facilities at factory level for manufacturing of better quality goods;

k) Development of appropriate technology for development of rural industrial and agriculture sector.

In short the Plan should aim at economic self-reliance through technological independence by channelling the limited resources for attainment of better productive capabilities for the benefit of the common man in the country.

Policy for Acquisition, Adaptation and Development of Industrial Technology

In Kenya, Government's intervention in the operation of market forces is limited to the most essential elements. The acquisition of technology at the enterprise level is normally decided by the entrepreneurs themselves. Government may be indirectly able to influence the selection of technology in the case of industrial projects having foreign collaboration through such institutions as the New Projects Committee which normally screens the projects before providing foreign capital repatriation guarantee under the Foreign Investment Protection Act. The import requirements for increasing capacity or diversification in the existing units are screened by the Foreign Exchange Allocation Committee. Few entrepreneurs may also approach different Ministries and/or the Industrial Survey and Promotion Centre of the Ministry of Commerce and Industry for assessing the prospects for the items they intend to manufacture, preparation of Project Profiles or Feasibility Reports etc. In these cases, Governments influence in the acquisition of foreign technology can only be indirect and marginal. With the strengthening of the National Council for Science and Technology and its various advisory committees the national capability to identify and select appropriate technology will be strengthened. Rigorous technological evaluation of new industrial investments may have to be undertaken if we are to rationalize the acquisition of industrial technology to suit local conditions.

The process of technology selection requires two basic prerequisites. They are:

a) information on alternatives and

b) capability of choice among alternatives.

If detailed information regarding costs, size of operation, quality of output, efficiency in production etc. is available for different technologies it is possible to make a viable choice and strengthen the negotiating position of the buyer.

It is necessary to build up local capability to disintegrate the various elements of a technological package such as 'core' and 'peripheral' so as to provide flexibility to select different elements from different sources and also promote the development of local capability for the manufacture of simpler elements in the technological package. Many developing countries have demonstrated that large industrial plants designed to operate in the industrially developed countries can be redesigned to suit smaller scales of production, introducing labour intensive stages as far as possible, facilitating easier upkeep and maintenance and substituting expensive and automatic control system by simpler ones. A capability for plant redesign is the foundation for sound and rapid indigenous industrial technological development. If one can see an industrial plant not as a package but a series of machines a major problem of technological adaptation would be overcome. With the variety of technologies that are being imported into Kenya, it is not easy to disaggregate 'turnkey' projects to benefit the country without a strong national technological set up and a technological policy. Such a technological policy is therefore a pre-requisite to sound industrial development.

Objectives of Industrial Technology Plan

The major objectives of an industrial technology plan are:-

a) Control over the importation of technology, and strengthening the bargaining power for obtaining the best terms and conditions.

b) Establish supporting organisations for generation and dissemination of Industrial Technology e.g.

   i) Regional Industrial Research & Testing Laboratories

   ii) Tool Room

   iii) Engineering Research Development & Design Centre

   iv) Local consultancy organisation

c) Increase the indigenous technological capacity for the application of appropriate technology relevant to development objectives and promote its diffusion and dissemination amongst the users.

d) Make industrial enterprises aware of the importance of creating local technological capability.

e) Create or strengthen machinery for screening, evaluating and assessing the direct and indirect costs of imported technology.

f) Plan measures to improve prductivity and product quality in the existing industries.

g) Assess the technical man-power requirements for production and managerial functions, and promote its output in the country.

h) Promote co-ordination between the Research, Development and testing centres, Engineering Institutions, Industry and technological institutions to develop new technologies to suit local requirements and avoid overlapping of activities, duplication of efforts and infructuous expenditure.

i) Systematic development for processing of locally available raw materials for better end-values, by promoting new industrial activities in the country.

Industrial technology is now almost wholly imported into Kenya. The I.L.O./U.N.D.P. Report on Employment, Incomes and Equality (1) pointed out that "the prevailing import-substituting approach has serious weaknesses from the point of view of an employment strategy, because it intensifies tendencies towards unequal income distribution, capital intensive technology, under utilization of capacity, lack of export incentives etc." It emphasised that a predominantly capital intensive technology is incompatible with the wider spread of employment opportunities when incomes are generally low and population growth rapid. This idea is even more dramatically presented by an UNCTAD Secretariat Report which states that "technologies designed where labour is scarce are transferred unaltered to poor countries where labour is

---

(1) I.L.O. Employment, Incomes & Equality 1972 p.18

abundant because they already exist and because the heavily protected monopolistic or oligopolistic markets of these countries obviate the need to develop new ones." The self-perpetuating feature of technological dependance is ensured so long as an industry or product group is under foreign control and the launching of domestic technological initiative in those lines remains academic. The I.L.O./U.N.D.P. Report suggested that Kenya should try to produce industrial products appropriate to Kenyan environment and to Kenyan needs, provide additional incentives to use efficient labour intensive technologies where they are available, to seek them out where they do not exist. It is reported that little research is done by private enterprises in Kenya on technology though a number of establishments are said to engage in such activities. The foreign owned enterprises which predominate in the formal sector rely on research by their parent companies. They also rely on parent companies and foreign engineering enterprises for other types of technical service such as machine and plant design. Private enterprises are estimated to be spending about £100,000 a year on local research and development. Thus Kenya's industrial research efforts can be summed up as a fragmented and uncoordinated.

The major objective of an Industrial Technology Plan is to change this situation and to create, for indigenous technologies, an appropriate scope for application. This would need some of the most challenging and innovative initiatives to build national technological capacities for urban industries and also to supply technology to rural areas.

It is neither necessary nor feasible to develop a whole set of new technologies through a massive research effort. Kenya has neither the money, the men, nor time for this exercise. The Government should be able to take advantage of the multi-national technological expertise through international aid agencies to help in the building up of local technological base. New technology programmes should be initiated to assist the industrial development targets set for the developing world by the international community. In particular the links between industry and research institutions have to be strengthened and a close relationship established between the needs of industry and the programmes of research.

## Strategy

The strategy for the control of technology can be considered under three headings:

a. The foreign exchange cost of technology transfer,

b. The appropriatness of technology,

c. Development of local technological capacity.

The Government of Kenya has followed a flexible approach towards foreign investment which is expected to be continued. However, the flexibility with respect to repatriation of capital, profits and dividends is the most crucial aspect of incentives to attract foreign entrepreneurs. Kenya's image in this respect has been good and should be continued. But the type of technology to be imported has to be decided in close consultation with the relevant Government agencies, so that Kenya is able to develop its own technological capacity to progressively reduce the present technological dependance on the industrialized countries. Uncontrolled importation of technology is a continuous drain on the foreign exchange resources of the country. In many cases it is reflected in the processing of highly protected consumer goods with imported raw materials and other inputs to cater to a small domestic market. Such a situation provides no incentives to develop local inputs and provides opportunities for transfer pricing of imports and exports and reducing commitment to Kenyan profits tax. The I.L.O./U.N.D.P. Report(1) pointed out that "this type of transfer pricing can have a particularly marked effect on an economy like that of Kenya where imported intermediates comprise a very large part of gross output in the manufacturing economy. It requires only a very small over-pricing ratios to bring about transfers of resources which can, since they are untaxed, constitute a very large proportionate addition to the resources transferred through the repatriation of profits". If technology import coming in with foreign investment is adequately analysed, it may be possible in many cases to develop substitute local raw materials and other inputs, fabricate simple machines and equipment locally and substantially increase local share of industrial investment. If a planned effort at technology is not made and industrial investment and technology is allowed to continue as in the past, a substantial proportion of the young people entering the labour force is likely to remain unemployed in the near future. The strategy for the control of imported technology and the development of national technological capability is to make the maximum use of Kenya's factor endowments and to induce Kenyan economy to operate more efficiently so that the people of Kenya achieve higher economic growth, get more employment opportunities and obtain a wider distribution of the increased national wealth.

---

(1) op.cit.p.454.

## Control of Technology

The normal channels of technology transfer are:

i) Partial or wholly private investment,

ii) Turn-key projects,

iii) Supply of equipment machinery and know-how,

iv) Employment of individual foreign experts, and

v) Licensing arrangements.

### i. Partially or Wholly Private Investment

Wholly private investment or joint ventures are the most common forms through which transfer of technology takes place in Kenya normally with majority control in the hands of foreign investors. The I.L.O./U.N.D.P. Report has pointed out that on the whole foreign firms are more capital intensive than local ones and that the share of labour in value added is lower in foreign firms than in local ones. Thus for the country, it is a drain of foreign exchange without at the same time contributing to solve the employment problems.

While approving of foreign collaborations and import of technology by local investors, the government should take appropriate measures to assess the direct and indirect costs of such technologies and benefits to the national economy. Some ceiling should be fixed for the capital outflow in form of royalties, technical know-how fees and Research and Development expenditure. Large units should be obliged to spend sizable portion of the profits in R/D work and development of indigenous technology in their local premises in Kenya.

### ii) Turnkey Arrangements

The turn-key manner of transfer of technology has the advantage of the contractor having full responsibility for the implementation of the project, with assured timely deliveries. Here again the government machinery should be in a position to screen and evaluate the actual cost of the machinery on world-wide basis. This mode of transfer is only possible, when the local expertise for the technology involved is adequately available and is in a position to take it over from the contractor after the trial runs.

iii) Supply of Equipment, Know-how and Experts

The transfer of technology through an agreement for supply of whole or part of the equipment, know-how and expertise, has the advantage of participation by the host country to a maximum extent from the very inception of the project and facilitate the local development of technology. For this purpose the Government of Kenya must have a national organisation with local engineering consultancy expertise to act as a receptor of technology. This method of transfer of technology should be preferred over others inspite of its disadvantage of longer gestation periods.

iv) Individual Experts

Countries having their own well developed technological potential sometimes demand services of individual experts and in specialised fields, where local expertise is not available, thus making maximum use of their own experts and creating sense of self-confidence in them for taking important investment decisions. The Government should adopt this method in all such projects where a basic technological capacity has already been generated in the country e.g. consumer industries.

v) Licensing System

This method is utilized for availing of the marketing advantage of reputed trade names or patents by purchase of secretive technology. Whereas it does save the initial cost of research and development work that goes into it so long as the trade mark and/or the licence is used it is necessary to use the technology that goes with it. Usually the local investor is hesitant to develop indigenous technology, and run the risk of losing the market. Once the branded product has gained widespread consumer acceptance, there is little incentive for the licencee to abandon it and sustain the expense and risk of promoting his own trademark. This method is the most disadvantageous to the host country with maximum draining of capital out of the country through a number of direct and indirect channels, besides its high initial cost. For this reason the Government might consider establishing the maximum limit of royalties, both in terms of annual instalment and total period for repayments and import of intermediate products. The receptor unit in such cases might be obliged to invest in research and development work, a minimum percentage of the royalties paid, for development of indigenous technology thus ending perpetual technical dependence. The Government could

play its role effectively for transfer of such technologies, by progressively reducing the per pack or per unit of imported content, inducing the party to encourage the progressive use of indigenous content through local manufacture.

It is not possible to determine a general formula to be used for transfer of technologies for different types of industries planned to be set up in future, as each case has to be studied and assessed on its merit taking into account the complexity of the technology involved, its national priority and the local expertise indigenously available.

Appropriatness of Technology

One of the major aims of the government for rapid industrial development is to help solve the problem of unemployment or underemployment by creating new job opportunities. In countries where capital is scarce and labour unemployed or underemployed, the emphasis should be put on maximising capital productivity rather than labour productivity. Inspite of Kenya encouraging growth of industrial economy in the past decade there has not been a corresponding increase in industrial employment. This is mainly due to importation of capital intensive machinery with little attention given to development of labour intensive industries based on local raw materials and skills.

Development of Local Technological Capacity

For development of local technological facilities, it is necessary to have a number of institutions for training of local personnel in different specialised disciplines, as well as to provide assistance to the existing and new industries to develop technological capabilities. Most of the essential assistance to be provided in the form of facilities could be classified under the headings:

i) Industrial designs

ii) Industrial Research, Development and Testing Laboratory

iii) Industrial Project Engineering

iv) Standardisation

v) Training Facilities for Technical manpower

vi) Tool Room facilities

i) Industrial Designs

Industrial or Engineering design capability is the basic requisite in building up self-sustained industrial activity in any country. Availability of such facilities greatly helps a developing country in acquiring and adopting technology from developed countries. It can specially help to design consumer and other products to suit the locally available raw materials and other inputs and also redesign the imported operative technology relevant to the scale of economy and local skills. The establishment of an Industrial Designs institute could coordinate the industrial research activities undertaken in the college of Engineering Nairobi, East African Research Organisation etc. so as to dovetail them to the needs of the local industries.

The main functions of this institute will be:

Product design

Machine design

Designing jigs, fixtures and tools for Production Engineering

Operation Sheets and production control

Machine loading schedules

Material specifications and testing procedures

Layouts

In order to be an effective organisation with practical approach for rendering such services to industry it should preferably be linked with a Tool Room and have close liaison with industry. It demads the services of a team of well qualified engineers with specialised experience in different fields of engineering designs. It will not be advisable to link it with any training or Engineering Institution, which does not have the opportunity to interact with industry and be conversant with their design requirements.

Industrial Research, Development and Testing

Much of the industrial technology already available in developed countries could be utilized for the establishment of new industries in Kenya, with or without any adaptation. But there are certain industrial problems related to utilization of local raw materials, climate, the size of market etc. which are peculiar to Kenya requiring adaptation of imported technology. The operative technology related to such projects

needs to be developed through research in local laboratories. Such laboratories will also be responsible for devising new innovations for achieving increased productivity and better quality end-products and for disseminating technical knowledge on use of raw materials, processes and industrial operations to the existing industry. The degree of protection afforded to the local industry has ensured it the domestic market without entailing quality consciousness and adherence to standardisation - elements which are pre-requisites for export oriented industries. Very few industries are equipped with the barest minimum testing facilities or an organized system of inspection. An Industrial Research Development and Testing Laboratory should be entrusted with the responsibility for not only creating quality consciousness amongst the local industries, but also providing testing facilities for a selected number of industrial products. The main function of this Laboratory will be to:-

i) Undertake research work or pilot plant studies to develop operative technology for maximum utilization of locally available raw materials;

ii) Inculcate quality consciousness amongst the local industry and provide testing facilities for maximum number of locally manufactured products;

iii) Help to solve the day to day operational problems of the local industry;

iv) Provide facilities for adaptation of imported technology relevant to the local skills, raw materials and environmental conditions;

v) Prepare feasibility studies for the processes developed locally.

In the initial stages this institution will be multi-disciplinary, catering to the simple technical problems faced by various branches of Industrial Engineering. As experience is gained and more and more expertise is locally available, it could concentrate on specialised fields. It will be advisable to have two such institutions one each at Mombasa and Nairobi. Each institution should offer services in different branches of Engineering besides normal services of testing and technical guidance.

Industrial Project Formulation

An Industrial Project report covers some or all of the following points depending upon the type and size of the project:

Market Studies

Pre-investment Studies or Project Profiles

Feasibility report

Locational Studies

Selection of Technology

Industrial Process Engineering

Material Flow, Material Balances and Raw Material requirements

Layout Plans

Production Engineering

Civil work, services, offsite facilities

Commissioning, training of Personnel

Whereas in certain cases, interested investors may undertake such studies with the help of private consulting agencies, the Government should also in certain cases initiate such studies on its own or with the help of some outside agencies, as a part of its objective to promote new projects. The cost of preparing feasibility or project reports could be considered as part of promotional expenditure, which could be capitalized later at the time of its implementation. The Feasibility Reports may be undertaken with the assistance of specialists in the relevant fields. But national personnel should be fully involved at every stage so as to develop local expertise for preparation of such reports. It is also envisaged that services of private consultants locally based will be fully utilized in their field of specialisation.

It should be made obligatory on the part of foreign collaborators to associate local consultants right from the initial stage of any industrial projects, which will ultimately help to generate enough expertise indigenously in project engineering to independently undertake such assignments in the future. The Industrial Survey and Promotion Centre in the Ministry of Commerce and Industry has been in operation since 1970 and has gained considerable expertise in these fields.

<u>Standardisation</u>

One of the essential infrastructural facilities in a country is a standards Institution responsible for the formulation, adoption and observance of national standards so as to ensure that consumers get a fair deal for their money. This

institution must be vested with adequate authority to implement the adoption of national standards for locally manufactured products. This can only be achieved, if adequate quality control measures are taken right from the raw material to the finished product stage and testing facilities are provided for the finished products. Such measures will also help the industry to compete in the international markets both in quality and price.

In these respects the government has already created the Kenya Bureau of Standards which needs to be strengthened. There is an urgent need for establishing national standards for a number of goods of common use both in the consumer and engineering fields. The Bureau of Standards is already engaged in this exercise. The standards thus established should be acceptable in the export markets.

Training Facilities for Technical Man-power

The capacity of a country to acquire, adapt, disseminate and develop new technologies, depends upon its technical knowledge or manpower availability and the system of training of engineers and technicians to meet future demands. As at present in Kenya, there is lack of suitably qualified and experienced engineers and professionals at the decision making levels, which adversely affects the preparation of Industrial Development Plans and formulation of industrial policies. The private sector generally does not undertake long-term planning. The branches of foreign firms have their production programmes approved in their headquarters abroad and local firms normally do not have suitably experienced people for the planning exercise nor have they presumably found any need for it, because of the existence of a comparatively protected domestic market for their manufacturers. Though the present output of the existing training and academic institutions is adequate in numbers there is scope for improving the quality of the training imparted and re-orienting it to the occupational requirements of the country. The urgent need to promote an outward looking export-oriented manufacturing sector would require a high degree of professional efficiency among the local engineers and technicians. The need to create such training facilities locally cannot be over emphasized if Kenya is to make its contribution to world industrial production as visualized in the Lima Declaration and Plan of Action.

There are some conspicuous gaps in training facilities in certain trades particularly at the middle and low level technical and managerial cadres. This is particularly true of textile and leather technology and marine engineering.

With respect to on-the-job training of technicians, there is a need to organize a centralised training programme and control instead of leaving their training to the discretion of the employers.

The training programmes of engineering graduates in production engineering needs to be streamlined to suit the current and future needs of local industries. Fresh engineers should be provided with facilities and incentives to undertake pioneer task of developing appropriate technologies or solving practical engineering problems or adapting imported technology to suit local conditions. There is a dire need to revise the present syllabii which was adopted to suit a different pattern of manufacturing activities. The need to-day is to emphasize on industrial growth and diversification, adaptation of imported technology, creation of new designs and building up of indigenous technology to manufacture quality products for local market and exports.

Technical Information

One of the essential component for institutional arrangement for transfer and development of technology, is the machinery for provision of information of a kind appropriate for the purpose of technological decision making. The local manufacturers need to be provided with technical information related to production techniques, product specification etc. "Transfer of technology is an exceedingly complex process involving a sensitive combination of technological, economic, managerial, social and political factors." Technological information is necessary for the design, selection, installation and improvement of processes, materials, equipment, services, and methods. Information is a crucial input to assist in the formulation of coherent policies on technology acquisition and its development at the implementation stage. The utility of the decisions taken in these respects depends mainly on the quality of information available at the disposal of the decision makers. At the policy formulation level there is a need to be informed about the implications of policies relating to foreign investments, contractual arrangements for the transfer of technology, local research and development. At the enterprise level information about alternative technologies, sources of supply, minimum costs, technological specifications, guarantees, delivery and implementation schedules, man-power requirements is necessary. It is therefore necessary to have a technological information centre, for supply of such information on a continuous basis, on all interrelated fields of industry. The major items of information is summed up below:-

i) Foreign investment sources

ii) Contractual arrangement for transfer of technology

iii) Local Research development and designing facilities

iv) Sources of alternative technologies and its terms and conditions

v) Industrial specification of industrial raw materials and intermediate items

vi) Sources of supply of machinery and equipment with cost

vii) Local inputs - land, water, power and fuel with cost

viii) Other industrial inputs including skilled manpower cost of construction and transport etc.

ix) Government industrial policies, incentives and list of priority industries

x) Financial institutions and terms of lending

xi) General environmental conditions including climate conditions and soil data etc.

Presently the investor has to go to different places like the Ministry of Commerce and Industry, development banks, Chamber of Commerce etc. and still may not be able to get all the information to enable him to take informed decisions. Lack of adequate and reliable information is one of the major reasons for the importation and application of diverse and often inappropriate technologies into the country.

An expert group under the auspices of the United Nations Office for Science and Technology has recommended that developing countries should set up national centres capable of providing a complete technology information service for potential users. Such a Centre is also recommended to:-

a) develop methods to motivate technicians, skilled workers, entrepreneurs etc. to use the information;

b) identify the actual problems faced in an industry through periodic visits of specialists to the industrial houses, factories etc;

c) organise visits, get togethers, open houses etc. by which the people from industry visit meet and discuss their specific problems with specialists and get acquainted with new technology developed in the country and elsewhere;

d) present the information and ideas in a language readily understood by the people from industry;

e) provide complete packaged information covering not only the technical aspects of a problem but also the technological feasibility, economic viability, the suitability of a technology to the Socio-economic context, facilities available to utilize the technology etc; and

f) provide specialized industrial technological information such as market intelligence technology trends, regulatory, legal and other environmental information.

In Kenya, one of the institutions which has the background and potential capability to undertake the above responsibilities is the Industrial Survey and Promotion Centre in the Ministry of Commerce and Industry. With the existing of constrains of technical man-power and material resources, the I.S.P.C. is already functioning as the national centre of technological information. The material and man-power resources of the I.S.P.C. have to be substantially strengthened through national efforts and international assistance to reinforce this activity of the Centre.

Tool Room

Facilities for Tool Room work for manufacture of tools, jigs fixture and dies is an essential service, that should be made available for setting precision engineering in any acountry. As this involves purchase of very costly precision machinery, and is comparatively less remunerative vis-a-vis process industries or consumer items, it is generally capital shy. The promotion of such an activity is normally done by the government in any developing country in the initial stages of Industrial development. These services are generally coupled with Industrial Design facilities.

Normally a Tool Room will consist of:-

jig tool and die design section

Tool/die/jig/gauge manufacturing section

Tool/die servicing section

Metrological section

It also acts as an important channel for transfer of technology from a developed country to a developing country. As at present very little of such services are available in Kenya herefore, in order to achieve self-reliance in precision engineering it is necessary for the Govt. to take initiative for setting up at least two tool rooms at important industrial centres with the help of some international agencies.

The major objective for the proposed tool room will be:-

i) Training of technical personnel in designing and manufacturing of tools, dies, gauges, jigs and fixtures

ii) Provision of advisory services to local small and medium manufacturers

iii) Manufacture of tools, dies, gauges and jigs and fixtures.

iv) Training of technicians in meterological and quality control work.

v) Assistance for standardization of processes and quality control.

Besides providing the essential tool room facilities to the local industry, it will help to generate a local cadre of highly skilled tool room technicians, which will spread to other industries and be ultimately responsible for building the industrial pyramid of the country.

Electronic Industry

In this age of space engineering and computer science no country, aspiring to push through its industrialisation programme and compete in the international world, can afford to sit back and do little to develop its own electronic technological base. In Kenya few multi-nationals have ventured to assemble a few of the entertainment and telecommunication items, without undertaking any programme for manufacture of components and development of local skills. The import of different type of telecommunication, entertainment, office equipment and defence items based on the use of electronic components has nearly doubled itself in the last five years, and is likely to do so in future as well. It is therefore proposed to establish an Electronic Development Centre with facilities to design and develop simple electronic components and generate electronic expertise.

## Plan of Action

An Industrial Technology Plan for a country has to incorporate a variety of inter-related actions to cover a wide spectrum of activities. Many of these inter-related actions can be implemented simultaneously.

In Kenya two sectors need to be given priority consideration. These are engineering industries with emphasis on light engineering because of their importance to the manufacturing sector and in view of the skills and capabilities they help to create. Agro-based and agro related industries are also important because they provide "the most direct means of increasing incomes and employment for the nation as a whole and of generating exports with the minimum use of scarce resources." It is recognised that an important function of the Technology Plan is to protect local industry and indigenous research efforts. It aims at lowering the level of dependancy on foreign technology and channelling the flow of technology into the preferential sectors of industry. The different projects that need to be implemented to achieve these aims are described below:

### Project I - Creation of an Industrial Technology Advisory Committee

The Industrial Technology Advisory Committee will be one of the committees functioning under the National Council of Science and Technology for advising the Council on various aspects of development of Industrial technology in the country. Its advisory functions will cover the following aspects:

i) Basic policies for the promotion of Industrial technological capacity in Kenya

ii) Preparation of Schemes and plan related to the Industrial Technology, and submitting the same to the ministerial decision making body for approval and implementation.

iii) Liaison with developed and developing countries and international agencies for importation of appropriate technology;

iv) Creation of necessary infrastructure for development of indigenous technology

v) Assessment of technical man-power requirements and revision of the curriculum of the existing institutions to suit local needs and creation of additional facilities for training wherever necessary;

vi) Maintenance of a national registry of technical-manpower in the country, and

vii) Any other aspect on which the NCST would seek its advice.

Project 2 - Regional Industrial Research Development & Testing Laboratory

The present facilities for Industrial Research are limited to the few educational institutions and the E.A. Research Organisation. Because of the limited financial and manpower resources, and multifarious educational responsibilities, these institutions are not adequately equipped to undertake applied industrial research. It is therefore necessary to have one or more independent institutions encompassing the following industrial research and development activities:

i) Pilot project studies for industrial processing of local agricultural produce including cereals, oil seeds, forest resources, medicanal plants, leather etc., to achieve better end-values;

ii) Beneficiation, extraction and processing of minerals/ores locally available and suggest new manufacturing activities

iii) Develop processes for utilization of agricultural and industrial waste

iv) Design and manufacture prototype of post-harvest agricultural equipment to facilitate its local production, e.g. oil seed/sugar cane crushing machinery, wheat threshers, rice hullers, storage bins, simple transport equipment etc.

v) Assessment of technology requirements and evaluation of imported technology

vi) Establish testing facilities for raw materials, finished and semi-finished goods locally used including:

a) chemical and metallurgical testing

b) physical testing

c) performance testing of locally manufactured goods

vii) Encourage testing and quality control and promotion of R/D activities at site by the local industry

Project 3 - Standardisation Institution

The Kenya Bureau of Standards has already been set up as an autonomous body and has been made responsible for formulation and implementation of national standards in the country, to help produce quality goods. It however needs to be appreciably strengthened, both as regards manpower and testing equipment. There is immediate need for formulation and adoption of some national standards for a number of locally manufactured items which could be done in consultation with industry and trade and based on British or any other international standards normally acceptable in the World market.

It is also necessary to set up a testing laboratory suitably equipped to test most of the items for which local Standards are formulated.

Project 4 - Technical Information Centre

A technical information Centre (Data Bank) is an important mechanism for technology transfer. This Centre should acquire all relevant information related to the type of technology and industry to be developed locally, specifically sources of technology, raw materials, intermediate goods and machinery and equipment.

The main function of this Centre will be to collect and disseminate information regarding:

i) Foreign investment sources

ii) Contractual arrangements for transfer of technology

iii) Sources of alternative technologies and its terms and conditions

iv) Foreign equipment and raw material suppliers

v) Cost of local industrial inputs e.g. land, water, power, labour etc.

vi) Cost of construction, transport etc.

vii) Government Industrial policies incentives and list of priority industries etc.

viii) Foreign government commercial agencies

ix) Terms and conditions for the technical collaborations

x) General environmental conditions including climatic condition and soil data etc.

It is rather difficult to have access to the foreign sources of such information, for which assistance of international agencies like UNIDO, UNESCO, ILO, UNCTAD, C.F.T.C. etc. would be relevant. The Industrial Survey and Promotion Centre, of the Ministry of Commerce and Industry, currently undertakes some of this work.

Project 5 - Industrial Project Engineering

In order to develop local Industrial Project Engineering Consultancy Services in the private sector, the Government should encourage the local consultancy firms by:

i) Hiring services in their specialized fields in preference to foreign consultants.

ii) It should be made obligatory on the part of the foreign collaborators for big projects, to associate local industrial consultancy firm for preparation of feasibility or project reports.

iii) Maintain a directory of approved local Industrial Consultants with detailed information regarding the qualifications and experiences of their staff and specialized fields for the benefit of potential investors.

iv) Tax holiday for the first 3-5 years of operation for the Consultancy Firms.

Project 6 - Tool Room

The weakest link for the manufacture of precision products of consistant quality in Kenya is the lack of facilities for manufacture of tools, dies, gauges, jigs and fixtures. Being highly capital intensive and skill based, this activity is capital shy. The government should therefore take the initiative to setting up tool room as public sector development projects with the assistance of bilateral or international agencies in important industrial centres, with the following objectives:

i) Training of technical personnel in designing and manufacture of tools, dies, gauges, jigs and fixtures.

ii) Manufacture of tools, die, gauges and jigs and fixtures for the industry on jobbing basis

iii) Training of technicians in metrological and quality control work

iv) Assistance for standardisation of processes and quality control

v) Provision of Advisory Services to local small and medium industries on production technology

Project 7 - Education & Training

The major schemes under this project are:

i) National registry of technical man-power available

ii) Revision of curricula with greater dose of practical application of technological knowledge

iii) Assess the future requirement of Engineers, Technicians and craftsman by the industry as per national plan and identiry gaps if any.

iv) Make provision for training of technicians for textile and leather technology and marine engineering in the existing polytechnics or new institutions

v) Organise production engineering course in the college of Engineering, Nairobi

vi) Centralized apprenticeship training schemes for on the job training in factories.

vii) Closer liaison between industry and technical training institutions

Project 8 - Export Promotion

Besides helping to narrow down the international trade deficits, export promotion programme has a considerable direct and indirect influence on improving the technological capacity in any country. It helps to:

i) Expose the local manufacturer to better production techniques used in other countries

ii) Improve the products designs

iii) Create cost and quality consciousness amongst the local manufacturer

iv) Exchange processing of local raw material for earning better end-values abroad.

v) Give an opportunity to better utilize capacity of industries based on local raw materials and skills.

It is therefore suggested that the Kenya External Trade Authority should:

i) Undertake more zonal studies - specifically in Middle East and African countries - for items of local manufacture having export potential

ii) Suggest processing of local raw materials - presently exported in raw form, for better end-values

iii) Organize visits abroad by local teams of manufacturer exporters

iv) Participate in more foreign industrial exhibitions

v) Import prototype samples of products having potential for local manufacture and for export.

Project 9 - Electronic Development Centre

Of all the industries in the developed and most of the developing countries, the electronic industries have the fastest growth rate in the recent years. It is mainly because of its importance for the manufacture of defence and entertainment equipment, inter-communication systems, business machines and instrumentation. There is also maximum concentration of Research and Development activities in this field in most of the countries resulting in fastest obsolescence rate in this industry due to new innovations and inventions. It is difficult for any country to achieve any degree of self-reliance in defence or industrial production without keeping pace with the latest development in electronic technology. The present system of merely having assembly plant for entertainment or telecommunication items can hardly contribute to the development of local electronic expertise and skill. Saving of foreign exchange or minimise complete dependency on foreign technical know-how. It is in this context, that it is suggested to have an Electronic Development Centre in Kenya, which help to generate local expertise and skills, offer common service facilities and also serve as a good media for transfer of electronic technology.

The consumption of various types of equipment in the country, based on use of electronic technology, has increased from K.Sh 129.8 million in 1973 to K.Sh 144.6 million in 1975, as compared to K.Sh 73.54 millions in 1970. Though it may not be possible to undertake manufacture of a number of electronic components locally due to economy of scales or intricacy of technology involved, there are other items, which could be considered for local manufacture provided suitable facilities

and technology is made available to local entrepreneurs. Some of these components, which are already being manufactured by small scale sector in other countries are:

i) Capacitors, resistors and condensors of different types

ii) Electronic switches of different types

iii) Miniature magnets

iv) Miniature relays, transformers, I.F. coils, R.F. coils, capacitors, motors etc.

v) Microphones, loudspeakers, cones

vi) Counters - electronic, magnetic, digital and impulse

vii) Transreducers of different type

viii) Magnetic tapes, carsets, cartides

ix) Pick-up and pick-up cartridges

x) Electronic calculators

xi) Walkie talkie

xii) Printed circuit board and many other such items

The feasibility and priority for local manufacture of different items could be determined by undertaking a survey for its demand in the country by the proposed electronic Dev. Centre, with the help of any International aid agency.

<u>The Objective</u>

The major objectives of this Centre are proposed to be:

i) Practical and theoretical training for manufacture of simple electronic items to qualified and experienced technicians and engineers

ii) Design and development of prototype electronic items

iii) Testing facilities and

iv) Advise the government on evaluation and adaptation of imported technologies

v) Manufacture of few key electronic components.

The proposed Electronic Development Centre will not conflict with the existing assembly and/or manufacturing activities in the field. On the contrary the local entrepreneurs will be in a better position to negotiate with foreign collaborators from a position of strength in view of the technical facilities and expertise locally availabe.

For this purpose it may be necessary to seek technical and financial assistance of some International Aid Agency.

## B. INDUSTRIAL RESEARCH AND DEVELOPMENT INSTITUTE

### Introduction

Kenya has achieved a remarkably impressive industrial growth during the first decade of Independance. In the 1974-78 Development Plan a growth rate of 10.2% per year is envisaged, though the performance during the first two years of the Plan has been less than satisfactory. During the first phase of industrialisation, the strategy was import substitution to cater to local demand in a well protected market. This easy phase has now almost worked itself out, and, the need has arisen for an outward looking policy of industrialization to cater to export markets, using as much as possible local raw materials. In this phase, more emphasis has to be laid on the quality of goods produced and their prices to be internationally competitive.

The achievement of this national goal demands establishment of certain infrastructural facilities to cater and expedite the desired level of industrialisation. One of the most essential of these services is the facility for Industrial Research and Development to help maximise the output with the available human and material sources and limited financial resources. The level and field of Industrial Research activity, the organisation, the nature of problems to be undertaken, will greatly depend upon the financial and human resources locally available, and the mental attitudes of the men at the helm of affairs in the industrial field. It may neither be feasible, nor advisable to plan for fundamental or basic research in the initial stages. A beginning has to be made in rendering simple industrial and technical services to fulfil the immediate need of the industry and modification or adaptation of imported technology in certain industrial fields for maximum utilization of skills and raw materials locally available.

The industrial activity in Kenya has already reached a level, where it is a position to penetrate the foreign markets particularly neighbouring African countries and compete both in quality and price. The proposed Institute will help the exporters to cut down their production costs, improve the quality of their product and process the local exportable raw materials, so as to have better end-values and still be able to compete in the international markets.

## The Present Position

Inspite of the multitude of the existing R/D establishments in the country, very few are engaged in worthwhile manufacturing activities. The E.A. Industrial Research Organisation at Nairobi is exclusively devoted to Industrial Research and Development problems, but its field of activities are limited mainly to food and ceramics industries and to some extent the Agriculture sector. Some of the educational institutions also claim to extend testing facilities to the local industry and also undertake simple industrial projects involving appropriate technology. The types of equipment installed in these institutions are however designed for teaching purposes and are not adequate to suit the requirements of an industrial research and development work. Moreover the University facilities are more suited for academic purposes and are not geared to commercial purposes.

In the fourth plan (1974-78), the government has proposed to increase the expenditure on Research and Technical Development from 0.91% to 1.0% of G D.P. by 1978 which works out to be K£. 11 million for all the sectors.

A minor part of this budget ear-marked for Industrial Research, is mostly allocated to E A.I.R.O., I.S.P.C., College of Engineering and Polytechnic, Nairobi. Considering the fast growth of industry as envisaged in the plan, and the need for providing such services to the industry, these funds may have to be appreciably increased.

In the private sector, the position is no better. Very few of the existing industries are equipped even with the minimum essential equipment at site for quality control. The large scale factories, mostly owned by multi-nationals, solely depend upon their parent organisation even for simple testing of raw material or finished goods which were so far meant for local consumption. With the changed emphasis on an outward looking policy the need for local research and development facilities to create a technological base locally, can hardly be over emphasised.

It is in this background, that it is proposed to establish an Industrial Research and Development Institute at Nairobi in Kenya, followed by another similar Institute at Mombasa.

## Scope of Services

Because of general shortage of highly specialised scientific personnel and limited resources, the research activities of the Institute will be limited to applied and developmental research, in fields not already covered by the existing R/D organisations and devote its attention to adaptation and application of known technologies. The investment so made, may be considered as an investment in industry, as the activities of the institute will be mainly oriented towards practical problems and the actual needs of the industry, yielding quick benefits to the industry. When sufficient research consciousness has been created amongst the industrialist, and local scientific and technological talent has been generated, problems related to higher level of applied research or basic research could be undertaken.

In view of the facts mentioned above the R/D activities of the Institute will be limited to:

Engineering Industries

Textile Technology

Leather, rubber and plastic industries.

For this purpose, it may enter into academic partnership with some foreign research institutes in developed countries specialising in such fields and avail of the known technologies. It should also have close links with universities and the existing R/D organisation in the country, for inter disciplinary cooperation, in the best interest of the country.

## Functions

The major functions of the Institute will be:

i) Investigation and development of raw materials and natural resources related to Engineering, leather, rubber, plastic and textile industries, for better end-values.

ii) Provision of technical services to industry including

- Performance testing of finished goods
- Chemical testing of raw materials and intermediate products
- Physical testing of raw material and finished goods

- Trouble shooting day to day operational problems of the industry
- Introduction of quality control measures within the industry
- Improve productivity per unit man and machine

iii) Promotion and assistance in standardisation of raw material, processes and qualities of finished products in the related industries in collaboration with Kenya Standards Institute.

iv) Project Studies on processes related to the locally available raw materials or intermediate products, having scope for commercial exploitation.

v) Pilot Project Studies for processes developed at laboratory scale or for adaptation of foreign technologies.

vi) Project engineering including process engineering, designing of equipments and layout plan etc.

vii) Assistance to government on policy matters related to the specialised field of industries.

viii) Training of sponsored candidates by the industry in analytical and quality control work.

The Organisation

The organisation of any Industrial Research Institute has to be so planned as to create a congenial atmosphere for the scientists and technologist to work devotedly as a team, and be in a position to deliver their best in the overall national interest. They should have freedom of work, within the overall frame-work laid for the national development programme. They should also be provided with adequate funds and facilities for undertaking industrial research problems or pilot studies having maximum potential for industrial development. In case of shortage of funds, they should have an opportunity to tackle the problems identified, in other associated institutions. The institute should have enough flexibility to encourage initiative on the part of technologist and engineers and workers to generate useful work, of practical application to the industry. and not be burdened with the rigid administration procedures.

Considering its multi-purpose functions, interdisciplinary approach and the operating conditions mentioned above, the following alternative organisational set-up may be examined:

a) Part of the College of Engineering, Nairobi

b) Part of the Polytechnic Institute

c) Semi-autonomous body within the Ministry of Commerce & Industry

d) Semi-autonomous body under the control of National Council of Science and Technology

e) An Independent Institution.

As mentioned earlier, such institution may not be able to function affectively as a part of the university, particularly in a developing country. The University atmosphere is more academic and it may not be practicable to deal with day-to-day problems of industry in such an institution. It has been experienced in other developing countries, that practical problems of great importance to industry requiring immediate applied research are seldom considered equally important from the academic point of view. Such institutions if set up within the university, altimately drift to become an elegated university Eng. Laboratory, and lose contact with industry. The same holds true in case of polytechnics.

As the proposed Institute should function as a semi-autonomous body, with great degree of freedom and flexibility, it is likely to function better and more effectively under the aegis of National Council of Science and Technology, rather than under any ministry. In the latter case it is bound to get influenced by Civil Service practices and ultimately be bogged down into rules and procedures. Moreover the National Council of Science & Technology being manned by qualified and experienced personnel, will be in a better position to lay guidelines within the overall national framework, and evaluate its output occasionally, than the ministry.

As such institutions are mainly to be promoted and financed by the government, the financial resources are likely to be very much limited in the initial stages, which does not justify its being an independent entity, and try to duplicate expenditure on non-professional staff. Having direct contact with the industry and opportunity to tackle meaningful and practical problems of immediate application to the industry, the institute should be in a position to convince the industry of its utility within a short period of its operation. After gaining such experiences and generation of local expertise, its workload and resources are bound to multiply. It may only then be quite appropriate to consider its independent entity with greater autonomy and expansion of activities to undertake applied and basic Industrial Research problems of greater complexity.

A partnership with similar Industrial Research Institute in other friendly developed or developing countries, is considered essential for availability of known technologies and mutual exchange of information and personnel in the initial stage.

In view of the facts mentioned above it will therefore be most appropriate to place the Institute under the overall control of an Advisary Body, with at least 50% representation from Industry and the rest including representatives of:

a) National Council of Science & Technology

b) The Industrial Survey & Promotion Centre

c) The Financial Institutions

d) The Ministry of Agriculture

e) The International Aid Organisation e.g. U.N.D.P. U.N.E.S.C.O.

The Advisory Committee will be answerable to the National Council of Science and Technology for its performance.

Capital Cost

Capital cost includes cost of:

- land
- Building and other services
- Machinery & equipment

Normally for this project a 5 acre plot of land around Nairobi, with a covered area of 4-6,000 sq. meters should suffice in the intial stage, provided adequate provision is kept for expansion purposes at a later stage. The exact requirement of covered area, required for each wing shall however greatly depend upon the exact scope of services.

Similarly the cost of machinery and equipment, mostly required in the intial stages for different Laboratories and the maintenance workshop, shall also have to be determined later, after approval of the scheme in principle. As a rough estimate, the breakup of cost of equipment is likely to be:

| | | |
|---|---|---|
| Chemical Lab. | .. .. | K.Sh 550,000 |
| Mechanical Lab. | .. .. | 500,000 |
| Electrical Lab. | .. .. | 200,000 |
| Textile Lab. | .. .. | 450,000 |
| Rubber Leather Plastic Lab. | .. | 250,000 |
| Misc. Lab. equipment | .. | 200,000 |
| Workshop | .. .. | 150,000 |
| | | K.Sh 2,300,000 |

Adequate Provision should however be made for additional equipment and machinery, when sufficient funds are made available through some international aid agency or a country on bilateral basis.

Staffing Pattern

The efficiency and success of an Industrial Research Institute of this nature will largely depend on the system of recruitment, and availability of able professional staff in the country. A Director will be responsible for overall control and day to day functioning of the Institute, and will also function as the General Secretary or Convenor of the Advisory Committee. He will play the pivotal role of an Administrator, a leader of the research team and a public relation man. He should be in a position to inspire and stimulate his team of research workers to be thoroughly committed to their mission in the national interest.

The Director should be assisted by Assistant or Deputy Director, who will be heading each division. In the initial stages at least six Assistant Directors, highly specialised in the following fields, may be recruited:-

a) Industrial Engineering/production Engineering

b) Industrial Design/Project Engineering

c) Laboratories - Chemical )
- Physical )
- Electrical )

d) Textile

e) Rubber Plastic & Leather

f) Administrative/Public Relation

Each Assistant Directors will be assisted by a Senior Scientific officer and Technical officers, specialised in various sections. Their number will depend on the quantum of work in demand. The general break-up of a minimum set of technical officers required in the initial stages is given in the Chart at appendix I.

It is further suggested that these technologists and Engineers should be offered grades and salaries attractive enough to make them look for career in the Institute. It should be comparable to the salaries offered in the private sector if not better.

It may also be desirable to recruit few foreign technologist or engineers in some of the highly specialised fields. The assistant Directors concerned should act as their local counterparts.

Financial Pattern and Investment

In most developing countries, the government has to promote finance and organise such Industrial Research organisation, for the main purpose of accelerating industrial activity in the country as no other institutions capable of undertaking this responsibility are there. The amount of money required depends upon the scale and level of research work proposed to be undertaken or vice versa. It is therefore difficult, if not impossible even to estimate the total investment at this stage. This shall have to be done by the Advisory Committee, after the Government has approved of this proposal in principle and a commitment of a long term financial backing by some international organisation. Depending upon the total funds available, the advisory committee will work out the details of the objectives, the personnel required, their salaries and system of recruitment, the nature of research work to be undertaken, the layout and design of the building, the equipment, the system of charges for the services rendered etc.

As this project is mainly to be promoted by the Government, the entire capital expenditure shall have to be provided by it. Because of the limited funds available for such purposes, it may be necessary to approach, UNESCO, UNDP or other International organisation or friendly countries for technical and financial assistance. The instances in other developing countries are not lacking, where entire cost of the machinery, equipment and the foreign experts, has been met by International institutions, and the host countries has only contributed the local cost, including cost of land and building. A similar financial pattern is possible in this case provided a serious approach is made to a donor country or an international institution.

As regards the recurring cost, the major portion excluding cost of foreign experts or fellowship is to be met by the government. There is a possibility of meeting 20-30% of this cost by the industry by way of levy or the charges paid by it for the services rendered.

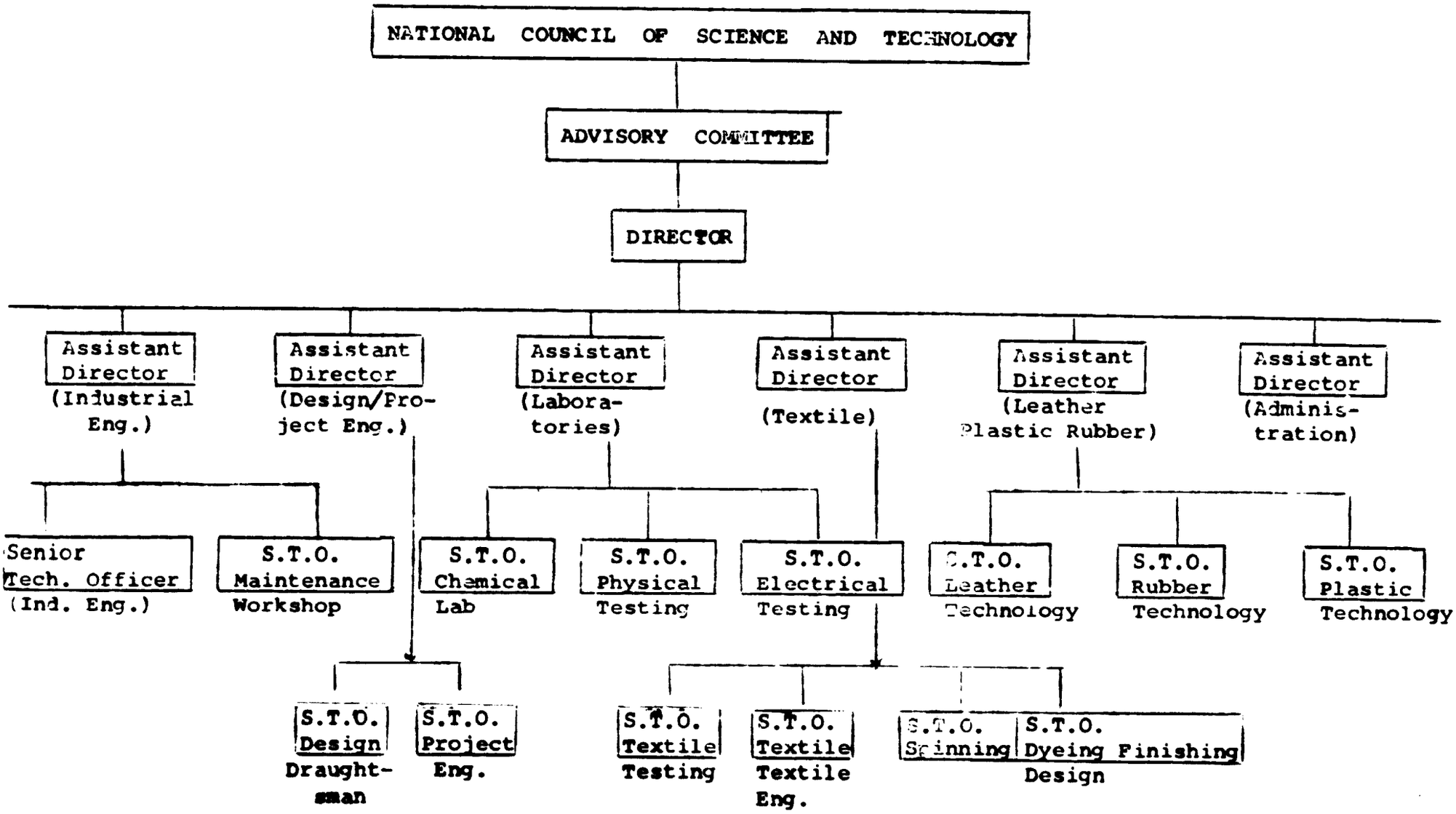
The Director of the Institute, in consultation with the Advisory Committee will be responsible for annual budgetting the plan, ensuring long term continuity of Industrial research in the country. Besides the capital required

for normal recurring expenditure, some provision for contingency funds should be placed at the disposal of the Director to meet the expenses of urgent industrial problems or unforeseen expenditure.

The charges to be paid by the industry has to be fixed pragmatically following the general rule 'the load it can bear'. In order to convince the industry about its utility and get used to the services to be offered by the industry, it will be advisable to charge not more than 20-25% of the prescribed charges in the first phase of operation. This may then be increased in stages, depending upon the quality of services rendered and the extent of consciousness developed in industry for its utility. It should not normally take more than 5 years of operation, before industry should be willing to afford 100% of the charges fixed for cost of the services rendered. For this purpose a good public relation work and sincerity to serve on the part of the research worker are essential prerequisits. Successfully helping the industry in day to day problems of immediate importance to it, will be the best advertisement for the proposed institute.

Appendix I

## ORGANISATION CHART FOR INDUSTRIAL RESEARCH AND DEVELOPMENT LABORATORY



## C. TOOL-ROOM PROJECT

### Introduction

Normally in an engineering concern, the components or finished items are manufactured in a machineshop with the help of production or general purpose machine tools. The cutting or other type of forming tools used with the machine tools for this purpose, are manufactured and serviced in a Tool Room equipped with sophisticated precision machinery. Manufacture and servicing of such tools is a highly skilled job besides the costly precision machinery required & is an essential infrastructural facility necessary for development of an engineering industry.

Besides the cutting tools used in a machineshop, there are other type of tools, dies, jigs fixtures and gauges used for pressing, trimming, blanking, forging or inspection, which also demand tool room facilities for their manufacture and maintenance. Whereas the tools are generally used for cutting shaping or forming of a material with the help of different types of machinery, the jigs and fixtures are required for workholding, work-supporting or tool guidance. The gages are required for inspection of items at different stages of manufacture as a quality-control measure for production of goods of a consistant quality. The extent of use of these tools, dies and gages and their cost is governed by the accuracy required and the volume of production of the finished items.

It is quite natural, that in Kenya, the engineering industry has not taken sufficient roots, and the demand for tool room services, both in terms of quality and quantity is not fully developed to the extent to justify heavy investment in tool room and attract private capital. For that reason a tool room project is capital shy. Under the circumstances, it becomes the responsibility of the government to promote such a project in collaboration with any international Aid Agency or a country competent and willing to offer aid for this project on bilateral basis, to help faster growth of engineering industries and local expertise.

### Present Position

Kenya today is at the take-off-stage, as far as development of engineering industries is concerned. With hundreds of existing engineering industries, badly in need of such services, and the need for development of scores of new

ancillary industries to feed finished components or sub-assemblies to the automobile assemblers and the machine tool plant in the near future, it is not a day too early to establish a Tool Room project in this country. Development of Tool Room skills is a highly time consuming operation, and it takes 5-10 years to train a reasonably good tool room man, depending upon his past experiences. The existing tool room facilities are too inadequate even to meet the present day demand, and there are practically no institutions for training local technicians for this trade.

In view of this background, it is suggested to set up a Tool Room at Nairobi, having maximum concentration of engineering industries demanding such services, to be followed by establishment of another tool room at Mombasa after gaining some experience in it. While making this proposal, the possibility of under utilization of costly tool room machinery in the initial stages, has fully been taken into consideration. In fact the main emphasis of this project will be development of indigenous tool room skills, rather than commercial production and servicing of tools. Short term and long term courses in tool room technology are planned to be organised for sponsored and non-sponsored candidates, with limited commercial production and servicing of tools.

The Process

A Tool Room normally consist of:

i) Design section

ii) Servicing section for regrinding or reworking of used tools

iii) Manufacturing section for manufacture of new tools including a heat-treatment section.

iv) Matrological section for inspection of tools and maintenance of gages.

Most of the tools - gages and dies are manufactured as per a given design from costly alloy and tool steels. They are heat-treated to required hardness to maintain their sharp cutting edges and dimensions for sufficiently long periods in service. They are finally ground to high degree of accuracy with the help of precision grinding machines. Once the cutting edge gets blunt and fails to cut at the desired speeds and feeds, or loses it dimension due to normal wear and tear, it is sent back to tool room for regrinding or reworking purposes, whichever applicable.

Similarly the inspection gages used in any engineering concern get wornout after constant use beyond the prescribed tolerance. In order to keep a strict check on their dimensional accuracy for production of goods of a consistant quality, they are frequently inspected and caliberated in an air-conditioned room with the help of master gages, after regular intervals The same holds true in case of the jigs fixtures and die used for different operation in an engineering factory. Such facilities, if available in any developing country, also serve as an important media for transfer of technology, both as regards adoption and adaptation of imported technology, appropriate to the local endowments.

As the main purpose of this project is to develop indigenous tool room expertise, the most important wing will be the train ing section suitably equipped with all other facilities and training aids other than tool room machinery.

Principal Functions

The Tool Room project is proposed to be located in suitable location around Nairobi, where there is immediate demand for such services and likelyhood of its being multiplied in the near future. The proposed Tool Room will undertake the following major activities:

i) Training of technicians in designing and manufacturing of tools, dies, jigs and fixtures and gages.

ii) Manufacture and servicing of tools, die jigs and fixtures and gages on jobbing basis at reasonable charges.

iii) Heat-treatment facilities for heat-treatment of tools.

iv) Provide design drawings and production technology, with process flow charts etc. to industry on charge basis.

v) Assist for standardisation of components and tooling required for the same.

vi) Provide testing facilities for tools and components to the industry.

vii) Training of local technicians in metrology and quality control.

viii) Manufacture of proto-types of machinery and component locally designed after necessary adaptation appropriate to local condition.

ix) Advisory services to engineering units for trouble shooting of day to day operational problems on nominal basis.

## The Organisation

As stated earlier, it is presumed that this project will be established in collaboration with an international agency or a country on bilateral basis. The overall responsibility for the technical execution of the project for a period of at least five years, will rest with the Executing Agency, answerable to an advisory committee with representation of the agency, government and industry.

A Chief of Project, appointed by the Executing Agency in consultation with the advisory committee, will plan the project and will be directly responsible for the timely implementation and success of this project, and will serve as a channel of communication between the aid agency and the government.

The agency will depute experts specialised in various services as per requirement, with adjustments of individual post assignments as and when required. It will also offer fellowship to local engineers and technician for being trained in suitable foreign institutions.

Besides the experts, it will have professional and non-professional local staff. The breakup of the entire staffing pattern and recurring cost is given in annexture II.

## Machinery & Equipment

The Tool Room will be equipped with minimum number of precision and sophisticated machinery, essentially required to meet the demands for tool room services for at least next 10 years. The major list of machinery required for each section is given in annexture I with approx. cost.

## Raw Materials

The main raw material required will be:

i) Alloy and tool steel

ii) Consummable stores e.g. lubricants, machinery spares

iii) Measuring and cutting machinery spares etc.

iv) Material required for maintenance of services.

As the manufacture of tools is a heavily skilled-based industry the percentage cost of raw material is much less as compared to other industries.

## Training Courses

Considering the present and future requirement for Tool Room Engineers, supervisors and technicians, and the calibre of local candidates available, the long term and short term courses recommended are given in annexture III. It is however assumed that most of the candidates will be sponsored by the industry or by the government under the apprenticeship scheme. The intake of trainees will mostly comprise Eng. Degree holders, diploma certificate holders or candidates with some experience in tool room practice. The main emphasis will be on practical work with appropriate small doses of theoratical knowledge. The quality of training will therefore be purely demand oriented, so that the outgoing candidates are acceptable to the employers and have a better market value than their counterparts in other industries.

The maximum candidate at one time is not expected to exceed 25. There will be no examination as such for conferring any degree or diploma on the passed out candidates, but they will be suitably graded on continuous basis as an incentive to create interest in tool room technology amongst the candidates.

## Cost of the Project

In order to enable the government take a decision for approval of this project in principle, a rough cost estimate for it is given in annexture IV.

## The Plan of Action

Tool Room project is a development scheme, which needs to be promoted by the Government itself in the interest of encouraging Eng. industries in Kenya. Because of the high cost and sophisticated technology involved, the government may seek technical and financial assistance from any International Aid Agency or a country on bilateral basis. For this it may be necessary to contact all potential sources of help for implementation of this project, after its approval in principle by the government.

The estimates for capital, machinery and manpower are indicative only and may need some adjustment in consultation with the Aid Agency, depending upon the total funds available, priority and quantium of services to be rendered and the extent of cooperation from the industry.

Appendix I

## List of Major Machinery & Equipment

| | | No. Reqd. |
|---|---|---|
| 1. | **Centre Lathes** | |
| | i) Precision Centre Lathes - small | 2 |
| | ii) Precision Centre Lathe - med. | 4 |
| | iii) General Purpose Centre Lathe - large | 1 |
| 2. | **Milling Machines** | |
| | i) Universal milling machine .. | 2 |
| | ii) Tool milling machine .. | 2 |
| | iii) Copy milling machine .. | 1 |
| | iv) Die Sinking machine .. | 1 |
| | v) Vertical milling machine .. | 2 |
| | vi) Pantograph milling machine .. | 1 |
| 3. | **Grinding Machines** | |
| | i) Universal Cylinderical grinder .. | 2 |
| | ii) Surface grinder .. .. | 3 |
| | iii) Tool and cutter grinder .. | 3 |
| | iv) Optical profile grinder .. | 1 |
| | v) Internal grinder .. .. | 1 |
| | vi) Twist drill grinding machine .. | 2 |
| | vii) Lapping machine .. .. | 1 |
| 4. | **Shaping Machines (Hydraulic)** .. .. | 2 |
| 5. | **Drilling Machines** | |
| | i) Radial Drill .. .. | 2 |
| | ii) Pillar Drill .. .. | 2 |
| | iii) Bench Drill .. .. | 4 |
| 6. | **Jig Boring machine with accessories** .. | 1 |
| 7. | **Horizontal boring machine** .. .. | 1 |
| 8. | **Spark erosion machine** .. .. | 1 |

| 9. Service Machines | | No. Reqd. |
|---|---|---|
| i) | Filing & sanding machine .. | 1 |
| ii) | Band Saw (Metal cutting) .. | 1 |
| iii) | Power Hack-Saw .. .. | 2 |
| iv) | Fly Press .. .. | 2 |
| v) | Flexible Shaft grinding equipment | 4 |
| vi) | Bench grinders .. .. | 2 |
| vii) | Pedestral grinders .. .. | 2 |
| viii) | Hydraulic Press .. .. | 1 |
| ix) | Engraving and Punching machine .. | 1 |
| x) | Guillotine Shear .. .. | 1 |
| xi) | Set of Drawing board equipment .. | As required |
| xii) | Hand Tools .. .. | " " |
| xiii) | Teaching Aids .. .. | " " |
| xiv) | Compressor .. .. | 1 |
| xv) | Electric arc welding set .. | 1 |
| xvi) | Gas welding set with accessories .. | 1 |

| 10. Heat treatment Equipment | | |
|---|---|---|
| i) | High Speed salt bath furnaces (Pre-heat and Final & Temper) | 1 set |
| ii) | Electric chamber tool hardening and tempering furnace .. .. | 1 set |
| iii) | Straightening press .. .. | 1 |
| iv) | Hardness testing machine .. | 1 |
| v) | Shot blasting machine .. | 1 |
| vi) | Quench baths .. .. | As required |
| vii) | Compressor .. .. | 1 |

| 11. Laboratory Equipment | | |
|---|---|---|
| i) | Hardness testing machines | |
| | Rockwell .. .. | 1 |
| | Brinell .. .. | 1 |
| | Vickers .. .. | 1 |

| | | No. Reqd. |
|---|---|---|
| ii) | Metallurgical Microscope .. | 1 |
| iii) | Polishing equipment .. | 1 set |
| iv) | Chemical testing equipment (Ferrous and non-ferrous) .. .. | 1 set |

12 Inspection Equipment

| | | |
|---|---|---|
| i) | Tool Room microscope .. | 1 |
| ii) | Profile Projector .. .. | 2 |
| iii) | Set of measuring & inspection tools and gages .. .. | As required |
| iv) | Surface plate .. .. | 2 |

Appendix II

## Staffing Pattern

| | | | |
|---|---|---|---|
| 1. | Chief of Project | .. | 1 |
| 2. | Foreign Experts | | |
| | Training Manager | .. | 1 |
| | Tool/Die Designer | .. | 1 |
| | Tool maker | .. | 1 |
| | Inspection | .. | 1 |
| 3. | Director | .. | 1 |
| 4. | Works Manager | .. | 1 |
| 5. | Chief Designer | .. | 1 |
| 6. | Designers | .. | 3 |
| 7. | Draughtsmen | .. | 3 |
| 8. | Foreman | .. | 5 |
| 9. | Chief Inspector | .. | 1 |
| 10. | Inspectors | .. | 5 |
| 11. | Metallurgical Engineer | .. | 1 |
| 12. | Laboratory Assistants | .. | 3 |
| 13. | Maintenance Engineer (Mechanical) | | 1 |
| 14. | Maintenance Engineer (Electrical) | | 1 |
| 15. | Highly skilled workers | .. | 15 |
| 16. | Instructers | .. | 3 |
| 17. | Skilled workers | .. | 20 |
| 18. | Office & Administrative Staff (Non-professional) | | As required |

Appendix III

## Training Courses

| A. Long Term Courses | Duration | Capacity | Minimum Qualification Required |
|---|---|---|---|
| i. Advanced course in Design of Tools, jigs and fixtures | 1 year | 4 | Degree in Engineering or Diploma from Polytechnic with experience |
| ii. Tool and Die making course | 2 years | 10 | Diploma (mechanical) from Polytechnic or technicians with adequate practical experience |
| **B. Short Term Courses** | | | |
| a) Advanced Tool & die making for supervision | 6 weeks | 10 | Candidates employed and sponsored by industry |
| b) Jigs & Tool Design for Supervisors | 6 weeks | 5 | -do- |
| c) Tool grinding operation | 6 weeks | 6 | -do- |
| d) Tool Inspection | 6 weeks | 6 | -do- |
| e) Milling machine operators | 6 weeks | 6 | -do- |
| f) Heat-treatment of tools | 6 weeks | 6 | -do- |

Appendix IV

## Total Project Cost

**A. Estimated Capital Cost**

| | | |
|---|---|---|
| 1. | Land, Building & Services | K.Sh. 4.0 mill. |
| 2. | Plant & Machinery | 7.2 |
| 3. | Fixture, furniture Office & works equipment .. | 2.5 |
| 4. | Misc. expenses .. | 1.0 |
| | | 14.7 |

**B. Recurring Cost (annual)**

| | | |
|---|---|---|
| 1. | Salary & wages .. | K.Sh. 4.65 mill. |
| 2. | Raw materials .. | 0.20 |
| 3. | Services contingencies .. | 0.75 |
| | | K.Sh. 5.60 mill. |

## D. GREY IRON FOUNDRY

### Introduction

Grey iron castings are essential inputs for manufacture of variety of engineering industries e.g. Automobile, Machine Tools, Diesel Engines, Pumping Sets, Textile/Sugar Machinery and Farm Equipment.

Its demand increases with the growth of such industries in any developing country. The quality and precision of these items depend greatly on the quality of castings used. With the advent of fast development of engineering industries in Kenya, specifically machine tools, diesel engines, pumping sets and farm equipment, the immediate need for a modern foundry in Kenya, for production of quality castings, can hardly be overemphasized.

The grey iron is an alloy of iron carbon and silicon, with minor addition of other alloying elements like mangenese, chromium, nickel. It is produced by melting pig iron, steel scrap, grey iron scrap and other refining materials like limestone and calcium silicide in a suitable melting furnace, depending upon the availability and cost of the fuel or electric energy.

### The Capacity and Product Mix

As at present there is hardly any demand for quality castings, as major industries demanding such castings are still in the process of being implemented. The few foundries existing today are either too small for the purpose or are not in a position to manufacture quality castings. The foundry in E.A. Railway workshop is the only foundry capable of delivering some of the castings of required quality, but it is more or less a captive industry, for production of castings for its own use.

Over 75% of the weight of machine tools, diesel engines and pumping sets and approximately 30-50% of the cost comprise the grey iron castings, which more than justifies for establishment of a modern grey iron foundry in Kenya to facilitate establishment of such industries in the near future.

The variety of castings required will vary both in weight and in number. For machine tool castings the lathe beds may vary from 1-3 tons each and the number required will be rather small. On the other hand in case of diesel engine or pumping sets, the weight may vary from 100 kg to few hundred grammes and it may be required in large numbers.

The proposed foundry is therefore expected to be flexible enough to manufacture machine tool castings by floor castings and others as production castings with the help of a casting bay and moulding machines.

It is therefore proposed that in the initial stage this foundry may have a capacity of 100 tons a month inclusive of floor and production castings, keeping a provision to double the capacity within a period of five years or so from the date of operation.

The approximate breakup of the type of castings to be made in the proposed foundry for different industries is as follows:

| | | |
|---|---|---|
| Machine tools | - | 500-600 tons |
| Diesel engines | - | 200-300 tons |
| Pumping sets | - | 50 tons |
| Generators, electric motors | - | 50 tons |
| Automobile components (simple castings only) | - | 200-300 tons |
| Textile/Sugar machinery parts | - | 150-200 tons |

Land and Building

A modern foundry needs ample space for storage of raw materials and disposal of foundry rejects besides the normal factory building. In order to make it more remunerative at a later stage, is may even become necessary to supply machined castings, for which adequate space for a machine shop will also be required. It is therefore considered desirable to have 5 acres plot of land for this purpose.

The built up area including the factory shed and the administrative block is proposed to be approx. 2000 sq. meters in the initial stage, keeping a provision to double the present rated capacity in future.

The layout of the foundry has to be so planned, as to concentrate the hot zone in one corner, and flow of material at the minimum cost.

The foundry should be located nearest to the source of major raw materials required e.g. sand, pi, iron and coke and is possible close to the railway track. Considering all these factors its location in Mombasa near some railway track will be preferred.

**Raw Materials**

Pig iron, steel scrap and ferro-silicon are the major raw materials required, with minor consumption of Ferrochrome or Nickel. Besides this the other consumable materials are coke limestone, sand refractories, binders and many other small items in different proportions depending upon the quality of the finished casting required and the major raw materials used as mentioned above. Normally one ton of good castings will need

| | |
|---|---|
| Pig iron plus cast iron scrap | - 0.80 - 0.9 tons |
| Steel scrap | - 0.10 - 3.0 tons |
| Coke (in case of cupola melting) | - 0.2 - 0.3 tons |
| Ferrosilicon | - 0.01 - .02 " |
| Sand | - 2.0 - 5.0 " |
| Bentonite/clay | - 0.010 - 0.025 tons |
| Limestone | - 0.050 - 0.075 tons |

The ratio of pig iron, cast iron or foundry return scrap and steel scrap has to be so adjusted as to get the desired composition of liquid metal. The percentage of carbon and silicon and the grain structure mainly determine the strength ofthe castings. A number of minor mixtures are added to the molten metal for refinement of grains and hence the improvement in physical properties of the cast metal.

The average yield of finished good castings vary from 60-70% of the molten metal and the melting capacity of the furnace has to be worked out accordingly.

At places, where good quality coke is either not available or is rather expensive, as compared to equivalent electric energy, electric melting furnaces are used instead of the conventional cupola. In such cases the power consumption per ton of good castings varies from 400 KwH to 500 KwH. The power requirement in such cases will be 1000 KvA with a transformer, and two electric furnaces 300 Kw each or 500 KvA with one electric furnace.

In case of the use of an electric furnace the water requirement amounts to 6-8000 gallons of water per day for cooling purposes which could be reduced by recycling. For this purpose an overhead tank is quite essential.

The monthly requirement of raw materials forthis foundry is given in Annexure I.

## The Process

Considering the prevailing conditions in Kenya and the quality of castings required, it is proposed to melt the charge in mains frequency core less induction furnaces of 0.75 ton capacity. The installation of a conventional cupola to feed hot metal into electric furnaces to economise electric energy, is also considered.

The molten metal from the electric furnace at 1400-1500°C is poured into moulds on the conveyor or on the foundry floor, with the help of a E.O.T. crane.

The moulds for production castings will be made on two set of moulding machines and assembled on the conveyor. The heavy castings required for machine tools, will be cast on the floor, where moulds for the same will be made manually.

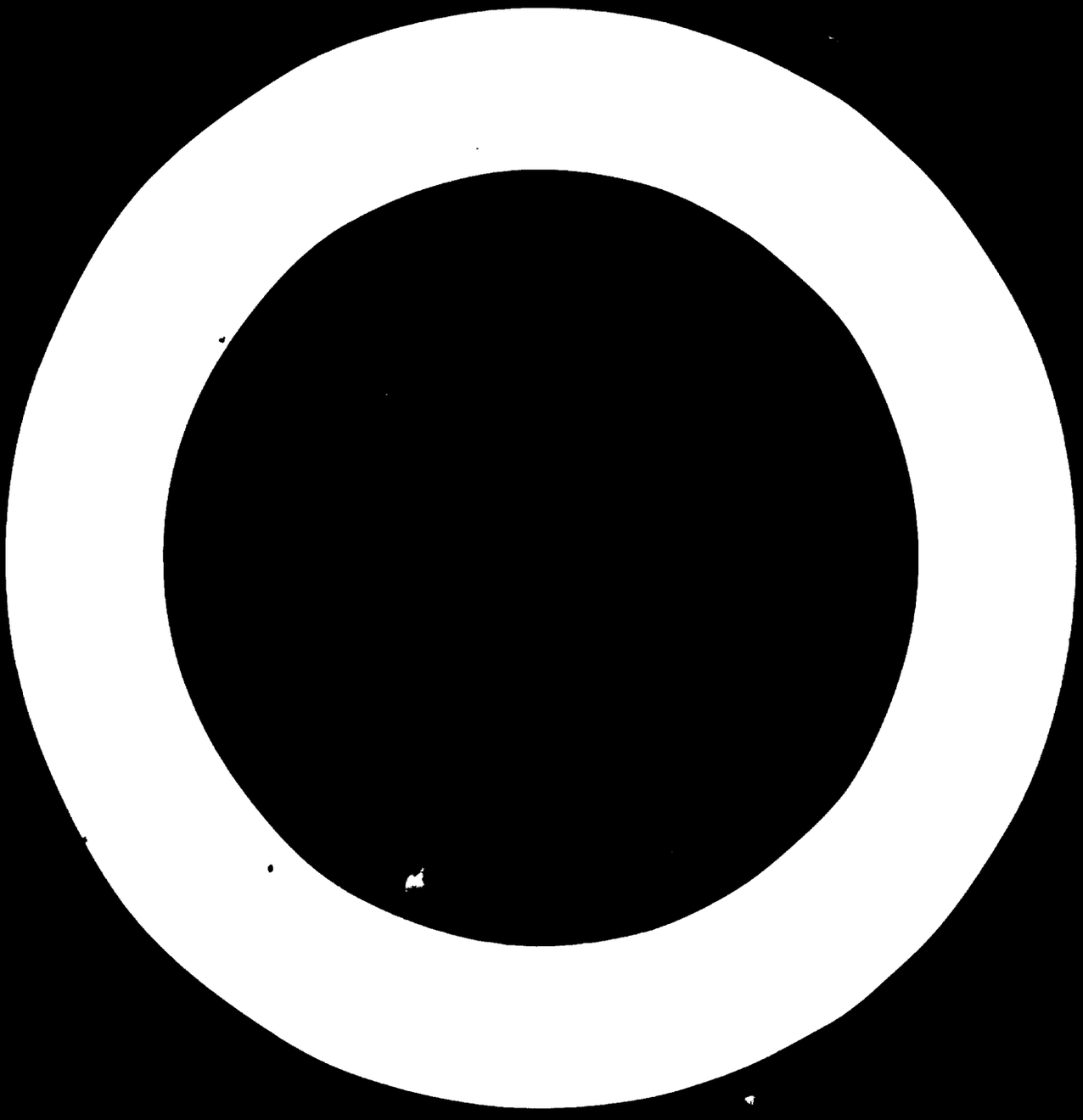
The cores required for the intricate type of castings will be made with the help of core making machines, in case they are small and required in bulk lot, or otherwise made manually.

The cores required for the intricate type of castings will be made with the help of core making machines, in case they are small and required in bulk lot, or otherwise made manually in wooden core boxes. The cores so made will be dried in a core making oven with controlled temperature, to required strength and hardness. The core mixture used is mixed in special sand mixing machines.

The metallic and wooden patterns, core boxes and the moulding boxes are to be made in a pattern shop, suitably manned and equipped to manufacture both wooden and metallic patterns and core box boxes.

The moulding sand required is milled in sand mullers with proper ratio of binders in the form of bentonite and molasses. After proper mixing it is conveyed to the moulding machines on the floor moulding space with the help of overhead conveyors. The used sand after casting from the shaker is recycled in sand reconditioning plant for further use after screening and mixing with fresh sand.

The castings from the shake out from the casting floor are knocked off free of moulding sand and runners and risers and sent to the grinding section for cleaning of the excess metal or grinding off rough surfaces. In case of small castings they are also cleaned in tumbling barrels or shot blasting machine.



After cleaning the castings are duly inspected for any surface defects or internal hardness and for its dimensional accuracy before despatch. The chemical and physical properties of the castings is controlled by taking samples of hot metal and get it tested in chemical or physical test laboratory.

Equipment and Machinery

As mentioned earlier, this foundry is to be equipped with both electric melting and cupola furnaces along with all other auxilliary equipment for moulding, core making, casting and fettling. The list of major equipment and machinery required is given in annexure II.

Manpower

This foundry will employ 100 persons in the initial stages including 10 supervisory and administrative staff and 90 skilled and unskilled workers. The detailed list of the staffing pattern is given in annexure III.

Capital cost and economic viability

See annexure IV.

To a layman the idea of setting a modern foundry project may sound little odd at this stage. But looking ahead into the future pattern of industry, it is one of the most important infrastructural facility to be provided for the fast development of manufacturing sector in general and engineering industries in particular. Because of the lack of immediate demand for quality castings, the project is likely to take longer to break even as compared to other engineering industries.

The details of machinery and equipment, manpower and costings are rather indicative at this stage, and may have to be suitably modified at the time of preparing the detailed project report for the same.

Appendix I

## MAJOR RAW MATERIALS REQUIREMENT

(100 tons of finished castings per month)

| | Item | Quantity required (Approx.) |
|---|---|---|
| 1. | Pig Iron | 80 tons |
| 2. | Steel Scrap | 25 tons |
| 3. | Ferro-Silicon | 2 tons |
| 4. | Sand | 500 tons |
| 5. | Bentonite (clay) | 12 tons |
| 6. | Lime Stone | 5 tons |
| 7. | Coke | 25 |
| 8. | Miscellaneous | |
| | Fuel oil ) | |
| | Molasses ) | |
| | Refractories ) | 15-20% cost of |
| | Graphite electrodes) | major raw materials |
| | Ferro-alloys ) | |
| | Pattern Material ) | |
| | Chaplets etc. ) | |

Approximate cost of raw materials per ton of finished good castings = L.Sh. 2000.00

Appendix II

## THE LIST OF MAJOR MACHINERY AND EQUIPMENT

### A. Melting section

| | | |
|---|---|---|
| 1. | Cupola with accessories (36" dia.) | one |
| 2. | Coreless induction furnaces 300 KW | one |
| 3. | E.O.T. crane (2 tons) | one |
| 4. | Weighing platform scale | one |
| 5. | Ladles and other accessories | twelve |
| 6. | Overhead rail with electric lift | one |

### B. Moulding and core making section

| | | |
|---|---|---|
| 1. | Moulding machine (one small and one medium) | two sets |
| 2. | Roller table for conveyor | one |
| 3. | Pneumatic Rammers | six |
| 4. | Core making machines | two |
| 5. | Core baking oven (chamber type) | one |
| 6. | Trolleys for charging of cores | as required |
| 7. | Mould drying equipment | as required |
| 8. | Moulding boxes | as required |
| 9. | Ladle driers | one |
| 10. | Misc. equipment including wheel barrows, core benches, racks and shovels etc. | as required |

### C. Sand Plant

| | | |
|---|---|---|
| 1. | Complete sand handling and conditioning plant to handle 8-10 tons of sand/hour complete with all accessories | one set |
| 2. | Core sand mixer | one set |
| 3. | Sand drying rotary kiln | one |

### D. Fettling Section

| | | |
|---|---|---|
| 1. | Shake out table | one |
| 2. | Shot blast machine (car bogie type) | one |
| 3. | Tumbling barrels | one |
| 4. | Swing frame grinders | two |
| 5. | Stress relieving furnace | one |
| 6. | Pneumatic grinders | four |
| 7. | Pedestral grinders | two |
| 8. | Pneumatic chipping hammers | six |
| 9. | E.O.T. crane (2 ton) | one |
| 10. | Fettling tools and misc. equipment | as required |

E. Laboratory and Inspection

| | | |
|---|---|---|
| 1. | Complete set of equipment for testing of<br>sand<br>chemical analysis of metal<br>physical testing of metal | |
| 2. | Surface table for inspection | one |
| 3. | Inspection tools | as required |

F. Maintenance Shop

| | | |
|---|---|---|
| 1. | General purpose centre lathe | one |
| 2. | Pillar Drill | one |
| 3. | Fitters benches | as required |
| 4. | Arc Welding set with transformer | one |
| 5. | Gas welding set | one |
| 6. | Compressor | one |
| 7. | Material handling equipment incl. platform truck, battery operated | one set |

G. Pattern Shop

| | | |
|---|---|---|
| 1. | Thickness and Planing machine (wood) | one |
| 2. | Band saw (wood) | one |
| 3. | Vertical boring recessing machine | one |
| 4. | Vertical milling machine | one |
| 5. | Shaper | one |
| 6. | Misc. pattern shop equipment for wooden and metal patterns | as required |

Appendix III

## STAFFING PATTERN

| | | |
|---|---|---|
| 1. | General Manager | 1 |
| 2. | Metallurgist Engineer | 1 |
| 3. | Works Manager | 1 |
| 4. | Pattern Shop Manager | 1 |
| 5. | Chief Inspector | 1 |
| 6. | Foremen | 5 |
| 7. | Laboratory Chemist | 1 |
| 8. | Skilled workers | 35 |
| 9. | Semi-unskilled workers | 55 |
| | Total | 100 |

Approximate monthly wages = K. Sh. 125,000.00

Appendix IV

## CAPITAL INVESTMENT AND ECONOMICS

| | | | K.Sh. |
|---|---|---|---|
| A. | **Fixed Capital** | | |
| | 1. | Land and Building | 1,200,000 |
| | 2. | Machinery and Equipment | 3,500,000 |
| | 3. | Installation and miscellaneous expenditure | 400,000 |
| | | Total fixed capital | 5,100,000 |
| | 4. | Working capital | 600,000 |
| | 5. | Total capital required | 5,700,000 |
| B. | **Approximate cost of production** (monthly) | | |
| | 1. | Salary and wages per month | 125,000 |
| | 2. | Raw materials required per month | 200,000 |
| | 3. | Cost of services - water & power | 40,000 |
| | 4. | Misc. including sales promotion and transport, other overheads | 10,000 |
| | 5. | Cost of capital (monthly) | 50,000 |
| | 6. | Depreciation (monthly) | 35,000 |
| | | | 450,000 |
| C. | Total turnover at K.Sh. 5.5. per kilo | | 555,000 |
| | | G. Profit (monthly) | 105,000 |

## E. STEEL FORGINGS

Steel Forging industry is a basic feeder industry to most other engineering industries, engaged in manufacture of components, sub-assemblies or complete salable items ready for use. Being a feeder industry, the pattern of production of forgings is directly dependent on the off-take by the industries engaged in further processing it into consummable articles.

The forging industry mainly services the Machine Tool, Hand Tool, Diesel Engine, Transport, Railways and similar other industries manufacturing complete equipment or components based on forged items as one of their starting raw materials. The type and number of forgings required determine the process of forging and the equipment to be employed. If the number is small and the final shape demands simple unidirectional differential flow of steel, while forging the heated steel bar or blank, it can be done by using a pneumatic or mechanical free forging hammer with repeated number of strokes. The size of the forging and amount of reduction required in size of the bar, determines the capacity of the free forging hammer. If on the other hand the shape of the finished item is rather odd, demanding flow of metal in different planes and is rather difficult to be cast or rolled, it is forged or shaped in a drop-forging hammer, by applying two or three strokes to the heated bar, under powerful pressure of a falling weight. The required impression as per final shape, is sunk in two halves of forging dies, which are securely held in the falling weight (Tup) and bottom anvil block. The same can also be achieved by using presses where the hot metal is squeezed under heavy pressure in single stroke to required shape.

Besides the advantage of forming intricate shapes, not easily attainable by any other known processes, the forged items are considered to be stronger and are in a better position to withstand severe stresses in service, due to favourable grain orientation as compared to similar items manufactured from the same material, by other processes.

### The Demand and Product Mix

Most of the commonly forged items are presently imported in finished form as forged and machined for different purposes, which makes it rather difficult to assess the demand of forged items as such in the country. As an example it is stated that over K.Sh.20 million of commonly forged hand tools items only were annualy imported in 1974 and 1975.

which may involve at least 500 tons of forgings. Similarly, a number of forged and finished items are imported by other industries as well as part of a major equipment or as individual items.

There are practically no drop-forging facilities available in the country today except in Railway Workshop, where it is more or less a captive unit catering to the railway requirement only. Elsewhere few pneumatic or mechanical hammers of small capacities have been installed to forge odd jobs in small numbers. These hammers, as already stated, do not have the capacity to forge precision intricate forgings on production basis, as demanded by industry. If forgings for such items are made available locally, it will spur off growth of new industries for machining and processing the same into finished items and appreciably contribute in saving precious foreign exchange.

In view of the facts mentioned above, it is proposed to start a Steel Forging plant with 500 tons of annual capacity for forging of small items with maximum 4-5 kg weight and supply the same to the present consumers after machining and finishing it in other units. This will greatly help to generate the necessary skills for forging technology locally and ultimately help to be in a position to not only meet the entire demand for forging in the country, but also export the same to adjoining or even the developed countries.

The tentative industry-wise product-mix is expected to be

| | |
|---|---|
| Automobile components | 150 tons |
| Hand tools | 150 tons |
| Machine tools | 100 tons |
| Diesel engines | 50 tons |
| Power distribution, Post and Telegraph and other industries | 50 tons |
| | 500 tons |

The simple components, which can be used as forged or after little machining should be preferred in the initial stage e.g. steel balls for cement industry, knuckle levers, links and rockers for transport industry, eye hooks and bolts, shackles, conveyor links, hand tools forgings, simple gear blanks, flangs, simple machine tool forgings and cycle cranks etc.

## The Process

The rolled steel, square or round, bars are cut to required length with the help of a shearing machine, power hacksaw or a circular saw, depending upon the size of the bar and number required. It is heated to plastic stage (1000-1200°C) in an oil fired furnace and placed in the bottom half of the forging die. It is then forged into the desired shape by sudden impact of the falling weight (Tup) to which the other half of the forging die is securely fixed. The excess metal (Flash) squeezed out of the impression in the die, is trimmed off in the trimming press. The trimmed forging is then ground off on the sheared edges, and heat-treated in suitable furnaces to impart the desired hardness and strength to it. The finished forgings are finally inspected for surface defects, dimensional accuracy and hardness as per prescribed specifications before despatch for further operations.

## Location and Civil Works

As most of the consumer industries for steel forgings are located in and around Nairobi, a suitable location within a reasonable distance of it should be preferred. Because of the possibility of atmospheric pollution from the smoke emitted from the forging furnaces, it will not be advisable to locate it in a big town like Nairobi or Mombasa. Considering the harzadous working conditions in a forge shop, it is better to locate in an area with a climate condusive for hard and efficient working conditions. It is therefore recommended that it may be located within 20-25 km of Nairobi. For a plant of this size a 2 acre plot of land is considered adequate, with a provision for further expansion as well.

The factory building will comprise

i) Forging section
ii) Finishing and heat treatment
iii) Inspector and maintenance section
iv) Raw material and despatch godowns
v) Administrative block

The covered area required in the initial stage is estimated to be 8000-10,000 sq. ft. keeping adequate provision for doubling the capacity within few years after operation.

Plant and Machinery

There is no definite demand of forging as such in the country today. But considering the importance of this basic industry it has to be created in the overall interest of national economy and impart an impetus for faster growth of engineering industries in the country. The proposed plant has therefore to be so equipped, as to be flexible enough to meet the general demand of simple forgings so created and later switch over to specialised lines of production, with increase of demand. The main emphasis in the initial stage will be to forge hand tool forgings, simple levers, knobs, links for machine tool industry, rockers, levers, flangs, links and joints for the transport industry, cement balls, Diesel engine components, eye bolts and hooks, forged components for electrical transmission and telegraph and some sugar and textile machinery parts. The maximum weight of the forgings to be undertaken may vary from 3.5 kilos, depending upon the complexity of the shape desired and the quantum of the material flow during the forging process. Items heavier than this will demand highly expensive equipment, which could only be considered in the second stage.

A forging shop will normally comprise of

a) Heating furnace
b) Forging hammer
c) Trimming press
d) Grinding and finishing equipment
e) Heat treating furnaces
f) Inspection equipment
g) Die making equipment

Most of the forging shops are also equipped with a machine shop to supply forged and finished machined items, which may thus have to be done in this case, and in the second phase for which adequate provision has to be kept while planning the layout and construction of factory building.

Heat treatment and die making operations involve expensive equipment and high degree of skill. It is therefore quite customery for small forging shop to depend on outside sources for such services on jobbing basis. As these services are not locally available, it is considered necessary to equip the plant with minimum equipment required for the same.

A list of major machinery and equipment required is placed at annexure I.

## Raw Materials

The raw material required for the proposed forged items is mild steel or medium carbon steel in form of round or square bars of suitable sizes, which is determined by the thickest section of the finished forgings. Most of the raw material required is expected to be available locally from the existing steel melting units. The cost of the raw material varies between 40-60% of the cost of the production depending upon the complexity of design of the forgings. The yield of the finished forgings is approx. 80-85% of the bar stock, due to loss during heating and in form of trimmings of excess metal.

## Organisation and Management

As this plant is expected to work on the basis of job-order-production system, and the demand for it has to be created afresh, it needs to be manned by very senior and experienced persons. It may be necessary to employ a complete team of expatriates in the initial stage, till the local technicians have picked up the skills involved in die design, die making, forging and heat treatment operations. This dual expenditure on labour is bound to adversely affect its financial structure during the first couple of years of its operation. The total manpower required including 12 supervisory and managerial staff is given in annexure II.

At the end it is stressed, that this basic feeder industry is an essential infrastructure required for growth of engineering industries in the country, but is seriously handicapped due to very slow rate of return in the first couple of years of its working. It therefore needs to be carefully nursed by the Government in the initial stage by way of special incentives in form of softer loans, heavier tax rebates and preferably greater financial participation.

Appendix I

## List of Major Machinery and Equipment

| | | |
|---|---|---|
| **A. Forging Section** | | |
| 1. Drop Forging hammers | | |
| 1000 kg .. .. | | 1 |
| 2000 kg .. .. | | 1 |
| 2. Free Forging pneumatic hammer 50 kg | | 1 |
| 3. Oil fired furnace 4'x3'x2' complete with burner and accessories | | 3 |
| 4. Trimming Press 200 ton .. | | 1 |
| 150 ton .. | | 1 |
| 5. Power Hacksaws .. .. | | 1 |
| **B. Finishing & Heat treatment Section** | | |
| 1. Bench grinders .. .. | | 1 |
| 2. Pedestral grinders .. .. | | 2 |
| 3. Roto Shot blasting machine .. | | 1 |
| 4. Heat treating furnaces (Hardening & tempering) with quench tanks .. | | 1 set |
| 5. Hardness Tester-Brinell .. | | 1 |
| 6. Surface table for inspection .. | | 1 |
| **C. Die and Maintenance Section** | | |
| 1. General Purpose lathe - 6ft bed | | 1 |
| 2. Shaper 24" .. .. | | 1 |
| 3. Pillar Drill 25 m. .. .. | | 1 |
| 4. Pneumatic portable die grinders | | 2 |
| 5. Surface plat .. .. | | 1 |
| 6. Vertical milling machine .. | | 1 |
| 7. Measuring Instruments .. | | As Required |
| 8. Electric Arc Welding set .. | | 1 |
| 9. Gas welding set .. .. | | 1 |
| 10. Compressor .. .. | | 1 |
| 11. Misc. equipment including material handling equipment .. .. | | As required |
| Approx. cost of Machinery & Equip. | | Sh 2,068,000 |

Appendix II

## Staffing Pattern

| | | | |
|---|---|---|---|
| 1. | General Manager .. | .. | 1 |
| 2. | Foreman Forging Shop .. | .. | 2 |
| 3. | Foreman Die Shop .. | .. | 1 |
| 4. | Chief Inspector .. | .. | 1 |
| 5. | Commercial Manager .. | .. | 1 |
| 6. | Inspectors .. | .. | 2 |
| 7. | Supervisors .. | .. | 4 |
| 8. | Skilled workers .. | .. | 10 |
| 9. | Semi/Unskilled workers .. | .. | 25 |
| 10. | Office Staff - non-professional | .. | As Required |

Approximate monthly salary bill K.Sh 66,000 m.

Appendix III

## Profit Cost and Cost of Manufacture

| | | | K. Sh |
|---|---|---|---|
| A. | **Fixed Capital** | | |
| | 1. Land & Building .. .. | | 520,000.00 |
| | 2. Machinery & Equipment .. | | 2,068,000.00 |
| | 3. Installation & other promotional Expenses .. .. | | 206,800.00 |
| | Total Fixed Capital .. | | 2,794,800.00 |
| B. | **Working Capital** | | 200,000.00 |
| | Total Capital Required .. .. | | 2,994,800.00 |
| | | Say | 3,000,000.00 |
| C. | **Cost of Manufacture (40 tons of forgings per month)** | | |
| | 1. Raw material | | |
| | Steel | 48 tons | |
| | Furnace oil | 20 ton | |
| | Consumable raw materials | | 132,000.00 |
| | 2. Salaries and wages .. .. | | 66,000.00 |
| | 3. Cost of Dies and Maintenance .. | | 3,000.00 |
| | 4. Service, water, power air .. | | 2,500.00 |
| | 5. Overheads .. .. | | 10,000.00 |
| | 6. Cost of Capital .. .. | | 25,000.00 |
| | 7. Depreciation .. .. | | 28,000.00 |
| | | K.Sh | 266,500.00 |
| D. | **Gross Turnover** .. .. | K.Sh | 320,000.00 |

## F. ELECTRONIC DEVELOPMENT CENTRE

No developing country aspiring to compete in the International race of industrialization can afford to set back and relax, without creating a base for fast development of its electronic industry. Considering its widespread application in defence, industry, telecommunication, medicine, education, business and durable consumer items, a minimum level of self-sufficiency in its technology and manufacture, for any country, is inescapable in the modern space and computer age.

In the recent past, electronic technology was mostly dominated by the highly industrialised countries. However, the prevailing climate of the world opinion and legitimate aspirations of the developing countries, has made it imperative, that this knowledge is more widely shared. The developing countries like Pakistan, India, Korea and many others, have many times multiplied their output of electronic equipment during the past decade. In Kenya its industrial production is merely limited to assembly of imported kits of telecommunication and entertainment equipment items. Besides the assembly lines set up by some of the multinationals, the generation of skills is limited to service after sales of the equipment assembled and sold locally, as organised by them and some local private parties.

The educational aspect is equally lacking in training of higher level of electronic technology and is limited to training of mechanics for repair and servicing of mainly the entertainment items.

A survey was made for the import of various types of equipment involving use of electronic components. A copy of the information so collected and tabulated is placed at annexure I. The extent of electronic components used therein is not available. It is however evident that the import of these items have shot up from K.Sh.144.9 mill. in 1972 to K.Sh. 170.5 mill. in 1975, and it is expected to atleast double up every five years.

It is therefore high time, that the Kenya Government takes action for identification, planning and execution of electronic projects. This will involve higher level of training for electronic engineering, establishment of an Electronic Development Centre and initiate manufacture of electronic components in the small scale and organised sectors. The Electronic Development Centre is essentially required as an infrastructural facility to extend designing, development testing and some common facility services to the small

scale sector. The type of electronic components, having scope for local manufacture in small scale sector is given as under:

1. Capacitors, resistors and condensers of different types.
2. Electronic switches
3. Miniature magnets
4. Miniature relays and transformers, I.F. coils, R.F. coils, capacitor, condensers and motors etc.
5. Microphones, loudspeakers, cones
6. Counters - electronic, magnetic, digital and impulse
7. Transreducer of different types
8. Magnetic tapes, carsets, cartides
9. Pickup and pickup cartridges
10. Electronic calculators
11. Walkie-talkie
12. Printed circuit boards

These items are already being manufactured in many developing countries in the small scale sector and the industry is highly labour intensive. The list however is indicative only and far from being exhaustive.

Appendix I

## IMPORT/EXPORT OF ELECTRONIC EQUIPMENT

| Code No. | Name | 1973 K.S. mill. | | | | 1974 K.S. mill. | | | | 1975 K.S. mill. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Import | Import from EAC | Re-Export | Home Cnsmn | Import | Import from EAC | Re-Export | Home Consmn | Import | Import from EAC | Re-Export | Home Consumption |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| 724-100/101 | Television Receivers | 3.254 | - | - | 3.254 | 4.171 | - | - | 4.171 | 3.215 | - | - | 3.215 |
| 724-102 | Tel. unassembled | - | - | - | - | - | - | - | - | 1.193 | - | - | 1.193 |
| 724-200/201 | Radio Broadcast | 13.489 | 4.650 | 0.502 | 17.637 | 7.992 | 6.451 | 0.141 | 14.450 | 4.018 | 8.417 | 0.240 | 12.195 |
| 724-202 | Receivers unassmbld. | - | - | - | - | 13.146 | - | - | 13.146 | 13.218 | - | - | 13.218 |
| 724-910 | Elec. line telephone & telegraph equipment | 63.471 | - | 0.028 | 63.443 | 46.809 | - | - | 46.809 | 56.274 | - | 0.428 | 55.346 |
| 724-920 | Microphones, loudspeakers & amplifiers | 2.996 | - | - | 2.996 | 4.708 | - | - | 4.708 | 3.092 | - | - | 3.092 |
| 724-900/999 | Other tel. equip.NES | 30.173 | - | - | 30.173 | 33.627 | - | 0.192 | 33.435 | 24.783 | - | - | 24.283 |
| 724-991 | Other Tel. equip. as parts of radio & television | - | - | - | - | 5.876 | - | 0.094 | 5.876 | 24.786 | - | 0.237 | 24.549 |
| 891-112 | Tape recdrs. dictating m/c & the like. | 5.623 | 0.073 | 0.051 | 5.645 | 4.639 | - | 0.024 | 4.615 | 2.369 | - | 0.120 | 2.249 |
| 891-120 | Accessories of tape recorders | 1.076 | 0.041 | 0.018 | 1.099 | 0.987 | - | - | 0.987 | 1.285 | - | - | 1.285 |

| Code No. | Name | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 891-209 | Recorded tapes & " media | 5.640 | 0.014 | .044 | 5.610 | 5.338 | - | 0.077 | 5.261 | 2.339 | - | 0.066 | 2.773 |
| Total Entertainment & telecommunication | | 125.622 | 4.778 | 0.543 | 129.857 | 127.288 | 6.451 | 0.528 | 133.458 | 136.572 | 8.417 | 1.191 | 144.598 |
| 714-210 | Electronic Computers | 0.259 | - | - | 0.259 | 0.533 | - | 0.223 | 0.310 | 0.310 | - | - | 0.310 |
| 714-220 | Cal.Acc.Add & similar calculating devices | 9.631 | - | 0.223 | 9.408 | 10.028 | - | 0.123 | 9.805 | 5.994 | - | 0.078 | 5.916 |
| 714-301 | Automatic data process. m/c | 0.627 | - | .061 | 0.566 | 2.801 | - | - | 2.801 | 7.591 | - | 0.254 | 7.335 |
| 714-302 | Electronic Comp. operated in conjunction with punch cards | 1.253 | - | - | 1.253 | 2.965 | - | - | 2.965 | 3.747 | - | - | 3.747 |
| 714-910 | Office m/c NES duplicators | 0.774 | - | - | 0.774 | 1.302 | - | 0.178 | 1.124 | 1.999 | - | - | 1.999 |
| 714-920 | Parts of m/c N.E.S.(mentioned under 714) | 2.843 | - | 0.042 | 2.801 | 4.331 | - | - | 4.331 | 6.647 | - | - | 6.647 |
| Total office machines | | 15.387 | - | 0.326 | 15.061 | 21.660 | - | 0.524 | 21.136 | 26.288 | - | 0.334 | 25.954 |
| Grand Total of Entertainment and Telecommunication, and office equipment | | 141.009 | 4.778 | 0.869 | 144.918 | 148.948 | 6.451 | 1.052 | 154.694 | 162.860 | 8.417 | 1.525 | 170.552 |

## IV. AGRO INDUSTRIES

### A. BIO-GAS PLANT

**INTRODUCTION**

The sudden increase in oil prices in the recent years has created an awareness for growing shortage of energy all over the world and has been mainly instrumental to focus attention on exploring new sources of energy like solar, geothermic wind and nuclear and many other minor sources of energy, which have been allowed to be wasted in the past due to availability of cheaper and more convenient conventional sources of energy. One such typical example is the generation of Bio-gas from animal waste, garbage or some organic waste, with the help of suitably designed digester, which were commonly used during World War II in Germany and elsewhere, but were given up later in favour of cheaper and better conventional sources. These Bio-gas generators are now again becoming quite popular in countries, whose economy has been hard hit due to increased oil prices.

**DEFINITION**

The Bio-gas plant (also known as Gobar-gas plant in India), is one which subjects organic waste like animal waste, poultry sweeps, agricultural by-products, shrub leaves, water haycienth and other wastes to fermentation in the absence of air (oxygen), and generates methane gas, which among many other uses, can be economically used for domestic lighting and cooking purposes.

## HISTORY

The idea of generation of gas from organic waste is nothing new to this world, and was demonstrated at an exhibition as far back as 1871 in London. Chinese claim to have practiced it even much earlier. In 1905 a very large plant designed to produce both gas and fertilizer from sewage was installed in Bombay. Due to shortage of conventional fuels in Germany in World War II, such plants were commonly used for generation of gas to be used for heating, lighting and even running of diesel engines. Thousands of Bio-gas (Gobar gas plants) are in use today in Algeria, South Africa, Korea, France, Hungary and India. The design and size of these plants vary from country to country, depending upon the raw materials used, climatic conditions and other environments.

During the last few years, India has embarked on a national policy to explore alternate sources of energy and has popularized Bio-gas plants in the rural areas on a priority basis. The Government of India, through various institutions and commercial banks is providing subsidies and low interest rate loans in the rural areas to encourage the installation of Bio-gas plants. With a cattle population of 300 million, this idea is catching on in the country. The Directorate of village and Khadi Industries in India undertook some research work to so simplify the existing designs in other parts of the world, so as to make it economical for the small farmers in the rural areas. It is reported that over 29,000 Bio-gas plants have been installed in India during the last fes years. During the last 2 - 3 years several Bio-gas plants have also been installed in the rural areas of Tanzania with success.

The Bio-gas plant not only generates gas to be used as a non-polluting domestic fuel and for lighting, but also produces a better quality organic fertilizer. The plant is simple enough and can easily be fabricated with the facilities available in the rural areas. The size of the plant is flexible enough to suit the pockets of small farmers, and can be started if a minimum of five cattle are available to supply the animal waste as raw material.

In view of the requirements mentioned above, five different sizes of Bio-gas (Gobar gas) plants (Table I) have been developed with more or less standard designs to suit the requirements of small and big farmers. A typical drawing for a Bio-gas plant with 100 cu. ft. capacity (2.75 cu. meters) is appended. These dimensions can be easily scaled to suit the capacity of the other sizes of plants.

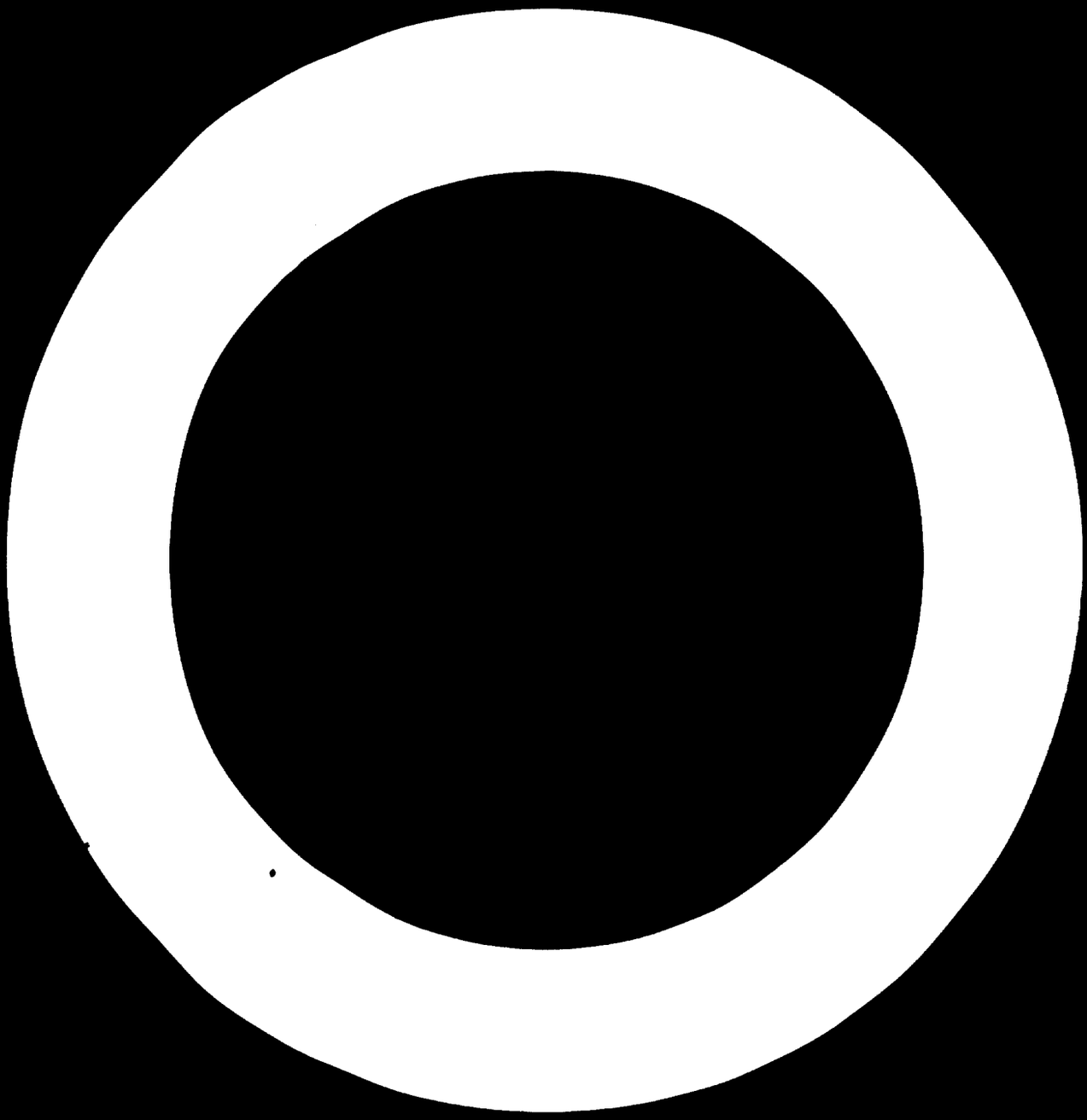


Table I

| Size of Plants | Capacity for gas generation cu/meters/day | No. of cattle required |
|---|---|---|
| 1 | 1.60 (60 cu. ft.) | 5 - 7 |
| 2 | 2.75 (100 cu. ft.) | 8 - 10 |
| 3 | 4.0 (150 cu. ft.) | 12 - 14 |
| 4 | 5.50 (200 cu. ft.) | 17 - 20 |
| 5 | 6.75 (250 cu. ft.) | 22 - 25 |

The number of cattle required to produce adequate raw material for the plant will vary from country to country and also the kind of animal, its age and feed etc.

## THE PROCESS

Any organic matter like animal waste, when covered or mixed with warm water over a length of period, will get digested or fermented and will generate ammonia or methane gas, depending upon, whether the digestion is occuring in presence or absence of oxygen/air. When the digestion is done in presence of oxygen in open air, the end-product is ammonia, which escapes into the air, leaving a poor quality fertilizer. On the other hand, when the same is done in a closed atmosphere in absence of oxygen, the end-product is methane gas (Bio-gas) and a better quality fertilizer richer in nitrogen content.

The biological digestion in each case is helped by different type of bacteria known as aerobic or anaerobic depending upon the presence or absence of oxygen. The speed of this reaction greatly depends upon the temperature and acidity or basicity (PH) of the mixture. In the first stage of reaction the aerobic bacteria is active, which produces food for the second bacteria i.e. anaerobic. For the successful digestion of the organic matter, a happy balance of the two types of bacteria has to be maintained, by controlling the quality and quantity of charge, the temperature and the PH (a number indicating acidity or basicity of any solution) of the mixture. For optimum generation of gas 7-5-8-5 PH, and a temperature in the range of 95-100°F (35°-38°C) has to be maintained. A PH beyond this range will tend to produce more of carbon dioxide instead of methane gas, which has no heating value, and is also likely to arrest the reaction considerably. The PH of the mixture can be measured by using a special quality paper, which when dipped into the mixture changes its colour, if the PH is beyond the prescribed limits. In such cases it can be rectified by reducing the feeding rate, or by addition of some greens or by simply waiting patiently to let it adjust itself.

### Temperature

As mentioned earlier 36-38°C (95-100°F) is the most desirable range of temperature for optimum digestion and hence generation of gas. Lower temperature will slow down the gas generation and below 60°F, it almost comes to stand still. At higher temperatures, the reaction is faster, but it is difficult to maintain it. At 118°F or beyond, the bacteria dies and there is no generation of methane gas. It is therefore desirable to maintain the temperaute range at 90-100°F and in no case it should exceed 110°F. In colder climate, where the maximum temperature is much lower than 90°F it may be essential to heat the mixture internally by using some kind of hot water heating coils.

## THE BIO-GAS

The gas produced by digestion of animal waste, is generally known as methane gas, and its general chemical composition is given in Table II. The percentage of methane and carbon dioxide - its two major constituents, depends on the quality or raw material charged and the operating conditions.

Table II

| Name of the Gas | Chemical Formula | Percentage |
|---|---|---|
| Methane | $CH_4$ | 54-70% |
| Carbon Dioxide | $CO_2$ | 27-45% |
| Nitrogen | $N_2$ | 0.5-3.0% |
| Hydrogen | $H_2$ | 1-10% |
| Carbon Monoxide | CO | 0.10 max. |
| Oxygen | $O_2$ | 0.10 max. |
| Hydrogen Sulphide | $H_2S$ | traces |

Its fuel or heating value, as compared to other commonly known fuel gases is given in Table III.

Table III

| Fuel Gas | Fuel Value BTU/cu. ft. |
|---|---|
| Coal (Town) gas | 450-500 |
| Bio-Gas (Gobar Gas) | 540-700 |
| Methane | 896-1069 |
| Natural Gas | 1050-2200 |
| Propane | 2200-2600 |

The BTU or the fuel value of the Bio-Gas generated by digestion of animal waste, considerably varies with the quality of raw material charged and the working temperature. Excessive percentage of vegetable waste tends to produce more of carbon dioxide and less of methane, resulting in lower fuel/heating values.

The Bio-gas is mainly used as domestic fuel for heating and lighting and in exceptional cases as an industrial fuel. As a rough guide for assessing the requirement of gas it may be mentioned that gas-consumption for:

Cooking - 10-15 cu. ft. per day/man
Lighting - 3 - 4.5 cu. ft. per lamp or 100 candle power
Motive power - 15 cu.ft per H.P./hour
Gas refrigerator - 1.2-1.5 cu.ft./per cu.ft./refrigerator
Incubator - 0.5 - 0.7 cu. ft./per cu.ft./incubator

## RAW MATERIALS

Both plant and animal waste including animal waste (Excrete), animal beddings, poultry sweeps, sewage, agricultural waste, haycienth weeds grass clippings, leftover foods and all kinds of garbage and wastepaper in the urban centres, could be used, one way or the other, as raw material for the Bio-gas plants. The design of the end-products will vary considerably depending upon the quality of raw material available.

When the ultimate objective is to have gas for domestic consumption in the rural areas and quality fertilizer for the crops, animal waste or poultry sweep is the best choice. The quantity and quality of animal waste will further depend upon the type of cattle or animal, its age and feed, degree of confinement and the breed. Because of the urine mixed with it the amount of agricultural waste (beddings), has appreciable affect on the ultimate quality and quantity of gas generated.

Normally the animal waste consists of 72-80% of water, and balance 20-28% is solid (total solids). Part of the solid will burn on ignition and is known as volatile solids and the rest as ash is called fixed solids (sludge). The volatile portion of the animal waste or any other organic matter is biologically active and is responsible for generation of gas. The volatile solids available from different sources is given in Table IV.

Table IV

| Animal | Approx. weight | Lbs/day/animal | | Total solids per day (20% of the waste) T.S. | Volatile solids/day 80% of the total solid V.S. | Cu.ft. gas per lb of dry matter |
|---|---|---|---|---|---|---|
| | | Urine | Feces | | | |
| Cows & Bulls | 1000lbs. | 20 | 45-52 | 10 | 8.0 | (Indian) 3.1-4.7 |
| Horses | 850 " | 8 | 30-36 | 7 | 5.5 | - |
| Pigs | 160 " | 4 | 6-7.5 | 1.5 | 1.3 | 6.0-8.0 |
| Sheep | 67 " | 1.5 | 2-3 | 0.5 | 0.4 | - |
| Chicken | 3½ " | - | 0.3 | 0.1 (35%) | 0.06 | 6.0-9.0 |

The actual collection of animal waste will greatly depend upon the breed and the degree of confinement. Normally for animals let out for grazing, only 50% or less collection is possible.

The solid portion of the animal waste consists mainly of carbon and nitrogen, both of which are essential foods for the different types of bacteria, responsible for generation of gas. The bacteria consumes carbon 30 times more than nitrogen. For the optimum generation of gas, the raw material should contain carbon and nitrogen in the 30:1 ratio. This is generally known as C/N ratio. If there is too much carbon in the raw material, because of excessive mixing of agricultural waste, the entire available nitrogen will be consumed first and the biological action for generation of gas will come to stop. If on the other hand nitrogen content is more than the optimum value, the carbon will be consumed first and the rest of the nitrogen will be lost as ammonia, resulting in poorer quality of fertilizer. For optimum generation of quality gas and a fertilizer with maximum nitrogen content, the carbon and nitrogen content in the raw material should be balanced in the ratio of 30:1. Table V gives the percentage of nitrogen present in different type of raw materials.

Table V

| Raw Material | Total Nitrogen % of dry weight |
|---|---|
| Animal urine | 16 |
| Animal waste | |
| cow | 1.7 |
| horse | 2.3 |
| pig | 3.8 |
| sheep | 3.8 |
| chicken | 6.3 |
| Sewage (fresh) | 5 |
| Plant waste | |
| hay-young grass | 4 |
| sea-weeds | 1.9 |
| Vegetables | 2.5-4 |
| Wheat straw | 0.5 |
| Saw dust | 0.1 |

## PLANT DESIGN AND OPERATION

There are two basic systems of digesting the organic matter i.e. Batch Load Digestor and a Digestor with Continuous Feeding system. The batch type digestor is simpler in design. It usually consists of two cylinders (drums) closed on one end, and fitted into each other at the open ends. The lower drum with bigger diameter acts as a holder for the slurry and the smaller dia drum on top as a holder for the gas generated. The charge is fed once in a fixed interval of time. At the end of the reaction, the whole thing is emptied out and cleaned before recharging it, which involves extra labour cost, besides interruption caused in gas supply. Because of this operational disadvantage it has not become popular as compared to a digestor with continuous system.

As regards its operations, the digestor is fed with a mixture of animal waste and water in equal proportions in slurry form. After 28-40 days, depending upon the working temperature, the Anaerobic bacteria starts functioning and produces methane gas, which bubbles through the slurry layer and collects in the gas holder or receiver in the top. The distinct layers of different ingredients in a digestor are shown in Figure I, which also holds true in case of a digestor with continuous feeding system.

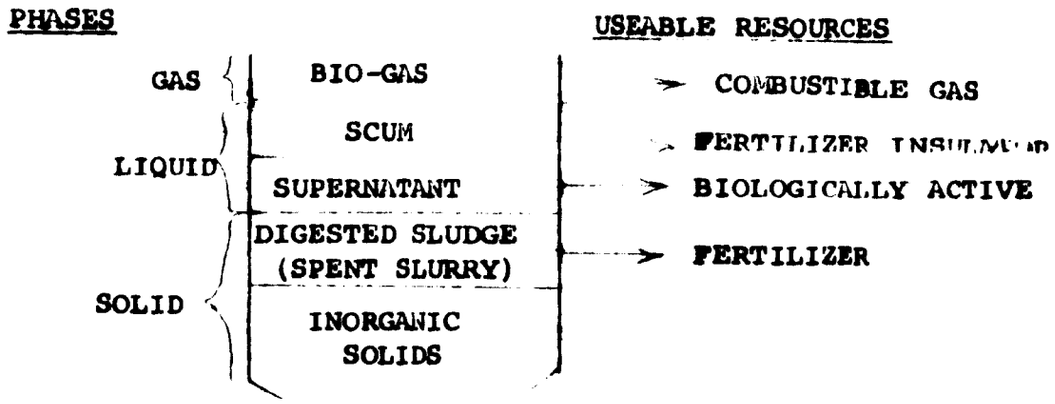



**Figure I** Layering of By-Products in the Digestor

### Continuous Feeding Digestor

The continuous feeding digestors are more popular and commercially used. They however vary in design and size depending upon the types of raw materials and the climatic conditions. It can be either of vertical or horizontal (displacement) design.

The Horizontal (displacement) designs are more efficient and also has the advantage of less scum formation. The vertical digestor is simple and cheaper, and more practical to suit the requirements of small farmers. A typical drawing for a vertical digestor with 100 cu. ft. capacity is appended at Annexure I

The vertical digester as per the drawing appended, is widely popularized in India in five different sizes, and consists of:

a) Slurry mixer
b) Digester
c) Gas holder
d) Inlet and outlet pipes
e) Partition walls
f) Outlet tank or discharge pit for spent liquor or fertilizer

Because of the simplicity of design, the entire plant can be easily fabricated in the rural area with the technical and other facilities locally available.

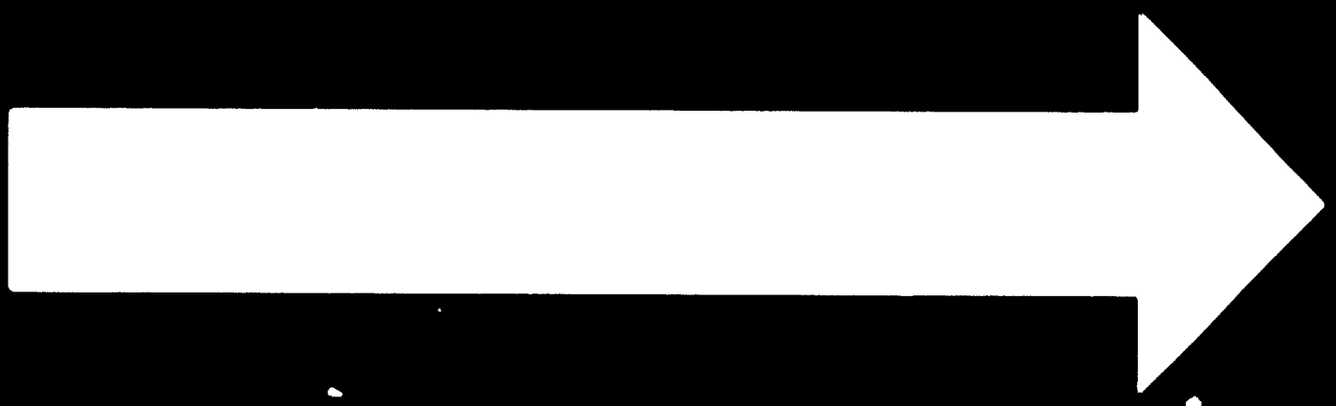
a) Digestor

The digestor is a sort of well dug and built of masonary work below the level of the ground. The depth and dia of the well varies - 12-20 ft and 4-20 ft. respectively, depending upon the capacity of the plant. The well is divided into two semi circular halves by a partition wall. The well has a concrete base atleast 6" thick with a mixture in the ratio 1 . 4 . 8 of cement, sand and aggregate. On top of it a 3" thick layer of concrete mixture in the ratio of 1 . 2 . 4 is constructed which acts as the bottom of the digestor. On top of it the walls of the well are constructed to the required height and cement plastered both inside and outside to ensure against any leakage of gas. The inlet and the outlet pipes are let through the walls at the appropriate levels, and tightly packed all around with concrete to avoid any leakages.

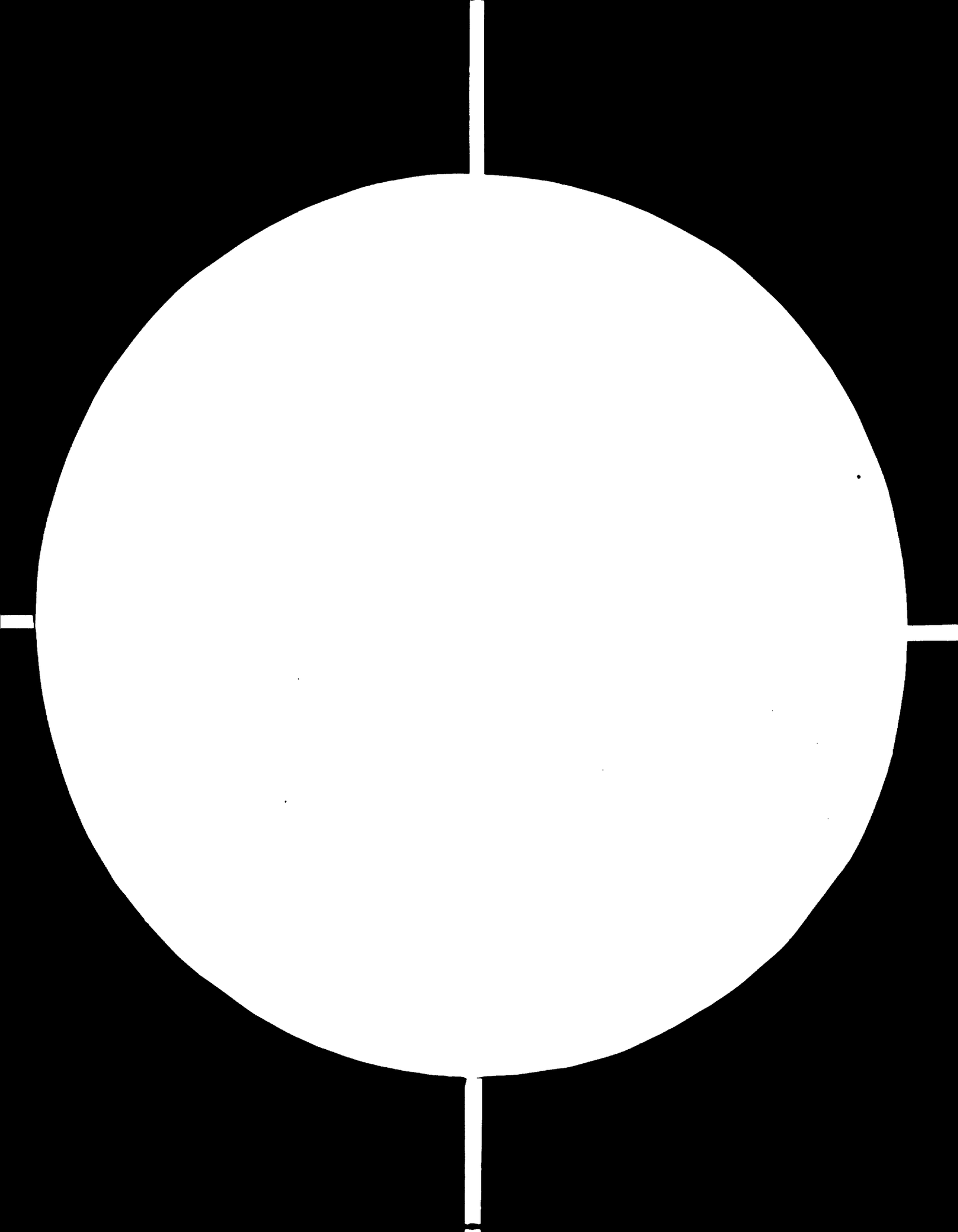
In order to provide sufficient insulation to the mixture in colder climates, a brick wall is constructed all around the well leaving a gap in between, which is later filled with some insulation material like wheat or rice straw. At the top level of the well a 3-4 ft. wide walkaway is provided.

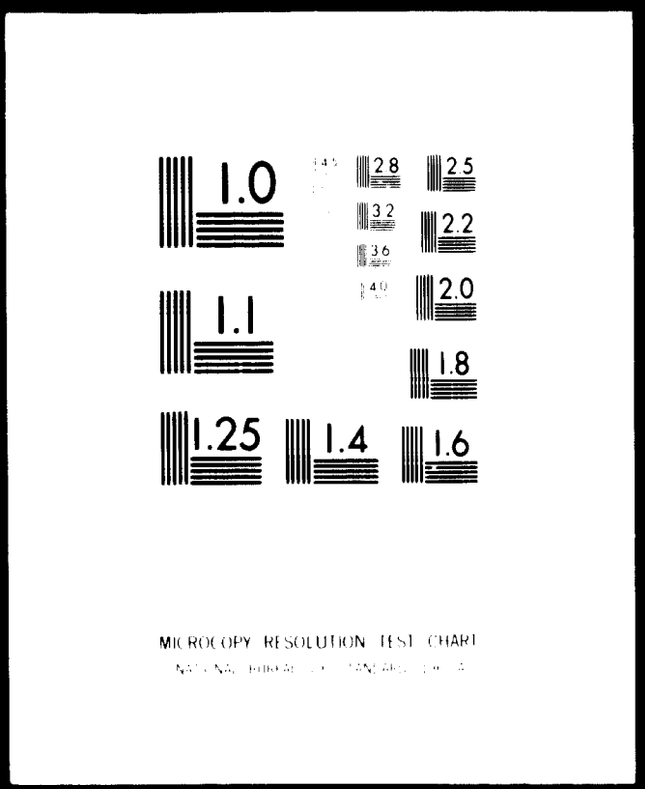
The partition wall, dividing the well is approx. 4" thick and 8' high. A circular steel structure fabricated from angle iron is placed on top of the partition well and well supported on some projections from the walls of the well. A 3" dia G.I. pipe is installed right in the centre of the well and the partitioned wall, which serves as a guide for the upward and downward travel.

G-343



77.10.05





It is rather important that this pipe should be exactly in the centre of the well, otherwise the gas holder travel may be intercepted due to small clearances between the walls of the well and the outside diameter of the gas holder.

b) The Mixing Tank

The mixing tank is a concrete cylinder with 2½-3 ft. dia and 2 ft. high walls. Its floor is approx. 1 ft. above the ground level to provide enough hydraulic head to feed the plant with the slurry. The top end of the inlet pipe should be flush with the bottom of the tank. The floor of the tank should be properly sloped away from the inlet pipe head to facilitate occasional washing.

c) The Outlet and Inlet Pipes

The outlet and inlet pipes are made of 4" Dia G.I. pipes. It could also be made of cement pipe, but may not be lasting as much as steel pipes. The slurry from the mixing tank is fed through the inlet pipe to the bottom of the digestor. The lower end of this pipe is firmly supported on a small brick structure 1-1½ ft. high in the centre of the first segment of the digestor.

Similarly the lower end of the outlet pipe is firmly supported on another brick structure in the other half of the digestor The outlet pipe is led through the digestor wall and ends up in the outlet tank or discharge pit to help discharge the spent slurry.

d) Gas Holder

The gas holder is a roofed cylinder of a suitable size to accommodate atleast 75% of the gas generated in the digestor. It is fabricated from 12 gauge M.S. sheet. A G.I. pipe 4" Dia is centrally fixed in the gas holder into which the guidepipe in the digestor losely fits in. This helps the downward and upward travel (4-5 ft) of the gas holder with the generation or consumption of gas. It is also provided internally with iron rings at different heights, to facilitate breaking of the scum formed at the top of the surface, by rotating the gas holder around the central pipe. The gas holder is first rivetted and then welded on the joints and tested for any leaks by filling it with water. After completely sealing it off for any leaks, it is suitably coated with an antirust coat and then enammelled, to withstand the severe corrosive conditions. It needs to be repainted once every two years under normal conditions. The bottom portion of the cylinder dips into the slurry, and completely seals it off.

The top of the gas cylinder on the dome side, is fitted with a tap and valve of 1" dia. to which is connected a flexible pipe. The flexible pipe is further fitted to the main gas pipe line. The gas pressure is controlled by the weight of the gas cylinder and generally varies between 3" (7.5 cm) to 6" (15 cm) of water column.

Besides the gas pipe, the other requirements are the burners, gas filaments and fittings, which have to be specially designed to suit the low pressure of the gas. The fittings burners and gas filaments to required specifications, can easily be purchased from India in the initial stages and later fabricated in the country if the demand warrants it.

e) The Discharge Pit

The discharge pit should be large enough to accommodate all the spent slurry accumulated in between its clearance intervals. The top end of the outlet pipe is positioned at the top of this pit, which is generally in level with the ground. The level of the mixture in the digestor is controlled by this level, and hence the total slurry that can be stored in the digestor. The pit is sufficiently sloped away from the top end of the outlet pipe, to facilitate automatic flow of the spent slurry away from the digestor.

Construction material required

The construction material required for a Bio-Gas generator with 100 cu. ft. capacity (as shown in the drawing) is given below in Table VI for general guidance of the user.

Table VI

Material required for 100 cu. ft. gas production Bio-gas plant

| S. No. | Material | Quantity |
|---|---|---|
| 1. | Cement | 40 bags |
| 2. | Sand | 300 cu. ft. |
| 3. | Brick ballast | 100 cu. ft. |
| 4. | Bricks | 7500 |
| 5. | 12-14 gauge M.S. sheet drum 5 ft Dia. and 4 ft. in height open at the bottom | One |
| 6. | M.S. Angle iron for structure and gas holder guide | 100 ft. |
| 7. | Alkathine pipe ½" dia. | 50 ft. |
| 8. | Alkathine pipe fitting bend, elbow sockets of 1 and ½" fittings | 3 each |
| 9. | Wire gauge 30 mesh | 1 sq. ft. |
| 10. | Paints (enamel) | 4 litres |
| 11. | Miscellaneous fittings | one set. |

**OPERATION**

The animal waste or cow-dung, is mixed with an equal quantity of water in the mixing tank to form a slurry and fed into the first half of the digestor. The process is repeated till the digestor is nearly full. After about 28-40 days, depending upon the working temperature, the gas formation starts, and the spent slurry is discharged in the discharge pit through the outlet pipe. Further addition approx. 1/40th of the total volume of the mixture in the digestor of fresh slurry are added daily, depending upon the rate of consumption of gas, and an equal amount of spent slurry is forced out into the discharge pit.

The fresh mixture is fed right at the bottom of the first half of the digestor. Being heavier than the digested mixture, it stays there till it starts fermenting. As it gets digested, it becomes lighter and slowly moves to the top, till it flows over the top of the partition wall into the second half of the digestor. Approx. 70-80% of the gas is generated in the first half of the digestor and the balance 20-30% in the second half. The discharge pit is cleared of the spent slurry or fertilizer as frequently as possible to keep it clean.

For smooth and trouble free operation of the plant the following may be kept in view:

i) Vent out the gas formed initially till it is free of trapped air or oxygen;
ii) Watch carefully for any leak of gas in the gas holder, pipes or fittings and rectify the same immediately,
iii) Paint the gas holder regularly to avoid rusting
iv) If the rate of generation of gas is too slow for reasons other than working temperature, check for P-H of the mixture.

If it is lower than specified:

- reduce feeding rate
- add raw material with high nitrogen content or remove scum

If PH is too high:

- wait patiently and allow the mixture to adjust itself. Sometimes adding a bit of chopped tender green grass or crushed leaves of cactus helps.

v) If the gas generation is too slow and the ambient temperature is much lower than 90°F, provision should be made to heat the mixture to the desired temperature, for which special provision shall have to be made.

## LOCATION OF THE PLANT

The gas plant should be located as near to the source of animal waste as possible to avoid costs of transportation. At the same time it should be as close to the kitchen as possible, keeping in view the cleanliness of the surroundings and the possibility of any smell of the fresh slurry in the kitchen. If on the other hand it is located too far away from the kitchen, it will unnecessarily add to the cost of the pipings required, and may also result in drop of gas pressure. 30-50 ft. distance from the kitchen is considered derirable and in no case it should exceed 100 ft.

It should also be taken care not to locate it too near a drinking water well, as there is a chance of slurry percolating to the well.

## UTILIZATION OF THE PROJECTS OF BIOGAS PLANT

The gas is mainly used as domestic fuel for cooking or heating for lighting purposes. Because of its low calorific value and pressure the burners and the filament lamps have to be specially designed. The gas burns with a very clean bluish flame without any smoke, and thus avoids the pollution caused by other fuels used in the rural areas, besides making the house wife's job more comfortable and enjoyable.

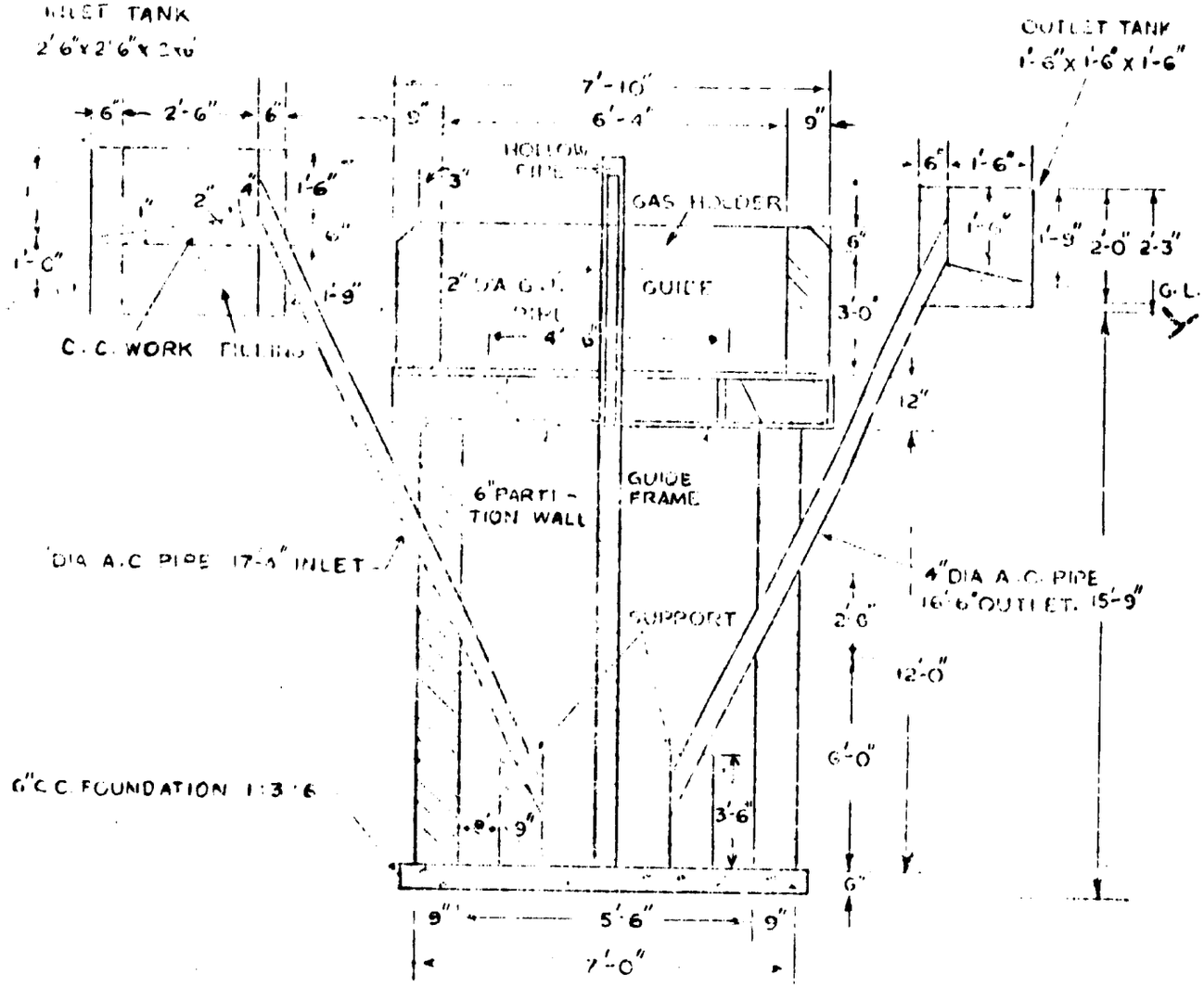
The gas can also be used for running of small diesel engines after bottling it. The carburettor combustion chamber and other parts of engines have to be specially designed to suit its low calorific value and pressure.

The spent slurry is much better quality fertilizer as its nitrogen content is at least 2-3 times more than the original animal waste used. Under normal conditions most of the nitrogen is lost as ammonia into the air, due to natural oxidation. Besides being enriched in nitrogen, the spent slurry is in a very finely divided state, mixes much easier with soil and can be used instantaneously without creating the problem of breeding flies, maggots or other insects. It does not act as a carrier of seeds of any weeds as in case of animal waste under normal conditions. The crop yields under given conditions is 25-30% more than natural manure as it helps to keep the soil open and well aerated and hold the moisture better against seapage and evaporation.

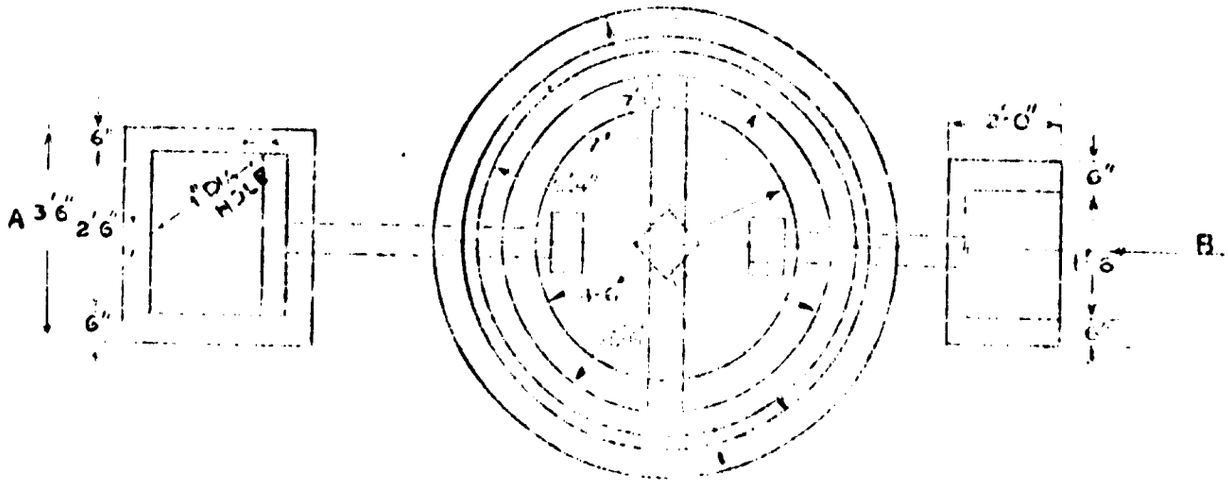
For further details please contact.

1) Directorate of Gobar Gas Plant
Khadi & Village Commission,
IRLF Road Ville, Parle (West) Bombay 56.

2) Ram Bux Singh, Incharge
Gobar Gas Research Station,
Ajitmal Itawah UP, India.



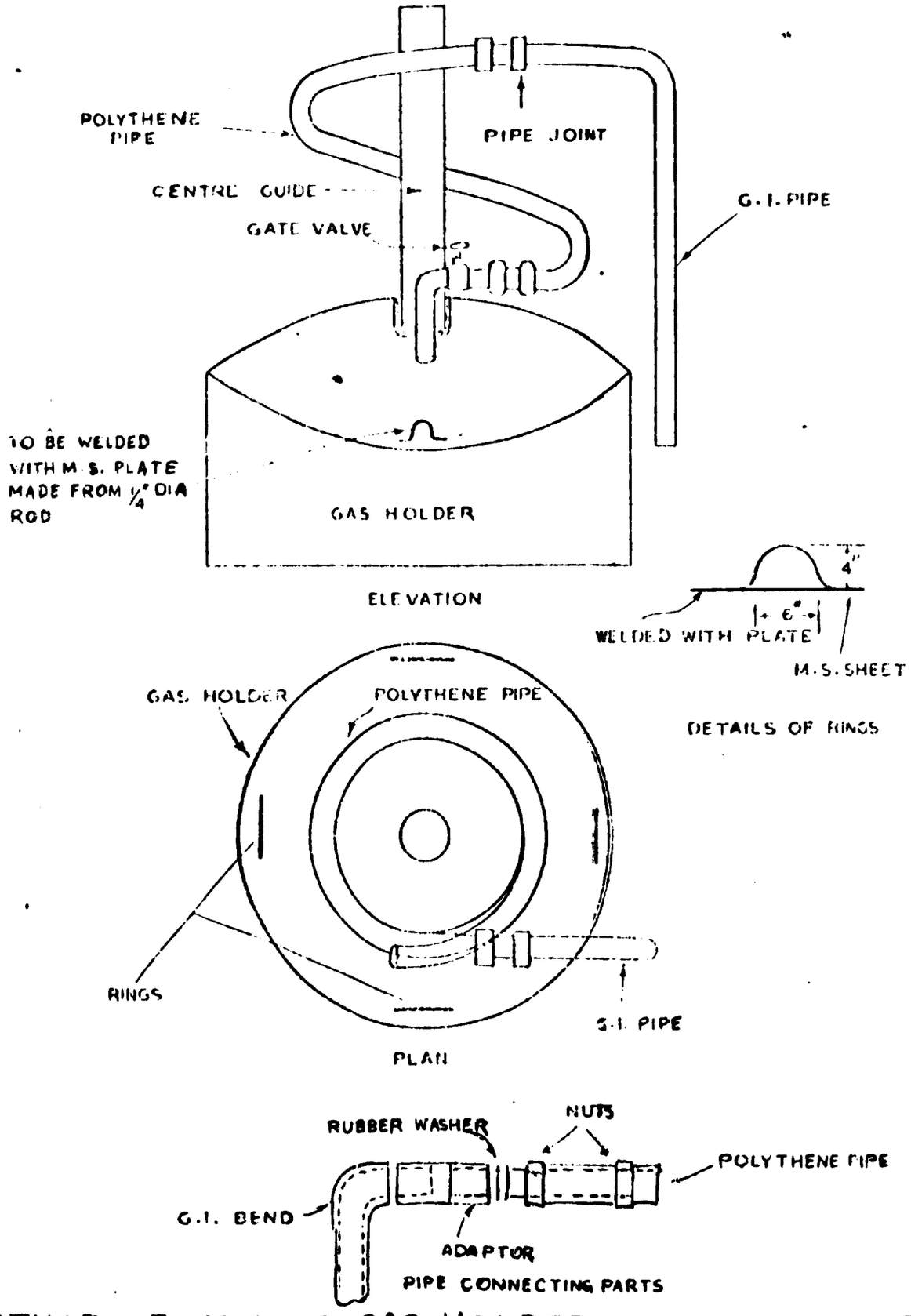

CROSS SECTION ELEVATION AT A B




PLAN

# GOBAR GAS PLANT

(FOR 100 CUBIC FEET GAS PER DAY- SCALE $\frac{3}{8}$"= 1')




METHOD OF JOINING GAS HOLDER TO MAIN GAS PIPE.

(NOT TO SCALE)

## B. DEVELOPMENT OF AGRO-INDUSTRIAL COMPLEX

### Introduction

The (1974-78) Plan lays emphasis on faster development of rural areas by creation of job opportunities at site and attaining better distribution of national income. It demands a concerted effort for expansion of productive measures, open new avenues of rural employment, reduce seasonal variations in labour demands, conservation of soil and water, up-grading the commodity mix and help to maximise the agricultural output per unit of land and labour. The Agro-Industrial Complex proposal in the following paragraphs is the first step in the systematic transfer of modern technology to the rural areas and to make optimum use of the inter-relationship between industry and agriculture to achieve the above objectives.

A Pilot Area Development Scheme in the form of an agro-industrial complex at a potential growth centre is likely to help the farmers in adopting modern methods of cultivation and farm management, generate surplus to develop agro-based industries, provide additional and continuous employment opportunities in the area, reduce rural-urban migrating, function as a Demonstration Centre and as a vehicle of rural technology transfer. Normally the sphere and activity of an Agro-Industrial Complex is limited to manufacture of agricultural inputs to suit the requirement of the area and organise processing of agricultural produce for better end-values. But considering the peculiar prevailing local conditions in Kenya and the paucity of infrastructural facilities to the farmers, the scope of Agro-Industrial Complex has to be widened further to cover all aspects related to agricultural production so as to establish a base for modern agriculture as well as agro-based and agro-related industries on a sustained basis. The major activity of the proposed Complex is to provide custom services (contract services) coupled with repair and maintenance facilities and establishment of export oriented vegetable dehydrating and fruit preservation plants. These activities will also give rise to a number of resource based agro-industries in the selected area. As experience is gained from this pilot scheme and local expertise generated with passage of time, it is envisaged that a chain of such Agro-Industrial Complexes will be set up at other potential growth centres with varying sphere of activities depending upon the local resources and potentialities.

The general requirements of a potential growth points are:

i) A sizeable tract of land located within a densely populated subsistence farming area for the estate, having potential for mechanised farming and irrigation;

ii) Market connections for supplying necessary inputs and for marketing of finished product;

iii) Suitable soil and climatic conditions for growth of vegetables and fruits;

iv) A competent agency to manage the entire scheme in collaboration with existing government agencies;

v) Financial resources.

As the Pilot Scheme has a demonstration effect its success is vital to ensure its absorption all over the country. In the absence of local expertise for implementing such a scheme, it will be necessary to seek assistance from external agencies both for necessary expertise and financial assistance. As the expertise available in the initial stage will be limited and expensive, it is proposed to concentrate efforts in one area selected for the purpose. If bilateral or multi-lateral aid agencies can be pursuaded to assist in the setting up of similar schemes, a start can be made by selecting an area in each of the Provinces.

The proposed scheme is bound to have a great impact on the farmers of the surrounding areas by providing them outlet for their farm produce and encouraging them to commercialise agriculture through the adoption of modern farming methods and farm management. The generation of increased purchasing power will encourage the establishment of consumer industries and thus open up new vistas of industrial activity and employment in the area.

Objectives

The major objectives of establishing a Pilot Agro-Industrial Complex in a suitable area are to:

i) Produce dehydrated vegetables, canned fruits and fruit juices and other suitable agricultural processing industries

ii) Assist the small and subsistence farmers in obtaining better output and return on their holdings through the provision of customs services coupled with repair and maintenance facilities

iii) Provide a market for farm produce by establishing processing facilities in the area;

iv) Door delivery of essential agricultural inputs and other package assistance to the farmer through a unified agency;

v) Expose the farmer to modern farming methods including use of high yielding variety seeds and fertilizers, farm mechanization, optimum cropping pattern, spraying of crops against diseases, harvesting and post-harvesting techniques etc.;

vi) Provide soil testing facilities for proper selection of crops and use of fertilizers;

vii) Demonstrate the utility of irrigation facilities to reduce the risk of crop failures due to inadequate rains at times of maturing of crops and drought periods;

viii) Promote agro-related and agro-based industries in the area and develop local entrepreneurship.

ix) Devise appropriate transport equipment for greater mobility of the rural population

x) Create consciousness for economic viability of providing custom services by individual progressive farmers and thus multiply farm mechanisation activities in the neighbouring areas;

xi) Reproduce similar activities in potential growth points in other areas in the country.

<u>The Need for an Agro-Industrial Complex</u>

Agriculture accounts for about a third of gross domestic product, over 70% of the export earnings and supports directly or indirectly about 90% of the population in the country. Since 1967 monetary agriculture has grown at an average rate of about 65% in real terms, but real capital formation in agriculture has virtually remained stagnant at around £10 million a year. The World Bank has pointed out that in relative terms the share of agriculture to total capital formation in the monetary economy has fallen from 17% in the mid-sixties to 8-10% during the last two to three years. The sluggish rate of capital formation will act as a decisive break in maintaining the momentum of agricultural growth in the country and it demands an immediate appropriate action to rectify the same.

Due to variation in topography of land, climate, soil conditions, and land distribution amongst people, there is wide differential in labour productivity, agricultural production and wealth distribution from one area to the other. The problem of introducing any system of productive farming amongst subsistence farmers in certain areas to help rectify imbalance of wealth distribution. is made rather difficult by the rapid growth of population (3.5%) and by tribal influence in distribution of land. Population pressure in certain areas (Kisii and Kakamega) has compelled local population to migrate to other areas in search of more remunerative jobs. In order to arrest the situation from getting worse and reverse the cycle of migration, it is imperative to launch a scheme to help improve the productivity of the land and the farmer and create job opportunities at site to lessen population burden on land. The setting up of Agro-Industrial Complex in such congested areas is one of the appropriate solution to this grave national problem.

The development of Agro-Industrial complexes demands simultaneous development of agriculture and industry, to economically exploit agro-industrial inter-relationship to promote balanced economic development in the rural areas. Whereas development of agro based industry helps to produce essential agricultural inputs through backward linkage effects it also acts as a catalytic agent in developing agro-related industries producing inputs for agricultural and durable and non-durable consumer items in response to increasing demand from the rural population. It also helps to increase the investible surpluses to further stimulate industrial activity and thus create additional job opportunities in the area.

The nature of activities of the proposed Agro-Industrial Complexes may vary from area to area depending upon the local resources. In this particular case it is proposed to mainly grow and process commodities having export potential e.g. dehydrated vegetables and processed fruits. The local farmers will be provided package assistance by way of customs services, contract services, quality seeds and fertilizers and allied extension services in co-ordination with other government departments so as facilitate them to grow commercial crops to supply raw materials to the processing units proposed to be established in the area.

Location

There are a number of potential areas in the country, which are most suited for setting such agro-Industrial Complexes. Initially it is proposed to make a start in the Koroka-Sotik

belt. This area has fairly large concentration of subsistence farmers, suitable land and rainfall facilities for surface and underground minor irrigation schemes which are basic requisites for the success of this proposal. The macrolocation of the area is marked in the map (Annexture 1). The microselection for location of the nucleus shall have to be determined after a detailed survey of the area.

This area falls partly into Kisii and partly into Kericho districts. It has a rolling ground with incessant low hills at an altitude varying between 3000-4000 meters. The annual rainfall varies between 1200-1500 mm. The soil varies from dark red friable clays to black clay and is considered to be good for cultivation of vegetables and other cash crops, provided adequate irrigation facilities are assured. The intensity of population varies from 150 - 200 per sq. km. consisting mostly of subsistance farmers with little economic activity. It is served with one major tarred road running from Kisii to Kericho and few other minor cross-country roads. The area is amenable to tractor cultivation and use of other farm machinery. It includes the following rural and marketing centres, which could be considered as a basis for providing nucleus for custom service centres and other essential facilities to the farmers, as described later.

1. Rural Centres

   i) Keroka

   ii) Sotik

2. Marketing Centres

   i) Gesima

   ii) Nyansiongo

   iii) Manga (Borabu)

   iv) Keumbu

   v) Yaganek

   vi) Kapkelei

The small subsistence farmers of such areas hold key to the future of Kenya and deserve Government help for package assistance through a single agency providing material inputs and extension service so as to help them to absorb modern agricultural technology.

The major problems faced by these small farmers are:

i) Near absence of farm machinery and modern agricultural aids.

ii) Inability to take risk for switching over to cash crops.

iii) Seasonable labour peak demands and shortages

iv) Traditional farming inhibitions

v) Total dependence on the forces of nature and lack of irrigation facilities in drought periods and off season periods inhibiting intensive land usage.

vi) Lack of minimal transport facilities

vii) Rural-urban migration of educated young people because of lack of local job opportunities and other simple amenities of life.

Assuming 20 percent of the land outside the estate farm is used for vegetable cultivation and on contract supply to the dehydration plant, the entire area of operation of the Complex is likely to be 60-70 sq. miles. It is anticipated that this scheme will enable the local farmers with an average of one hectare land and willing to take up cultivation of vegetables to earn K.Sh 3000/- above subsistence.

The Scope

The scope of major services to be provided by the Agro-Industrial Complex independently or in collaboration with other government agencies functioning in the proposed area are:

i) Establishing a plant for:

- dehydration of vegetables
- fruit processing

ii) Custom Services for cultivation and post-harvesting coupled with repair and maintenance facilities.

iii) Supply of agricultural inputs

- seeds
- fertilizer
- credit

iv) Irrigation facilities with tube-well boring and supply of pumping sets

v) Crop spraying facilities

vi) Transport facilities

vii) Soil testing facilities

viii) Agricultural consultancy and management services

The mode of supply of these services is briefly described in the following paragraphs:

i) The Dehydration & Fruit Processing Plant

The soils and climate in the areas related are well suited for intensive cultivation of vegetables and fruits, which could be processed locally and have a promising export-market thus creating additional rural job opportunities. It will however need considerable extension services to educate the farmers in adopting new techniques of farming and management. The types of vegetables and fruit that could be grown and processed here are:

1. vegetables - carrots
   onions
   tomatoes
   leeks
   cabbages
   capsicum
   beans
   cauliflower

2. Fruits - Passion
   pineapples
   citrus fruits

It may not be possible to spell out precisely the order of priorities for processing of different vegetables and fruits which shall have to be done after detailed agronomical survey of the area to determine the optimum cropping pattern for each area.

Because of the climatic advantages in Kenya the possibility of continuous supply of vegetables and fruits the marketing of dehydrated vegetable etc. in the export markets pose no problems. The high cost of air freight will be counter balanced by the reduction in weight of vegetables after dehydration to the extent of over 90%, and thus help to improve its

competitiveness in western markets.

Assuming a production of approx. 5000 tons of different types of vegetables, it will need at least 60,000 tons of green vegetable production from 10-12,000 acreage. It is planned to grow 20-25% of the vegetables from 2000-3000 acres of factory farm and the rest will be purchased from the surrounding small farmers, who will be supplied with the necessary inputs and extension facilities. It is estimated that over 3-4000 families will be likely suppliers, and be able to earn over Shs 13,500/- per hectare.

The plant itself will be flexible enough to undertake processing of different types of vegetables and fruits locally produced and shall be suitably equipped with batch type and continuous process line equipment for hot air and spray drying facilities.

Besides the adequate covered area for factory production, storage and administrative block, it will need service facilities for power and fresh water supply. It will need more than 5000 gal. of water per hour for washing of vegetable and fruits and for steam generation.

The approximate break up of cost of production is likely to be

| | |
|---|---|
| Raw materials | 35 - 40% |
| Fuel and Power Services | 10 - 12% |
| Cost of establishment | 5 - 7% |
| Transport | 20 - 22% |
| Cost of capital | 18 - 20% |

The capital cost, its economic viability and other details are given in a project profile entitled 'Integrated Vegetable Growing and Dehydration - Kisii-Sotik Area' prepared by Mr. A.M. Muthee of Industrial Survey & Promotion Centre (Annexture II).

ii) Agricultural Custom Services

Presently the mechanisation of farms in concentrated around Nakuru and a few other places, where large farms exist as a legacy of colonial rule. Due to economy of scale, greater cost of manual operations and management techniques involved, there is no escape from use of modern agricultural machinery in such farms. But in areas like Kisii and Kakamega, with large concentration of small farms, farmers are still following the traditional methods of cultivating manually.

The farmers in such areas have refrained from adoption of modern methods of farming due to:

i) High cost of the equipment which is beyond their means;

ii) Lack of adequate training in the use of such equipment

iii) Lack of servicing facilities

iv) Inadequate extension services in farm management

The farmers have also no incentives to make use of ox-driven implements, because of the difficulty of feeding the oxen and the feeling that it is a retro-grade step. Therefore the only possibility to break them away from traditional farming methods and make farming a commercially remunerative proposition, is to offer custom services at a price farmers can afford.

One of the major functions of this scheme is therefore to organize a small farmers service system to provide custom services (contract services) for borehole drilling, irrigation, tilling, cultivating, furrowing, sowing, spraying, harvesting, threshing, road maintenance, transport, and minor repair service to the farmer, through a unified agency, at a price the farmer can afford. Besides these services the same agency will be responsible for supply of quality seeds and fertilizer, agricultural consultancy and management services, soil testing and supply of credit, in collaboration with other governmert or semi-government agencies. The dehydration plant under the control of the agency, will serve as a convenient outlet for marketing the major agricultural produce of the farmer.

The proposed custom service centre will mainly be located at Sotik or Keroka, adjoining the dehydration plant, with at-least six branches at marketing or other suitably located rural sub-centres in the demarcated areas as indicated earlier. The area of operation of the main centre will be limited to the factory/estate farm measuring 2000-3000 acres and the surrounding area within manageable radius of 3-4 miles. The other 6 branches or sub-centre will operate within their own areas of location within a 2-3 miles, radius depending upon the demand for such services.

The preference for the custom services will be given to those farmers willing to cultivate vegetables and sell the same to the vegetable and fruit processing plant at an agreed price. The other farmers could also avail of these services,

provided they become members of the small farmers system with recommendation of the concerned cooperative or any other competent society.

The charges for different type of services will be fixed in consultation with the local development committee and district agricultural officer. A proper record will be kept of the services rendered to each farmer at the central and branch offices, and the charges for the same will be deducted at the time of marketing his produce to vegetable dehydration plant or vegetable marketing cooperative.

The proposed list of agricultural machinery and equipment at the main centre and sub-centres is given in Annexture II. While positioning different machinery and equipment, its occupancy and demand for its services will mainly determine the number required at a particular location. It is estimated that it will need at least 9000-10,000 acres of land to cultivate 50-60,000 tons of green vegetables required for 5-6,000 tons of dehydrated vegetables. It is further assumed that only half of this area will be cultivated or servised by custom service centre and the rest will be done by the farmers on their own with private machinery or manually. It is further assumed that not more than 30-40% of this area will be irrigated by surface or underground water. The yield from irrigated farms is anticipated to be twice as much as of rain fed farms.

It is further proposed, that if necessary the enlisted equipment may be purchased in two installments to avoid idle capacity or low occupancy in the initial stages, as it will take quite sometime and effort to educate the farmers of its utility and better returns to them.

The log book for operation of individual major item of machinery will be maintained for cost calculation purposes. Use of a tractor over 1000 hours per year is considered as satisfactory when it pays for itself. It should however be ensured that the farm machinery to be supplied should not be too sophisticated in design and be able to withstand rugged service conditions and use by not too experienced operators. The tractors should preferably have 5-6 number of gear changes, larger or heavier ply tyres, better sealing and improved air filters and simpler designed lifts. It should normally be provided with gedgets for multi-purpose uses.

## Minor Irrigation Schemes

It will be futile to offer package services for intensive cultivation of vegetables without assured irrigation facilities. It has been demonstrated in areas around Naivasha, that the yield per acre in an irrigated land is atleast double, if not more, as compared to unirrigated land. In a rainfed area the crop output is extremely erratic depending upon not as much the total rainfall in a year as the frequency of rains. In a black clay soil or for that matter any soil rich in clay, intermittent failure of rains is likely to severely affect the yield of vegetables. Moreover irrigation system helps intensive cultivation through double or tripple cropping in a year by using larger doses of fertilizers to obtain higher yield per acre.

There are two possibilities for introducing minor irrigation schemes in the proposed area:

i) Pumping water from the rivers, reservoirs or rivulets and feeding the same through well planned piping system and/or tapping of underground sources

ii) Pumping water from the rivers or reservoirs and delivering the same through pipe system or even open channels in case of nearby fields, is much cheaper as far as recurring cost is concerned, but has the limitation of distance to which it can be fed.

No serious attempt has been made so far in this country to utilize the underground water for irrigation purposes even in the most promising areas. Some of the reasons put forward are:

i) Lack of initiative and sometimes resources on the part of the farmers

ii) Govt. restrictions for use of under-ground water, and

iii) Lack of surveying and bore hole drilling facilities in the country.

However, lack of surveying and bore-hole drilling facilities appears to be the most serious factor responsible for this inaction and apathy so far. It is reported that at present the bore hole drilling for such purposes is exclusively done by three foreign firms, whose charges are so heavy that small farmers are not able to take advantage of this system of irrigation.

In order to overcome these hurdles it is proposed to equip the main centre with two different types of drilling rigs for drilling in soft or rocky soils, under the control of an experienced tube well engineer. As per information gathered from the local officer abundant supply of ground water is available at reasonable depths.

It is further assumed that the drilling or boring will be done free of cost and the farmers shall bear the cost of casing (pipes) and the cost of pumping sets individually or collectively. Alternatively the entire cost could be borne by the Water Department and the farmers using water could be charged for the quantity of water utilized or on monthly rental basis.

The estate farm or the factory farm will be fully provided by an independent water supply system either from the rivers or tube wells.

Other Services

In addition to the custom services for cultivation, irrigation and marketing outlets, there is also need for other services like:

i) Soil testing

ii) Spraying against pests or crop diseases

iii) Agricultural consultancy and management services for cropping patterns

iv) Credit facilities

v) Seed and fertilizer supplies

vi) Post harvesting techniques, and

vii) Storage facilities.

The main custom centre is planned to be equipped with a soil test laboratory, which will test the soil for its members, free of charge and advise on its suitability for different crops and the type of fertilizer required.

The agronomist and the agricultural engineer in the centre will render advice free of charge to the farmers, covered under the scheme, on all aspects of farm management specifically the cropping pattern the selection of seeds and fertilizers, the farming techniques, water management, pest control, post harvesting techniques.

The management of the centre will work in close collaboration with other government and semi-government agencies for supply of credit, proper quality of seeds and fertilizers and transport facilities to the farmers.

The Impact of the Scheme

Given a fair chance for trial and due encouragement from the Government, this scheme is likely to have a positive impact on the economic condition of the community of the area selected for the purpose. The major advantages to be accrued with the success of this scheme are:

i) Higher export earnings from fresh and processed agricultural commodities. It will convert plentiful rural labour into scarce foreign exchange through export mechanism.

ii) Improvement of the lot of subsistence farmers by helping them to improve their productivity and income and thus raise the quality of life in the rural areas.

iii) Introducing modern farming techniques and management practices to small farmers through the contract service scheme.

iv) Demonstrating the potentiality of minor irrigation schemes for better crop output, and commercialisation of agriculture without impairing the overall national water resources.

v) Creation of additional discretionary income with the farmers giving rise to demand for more durable and non-durable consumer goods and thus acting as a catalytic agent for the establishment of new industries.

vi) Creation of an urge in other areas to repeat experiments on similar basis for popularising system of custom services, tapping of ground-water resources and establishing appropriate Agro-industries for processing the local agricultural produce.

Plan of Action

Considering the importance of this project to the national economy, its impact on the future pattern of Agricultural and Industrial sectors, magnitude of financial investment and multi-disciplinary nature of expertise required, the following actions are proposed for its successful implementation:

i) In this preliminary report, only broad estimates for requirement of land, capital, equipment, man-power and the type of services have been spelled out. It needs a study in depth of various inputs, including the microlocation of the Agro-Industrial Complex and its sub-centres, to achieve the desired results.

It is therefore desirable to depute some competent agency to make a detailed study of the project and submit its recommendations for government's approval. For this purpose it may be necessary to invite some foreign organisation, with sufficient background and experience in similar type of assignments in other developing countries.

ii) Circulate copies of this preliminary project report to heads of different governments, competent consulting organisation and International Aid Agencies. This will help to seek suitable financial and technical collaborators on most favourable terms, for implementation of the project.

iii) Collect basic data on local climatic, soil, agricultural production, man-power and infrastructural facilities available in the proposed area

Appendix I

## THE LIST OF AGRICULTURAL MACHINERY AND EQUIPMENT

| | Name of Equipment | Main Custom Service No. Reqd. | Sub-Centres No. reqd. |
|---|---|---|---|
| 1. | Light percussion rigs for drilling bore holes in soft and medium hard formation | 2 | - |
| 2. | Core drills (caly-x type) for drilling small holes in hard rocky formation | 2 | - |
| 3. | 30-35 HP tractor with belt pulley and accessories | 10 | 2 |
| 4. | 50 HP tractor with belt pulley and accessories | 4 | 1 |
| 5. | Power tiller with accessories and set of implements | 4 | 1 |
| 6. | 3-furrow mould board plough | 4 | 1 |
| 7. | 2-furrow Disc plough | 4 | 1 |
| 8. | Tiller - 3 tines | 5 | 1 |
| 9. | Seed cum fertilizer drills 9-row | 5 | 1 |
| 10. | Multi-purpose leveller | 2 | - |
| 11. | Disc harrow 5-6 ft width | 5 | 1 |
| 12. | Blade terracer | 4 | 1 |
| 13. | Trailer 3 ton nontipping steel body | 6 | 2 |
| 14. | Low volume tractor mounted sprayer | 2 | 1 |
| 15. | Power operated maize sheller | 2 | 1 |
| 16. | Power operated chaff cutter | 2 | 1 |

| | Name of Equipment | Main Custom Service No. reqd. | Sub-Centres No. reqd. |
|---|---|---|---|
| 17. | Knapsack sprayers | 10 | 2 |
| 18. | Small post harvesting agricultural equipment for demonstration purposes also including hand operated chaff cutter, maize sheller, wheat thresher, Peanut decorator, paddy thresher, farmers hand and bullock driven | Two sets | - |
| 19. | Crawler Tractor | 1 | - |
| 20. | Soil testing equipment | One set | - |
| | Approximate total price | K.Sh. 2398.0 mill. | K.Sh. 337.5 mill. |

Appendix II

## WORKSHOP EQUIPMENT

| | Name of Equipment | Main Custom Service No. reqd. | Sub-Centres No. reqd. |
|---|---|---|---|
| 1. | General purpose medium size lathe with accessories | 1 | - |
| 2. | General purpose precision small lathe with accessories | 1 | - |
| 3. | Crankshaft grinder | 1 | - |
| 4. | Pillar Drill 1" capacity | 1 | - |
| 5. | Bench Drill ½" " | 1 | 1 |
| 6. | Double ended Bench griders - motorised | 2 | 1 |
| 7. | Power Hacksaw | 1 | - |
| 8. | Shaper - medium sized | 1 | - |
| 9. | Gas welder | 1 | 1 |
| 10. | Electric Arc welder set | 1 | - |
| 11. | Portable electric drill ½" capacity | 2 | 1 |
| 12. | Smithy hearth with power operated blower | 1 | - |
| 13. | Pneumatic forging hammer - 100 kg | 1 | - |
| 14. | Handling equipment | | |
| | i) Hydraulic jack | 2 | 1 |
| | ii) Chain Hoist 2 ton capacity | 2 | - |
| 15. | Fuel pump repair | | |
| | i) Fuel pump test bench | 1 | - |
| | ii) Nozzle tester | 2 | - |
| 16. | Valve repair Kit | | |
| | i) Valve repair and grinding machine | 1 | - |
| | ii) Valve seat cutter | 2 | - |

| | Name of Equipment | Main Custom Services No. reqd. | Sub-Centres No. reqd. |
|---|---|---|---|
| 17. | Portable reboring machine | 2 | - |
| 18. | Connecting rod aligner | 1 | - |
| 19. | Connecting rod boring machine | 1 | - |
| 20. | Wheel alignment testing | 1 | - |
| 21. | Battery charges | 2 | 1 |
| 22. | Compressor | 2 | 1 |
| 23. | Servicing equipment including grease gun washing equipment | | 1 |
| 24. | Set of auto tools and gauges | 6 | 1 |
| 25. | Hand operated steelmetal shearing machine | 1 | |
| 26. | Set of measuring tools | 6 | |
| 27. | Work Benches | 4 | |
| 28. | Set of electrical tools including:<br>i) Ignition lining light with leads<br>ii) Condenser tester<br>iii) Armature growler<br>iv) Electric motor insulation testing equipment<br>v) Self-starter, dynamo test rig<br>vi) Universal test bench for tractor electric equipment | | |
| | Approximate total price | K.Sh. 390.0 mill. | K.Sh. 15.0 mill. |

Appendix III

## PERSONNEL REQUIRED (EXCLUDING VEGETABLE FACTORY)

| | | No. reqd. | No. reqd. |
|---|---|---|---|
| 1. | Manager Project | 1 | - |
| 2. | Agricultural Engineer | 1 | - |
| 3. | Agronomist | 1 | - |
| 4. | Tube well engineer | 1 | - |
| 5. | Workshop Engineer | 1 | - |
| 6. | Chemist soil test lab. | 1 | - |
| 7. | Assistant Agricultural Engineer | 1 | 6 |
| 8. | Assistant Agronomist | 1 | - |
| 9. | Tube well rig operator | 1 | - |
| 10. | Assistant workshop engineer | 1 | - |
| 11. | Assistant Chemist | 1 | - |
| 12. | Mechanics/machine operators | 12 | 6 |
| 13. | Tractor operators | 12 | 12 |
| | Total | K.Sh.1,272 mill. | K.Sh.648 mill. |

Appendix II

| | COST OF CIVIL WORK | Approx. cost KS x 000 |
|---|---|---|
| 1. | Building including vegetable dehydration factory and workshop and stores etc. with approximate 75,000 sq. ft. covered area. | 5000 |
| 2. | Six field offices, covered area approximate 2500 sq. ft. (125 x 6) | 750 |
| 3. | Site development ) | 500 |
| 4. | Road construction ) | |
| 5. | Supply of services - power and water | 500 |
| 6. | Residential accommodation for staff | 1200 |

Appendix VI

## Approximate Cost Estimates of Plant for Dehydration of Vegetables and Fruit Processing

| 1. Capital Cost | Farm K.Sh x 000 | Factory K.Sh x 000 |
|---|---|---|
| a. Land purchase and development | 2200 | - |
| b. Irrigation Equipment | 5850.0 | - |
| c. Housing | - | 800 |
| d. Factory Machinery and Equipment | - | 1600 |
| e. Vehicles | 1000 | 400 |
| Total | 9050 | 2800 |
| 2. Working Capital | 1200 | 6000 |
| Total Capital Requirement | 10250 | 8800 |

Appendix VII

Summary of the Total Cost and Other Requirements of the Agro-Industrial Complex

| A. Capital | K. Sh. million |
|---|---|
| 1. Land .. .. .. .. | 2.20 |
| 2. Civil works including factory building services and road construction etc. .. | 7.95 |
| 3. Farm Equipment for repair/custom services and own use .. .. .. | 3.14 |
| 4. Dehydration Factory | |
| Capital Cost .. .. .. | 9.650 |
| Working capital .. .. | 7.800 |
| Total Capital Required .. .. | 30.39 |
| 5. Salary and wages (annual) | |
| Repair/custom services .. .. | 1.920 |
| Factory .. .. | 2.500 |
| | 4.420 |

| B. Services Required | |
|---|---|
| 1. Electric Power .. .. | - 500 KW |
| 2. Water (can be reduced by recycling) | - 5-6000 gal/hr |
| 3. Steam .. .. .. | - 10,000 lbs/hr |

| C. Break-up of Cost of Dehydrated Vegetables | |
|---|---|
| 1. Raw materials .. | 35-40% |
| 2. Services (Power + fuel + water) .. | 10-12% |
| 3. Wages .. .. | 5- 7% |
| 4. Transport .. .. | 20-22% |
| 5. Cost of Capital .. .. | 19-22% |
| D. Employment .. .. | 400 |
| E. Approximate output .. .. | K.Sh.60-80 mill. |

## 3. MANUFACTURE OF FARM EQUIPMENT

### Introduction

In Kenya the agricultural sector contributes 60% of the G.D.P. and supports 90% of the workforce as compared to the industrial sector contributing 40% of G.D.P. and engaging 10% of labour force. Unlike developed countries, with serious shortage of farm labour due to attractive wages offered by industry, in Kenya there is gross unemployment and underemployment in the rural area except for the shortage of labour during peak harvesting seasons. As regards the farming energy in Africa, over 90% is derived from human effort, with the farm implement/ equipment mainly limited to jembes and pangas. The average energy used is 0.05 HP/ha as compared to 1.02 in U.S.A., 0.93 in Europe and 0.19 in Asia as against minimum 0.5 HP/ha required. The position in Kenya is only slightly better. This low level of energy used, limits the cultivation by an average family of 5 members to 2-5 hectares depending upon the soil conditions or an average of 0.5 ha per family member. As most of the subsistence level farmers can hardly afford to pay cash for hiring labour during peak seasons, nor any floating labour is generally available. The available farm labour is limited to family members only, who are idle during slack periods.

Because of these traditional farming methods used, the average farming income is of subsistence or below subsistance level. Of approx. 1,100,000 small farm holders, 620,000 have a total annual income of less than K.£ 60,225,000 between K.£ 60-110 and only 225,000 manage to earn more than K.£ 200 by expanded production of cash crops or dairy products.

The facts mentioned above highlight the co-existence of idle labour and dearth of labour, due to traditional farming techniques used, leading to the economic and social duality between the urban and rural sectors. This is mainly due to maldistribution of productive assets and investments between the two sectors and nonavailability of employment opportunities in non-farm sectors in the rural areas, and is a serious bottle neck in development of Kenyan agricultural economy. Keeping in view the Government's aim to not only be self-sufficient in food production, but also multiply its export of traditional and non-traditional agricultural products, to bridge the gap in its international trade balances, there is a dire need for suitably designing, development and production of farm implements to help improve the productive capacity of the subsistence farmer. The proposed project for manufacture of such farm implements or equipment is a step in this direction.

Kind of Farm Equipment Having Scope in Kenya

There are three distinct types of farm implements and equipment, which can be manufactured in Kenya, using different levels of technology. The design of an individual implement may vary slightly from region to region depending upon the soil conditions e.g. the design of an equipment suitable for rainfed area with loamy soil may be quite different from the one used in arid areas for a similar purpose.

a) Farm implements and equipment, which can be manufactured in small workshop with low investment at rural sub-centres or marketing centres e.g. simple hand tools, manually operated simple machines, selected animal drawn implements.

b) Farm equipment manufactured or fabricated on a batch basis, in a medium sized workshop equipped with basic fabrication and machining facilities e.g. most tractor drawn implements, irrigation equipment, spraying equipment etc.

c) Power driven equipment including tractors, diesel engines, powertiller requiring relatively higher levels of technology and manufacturing facilities for volume production to achieve economy of operation.

Considering the immediate and future requirement of farm equipment and implements in Kenya, it is proposed to manufacture items classified as (b) and few items classified as (a) and not presently manufactured by the existing manufacturers.

The manufacture of these items involves simpler technology and demands not too sophisticated fabrication and machine shop machinery. Some of the items that could be considered for manufacture are:

a) Pick axes, rakes, hand-hoes, wheel hoes, sickles, weeders, hand operated machinery for threshing, winnowing and rope making groundnut decorticators, chaff cutters, etc.

b) All types of tractor driven implements including mould-board ploughs, cultivators, disc-ploughs, levellers, bund formers, ridgers, harrow etc. More intricate types of ox-driven implements, mechanically driven wheat/paddy threshers and groundnut cultivators, reapers; Manually and mechanically operated spraying equipment, transport equipment including bullock carts and cycle trollies, seed-cum-fertilizer drills, planters etc.

c) Some fabricated steel items for domestic consumption in rural areas e.g. storage bins (domestic) simple steel furniture, steel boxes (Sanduku), steel baskets and buckets, hand pumps and water tanks etc.

It is quite evident that it will not be feasible at one time to undertake manufacture of all the items mentioned above. Implements and farm equipment of proved designs or the ones already accepted by the farmers and having immediate demand, should be given the highest priority. As most of such items have seasonal demands, the consumers items mentioned at (c) could be manufactured during slack periods.

The proposed workshop should also have the facilities for designing and development, to help modify the existing implements and equipment used, adaptation of imported items, and also design new items specifically to suit the local environments.

Demand

In the absence of adequate data for the present population and past consumption of such items it is rather difficult to exactly assess the present and future demand for each type of implement and equipment. A broad idea of the demand over and above the local production, could be had from the total import of agricultural equipment imported under different categories as given in Appendix I. The total import for the year has been for K.Sh 32 millions, with over 30% average rate of growth during the past four years (1972-75). Assuming 20% as the share of agricultural implement and equipment other than tractors and combines, its total import in the year 1975 is estimated to be K.Sh 6 millions. Considering 10% as a modest rate of growth in consumption for farm implements and equipment, the estimated demand in 1980 is for K.Sh 9.5 mill. It is therefore planned to manufacture farm equipment worth approx. K.Sh 4.5 mill. in 1980 which will meet 50% of this demand, leaving the rest either to be imported or be taken up by the existing manufacturers. To this may be added the value of other steel consumer items as mentioned under (c) to have a total output of K.Sh.5.0m. The main emphasis will however be on production of items required for cultivation, harvesting, sowing, spraying, drying, storage and transport of agricultural products. There is also a potential for manufacture of simple machinery for sugar cane cultivation, seed preparation and special equipment for semi-arid or arid areas, which could be undertaken in future in collaboration with some foreign institutions or private parties.

## Present Manufacture

Presently some farm implements and equipment including harrows, ploughs and few other items, are manufactured by the following parties in Kenya:-

1. Davis J.S. and Co. Ltd., Nairobi
2. Cassim & Tonolo Ltd., Nairobi
3. Ideal Cssements (E.A.) Ltd., Nairobi
4. Leading Engineering Works Ltd., Nairobi
5. Ndume Ltd., Gilgil
6. P.W. Andrews and Co. Ltd., Nairobi.

Besides being concentrated in Nairobi, most of the units, manufacture agricultural items as a side business only using initiative or innovated methods and few of them are having designing facilities of their own or use the proper raw materials for their manufacture. The proposed unit is not only meant to supplement the production achieved by the existing units but undertake manufacture of suitably designed farm equipment, not presently manufactured locally. Most of the developed countries have almost stopped to manufacture the quality of implements required by the local farmers and are vacating this area of manufacture for the developing countries. The technology for manufacture should therefore be easily available both for the benefit of the existing manufacturers and the proposed new unit.

## The Machinery Required

As mentioned earlier, it is proposed to instal low-capital intensive machinery for this manufacturing programme, laying more emphasis on developing of local skills. The items proposed to be manufactured are of diverse design and specifications, but requiring basically fabrication and machinery facilities on batch production basis. The major productive sections will be:

- Press shop
- machine shop
- small forge shop
- fabrication and welding shop
- assembly and paint shop

The ferrous and non-ferrous castings are expected to be bought from other units along with some finished items and consumable raw materials. Adequate provision has also to be made for manufacture of jigs and fixtures and toolings required. The major list of machinery required is placed at Annexture II.

Land & Building

Land

The proposed unit needs fairly large size of plot of land for field trial of implements locally designed and manufactured, besides the land required for factory premises. It is therefore proposed to acquire atleast 10 acres of land in an area away from Nairobi and Mombasa, with maximum concentration of subsistence farm holdings.

Building

The building complex has to have a plant layout to facilitate smooth flow of raw material with the least cost of material handling and labour. The building will be planned to accommodate the following buildings:

- Raw material store
- Press Shop - Forge shop
- Fabrication and welding shop
- Machine shop
- Assembly and Paint Shop
- Finished items stores
- Administration block

The total covered area of the buildings is estimated to be 15-20,000 sq. ft.

Services

It is rather difficult at this stage to precisely assess the exact requirement of power, water and other services, which mainly depends upon the product-mix and the annual capacity of each items. A provision should however be made for 250-300 k.w. power supply and water for paint shop and cooling purposes

## Organisation and Management

The organisation will be under the overall control of a senior executive with sufficient experience in similar type of industry preferably in a developing country. The general pattern of the man-power will be:

| | |
|---|---|
| Senior Executive .. .. | 1 |
| Junior executive including sale/purchase, factory manager, Accountant .. | 3 |
| Technical supervisors .. | 5 |
| Skilled workers .. .. | 21 |
| Semi-skilled workers .. .. | 50 |
| Unskilled workers .. .. | 17 |
| Non-professional staff .. | 13 |
| Design/dev. Engineer .. .. | 1 |
| Assistant dev. Engineer/Draughtsman | 1 |
| Inspectors .. .. | 2 |
| TOTAL .. .. | 114 |

## Raw Materials

The raw materials required are generally steel bars and sections, hot or cold rolled sheets, cast iron castings, non-ferrous castings and components, rolled steel flats, and some high carbon alloys steel sectors to manufacture components demanding high degree of wear resistance and strength to withstand the severe service requirements. Whereas most of the mild steel bars and sections, ferrous and non-ferrous castings will be locally available, the high carbon and alloy steel sections required may have to be imported.

Besides the raw materials required for production items, an appreciable quantities of consummable raw materials like lubricants, cutting tools, welding rods, welding gases, measuring and hand tools will also be required. As the demand for finished items is likely to vary from time to time, no attempt has been made at this stage to calculate the exact requirement of raw material for each item and its sale value.

It is estimated that the total cost of the raw materials may vary from 55-60% of cost of production in the initial stage to 65-70% in the final stage, when the plant attains its full capacity.

Appendix I

## IMPORT OF AGRICULTURAL EQUIPMENT AND MACHINERY (TRADE JOURNALS)

| Code No. | Name | 1972 | | 1973 | | 1974 | | 1975 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Quantity Tons | Value K.Sh. Mill. | Quantity Tons | Value K.Sh. Mill. | Quantity Tons | Value K.Sh. Mill. | Quantity Tons | Value K.Sh Mill. |
| 712-100 | Agricultural machinery appliance for preparing the soil | 587.2 | 7.622 | 578.2 | 7.306 | 837.9 | 9.528 | 787.9 | 18.44 |
| 712-200 | Agricultural machinery appliance for harvesting and threshing | 307.7 | 3.614 | 371.5 | 3.170 | 393.3 | 8.593 | 589.2 | 13.8 |
| 712-900/999 | Agricultural machinery and appliances NES | 71.8 | 1.405 | 4.5 | 0.037 | 24.1 | 0.264 | 23.0 | 0.69 |
| 695-109 | Other handtools mainly used for Agriculture and forestry | - | 2.615 | - | 1.53 | - | 1.899 | 427.6 | 2.43 |
| | TOTAL | 966.7 | 15.256 | 954.2 | 17.043 | 1255.3 | 20.284 | 1827.7 | 35.36 |

Appendix II

## LIST OF MACHINERY AND EQUIPMENT

A. Press and Forge Shop

1. Power press - 150 tons
2. Power press - 40 tons
3. Shearing machine - 3.15 x 3000 mm
4. Fly press
5. Hand shear
6. Tube bending rig
7. Sheet rolling machine
8. Spot welder
9. 50 kg Forging hammer complete with heating furnace and other accessories
10. Dies and tools

B. Machine Shop

1. Centre Lathe 8 ft - one
2. Centre Lathe 6 ft - two
3. Shaper 24"
4. Pillar drill 40 mm - one
5. Pillar drill 25 mm - two
6. Bench drill 12 mm - two
7. Power hacksaw 200 mm - two
8. Universal grinder - one
9. Horizontal milling machine - one
10. Heat treatment equipment (set of electric furnace) - one set
11. Measuring and inspection equipment - one set
12. Jigs and fixtures - as required

C. Fabrication Shop

1. Electric arc welding set with transformer - two
2. Gas welding set with accessories - two
3. Hearth furnace with anvil - one
4. Flexible shaft grinders - as required
5. Set of Pneumatic tools - one set
6. Heavy duty pedestrial grinder - two
7. Material handling equipment - as required
8. Welding fixtures - as required
9. Compressor unit - one to feed the entire shop
10. Hand tools - as required
11. Hydraulic jack - one
12. Spot welder - one

D. Assembly and Plaint Shop

1. Paint spraying and drving equipment
2. Paint Booth
3. Assembly trollies - as required
4. Assembly fixtures - as required
5. Material handling equipment including a small jig crane and overhead pulley track.

## Appendix III

### Estimated Project Capital Cost

A. Fixed Assets

| | | |
|---|---|---|
| Land 10 acres | K.Sh | 1,000,000 |
| Building 10,000 sq. ft covered area | | 1,000,000 |
| Machinery & equipment | | 1,350,000 |
| Miscellaneous Capital cost | | 550,000 |
| Total Capital cost | K.Sh | 3,000,000 |
| Working capital required | | 1,000,000 |
| Total Capital | | 4,000,000 |

B. Labour -

Total number 107

Annual labour wages K. Sh 0.900 mill

C. Estimated annual turnover K.Sh 4.5 mill

## D. SURVEY OF AGRICULTURAL IMPLEMENTS

A need was felt to collect information regarding the type and number of farm equipment and implements, presently used in different parts of the country, which considerably varies due to wide variation of topography of the land, soil conditions, pattern of land distribution and farming methods used. Similar information was required regarding the modes of transport used by the farmer for haulage of his agricultural produce and to meet his other day to day transport needs, and also the existing repair and maintenance facilities available.

This basic statistical data was considered essential for forecasting the type and number of equipment needed by the farmer in future and make necessary provision for manufacture of the same as close to the point of consumption as possible in rural or marketing centres instead of concentrating it at few manufacturing centres in the urban area. This would help the farmers to modernise his farming methods to some extent, and increase his productive capacity appreciably.

Accordingly a questionnaire was framed in co-operation with Mr. Muthea of I.S.P.C. and Ministry of Agriculture for collection of this information, as widely as possible. A copy of the questionnaire is placed at annexure I.

Appendix I

## INDUSTRIAL SURVEY & PROMOTION CENTRE

## MINISTRY OF COMMERCE & INDUSTRY

## SURVEY OF AGRICULTURAL IMPLEMENTS

1. **Name**_____

   **Location**_____

   **Division**_____

   **District**_____

Put a tick where it is applicable

2. **Size** of holding_____ acres.

3. **Type** of Land ☐ Level ☐ S ight slope ☐ Steep slope

4. (i)

| Quality of roads: | Tarmac | Murram | Earthroad | Footpath |
|---|---|---|---|---|
| 1) Farm to home | | | | |
| 2) Farm to: | | | | |
| a) Shops | | | | |
| b) Cooperative store | | | | |
| c) Market centre | | | | |

(ii)

| Distance from farm to: | < 1 mile | 2-5 | 6-10 | >10 miles |
|---|---|---|---|---|
| a) Shops | | | | |
| b) Cooperative store | | | | |
| c) Market centre | | | | |

5. **Membership** of cooperative societies:

☐ Coffee
☐ Dairy
☐ Pyrethrum
☐ Cotton
☐ Sugarcane
☐ Pigs
☐ Maize/cereals

Others

☐ _____
☐ _____

## 6. Agricultural Production

i)

| Crops | Area under crops/acres | Amount harvested bags/kg | Amount sold bags/kg |
|---|---|---|---|
| Coffee | | | |
| Tea | | | |
| Pyrethrum | | | |
| Cotton | | | |
| Maize | | | |
| Beans | | | |
| Potatoes | | | |
| Groundnuts | | | |
| Sugarcane | | | |
| Wheat | | | |
| | | | |
| | | | |

ii)

| Animals | | Numbers owned | Approximate local market price per animal Shs. |
|---|---|---|---|
| 1) Grade cattle | Cows | | |
| | Bulls | | |
| 2) Local cattle | Cows | | |
| | Bulls | | |
| 3) Pigs | | | |
| 4) Donkeys | | | |

## 7. Agricultural inputs

| Item | Fertilizer 50 kg bags | Hybrid maize seeds 10 kg bags | Animal feeds bags | Farmyard manure (purchased) tons |
|---|---|---|---|---|
| Amount used per year | | | | |

8. Farm Equipment

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| | Nos. owned | Place of purchase | Year of p/chse | Cost when new | Distance to repair (Km) |
| Animal drawn carts | | | | | |
| Hand drawn carts | | | | | |
| Ploughs | | | | | |
| Harrows | | | | | |
| Wheelbarrows | | | | | |
| Milk separators | | | | | |
| Spray pumps | | | | | |
| Sprinklers | | | | | |
| Tractors | | | | | |
| Water pumps | | | | | |
| Pangas | | | | | |
| Jembes | | | | | |
| Axes | | | | | |
| Sickles | | | | | |
| Fork jembes | | | | | |
| Buckets | | | | | |
| Shovels | | | | | |

Other transport equipment

| | | | | | |
|---|---|---|---|---|---|
| Car | | | | | |
| Lorry | | | | | |
| Van | | | | | |
| Trailer | | | | | |
| Motorcycle | | | | | |
| Bicycle | | | | | |

Transport requirements (Existing facilities)

9. Maximum loads to be hauled:

1) Farm to shops _____ kg.

2) Farm to cooperative store _____ kg.

3) Farm to market centre _____ kg.

10. Present system of transport

| Type of commodity | Weight | Carried by: | | | | |
|---|---|---|---|---|---|---|
| | | Head or back | Bulls or donkeys | Carts | Bicycles | Power driven means |
| Agricultural inputs:- | | | | | | |
| Fertilizer | | | | | | |
| Seeds | | | | | | |
| Implements | | | | | | |
| Animal feeds | | | | | | |
| Fodder from farm to home | | | | | | |
| Agricultural produce from farm to home | | | | | | |
| Water for home consumption (galls) | | | | | | |
| Travelling for social functions | | | | | | |

12. Transport requirement (Preferred)

| | Pair of animals | Animal drawn modern trolley | Cycle 3-wheel | Power driven trolley | Tractor driven trolley |
|---|---|---|---|---|---|
| Given the financial facilities what would you prefer to have? | | | | | |
| How much money would you need for the item? | | | | | |
| Approximate load carrying capacity tons | | | | | |

13. Preferred distance for repair and maintenance

Agricultural implements _____ km
Harventing equipment _____ km
Animal drawn equipment _____ km
Power driven equipment _____ km

14. Can you suggest ways of improving your transport system.

_____
_____
_____
_____
_____
_____
_____

## STORAGE FACILITIES

15. Where do you store your produce? ☐ In the house
☐ In a store

16. If you store your produce in the House describe how it is stored. ☐ In bags on the floor
☐ Without bags on the floor
☐ In bags on wooden racks.
.....(other)

17. If you use a special store outside the main building, describe the type of store.
☐ round, twig walls, grass thatched
☐ mud walls, grass thached
☐ mud walls, corrugated iron roof
☐ timber walls corrugated iron roof
.....

18. What type of floor has your house? ☐ cemented
☐ earth ☐ timber

19. What is the dimension of the store?
Length ☐ ft.
Width ☐ ft.
Height ☐ ft.

20.a) What is the capacity of the store?
..... bags of .....
..... bags of .....
..... bags of .....

b) Is the store enough for your produce? ☐ yes ☐ no

21. How do you store your maize? ☐ shelled ☐ not shelled

22. Do you treat your produce with chemicals? ☐ yes ☐ no.

23. What are the major problems in storage? ☐ rats
☐ weevils
☐ water
☐ rotting

24. How many bags do you lose in a year?

- ▱ bags/maize
- ▱ bags/beans
- ▱ bags/potatoes
- ▱ bags/.....

25. What was the cost of your store? ..... Sh. in the year ....

26. Are you prepared to put up a new store? ▱ yes ▱ no

27. How much are you prepared to pay for a new store? ..... Shs.

## V. CONCLUSION

A modest effort has been made in the preceding pages to put forth new ideas for few projects, having an important bearing in shaping the future pattern of industry in Kenya, and accelerating its growth. The identification of such projects, its planning and execution is a continuous process, in which the volume of work and the number of personnel required multiplies as it progresses from its conception stage to the stage of its realization in shape of a project on the ground. This process needs vigilant follow-up action for projects in hand and constantly adding new project ideas to the pool. The Industrial Survey and Promotion Centre (I.S.P.C.), which is entrusted with this responsibility therefore needs to be adequately manned with competent persons to deliver results.

A number of such project ideas, if available, helps a donor country to pick and choose the most appropriate field for offering aid in the form of technical and financial assistance. It also helps a potential entrepreneur desirous of investment in an industrial venture to select a project to suit his resources and managerial capability. Maintaining of stock of project profiles on industries having scope in Kenya by I.S.P.C. will greatly help to mop up surplus funds locally available or utilize financial and technical assistance offered by various donor countries.

The existing pattern of industries mainly limited to service industries, low degree of processing of local raw materials and assembly units is a structure without a sound foundation. The establishment of core sector industries like Mini-integrated Steel Plant, Grey Iron Foundry, Steel Forging, Machine Tool and Tool Room coupled with essential infrastructure in the form of Industrial Research Testing and Training facilities will act as the pillars for building the National Industrial pyramid. It is strongly recommended that the Government consider harnessing all local and foreign resources to ensure its implementation as early as possible.

A chain of Agro-industrial complexes and manufacture of farm equipment and pumping sets etc. as suggested in the reports, are equally important for helping the productive capacity of land/farmer and generate a potential agro industries both for domestic market and exports.

Another aspect which is closely linked with execution of industrial projects, is the motivation of local entrepreneurship. For this purpose area surveys, for their industrial potential should be carried out by teams of experts. The local people should then be well acquainted with the projects so identified and having potential for development the preliminary formalities to be followed for setting up industries and about the sources for technical know-how and equipment etc. by organising group meetings. It is also suggested to organise regular short term courses for generating entrepreneurial talent amongst the educated and qualified persons in the country.

ANNEX X

## LIST OF CONSULTANTS & COLLABORATORS

I Summary of the offers received

(a) Total number of the consultant/collaborator responded as on 30.6.76 - 190

(b) Total number of countries when the offers have been received - 16

II Key to the discipline/fields of specialization of Consultants/Collaborators.

1. Project Engineering General Management & Technical Consultancy (PRO-ENG).

2. Agro Industries - Food, Vegetable oils, Textile, paper, Sugar etc. (AGRO)

3. Chemical Engineering - Petroleum Products, rubber, plastic, chemicals (CHEM)

4. Iron and Steel Industry (STEEL)

5. Machine Tools and Hand Tools (M/c)

6. Light Engineering and Consumer Items - Auto Parts (LI-ENG)

7. Foundry Forge Technology (FOU-FOR)

8. Transport Equipment - Tractors, Scooters, earch moving machines and conveyors etc. (TRAN-ENG)

9. Non-metallic Items - Refractory, Ceramics, glass etc. (REF-CER)

10. Civil Engineering - Building Construction - Dams, Roads and Water Management (CIV-ENG)

## LIST OF CONSULTANTS/COLLABORATORS

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Abetex | 2, Rue de L'oratorio 75001 Paris | France | x | x | | x | | | | | | x | Food and Steel Industry |
| 2. Advani-Oerlikon Ltd. | Shiva Sagar Estate Block D, Dr. Annie Basant Rd, Worli, Bombay 400018 | India | | | | | | x | | | | | Welding electrodes and welding machines |
| 3. Agri Consult | Agri-Consult-AB Box 17019, S-200 10 Malmoe-17 Sweden | Sweden | | x | | | | | | | | | Grain milling, grain handling, seed processing |
| 4. Akal Enterprises | 88, Exchange Road Katra Sher Singh, Amritsar-143001, Punjab | India | | | | | x | x | | | | | Drilling machines, fasteners for Auto Industry |
| 5. Allied Capital | 27, Industrial Area Chandigarh | India | | x | | | | | | | | | Supply of card/paper board plants |
| 6. Sir Alexander Gibb & Partners | P.O. Box 30020, Nairobi, Shell Hse. | Kenya | x | | | | | | | | | | |
| 7. Alfred Schwalbach | Hamburg Altona Virchowstrasse 8-14 | Germany | | | | | | | | | | | High frequency Plastic welding machine for Auto Industry. |
| 8. Amin Chand Payare Lal Limited | Apeejay House 15 Part St. Calcutta 700016 | India | | | | | | | | | | | Fastners |

1 = GEN-PRO 2 = AGRO 3 = CHEM 4 = STEEL 5 = M/C 6 = LI-ENG 7 = FOU-FOR 8 = TRAN-ENG 9 = REF-CER 10 = CIV ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Ane Overseas Impex | Room No. 490<br>4th Floor, P-36<br>India Exchange Place<br>Calcutta, 70001 | India | | | x | | | | | | | | Exporter of Plant Machinery |
| 10. Atlast Engineering Industries | Grand Truck Road,<br>Post Box No. 7,<br>Batala Punjab | India | | | | | x | | | | | | Machine Tools only |
| 11. Atox Private Ltd | Narang House,<br>2nd Floor,<br>41, Ambalal Doshi,<br>House, Fort<br>BOMBAY 400023 | India | | | | | | | | | | | Metal Finishing Plants |
| 12. Alfred Herbert [illegible] | P.O. Box 30,<br>Edgewick Works<br>Coventry CV6-5QT | U.K. | | | | | x | | | | | | |
| 13. Ameteep Machine Tools Private Ltd. | 5th Floor Suryakiran<br>Kasturba Gandhi Marg,<br>New Delhi-110001 | India | x | | | | | | | | | | Mechanical power presses and shears |
| 14. ATC Group of Companies | B-1 First Floor<br>Unity Building,<br>Bangalore-560002 | India | x | | | | | | | | | | |

1 = GEN-PRO 2 = AGRO 3 = CHEM 4 = STEEL 5 = M/C 6 = LI-ENG 7 = FOU-FOR 8 = TRAN-ENG 9 = REP-CER
10 = CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15. AESL Associated Eng. Services | 10835-120th Street Edmonton, Alberta | Canada | | | x | | | | | | | | Oil and gas |
| 16. Arrow Projects Ltd | Greaves Place London SW17 one England | U.K. | x | | | | | | | | | | |

1 = GEN-PRO 2 = AGRO 3 = CHEM 4 = STEEL 5 = M/C 6 = LI-ENG 7 = FOU-FOR 8 = TRAN-ENG 9 = REP-CER 10 = CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. B.K.S. Jain | 7, Neeltrang, 208 Savarkar Marg. Bombay 400016 | India | | x | | | | | | | | | Management consultant Agro-Industries |
| 2. Bajaj Exports Pvt. Limited | Post Box 825 | India | | x | | | | | | | | | Cotton gining machines |
| 3. Bawa Iron & Steel Works Ltd. | Bawa Steel House Annexe G-1/5, Model Town, Delhi-110009 | India | | | | x | | | | | | | Small rerolling mills |
| 4. Beco Engineering Co. | 23/7 Delhi, Mathura Road, Ballabgarh, Haryana | India | | | | | x | | | | | | Machine Tools only |
| 5. Bhagat Motors Co. Pvt. Ltd. | 50-Okhla Industrial Estate, New Delhi 110020 | India | | | | | | x | | | | | Auto-Radiators |
| 6. Bombay Machinery Co | 9-Taj Building | India | | | | | x | | | | | | Low-priced lathe machines |
| 7. Bonali S.N.C. | 20029 Turbigo (MI) Via Molinara 32/34 | Italy | | | | | x | | | | | | Metal cutting Hacksaws |
| 8. Bracep | Empresa Brasileira, De Consultoria Eng., E Projects S.A. Rio-de-Janeiro | Brazil | | | | x | | | | | | | Mini-steel plants & heavy steel equipment |

1 - GEN-PRO 2 - AGRO 3 - CHEM 4 - STEEL 5 - M/C 6 - LI-ENG 7 - FOU-FOR 8 - TRAN-ENG 9 - REP-CER 10 - CIV-ENG

| Name | Address | Country | .1. | .2. | .3. | .4. | .5. | .6. | .7. | .8. | .9. | .10. | Specialized Fields |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Birla Consultants Pvt Ltd. | Textile Division P.O. Birla Line, DELHI | India | | | x | | | | | | | | Textile mills only |

1 = GEN-PRO 2 = AGRO 3 = CHEM 4 = STEEL 5 = M/C 6 = LI-ENG 7 = POU-POR 8 = TRAN-ENG 9 = REP-CER
10 = CIV-ENG

| Name | Address | Country | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | .10. | Specialised fields |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. C. Basil Griffiths | 14 James Road, Kidderminster KY-10-2TR | U.K. | | | | | | | 7 | | | | Centrifugally cast alloy c.i. castings |
| 2. Camaco Machinen GMBH & Co. | Lindenthal 41, Haydnstrasse-15 | W.Germany | | | | | x | | | | | | Reconditioned machines for plywood & saw mills |
| 3. Carrel Jurime | B.P. 3006, 15 Rue Edouard Aynard, 69 605 Villeurbannc Cedex, France. | France | | x | | | | | | | | | Cardboard machinery |
| 4. The Cast Iron Foundry | 21-22 Udyognagar, Surrendra Nagar 363001 | India | | | | | | | x | | | | Machine tools (small) |
| 5. Chemical & Metallurgical Design Co. | Vishal Bhavan, 8th Floor, 95 Nehru Place, New Delhi-110024 (New address) | India | x | | | | | | | | | | Chemical and Metallurgical |
| 6. Cincinnati Milacron | C/o P.O. Box 3929 | S.Africa | | | | | x | | | | | | |
| 7. Cocksedge & Co. | P.O. Box 41, Grey Friar Road, Ipswich IPI-IUW, U.K | U.K. | | | | | x | | | | | | Multispindle drilling machines |
| 8. Chiyoda | 1580 Tsurmi-cho Tsurmi Yokohama-230 | Japan | | | x | | | | | | | | Chemical Engineers |

1 = GEN-PRO 2 = AGRO 3 = CHEM 4 = STEEL 5 = M/C 6 = LI-ENG 7 = FOU-FOR 8 = TRAN-ENG 9 = REP-CER
10 = CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Fields |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Colt International Ltd. | East Molesey Surrey KT8-OSF, U.K | U.K. | | | | | | | | | | x | Heating, ventillation blowers. |
| 10. Consorzio Export | Corso Sempione-119 20025 Legnano, Italy. | Italy | | | | | x | | | | | | Consortium of consulting firms |
| 11. Corali | 24060 Carobbio, D Angeli (B.G.) Via Varlanta dl Clcola 6 | Italy | | | | | x | | | | | | Manufacturers of machines for automatic manufacture of crates & packages |
| 12. Cormet OY | 02920 Espoo-92, Finland | Finland | x | | | | | | | | | | |
| 13. Council of Scientific & Industrial Research | Rafi Marg. New Delhi-110001 | India | | | | | | | | | | | Govt. of India undertaking for transfer of technology |
| 14. Canadian Intn. Dev. Agency | 122 Bank St. Ottawa Canada KIA-064 | Canada | | | | | | | | | | | Financing Canadian firms joint ventures in Kenya |
| 15. Corcoran & Tyrrell Ltd., | Hughes Building, Kenyatta Avenue, P.O. Box 44365, Nairobi | Kenya | | | | | | | | | | | Market research |
| 16. Commercial Consultants | Pissano Stratt-392 4510 Eindhoven Holland | Holand | x | | | x | | | | | | | Consortium for civil Engineering & Industrial Engineering |
| 17. Confab Industrial S.A. | Avinida Prosperidate Caixa Postal 21 095000-Sao Caetano | Brazil | | | | x | | | | | | | Welded Steel pipes |

1= GEN-PRO 2= AGRO 3= CHEM 4= STEEL 5= M/C 6= LI-ENG 7= FOU -FOR 8= TRAN-ENG 9= REP-CER 10= CIV-ENG

| Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialized Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Dalal Consultant | R.L. Dalal & Co. 44, Maulana Abdul Gaffar Rd., Worli St., Bombay 400018 | India | x | | x | | | | | | | | Chemical Engineering Consultants |
| 2. Dankekar Bros. | Shivaji Nagar Sangli Maharashtra, India | India | | x | | | | | | | | | Rice mills, drying plants oil mills, flour mills, seed handling etc. |
| 3. Dastur M.N. & Co. | M.N. Dastur & Co. (P) Ltd., Faraday House, P.17 Mission Row, Extension, Calcutta 13. | India | x | | | x | | | | | | | Well reputed for iron and steel consultancy |
| 4. Dean O. Boettcher & Co. | RP 2 Box 167 Camby, Indiana U.S.A. | U.S.A. | | x | | | | | | | | | Alcohol Plants |
| 5. Deepak & Co. | Plot No. B-20 Road No. 16, Wagle Industrial Est. Thana 400 604 | India | | | x | | | | | | | | Refining of used oils |
| 6. Develop. Intn. (P) Ltd. | C-36 Greater Kailash-1 New Delhi-110048 | India | | | | | | x | | | | | C.P. Sanitary fittings & enamelled wares |
| 7. Davidayal Cables | Gupta Mills Estate Reay Rd., Bombay 10 | India | | | | | | x | | | | | Electric cables |
| 8. Dinesh & Co. | 3755 Churiwalan, Delhi-110006 | India | | | | | | | | | | | Intermediators for tech. know-how |

1= GEN-PRO 2= AGRO 3= CHEM 4= STEEL 5= M/C 6=LI-ENG 7= FOU-FOR 8= TRAN-ENG 9= REF-CER 10= CIV-ENG

| Name | Address | Country | .1. | .2. | .3. | .4. | .5. | .6. | .7. | .8. | .9. | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Development Consultants Ltd. | 24-B Park Street Calcutta 700016 | India | x | | | | | | | | | | Power-Steel |

1= GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FOU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | .1. | .2. | .3. | .4. | .5. | .6. | .7. | .8. | .9. | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. E.H. Worlee & Co. | 2-Hamburg-60 Belevue 7-8, Postfach - 602960 | W.Germany | | x | | | | | | | | | Dehydrated foods |
| 2. Eastern Switchgear & Electrical Co. Ltd. | 50 Mirza Ghalib St. Calcutta - 700046 | India | | | | | | x | | | | | Elect. Transformers up to 66 KVA |
| 3. Engineers India Limited | 4-Parliament Street New Delhi - 110001 | India | | | x | | | | | | | | Reputed chemical Eng. Consultants. Govt. of India undertaking |
| 4. Engineering Services Corp. | 2-R.C.V. Naidu St. Kilpauk, Madras | India | | x | | | | | | | | | Grain handling & rice milling |
| 5. Equil-Engenharia Quinica E Industrial Ltda | Rua Do Russel 300-4 Andar Rio de Janeiro - G.B. | Brazil | | x | | | | | | | | | Paper technology |
| | | | | | x | | | | | | | | Chemical plants for rubber, plastic and paper |
| 6. Escon-Consultants Pvt. Ltd. | B-21 Panch Shila Park New Delhi - 110017 | India | | | | | | | | | | | |
| 7. Escorts Limited | 11, Scindia House Connaught Circus, P.O. Box 187, New Delhi | India | | x | | | | | | | | | Tractors, scooters, Shockabsorbers |
| 8. E.T.A. Engenheiros Teonicos | Associados Ltda Caixa Postal 5919 Sao Paulo | Brazil | x | | | | | | | | x | | |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FOU-FOR 8=TRAN-ENG 9=REF-CER 10=CIV-ENG

| Name | address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Eurotechno S.R.L. | Via Vituvio - 47<br>20124, Milano. | Italy | | x | | | | | | | | | Simplified Agri. machinery, Tractors and animal pulled carts |
| 10. Engineering Consulting firm Association | P.O. Box 50<br>Kasumigaseki Building<br>2-5 Kasunigaseki 3-Chome<br>Chiyoda-ku<br>Tokyo-100 | Japan | | | | | | | | | | x | |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Financial and Industrial Consultants | 98 Jawaharabad, Almeida Rd., Bandra, Bombay 400050 | India | x | | | | | | | | | | Techno-economic feasibility Studies |
| 2. Finnconsult OY | Consulting Engineers | Finland | x | | | | | | | | | | General Engineering Consultant |
| 3. Forging Develop- | 20 St. John Street Bromsgrove-Worecestershire B61 - 8 & Y U.K. | U.K. | | | | | | | x | | | | Forging Technology |
| 4. Foundry Equipment International Ltd. | Leighton Buzzard Bedfordshire, LU7-7LL | U.K. | | | | | | | x | | | | Foundry Technology |
| 5. Foundry Management & Design Co. Ltd | 38, Albert Road North Reigate - Surrey, U.K. RH2-9EQ | U.K. | | | | | | | x | | | | Foundry Consultant |
| 6. Friedrich Kolb Kg. | Stuttgart - Zuffenhausen Postfach-400447 | West Germany | | | | | | x | | | | | Repair plants with training facilities |
| 7. Friends Auto Industries | Post Box No. 5, Phillaur - 144410 (Dist. Jullundur) | India | | | | | | x | | | | | Valves and valve guiders for Auto industry |
| 8. Fiattrattori | Viale Torino-2, 10040 Stupinigi (Torino) | Italy | x | | | x | | x | | | | | Reputed consultant for all industries connected with Auto industry. |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. F.I.D. International | Suite 535 Florida National Bank Building Jacksonvilla Florida 32202 | U.S.A. | | x | | | | | | | | | Food Industries only including alcohol & beer |
| 10. FIDECO | Fishery Development Corp of Norway, Flosangeron 45, P.O. Box 2382 5012 Bergen | Norway | | x | | | | | | | | | Fishing & Fishery |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. GEBR Wehrhahn | D-287, Delmenhorst Postfach 209 | West Germany | | | | | | | | | | | Sawmill machinery |
| 2. Chelani Industries (Wires) Ltd. | 12th Floor, International House P.O. Box 45276, Nairobi | Kenya | | | | | | x | | | | | Chokes & starters |
| 3. The Good Earth Group | Sunderson Court, 16 Asaf-Ali Road, New Delhi 1 | India | | | | | | | | | | | Diesel Engines |
| 4. Graham Building Services Ltd., | P.O Box 27, Woodrow Way, Bristol Road, Gloucester GL2 - 6DY | U.K. | | | | | | | | | | | Suppliers of Construction materials |
| 5. Groz-Beckert | 133-134 Industrial Area Chandigarh, Punjab | India | | | | | | | | | | | Hand Tools |
| 6. Grupo Forsa | Caixas Postais 1,496 e 5470, Sao Paulo | Brazil | | | x | | | | | | | | Consortium of eight firms Also plastics. |
| 7. Guru Nanak | Guru Nanak, Mechanical Works Sultanwind Road, Amritsar (Punjab) | India | | | | | | | | | | | |
| 8. Gebruder Weiss KG | 6343 Frohnhausen, Dillkreis | West Germany | | | | | | | | | | | Boiler manufacturer |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Geschweisst | Schwalbach-Herfurth GMBH & Co., 2 Hamburg 50, Virchowstr 8-14 | West Germany | | | | | | | | | | | |

1=GEN-PRO 2=AGRO 3=CHEM 4=Steel 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Hq Consultants | Baitul Fazal, 2527, Agra Road, Jaipur-302003 | India | x | | | | | | | | | | Project Eng. & General Consultancy |
| 2. Harath Ltd. | 7, Union St., Bedford UK-40-25F | U.K. | x | | | | | | | | | | Small & Medium scale industries in Dev. countries |
| 3. Hartle Machinery International | Hallstreet Dudley West Midlands DY2-7DA | | | | | | x | | | | | | Metal cutting machines |
| 4. H.E. Plank | 6638-Dillingen (Saar) Trierer Strasse-99 | West Germany | | | | | x | | | | | | Wood working machines & Special Veneer & Plywood plants |
| 5. Herbert Machine Tools Ltd. | P.O. Box 30, Edgwick Works Coventry-CVG-5GT | U.K. | | | | | x | | | | | | Machine tools - High repute |
| 6. Hidroservices-Engenharia-de-Projectos Ltd. | Rua Afonso Celso 235 Sao Paulo. | Brazil | x | | | x | | | | | | | Consortium of Consultancy firms |
| 7. Hindustan Machine Tools International (HMT) | 26/1 Lavelle Road, Bangalore-560001 | India | | | | | x | | | | | | Machine tool consultant of international repute |
| 8. Hungarian Co-operative Foreign Trading Co. | 1370-Budapest 5, P.O. Box 334 | Hungary | x | | | | | x | | | | | Complete projects for small Ind. e.g. ceramic, metal stamping, Cement blocks & tiles etc. |
| 9. Humphrey & Glasgow Ltd., | 22, Garlisle Place London S.W.1P-1JA | U.K. | x | | | | | | | | | | Reputed Engineering consultants |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=RDP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10. Heat Engineering | Foster Wheeler Corp. Reading, England | U.K. | x | | | | | | | | | | Heat Engineering |
| 11. HVA-International N.V. | P.C. Box 10328, Amsterdam-C. | Holland | | x | | | | | | | | | Firm of international repute for agro Ind. Complex |
| 12. Howe (India) Pvt. | B-34 Greater Kailash-I New Delhi-110048 | India | x | | | | | | | | | | Harbours and Material handling |
| 13. H.A. Simons Ltd., | 1010 Beaver Hallhill Montreal | Canada | x | x | | | | | | | | | Sawmilling, Paper & paper pulp material handling |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. I.B.I. Private Ltd. | I.B.I. House, S-33 Andheri-Kurla Rd. Bombay - 400059 | India | | | | | | x | | | | | Hospital Equipment |
| 2. IMAC | International Marketing Corp., 1300 Market St., City of Wilington, Delaware 19801 | U.S.A. | x | | | | | | | | | | Mediator for getting Project Eng. Consultancy from W. Germany |
| 3. Inbucon | International Business Consultants, Agip House Haile Selassie Ave., P.O. Box 30638, Nairobi | Kenya | x | | | | | | | | | | |
| 4. Indian Institute of Petroleum | Project Division CSIR Complex, Fifth Rd., Library Road, Pusa New Delhi-110012 | India | | | x | | | | | | | | Refining of used oils |
| 5. Indian Technical Consultancy Services | 1. World Trade Centre 3rd Floor, 14/1-B Ezra St. Calcutta<br>2. Surya Kiran, 19 Kasturba Sandhu Marg. 4th Floor, Flat No. 404, New Delhi 1 | India | x | | | | | | | | | | Consortium of reputed |
| 6. Indian Turn-o-Mat | 22-23 R. Industrial Area Area B, Ludhiana 141003, Punjab | India | | | | | x | | | | | | Machine Tools Automats |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=ERN-ENG 9=RLP-CEM 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7. Indo Machine Tools | 141-Two Tanks, Bombay 4 | India | x | | | | | | | | | | |
| 8. Industrial Consultancy Bureau P. Co. | Cijli House, Raveline St., Bombay - 40001 | India | x | | | | | | | | | | |
| 9. Industrial Management Sers. | N.I.C. Investment Hse 6th Floor, Wing B, Independence Ave., Dar-es-Salaam | Tanzania | x | | | | | | | | | | |
| 10. Industrial Cryogenic & Chem. plant Ltd | 15, Ganesh Chandra Ave Post Box 342, Calcutta 1 | India | | | x | | | | | | | | Industrial gases |
| 11. Ingersoll Manu. | Rockford, Illicnois 61101, 707 Fulton Street | U.S.A. | x | | | | | | | | | | Extension field for medium technology field |
| 12. Industrial Dev. Corp., International Services Co. Ltd. | Jerusalem - 4038 4, Chopin Street | Israel | x | | | | | | | | | | ..Extension field for medium |
| 13. International Eng. Export Ltd. | 202/203 Western Hse Smallbrook Queensway, Birmingham B5 6402 | U.K. | | | | | | | | | | | Exporter of British Machine Tools |
| 14. Intermediate Technology Dev. Group | Parnel House 25-Welton Road, London-SW1 V-lgc | U.K | | | | | | | | | | | Intermediate Tech. for Metal Processing Industries |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15. Integral | D-4020 Mettmann/ Dusseldorf, Goethestrasse-23 | West Germany | | | | | | | | | | | |
| 16 Industrial Projectos Ltda | Belo Horizonta Rua Felipe dos Santos-9 | Brazil | | | | x | | | | | | | Iron & Steel industry |
| 17. Intech Consultancy Pvt Ltd. | 39/55 Erandavana Poona 411004 | India | x | | | | | x | | | | | Bacterial fertilizer Solar heating & small & med. Eng. Industries |
| 18. Italtrading s.r.l | Via Durmi 5 2 022 Milan | Italy | | | x | | | | | | | | Glass, furfural Insullating materials, asbestos |
| 19. International Consulting Eng. by Canadians | The Consulting Service Division Dept. of Industry, Trade & Commerce Canada 112 Kent Street, Ottawa Ontario K1A0H5 | Canada | | x | | | | | | | | | Natural resources incl. mining and forestry |
| 20. Italplanning s. | Via Vincenzo Monti 25-20123 Milano | Italy | | x | | | | | | | | | Planning & Construction of high tech. of projects |
| 21. International Eng. Inc. | 220 Montgomery St Sanfranciso, Calif. | U.S.A. | | x | | | | | | | | | |
| 22. Iwatani & Co. Ltd. | I Hommachi 4-Chome Higashi-ku-Osaka | Japan | | x | | | | | | | | | Consumer goods Ind. gases & Metal working Ind. |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRANS-ENG 9=REF-CER 10=CIV. ENG.

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. J.C.S. International | 166/52 B.T. Road, Ashokegharh, Calcutta 700035 | India | | | | | | | | | | | Mediator for supply of tech. know-how |
| 2. Jai Group of Industries | Yamuna Nagar 135001, Haryana | India | | | | | | x | | | | | Auto leaf springs |
| 3. Jain Scientific Equipments | Jain Temple Street, Ambala Cantt-133 001 | India | | | | | | x | | | | | School scientific equipment, geometry boxes etc. |
| 4. Japan External Trade Organisation (JETRO) | P.O. Box 20203, Nairobi | Kenya | x | | | | | | | | | | Liaison Institute for Japanese Manufacturers |
| 5. John Miles & Partners (Lon.) Ltd. | Western House, Croydon. Surrey, CR0 2NT | U.K. | | | | x | | | | | | | Mini-steel plants, Tin plate plant etc. |
| 6. Joint Trawlers Ltd., Sweden ab | Kullagatan 8-10 S-252 20 Helsingborg | Sweden | | | | | | | | x | | | Fish & Fish Processing vessels - fish marketing |
| 7. Jungner Instruments - AB | S-171-20 Solna 1, Stockholm | Sweden | | | | | | x | | | | | cutting tools |
| 8. Jaarkopoyry & Co. OY | P.O. Box 16 SF-00401, Helsinki 40 Finland | Finland | | x | | | | | | | | | Paper & paper pulp Forest based industries |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG.

| Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Karl Doelitzsch | 1. Karl Doelitzsch K.G.<br>2 Hamburg 1<br>Amsinckstrasse 4.<br>2. Amsinckstrasse-4<br>2000 Hamburg | West Germany | | | | | x | | | | | | Metal Processing & wood working machines |
| 2. Kay Kay Agro Industries | Kay Agro Industries<br>6-A, Industrial Estate<br>Sirhind Road,<br>Patiala-147001 | India | | x | | | | | | | | | Mini-Sugar Plants |
| 3. Kennedy Donkin | Agip House,<br>P.O. Box 44679,<br>Nairobi | Kenya | x | | | | | | | | | | Mechanical & electrical General Consultants |
| 4. Kirloskar Bros. Ltd. | Udyog Bhavan, Tilak Rd<br>Poona - 411002 | India | x | x | | | | | | | | | Pumping sets, Diesel Engines, motors |
| 5. KLN Engineering Products Pvt. Ltd. | F-56, Industrial Est.<br>Rajajinagar,<br>Bangalore | India | | | | | | x | | | | | Filters for auto; air-conditioning & compressed air etc. Refining of used oil |
| 6. Kumar Piston | Kumar Eng. Corp.,<br>Akal Enterprises<br>Amritsar, Punjab | India | | | | | | | | | | | Auto-Piston & Piston rings |
| 7. Klaus Schlitt GMBH & Co. | D-6 Frankfurt/Main<br>Bergen/Encheim<br>P.O. Box 44 | West Germany | | | | | x | | | | | | Facilities for specialised training for workshop & laboratory systems |
| 8. D. Kumar Consulting (P) Ltd. | 72, Ring Rd , Lajpat Nagar III, N.Delhi 110024 | India | | x | x | | | | | | | | Food, liquors, pharmaceutical etc. |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7FAU-FOR 8=TRA- ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Lahmeyer International GMBH | D-6 Frankfurt - Main 71 Lyoner Strabe 22 | Wester Germany | | | | | | | | | | x | Power generation and water management |
| 2. Lambers Van Driel B.V., | Pisanostraat 392, 4510 Eindhoven | Holland | | | | | | | | | | x | Hand Tools |
| 3. Longhini S.p.A. | 20070 S. Rocco Al Porto (MI) | Italy | | | | | | | | x | | | Heavy earth moving & material handling |
| 4. Lonnstrom Oy | 26100 Rauma 10 Finland | Finland | | | | | | | | | | | Sanitary fittings |
| 5. Lurgi India Co. Pvt. Limited | Hindustan Times House, 18-20 Kasturba Gandhi Marg., New Delhi 110001 | India | | | | x | | | | | | | Iron and Steel consultants of International repute |
| 6. Lorch Schmidt & GMBH | 6 Frankfurt Am Main Hanauer Landstr-137 Postfach-3587 | West | | | | | x | | | | | | Small precision lathes |
| 7. Larsen & Nielsen Ind. Building Consultants | | Denmark | | | | | | | | | x | | |
| 8. The Lummus Co. | 1515 Broad St., Bloomsfield New Jercy | U.S.A. | x | | | | | | | | | | |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. M.M. Suri & Associates P Ltd., | 91, Nehru Place, New Delhi - 110024 | India | x | | | | | | | | | | Consultancy Services for design & manu. of Eng. items. |
| 2. Mahendra Consultants Pvt. Ltd. | C-5 Chirav Enclave Opp. Nehru Place, New Delhi 110048 | India | | | x | | | | | x | | | Mineral Processing machinery |
| 3. Malenco Eng. Co. Ltd. | Able Works, Solly St., Sheffield S1 4BA | U.K. | | | | x | | | | | | | Designing of specialised components for steel ind. |
| 4. Management Training & Advisory Centre | P.C. Box 4655, Kampala | Uganda | x | | | | | | | | | | Small Ind. consultants |
| 5. Maschinenfabrik Bernard Braun | Braun 7292 Baiersbronn 6 Postfach - 604 | West Germany | | | | | x | | | | | | Wood working machines |
| 6. Meccaniche | Molinara 32/34 - 20029, Turbigo | Italy | | | | | x | | | | | | Machine tools |
| 7. Metakrafts | 1980, Gali Nila Wali Bazar Sita Ram, Delhi 110006 | India | | | | | | x | | | | | Name plates |
| 8. Mohatta & Heckel Ltd. | Mustafa Building, Sir P.M. Road Fort Bombay 400 001 | India | | | | x | | | | | | | Barbed wire |
| 9. Multico Co. Ltd. | Brighton Rd., Salfords Redhill, Surrey, Eng. | U.K. | | | | | x | | | | | | Low priced gen. purpose woodworking machines |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| | Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10. | Madras Machine Tools Manu. Ltd. | P.O. Box 1812, 8/146-B Trichy Rd. Singanallur-Post Coimbatore 641005 | India | | | | | x | | | | | | |
| 11. | Macro Industries | A-76/2 Wazirpur Delhi 110052 | India | | | | | | x | | | | | Auto piston rings |
| 12. | Maxwell Stamp Associates Ltd | 55-63 Goswell Rd. London EC1V-7PT | U.K. | | | | | | x | | | | | Stampings for steel auto bodies, transformers motors & other ele. mach. |
| 13. | MCEM | Takanawa Kowa Build. | | | | x | | | | | | | | Limestone based chemical, Heavy chemical industries |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Natvarlal & Co. | 10/13 Benham Hall Lane Bombay 400 004 | India | | | | | | x | | | | | Auto-ancillaries, Auto camps and lights |
| 2. The National Small Ind. Corp. Ltd. | Near Okhla Industrial Estate, New Delhi 110020 | India | | | | | x | | | | | | Machine tools only |
| 3. Navin Wire Products Pvt. Ltd. | Sultanpur Road Kapurthala (Pb) | India | | | | x | | | | | | | Fence wire |
| 4. National Industrial Dev. Corp. (NIDC) | Chanakya Bhavan Vinay Marg, NDMC Complex New Delhi 110021 | India | x | | | | | | | | | | Government of India undertaking |
| 5. Normocadre-France | Boste Postale 29-45170 Neuville-Aux-Bois | France | x | | | | | | | | | | Structural manufacturers |
| 6. Natron | Consoltoria e Prector Rio-de-Janeiro, Rua-Dom-Gerardo 40/42 | Brazil | | | x | | | | | | | x | |
| 7. Norwegian Cons. Services | Norwegian Consulting Promotion RIF Wdm Thranes St-1-Oslo | Norway | x | | | | | | | | | | |
| 8. Numex Engineers | 140 Meadows St. Bombay 400001 | India | | x | | | | | | | | | Small oil mills |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Organisation Development Ltd | Prudential Buildings 12 Dunham Road, Altrincham, Cheshire WA14-4PE | U.K. | x | | | | | | | | | | |
| 2. Oy-Mec-Rastorab | Satamakatu 4-00160, Helsinki 16 | Finland | x | | | | | | | | | | Partner of Fin-consult-oy |
| 3. Orlanii | 01 Bruno Orlandi 20091 Bresso (MI) Via-Vitt, Veneto-i Milano | Italy | | | | | | | | | | | Non-ferrous cutting machinery |



1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. P.E. Consulting Group | Park House, Egham, Surrey, Eng. TW20 OHW | U.K. | x | | | | | | | | | | Big English group of Management consultants |
| 2. P.G.S. SpA | 29010 Cadeo Piacenza | Italy | | x | | | | | | | | | 10.15H.P. four wheeler tractor |
| 3. Parry (Eastern) Pvt. Ltd. | Dhiraj Chambers 9, Waudby Road, Bombay 400 001 | India | | | | | x | | | | | | Hand tools |
| 4. F. Parramore & Sons (1924) Ltd | Calidonian Works Chapeltown, Sheffield, S30 1WZ England | U.K. | | | | | x | | | | | | Hand tools |
| 5. Pass Management Consultants Ltd. | 77 Metcalfe Street, Suite 500, Ottawa, Ontario KLP-5L6 | Canada | x | | | | | | | | | | Can manage to get financial assistance from CIDA |
| 6. Pioggia Carnevali Mantova | 46047-5 S. Antonio Mantova | Italy | | x | | | | | | | | | Sprinkling Equipment |
| 7. Pioneer Stamping | C-339 Industrial Estate Peenya-562140, Banglore Dist. | India | | | | | | | | | | | Auto Radiator, Petrol Tank, Wiper blaces |
| 8. Planungsgesellschaft Fur Industrie und Handel mbH | 7500 Karlsruhe, Brohrainstrabe 3, | West | | x | | | | | | | | | Wood working tech. |
| 9. Propulsion BV | Leiden-Holland, Nieuwe Rijn 18, P.O. Box 13 | Netherland | | | | | | | | | | | Dredging & Fishing projects |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10. The Punjab State Small Inds. Corp. Ltd. | Batra Building, Sector 17 Post Box 11 Chandigarh | India | x | | | | | | | | | | V. small |
| 11. P.T.P. SPA | Ex-Pellergrini Traversa Pasto Rino, Tortona | Italy | | | | | x | | | | | | Hobbing machines |
| 12. Pepper Mill Brass Foundry Ltd. | Refuge House, Riverfront, Enfield, Middlesex EN1-352 | U.K. | | | | | x | | | | | | Wood working machinery |
| 13. Pierrefitte-Auby | 4-Avenue Velasquez Paris 8 | France | | | | | | | | | | | |



1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. R.C. Gupta & Bros. | 221 Okhla Industrial Estate, New Delhi 110020 | India | x | | | | | | | | | | Small Engineering consultant |
| 2. R.R. Projetos e Consultoria Ltda | Rua alverenga peixata Caixa Postal 2331 | Brazil | x | | | | | x | | | x | | Semi conductors, boilers, metallic containers, sanitary ceramics |
| 3. Ram Bahadur Thakur P. Ltd. | Clark House, Wodehouse Road, Bombay 400039 | India | | | | | | | | | | | |
| 4. Renardet Sauti - ICE | Kirchstrasse 1, Vaduz (FL) Swiss Post | Italy | | | | | | | | | | x | Consortium of civil eng. Also can undertake Bldg. mat. |
| 5. Rubery Owen C-E Cast Ltd (ROCE) | Darlaston, P.O. Bx 10 Wednesbury, W. Midlands England WS10 8JD | U.K. | | | | | | x | | | | . | Foundry Engineering |
| 6. The Hohilkhand Industries Pvt. Limited | P.O. Izzat Nagar Bareilly, U.P., | India | | x | | | | | | | | | Mini-sugar plants |
| 7. R.R. Machine Tools | Industrial Area-A Ludhiana - 141003, Punjab | India | | | | | x | | | | | | Lathes, milling machines |
| 8. Rhode & Dorrenberg | 4, Dosseldorf Oberkassel 11 Postfach - 510 | West Germany | | | | | | | | | | | |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19. Romconsult | Bucharest - Romania<br>25 - Armeneasea Str. | Romania | x | | | | | | | | | | Forest - water supply |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. S.P. Engineering Corp. | 79/7 Latouche Rd. Kanpur | India | | x | | | | | | | | | Oil expellers & oil extraction plants. |
| 2. Sahney Kirkwood Pvt. Ltd. | 27, Kirol, Vidya Vihar West, P. Box 9222, Bombay - 400086 | India | | | | | | x | | | | | Auto-parts-Dynamos, commutators, carbon bushes, needle bearings |
| 3. Samson Pulling & Lifting Machine Pvt. Ltd. | 12 Sri Ram Road, Civil Lines, Delhi - 110006 | India | | | | | | | | x | | | Pulling & lifting machine |
| 4. Sara Technical Services Pvt. Ltd. | 9, Vasant Vihar, Commercial Centre II, New Delhi - 110057 | India | | | | | | x | | | | | General consultancy for small projects |
| 5. Schwalbach - Herfurth - GMBH & Co. | 2000 Hamburg 50, Virchowstrasse 8-14 | West Germany | | | | | x | | | | | | Machines for processing of plastic seat covers, vacuum forming for auto industry. |
| 6. Servotech. Eng. Pvt. Ltd. | Commercial Centre, B21/27 2nd Floor, Tardeo Road, Bombay 400034 | India | | x | | | | | | | | | Oil crushing & solvent extraction plants |
| 7. Sethi Industries | Tanda Road, Jullunder 4, Punjab. | India | | | | | | | x | | | | Conveyors |
| 8. Singh Associates | 112/196 Swarup Nagar Kanpur 208002, U.P. | India | | | | x | | | | | | | Re-rolling mills |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Sider Export | 16121 Genova, via XII Ottobre-2 | Italy | | | | | | | | | | | Exporter only |
| 10. Siempelkamp & Co. | D-4150 Krefeid 1, Postfach 2580 | West Germany | | | | | x | | | | | | Hydraulic presses for metal plastics & rubber |
| 11. Simac Group (India) Pvt. Ltd. | 6/7 Sidhpura, Industrial Estate Swami Vivekananda Rd., Goregaon - West Bombay 400-062 | India | | | | | | x | | | | | Hand knitting machines and plastic wares |
| 12. Sparta | Apeldoorn-Holland, Prins Willem-Alexanderlaan 926-932 Post-bus 5. | Holland | | | | | | | | x | | | Mopeds & motor cycles |
| 13. Startrite Machine Tool Co. | 69-71 Newington Causeway, London SE1 6BH | U.K. | | | | | x | | | | | | Metal & Wood cutting |
| 14. The State Ind. & Invest. Corp. of Maharashtra Ltd. | Nirmal - 1st Floor, Nari-man Point, Bombay 400021 | India | x | | | | | | | | | | General consultancy small scale sector |
| 15. Stecker Ingenieurburo | 5000 Koln 60, Postfach 600766 | West Germany | | | | | x | | | | | | Machine tools |
| 16. Stevenson & Kellogg Ltd. | 1112 West Pender St., Vancouver B.C. Canada V6E 2S1 (604) | Canada | x | | | | | | | | | | |

1-GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17. Storebro Bruks Aktiebolag | S-590 83 Storebro Sweden | Sweden | | | | | x | | | | | | Machine tools, hand tools & other eng. ind. |
| 18. Sumathi Machine Tools | Avinash Rd., Peelamude Coimbatore 641004 | South India | | | | | - | | | | | | Drilling machines |
| 19. Sunbeam International | U-40 Green Park New Delhi-110016 | India | | | | | | x | | | | | Auto parts & Fanbelt pulley, Petrol tank caps, radiators |
| 20. Sikka-n-sikka Engineers Pvt. Ltd. | Udyambag, Belgaum 590-008 | India | | x | | | | | | | | | Mini-sugar plant |
| 21. Snail Tools | 87, Nagdevi Crosslane Bombay 400003 | India | | | | | x | x | | | | | Hand tools & cutting knives |
| 22. Schellu GMBH | Stuttgart Str. 115 7332 Eislingen/fils Postfach - 1260 | West Germany | | | | | - | | | | | | millnng machines |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | .1. | .2. | .3. | .4. | .5. | .6. | .7. | .8. | .9. | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Technimpianti | 20122, Milano Italia<br>Corso Europa-12 | Italy | x | | | | | | | | | | |
| 2. Tekma Machinery Manfg. Cp. P. Ltd. | P.O. Box 8931<br>Bombay 400072 | India | | x | | | | | | | | | Oil crushing & extraction plant |
| 3. Teutoburger Maschinenfabrik GmbH | 493 Detmold 18,<br>Postfach 8026 | West Germany | | | | | x | | | | | | Panel sizing automats & |
| 4. Texmaco Limited | Birla Building<br>9/1 R.N. Mukerjee Rd<br>Calcutta - 700001 | India | | x | | | | | | | | | Textile machinery, boilers, Mini-sugar plants |
| 5. Trade-Transporte, Administracao E Economia S.A. | P.O. Box 2100-CEP<br>01000 Sao Paulo | Brazil | x | | | | | | | | | | Trade, Transport, Admin. and economics |
| 6. Turbo Resources Ltd | 1019-7th Avenue S.W.<br>Calgary, Alberta | Canada | x | | | | | | | | | | Refining of used oil |
| 7. Thomas Morgan & Partners | 20 Gelliwasted Rda.,<br>Pontypridd, CF37 2BD | U.K. | | | | | | | | | | x | Water Management |
| 8. Touche Ross | 1. Murdoch, McCrae & Smith<br>P.O. Box 46578, Nairobi.<br>2. Executive Office, 1633,<br>Broadway, New York-NY<br>10019 (212) 489-1600 | | x | | | | | | | | | | Auditing & Accounting |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. Trivani En. Works | 1107-Ansal Bhavan, 16 Kasturba Gandhi Marg New Delhi | India | | | | | | | | | | | Mini-Sugar Plant |
| 10. Technoplan GMBH | 4000 Dusseldorf 1 P.O. Box 8002, Bismarckstrasse | West | x | | | | | | | | | | |
| 11. Technimont S.p.a. | P-za Turr 3, 20149 Milano | Italy | | | x | | | | | | | | |
| 12. Tetra Pak | Kenya Tetra Pak P.O. Box 30639, NAIROBI. | Kenya | | | | | | | | | | | |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Uniboard | Uniboard A.G.<br>CH-6300 Zug,<br>Baarerstrasse 112 | West Germany | | x | | | | | | | | | Decorative wooden panels |
| 2. Union Tractor W/Shop. | 8-B, Phase II, Mayapuri Industrial Area,<br>New Delhi - 110027 | India | | x | | | | | | | | | Tractor and animal deiven agricultural machinery |
| 3. United Biological Manufacturing Co. | Saudagar Bazar,<br>Ambala Cantt. | India | | x | | | | | | | | | Gobar Gas plants, storage bars & poultry equipment |
| 4. United Soviet Socialist Republic in Kenya | P.O. Box 30515,<br>Nairobi | Kenya | | | | | | | | | | | Files and machine tools |
| 5. Urwick International Ltd. | Broadmead House,<br>21 Panton Street,<br>London SW1Y 4DR | U.K. | | | | | | | | | | | Machine tools and hand tools |
| 6. U.S. Rubber Reclaiming, Inc. | P.O. Box 356,<br>Buffalo,<br>New York 14205, | U.S.A. | | | x | | | | | | | | Rubber reclaiming |
| 7. Universal Machine Industries | Sultanwind Rd.,<br>Amritsar, Punjab. | | | | | | | x | | | | | Plants for manufacture of fastners |
| 8. UMA Werzeug-Machinen | UMA-Werke Karlmuller & Sohne KG,<br>7336 Uhingen (BRD)<br>Post Fach - 47 | West Germany | | | | | x | | | | | | |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Varshnei Exports | 405 Vishal Bhawan<br>95, Nehru Place,<br>New Delhi-110048 | India | | x | | | | | | | | | Sugar Technology |
| 2. Varnamo Maskin AB | S-331 02 Varnamo 2, | Sweden | | | | | x | | | | | | Shaping machines |
| 3. Veekay Engineers | B/112, Vishnubang<br>137, S.V. Road,<br>Andheri (West)<br>Bombay 400 058 | India | x | | | | | | | | | | |
| 4. Velex Techno-crafts | 114, Armenian St.,<br>Madras 600 001 | India | | x | | | | | | | | | Rice hullers<br>Disintegrators |
| 5. Vidyut Switch-gears | Nand Jyot. Indl. Est.,<br>Andheri-Kurla Rd.,<br>Bombay 400 072 | India | | | | x | | | | | | | Wire mill, fence wire,<br>Bolt plant |
| 6. Verlag Fur Wirts-chafts | Verlag fur Wirtschafts<br>und Kartographie-<br>publikationen<br>D-6040 Offenbach am main<br>Aschaffenburger Strasse 65 | West Germany | | | | | | | | | | | |
| 7. V.D. Swami & Co. Pvt. Ltd. | Sire Mansion<br>123, Mount Rd.,<br>Madras 600006 | India | | | | | x | | | | | | Hand tools |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

| Name | Address | Country | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | .10. | Specialised Field |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Wilfried F. Todt. | Import Agency-Export<br>2 Hamburg 54<br>24, Alte Voksparkstrasse | West Germany | | | | | | | | | | | Export of wood |
| 2. W.S. Atkins & Partners | Woodcote Grove,<br>Ashley Road Epsom,<br>Surrey KT 18 SBW Eng. | U.K. | x | | | | x | | | | | | Machine Tools & Hand tools. Reputed gen. eng. consultants |
| 3. Well-man Mechanical Engineering Ltd. | Willenhall Rd.,<br>Darlaston,<br>Wednesbury,<br>West Midland WS-10-8LG | U.K. | | | | | | | | | | | Recovery of Waste materials, tin from tin plate |
| 4.Wadkins Ltd. | Greenlane works,<br>Leicester, LE-5-4PF<br>England | | | | | | x | | | | | | Woodworking machines |
| 5. Zocco | 22100 Como-Camerlata<br>Via P. Pauli-21 | Italy | | | | | x | | | | | | |
| 6. Wohlenberg | D-3 Hannover - 1,<br>Wohlenbergstrasse G-8 | West Germany | | | | | x | | | | | | Architecture & civil work for machine tools plants |
| 7. Zimmer Aktiengesel-saaft | Zimmer A.G. - 6<br>Postfach 600829<br>Frankfort | West Germany | | | x | | | | | | | | Basic plastic material & synthetic rubber |

1=GEN-PRO 2=AGRO 3=CHEM 4=STEEL 5=M/C 6=LI-ENG 7=FAU-FOR 8=TRAN-ENG 9=REP-CER 10=CIV-ENG

Annex II

## DEVELOPMENT OF MACHINE TOOL INDUSTRY

### Background

1. In the Third Development Plan 1974-78, the Government has placed priority on the local manufacture of capital goods and intermediate goods. In accordance with this policy and considering the important role of a machine tool industry for the development of other industries, the Industrial Survey and Promotion Centre has elaborated on a project for the development of machine tool industry in Kenya.

2. The Centre also contacted reputed manufacturers of machine tools in different parts of the world to cultivate their interest in the development of the project. A project list which included a Machine Tool Project, was also circulated widely by the Government. In response to this inquiry, a number of prospective technical partners have shown considerable interest. Among these are Messrs. Hindustan Machine Tools of India (which sent a team to undertake an on the spot assessment of the need for such a project), and British group comprising; Ove Arup & Partners, Herbert Consultancy and Guiness Peat, who have prepared a preliminary proposal for the development of this industry.

### Nature of the Industry

3. The Machine Tool Industry involves the manufacture of mother machines such as lathes, milling and drilling machines, and grinding machines, which are vital for the manufacture of other machines, tools and equipment required in the engineering industry.

4. An essential part of a machine tool plant is a Tool Room which is equipped with precision machinery for the manufacture of cutting, pressing or forming tools; jigs and fixtures for the manufacture of quality products on mass production basis and gauges for inspection of finished items.

5. Both a machine tool industry and tool room require heavy investment and yield comparatively a low rate of return on investment. They are typical of the type of industry that should be promoted and assisted by the public sector with the co-operation and participation of the private sector. The industry is skill-intensive and therefore the development of these skills through training is an extremely essential element of the project.

## The Kenyan Machine Tool Project

A machine tool project has a significant contribution to make in theprocess of the transfer and development of technology, which has been given high priority by the international community in various fora. Recent United Nations decisions on this subject included the adoption of World Plan of Action on the Application of Science and Technology: the resolutions of the Lima Conference, Seventh Special Session of the General Assembly, Third Conference of African Ministers' of Industry and 4th UNCTAD Conference.

It is against this background, that the concept of a Kenyan machine tool industry must be evolved. The project should be designed in such a way as to lay a foundation for the technological infrastructure for the transfer of technology and the development of local skills. In the past the transfer of technology to Kenya was limited among other reasons by the lack of compliment cadre of design and product development engineers, and absence of a receptor organisation to screen, evaluate, assimilate and adopt transferred technology. The net result was that the technology was not effectively transferred and did not take root in the economy. At the present level of Kenya's industrial development such an organisation is required. The organisation will not only adopt imported technology, it will also innovate indigenous technology for the better utilization of local mineral and agricultural resources.

## Alternative Approaches

On the basis of the field investigations undertaken by the Indian team, the Kenyan machine tool industry might be desinged as an integrated programme encompassing a Machine Tool Plant, a Tool Room and a Product Design Unit which may also provide training to engineers, technicians and skilled craftsmen for the complex. The respective functions of the different units will be as follows:

i) Machine Tool Plant

   a) Progressive manufacture of Machine Tools
   b) Orgnization of Purchase, sale and service sections
   c) Development of Ancillary Industries

ii) Tool Room

a) Manufacture of tools, jigs and fixtures, dies and inspection gauges for the Machine Tool Plant and private parties on jobbing basis at reasonable cost.
b) Extend facilities for training in Tool Room technology to craftsmen from local industry.
c) Render technical assistance to local industry for design, development and use of modern tools and production techniques.

iii) Training Section

a) Training of skilled craftsmen for Machine Tool Plant, Tool Room and private industry.
b) Training of quality control staff for Machine Tool Plant, Tool Room and private industry in Quality Control and Metrological Work.
c) Training of Engineers/Draughtsmen in Machine Design, jigs/fixtures/tool design.

iv) Designing/Development Section

a) Responsible for product design, detailed drawings for machine tools, jigs, fixtures, tools and gauges etc.
b) Development of new prototypes to suit the local conditions and optinum utilization of local resources.

Hindustan Machine Tools intend to send a senior engineer to further elaborate on this concept and to prepare a preliminary feasibility study, which they expect should be ready by the end of August, 1976. Subject to the viability of the scheme, they would be agreeable to transferring their technology and organizing training for local personnel in machine tool technology.

Another alternative might be to develop the machine tool industry as a commercial venture since in the long run it would be self-supporting, and the rest of the components (Tool Room and Industrial Design Unit) as development projects to be financed through bilateral or multilateral aid and government development funds.

The Indian team, seem convinced of the potentiality of a Kenyan Machine tool plant for progressive manufacture of general purpose, low priced machine tools to meet local demand and for export. The British preliminary proposal also confirms this potentiality.

Conclusion

Whatever shape the project takes eventually, the following principles are most likely to apply:-

i) The Government will have to play a pivotal role in the formulation of the project since the project must be promoted through deliberate action as a national priority.

ii) The project will require Government assistance especially in its early stages of development. Such assistance may include financing and seeking technical assistance and training facilities through competent sources on priority basis.

iii) The project if, properly formulated, should be a popular candidate for technical aid. UNIDO has expressed interest in continuing assistance for the development of this industry.

Annex III

# INTEGRATED VEGETABLE GROWING & DEHYDRATION - KISII-SOTIK AREA

## I Introduction

Kenya has a large variety of ecological conditions that almost any tropical or temperate climate crop can be grown any time of the year. This offers the possibility of providing an almost year-round supply to the local market and the possibility of adapting production to seasonal demand on the export market.

The market value for horticultural products exceeds K£ 10 million annually and its share of the gross marketed production is approximately 10% of all crops marketed. (1) The expected annual growth rate in production for pineapples is 17.9%, vegetables 10% and fruits 10.5% during the 1974-78 Development Plan period*.

Horticultural production in Kenya is expected to cater for three market segments; i.e. the local market the fresh export market, and the processing sector for both local consumption and for export. Each of this segment is growing rapidly and the estimated annual increases are as follows:-

| | Local market | fresh export | Processing |
|---|---|---|---|
| | % annual increases | | |
| Fruits | 10 | 16 | 35 |
| Vegetables | 10 | 22 | 44 |

This estimated annual increase in each market segment calls for increased horticultural production all over the suitable areas of the country. The Horticultural Crops Development Authority (HCDA) is encouraging all aspects of the industry from production to processing and marketing. HCDA has designated nine horticultural development areas+, which are expected to serve as broad organisational basis for future development.

---

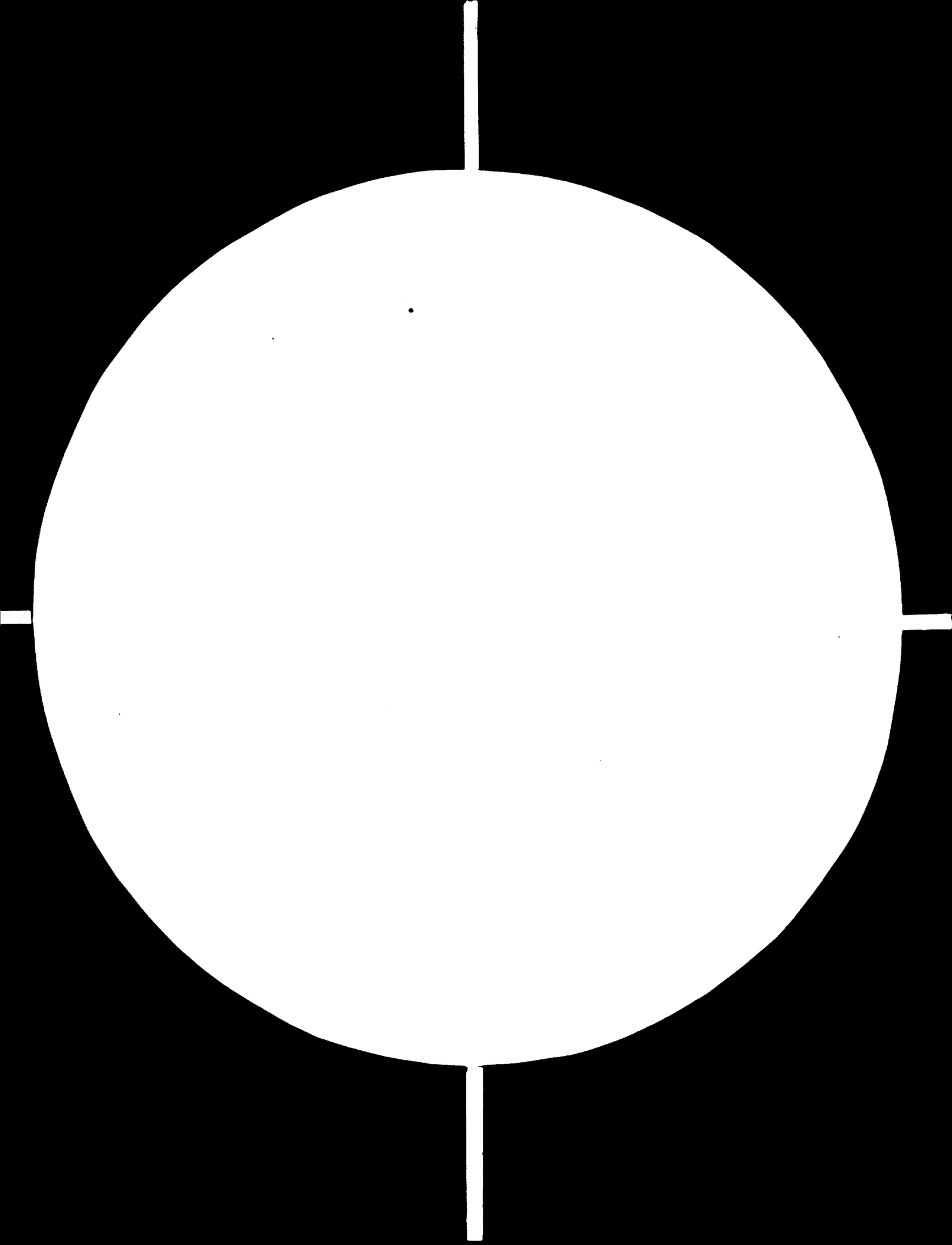
(1) 8.9% in 1969, 9.3% in 1970, 11.1% in 1971, 9.6% in 1972, 7.3% in 1973 and 6.9% in 1974

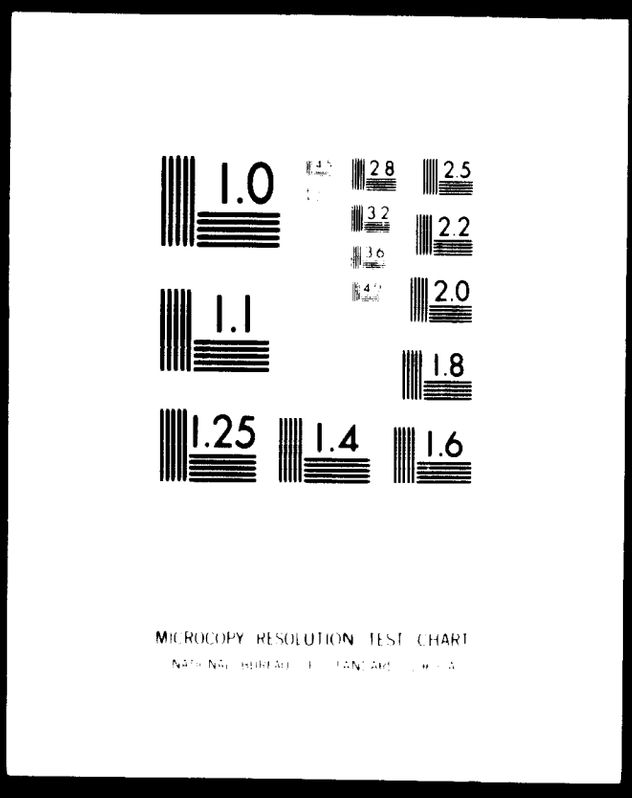
* Development Plan for Kenya's Horticultural Industry FAO/HCDA November 1975

\+
1. Nairobi - Machakos - Chyulu Hills
2. Naivasha-Nakuru-Lake Baringo
3. Nyeri-Kirinyaga-Meru
4. Kakamega-Busia-Siaya
5. Kitale-Eldoret
6. Kisii-Homa Bay
7. Taita-Taveta
8. Coastal areas
9. Garissa

G-343

77.10.05





In 1969 the Horticultural working party report identified the problems facing the horticultural industry and listed them as follows:-

- limited funds for research
- inadequate training on horticultural production at all levels of training
- lack of an organized 'package of inputs' to the industry (credit facilities, production inputs)
- poor marketing system etc.

On processing the report noted that the processing sector suffered from unreliable supplies, lack of sufficient production to secure low-unit costs and relatively high fresh market prices. The report recommended improvement in production efficiency of smallholders.

As stated earlier the processing sector is expected to grow at 35% p.a. and 44% p.a. for fruits and vegetables, respectively. The major problem in this sector is the inadequate supply of raw materials and it has been suggested that for processing industries to succeed there must be an 'integrated approach' which ensures close co-ordination between cultivation and processing. This calls for the processing industry to operate a nucleus estate to supply a certain percentage of raw materials while the rest is supplied by smallholders on contract basis. This system is operated at present by Panafoods Ltd. at Naivasha which is supplied by out-growers in the Kinangop area.

Horticultural production is a sophisticated type of agricultural activity and inclusion of smallholders into contract farming for processing creates many problems due to increasing costs of extension and credit. However they must be included, and in any case since they form the backbone of Kenya's production, any large scale processor has to develop 'a package of inputs' to the outgrowers. These will include:

- contract services
- provision of inputs (fertilizer, pesticides, suitable varieties)
- Upgrading of yields by organising standardization and storage facilities
- provision of transport facilities
- crop timing to maintain year-round production
- better extension services etc.

The market for processed horticultural products is expanding, especially in Europe and Middle East and Kenya needs to expand this sector rapidly. In 1973 out of the 100,000 tons (raw materials) Processing capacity available only 60% was utilized. In 1978 it is estimated that the production for processing will be 320,000 tons (raw materials) and only 52% will be utilized.

This calls for establishment of processing plants in rural areas to utilize the new materials and to give smallscale farmers an incentive to produce and a source of income.

## II. The Project

### Production Possibilities

This project profile provides for the establishment of a vegetable dehydration plant in an area in the Sotik Settlement, to be supplied by a nucleus estate of 2,000 acres and small-scale out-growers in Kisii and Kericho districts. The most suitable vegetables would include:- carrots, onions, cabbages, tomatoes, leeks, and others like cauliflowers. Brussels sprouts, capsicums etc.

The production capacity of the plant is assumed to be 5,000 tons of dehydrated material per year which would require at least 70,000 tons of raw materials annually.

It may not be possible to spell precisely the order of priorities for processing of different vegetables since this can only be done after a detailed survey of the area but it is assumed the plant will be flexible enough to undertake processing of the various vegetables to be produced, and to change production according to the demand. In this study the following production capacities are assumed.

| | Raw Materials | Dehydrated material |
|---|---|---|
| | tons per year | |
| Carrots | 15,000 | 1,000 |
| Onions | 10,000 | 1,000 |
| Potatoes | 15,000 | 1,000 |
| Cabbages | 15,000 | 1,000 |
| Tomatoes | 10,000 | 500 |
| Leeks | 3,000 | 300 |
| Others (cauliflowers, capsicums) etc. | 2,000 | 200 |
| Total | 70,000 | 5,000 |

Production of the above vegetables is supposed to be produced by the nucleus estate and smallholders. The nucleus estate will produce 25% of the raw materials which will total to about 20,000 tons annually. It is assumed all the 2,000 acres of the estate can be utilized as follows:-

| | Production tons/year | Yield tons/acre | Area needed acres |
|---|---|---|---|
| Carrots | 4,000 | 10 | 400 |
| Onions | 3,000 | 10 | 300 |
| Potatoes | 4,000 | 10 | 400 |
| Cabbages | 4,000 | 8 | 500 |
| Tomatoes | 3,000 | 20 | 150 |
| Leeks | 1,000 | 10 | 100 |
| Others | 1,000 | - | 100 |
| Buildings, factory experimental plots | - | - | 50 |
| Total | 20,000 | - | 2,000 |

The allocation of land is based on the assumed yields but with irrigation, yields are higher and this would mean more land can be released for other vegetables.

The outgrowers will be smallholders in Kisii and Kericho districts, but mostly in Kisii. Kisii district is densely populated (about 900 people per sq. mile). The land rises from 4,650 feet to 7,500 feet above sea level and the topography is composed of undulating ridges. The soils are rich well drained red loams. The rainfall is well distributed and ranges from 1,000 mm - 2,250 mm per annum. It is distributed throughout the year as shown below:-

Average Rainfall: 1974 - Kisii District

| | | | |
|---|---|---|---|
| January | 58 mm | July | 152 mm |
| February | 30 mm | August | 63 mm |
| March | 142 mm | September | 207 mm |
| April | 263 mm | October | 123 mm |
| May | 140 mm | November | 89 mm |
| June | 136 mm | December | 33 mm |
| TOTAL | .. | .. | 1,436 mm |

It is calculated that in one year out of ten rainfall is likely to be less than 500 mm (10% rainfall probability).

It is therefore assumed that the soil and climate conditions are suitable* for rainfed vegetables growing, supplemented with irrigation. The big percentage of smallholders production will be produced during the two rainy seasons March/April/May and September/October. Since the growing of vegetables is not very common among smallholders and since they have to depend on rains the yields will be low (assumed at about a half of irrigated production). Most farmers will only be able to release half an acre for vegetables due to scarcity of land. The following calculations for the production of 75% of the total factory requirements are based on the above assumptions:-

| | Total Tons | Yield Tons/Acre | Area Needed Acres | No. of Growers+ |
|---|---|---|---|---|
| Carrots | 12,000 | 5 | 2,400 | 4,800 |
| Onions | 8,000 | 5 | 1,600 | 3,200 |
| Potatoes | 12,000 | 8 | 1,500 | 3,000 |
| Cabbages | 12,000 | 5 | 2,400 | 4,800 |
| Tomatoes | 8,000 | 10 | 800 | 1,600 |
| Leeks | 2,000 | 8 | 250 | 500 |
| Others | 1,000 | 5 | 200 | 400 |
| Total | 55,000 | | 9,150 | 18,300 |

+ On the assumption that farmers can only release ½ acre

From the above calculations it can be seen that the project will involve up to 18,000 smallholders. This is about a quarter of smallholdings, in the district (691,000 farms in 1974). This compares with other crops which are grown in the area, as follows:-

| Crop | Est. No. of Growers | Ave. size of holding (ha) |
|---|---|---|
| Pyrethrum | 50,000 | 0.3 |
| Coffee | 50,000 | 1.2 |
| Tea | 22,000 | 0.5 |
| Maize | 54,000 | 0.25 |
| Vegetables (project est.) | 18,000 | 0.2 |

---

* 1974

| | | | | | |
|---|---|---|---|---|---|
| Nyakoe | 3278 mm | Moromba | 1019 mm | Nyamira | 1768mm |
| Nyabomite | 1688 mm | Wanjari | 1865 mm | Kenyenya | 676mm |
| Nyamarambe | 676 mm | Kisii | 1810 mm | Sotik Settlement | 1446mm |

At present it is estimated that 5,000 farmers grow vegetables producing about 10,000 tons annually. To reach the target of 55,000 tons production has to be increased at least 5 times and the number of growers at least 3 times.

Project Costs

Nucleus Estate Development

Land Purchase

It is assumed that the 2000 will purchased at a price of K.Sh 600 per acre.

Land Development

The area is assumed to be covered by a light to heavy forest, and therefore it will have to be surveyed and trees will have to be cut. For this operation the Caterpillar D8H tractors will be used. Two tractors pulling a heavy anchor chain can be used. If there are large trees a treedozer can be used. Heavy brush rakes can be used for piling bushes. The soil can be broken using heavy harrow (16 x 36 inches) discs.

With 3 caterpillar tractors (D8H) and associated equipment the operations to prepare land will take about 4 - 5 months.

| | |
|---|---|
| Felling at 100 acres per day | 20 days for 2000 acres |
| Windrowing 50 acres per day | 40 days for 2000 acres |
| Ploughing/harrowing 25 acres per day | 80 days for 2000 acres |
| | 160 days |

The estimated costs for land development (tree felling, windrowing, ploughing, drainage, demarcation etc.) will be about K.Sh. 500 per acre. This operation can be done on contract basis.

Irrigation

To set up irrigation equipment (pipes, sprinklers etc.) it is estimated to cost about K.Sh 3,000 per acre.

Housing

It is assumed that all houses for the factory and farm employees will have to be put up. There might be up to 400 employees and the total cost is estimated at K.Sh 1 million. This will include houses for senior staff and the labourers.

Tractors and other Farm Equipment

Five tractors of 30-50 HP with other equipment (ploughs, both mould board and disc, seed-cum-fertilizer drills, harrows, sprayers harvesting equipment etc.). The cost will be about K.Sh 1,600,000 (A Ford 4000 tractor costs K.£4,164).

Transport

This will include vehicles used in the farm and lorries used to collect produce from the smallscale producers. Five lorries (10 tons) can be used for collection from small-scale producer. In the farm tractor drawn trailers can be used. The estimated cost for all transport is about K.Sh 1.4m.

Agricultural inputs (seeds, fertilizer, pesticides etc.)

The costs of inputs vary (see Appendix I & II) but on average the cost of seeds is assumed at K.Sh. 350 per acre, fertilizer at K.Sh. 500 per acre, and pesticides at K.Sh. 200 per acre.

Labour, Wages and Salaries

This will include, a project manager a factory manager, farm manager, factory engineer, accountant, agronomist and other technical staff and labourers. The total number will be about 400 employees. The total wages and salaries will total to about K.Sh. 2.5 million.

Establishment of the Dehydration Factory

Buildings

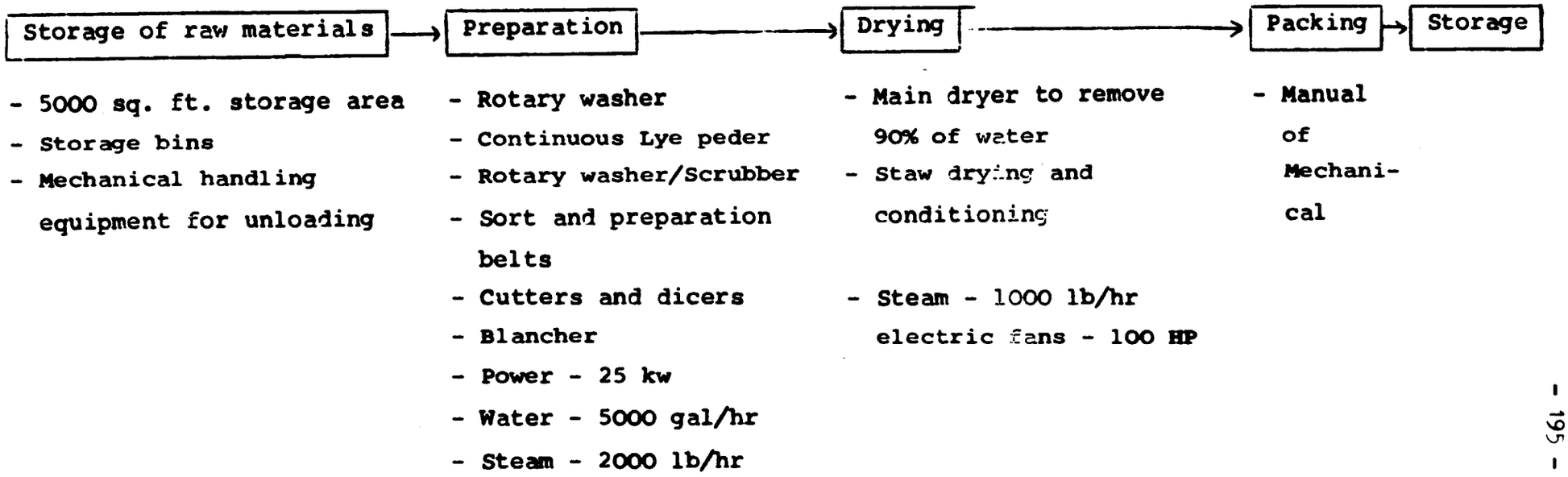
The factory will be set up in the middle of the nucleus estate and will occupy the area as follows:-

| | |
|---|---|
| Main factory building | 80,000 sq. ft. |
| Storage facilities | 30,000 sq. ft. |
| Services (offices etc.) | 15,000 sq. ft. |

The estimated cost for the buildings is about K.£ 255,000.

Production Lines

Four production lines with a capacity of 1000 tons per year each will be set up. These will be set up in stages as production increases. The cost for each line is estimated at about K.£ 200,000. Each line will consist of the following stages and machinery.


Storage of raw materials
Preparation
Drying
Packing
Storage
- 5000 sq. ft. storage area
- Storage bins
- Mechanical handling equipment for unloading
- Rotary washer
- Continuous Lye peder
- Rotary washer/Scrubber
- Sort and preparation belts
- Cutters and dicers
- Blancher
- Power - 25 kw
- Water - 5000 gal/hr
- Steam - 2000 lb/hr
- Main dryer to remove 90% of water
- Staw drying and conditioning
- Steam - 1000 lb/hr
electric fans - 100 HP
- Manual
of
Mechani-
cal

The tomato processing line will require a spray drier.

Working Capital

This increases gradually with output and covers raw expenses of running the factory. It is estimated at £300,000 per year. Working capital for the nucleus estate is estimated at £60,000.

Cost of raw materials and Expected Incomes from the Nucleus Estate and the Dehydration Factory

Under maximum utilization the nucleus estate is expected to produce about 20,000 tons of various vegetables. The prices are assumed to vary from K£ 10 to 30 per ton. With these assumptions the income from the farm would be as follows:-

| Average price per ton K.£ | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|
| Total Income K.£ '000 | 200 | 300 | 400 | 500 | 600 |

As the average price per ton of raw materials increases, the income from the farm increases.

Income from the Sale of Dehydrated Products

The price of one unit of dehydrated material is about 10 times more than the price of a unit of raw materials. Since the factory has to purchase all its raw materials (75,000 tons) including the material from the nucleus estate, its operating costs increase as prices of raw materials increases; as shown on page 11.

III The Market for Dehydrated Vegetables

There are three possible market outlets for dehydrated vegetables:-

i) Internal Market: At present, the demand from this market is negligible. This market can however be encouraged especially in the utilisation of dehydrated vegetables for soups, ready-to-serve foods and baby foods etc.

ii) The African & Persian Gulf Market: This market outlet is already important for processed fruits, jams and juices but it can be explored more as an outlet for dehydrated vegetables.

| Average price per ton, raw K£ | 10 | 12.5 | 15 | 17.5 | 20 | 22.5 | 25 | 27.5 | 30 |
|---|---|---|---|---|---|---|---|---|---|
| Factory operating costs K£ '000 | 1066.3 | 1253.3 | 1441.3 | 1618.8 | 1816.3 | 2003.8 | 2191.3 | 2378.8 | 2566.3 |
| Costs of raw materials K£ '000 | 750 | 937.5 | 1125 | 1312.5 | 1500 | 1687.5 | 1875 | 2062.5 | 2250 |
| Sale of dehydrated materials (x 10)* K£ '000 | 500 | 625 | 750 | 875 | 1000 | 1125 | 1250 | 1375 | 1500 |

* Assuming the price of dehydrated products is ten times more than the price of raw materials

iii) The European and American Market

This has been the traditional market for dehydrated vegetables. In 1973, it was estimated that the demand for this market was 275,000 tons.(1) The figure includes local production but we are more interested in import figures. A study by the Tropical Products Institute on imports of dehydrated vegetables in Europe put forward the following figures for 1971.

| | Tons |
|---|---|
| West Germany | 12,400 |
| Switzerland | 2,300 |
| Austria | 1,020 |
| Denmark | 270 |
| Norway | 670 |
| Sweden | 1,040 |
| Total | 17,700 |

The breakdown for the types imported into West Germany is as follows (1971)

| | Tons |
|---|---|
| Potatoes | 4,700 |
| Mushrooms | 620 |
| Tomatoes | 180 |
| Cauliflowers | 60 |
| Onions | 2,680 |
| Onions powdered | 890 |
| Beans | 290 |
| Carrots | 570 |
| Leeks | 350 |
| Others | 1,030 |
| Herbs | 1,020 |
| Total | 12,400 |

(1) P. Coxon. Dehydration project for Kenya. April, 1970

Although this study was carried out in 1971/72, it gives the picture of the European market, on which production can be based.

In 1975, the Kenyan exports to the European and American market was as follows:-

Exports of dehydrated vegetables (0.55.100) 1975

| | Amout Quintals | Value K.Shs | Value/Q K.Shs | Value/T K.Shs |
|---|---|---|---|---|
| Canada | 23 | 19,589 | 852 | 8,520 |
| France | 81 | 8o,295 | 1,004 | 10,040 |
| West Germany | 2,846 | 2,630,452 | 924 | 9,240 |
| U.K. | 1,821 | 1,332,318 | 732 | 7,320 |
| U.S. | 16 | 16,000 | 1,000 | 10,000 |
| | 4,787 | 4,079,654 | $\bar{x}$ 902 | $\bar{x}$ 9,020 |

From the above figures, the average value per ton is calculated at K£ 451.

N.B. Q = Quintals T = Tons

Most of the dehydrated vegetables are air-freighted and the current cost are K.Sh 3.00 per kg. to Europe and K.Sh 3.75 to U.K. and these rates are expected to go higher. With the opening of the Suez Canal, ships can be utilised more.

The following price further illustrate the consumer prices in West Germany.

Price per 1 kilo net including packing, based on import prices out of the most important countries of origin - Hamburg 31st December, 1975

| | DM | K.Sh (1DM = K.Sh3) |
|---|---|---|
| Dehydrated Onions, kibbled and sliced | 2.80 - 3.20 | 8.10 - 9.60 |
| Onion Powder | 2.10 - 2.50 | 6.30 - 7.50 |
| Carrots, dices dehydrated | 4.00 - 4.50 | 12 - 13.50 |
| Leek flakes dehydrated | 3.50 - 4.80 | 10.50 - 14.40 |
| Tomato flakes " | 6.20 - 7.50 | 18.60 - 22.50 |
| Garlic powder " | 2.50 - 3.00 | 7.50 - 9.00 |
| Cabbage flakes " | 4.20 - 4.80 | 12.60 - 14.40 |
| Beans dehydrated | 6.50 - 8.50 | 19.50 - 25.50 |

## IV Profitability Estimates

| Capital Costs | K£'000 Farm | K£'000 Factory |
|---|---|---|
| Land Purchase/development | 110 | - |
| Irrigation equipment | 292.5 | - |
| Housing | 60 | 40 |
| Factory buildings | - | 25.5 |
| Farm Machinery/equipment | 80 | - |
| Factory Machinery | - | 800 |
| Vehicles | 50 | 20 |
| Working capital | 60 | 300 |
| Total | 652.5 | 1,415 |

Financed by

| | | | | |
|---|---|---|---|---|
| Share capital 20% | | 130.5 | Share capital 30% | 424.5 |
| | | | Suppliers credit @ 10% | 424.5 |
| Loan @ 10% | 80% | 522.0 | Local loan 30% @ 10% | 424.5 |
| | | | Overdraft 10% @ 10% | 141.5 |
| | | 652.5 | | 1415.0 |

| Operating Costs | K£'000 Farm | K£'000 Factory |
|---|---|---|
| Salaries & wages | 60 | 65 |
| Purchase of inputs @ K.Sh 1,050 per acre | 102.375 | - |
| Purchase of raw material (75,000 ton) @ K.Sh 200 to Sh. 600 per ton | - | (750 - 2,250) |
| Transport | 20 | 30 |
| Services (power, fuel, water) | 40 | 65.5 |
| Depreciation Machinery & Vehicles (£130,000) @ 20% | 26 | 4 |
| Buildings & fixed equipment Farm (K£352,000) @ 5% | 17.625 | - |
| Factory (K£ 1,055,000) @ 5% | - | 52.75 |
| Interest on capital @ 10% | 52.2 | 99.05 |
| | 318.2 | 1,066.3 - 2565.3) |

## Return on Capital

This is calculated, based on the following assumptions:-

i) The price of raw materials varies from K.Sh 200 to K.Sh 600 per ton.

ii) The price of dehydrated products varies from K.£300 to K.£ 600 per ton.

The following percentage returns on capital have been calculated, based on the above assumptions

| Price of raw materials K.Sh. per ton | 200 | 600 |
|---|---|---|
| If price of dehydrated products (x 10) raw materials | % -40 | % -75.1 |
| Dehydrated products at K£ 300 | 30.65 | -75.4 |
| K£ 350 | 48.3 | -57.7 |
| K£ 400 | 66 | -40 |
| K£ 450 | 83.7 | -22.4 |
| K£ 500 | 101.3 | - 4.7 |
| K£ 600 | 136.7 | 30.7 |

The returns are illustrated further in Appendix III

## Conclusions and Summary

This project profile assumes various things which might all influence the profitability and success of the project; especially the following assumptions:-

i) The area chosen is suitable for all the suggested vegetables.

ii) The area both, in the estate and in small farms can give the yields suggested.

iii) Collection from the scattered smallscale farmers is possible.

iv) The prices of raw materials are 1/10 of the prices of dehydrated products

v) The factory is working at full capacity which is unlikely

vi) Smallscale farmers will be influenced to adopt vegetable growing as a commercial enterprise and will master the complications of horticultural activities.

If the project is implemented, after a comprehensive feasibility study it will bring the following benefits.

1. Earn the country the needed foreign exchange

2. Introduce a new cash crop to the smallscale farmers

3. Open a market outlet for vegetables

4. Create employment in the nucleus estate, factory and in small-scale farms. Vegetable growing is a very labour intensive activity and if smallscale farmers grow them in a large scale, it will go at long way in solving the problem of rural unemployment.

5. To organize such a large group of farmers a new vegetable marketing co-operative union would be introduced this creating some employment, and which will eventually own some shares in the factory.

A project of this nature involving such large sums of money would need to be implemented in stages.

i) A comprehensive feasibility study of the area, and market openings in Europe and elsewhere needs to be done.

ii) A very intensive extension service including demonstrations, on growing practices, has to be undertaken in all locations of the district, by the Ministry of Agriculture. This may take at least 2 years.

iii) The production lines in the factory will have to be introduced in stages concentrating on vegetables showing the largest market potential and gradually introducing other vegetables.

The return on capital for the project depend on the final prices of dehydrated products.

1. If they are high the factory can pay higher prices for raw materials thus encouraging farmers to grow more.

2. The factory has to work at almost 100% capacity for the project to be profitable. This means the raw materials must be available throughout the year.

As a summary it can be said that basing such a large project on production from over 18,000 small scale farmers presents a herculean management and co-ordination task and there has to be a pinpoint precision in pricing, collection of raw materials and in payment to farmers.

Appendix I

## PER ACRE COSTS & RETURNS FOR GROWING CARROTS

| | DRY | WET |
|---|---|---|
| Proposed price: | January - April | May - December |
| | -/25/kg | -/20/kg |

Price suggested here is in line with what the Panafoods in Naivasha are giving to the farmers.

Yield:

For dehydration 6 to 10 tons per acre may be expected, 25 tons have been achieved on fertile soil. We shall take 15 tons per acre for our calculations. This gives gross return of 3,000 K.Shs.

Per Acre Costs:

Seeds:

1½ kgs per acre at 147/20 per kg. Hence, total cost is per acre is about 222/-

Labour:

Sh. 500.00 100 man days per acre wage rate K.Shs 5 per day.

Fertilizers:

200 lb. Double super phosphate per acre
200 lb. Nitrogenous fertilizer per acre when crop is 4" high
Shs. 500.00/-.

Irrigation:

Shs. 200.00 many farmers in the main season will not require to irrigate.

Net return per acre: K.Shs 1,578

Per Acre Costs and Returns for Growing Leeks

| | DRY | WET |
|---|---|---|
| Proposed price: | January - April | May - December |
| | -/40 | -/35 |

Yield:

10 tons per acre. Gross return of K.Shs. 3,500

**Per Acre Costs:**

**Seeds:**

1½ kgs per acre at 200/- per kg. Therefore total cost is 300/-.

**Labour:**

600.00 This is higher than the carrots figure because you grow leeks in seedbeds then transplant later.

**Fertilizer:** 500.00

**Irrigation:** 200.00

**Net return per Acre:** K.Shs 1,900

Appendix II

## PER ACRE COSTS FOR GROWING POTATOES

The calculations have been done for three farmers who use different methods of production

| Yield, bags/acre (90 kgs each) | Farmer A 18 | Farmer B 90 | Farmer C 135 |
|---|---|---|---|
| Total Output | 360/- | 1,800/- | 2,700/- |
| Local seed (10 bags/acre) | 250/- | 250/- | - |
| Certified seed (10 bags/acre) | - | - | 600/- |
| Fungicides | - | 130/- | 130/- |
| Pesticides | - | 70/- | 70/- |
| Fertilizer | - | 200/- | 200/- |
| Transport Sh. 1/50 per bag | 27/- | 135/- | 202/- |
| Costs of bags Sh. -/50 per bag | 9/- | 45/- | 67/- |
| Total variable costs | 286/- | 830/- | 1,269/- |
| Gross margin before costs for casual labour deducted | 74/- | 970/- | 1,431/- |
| Gross margin after costs for casual labour deducted | -46/- | 805/- | 1,266/- |

The costs for the bags have been calculated on the assumption that the bag is not sold with the potatoes. It is bought for 3/- and can be used for 6 harvests.

The costs for labour are based on the assumption, that 50% of the work is done by hired labour paid 3/- per day.

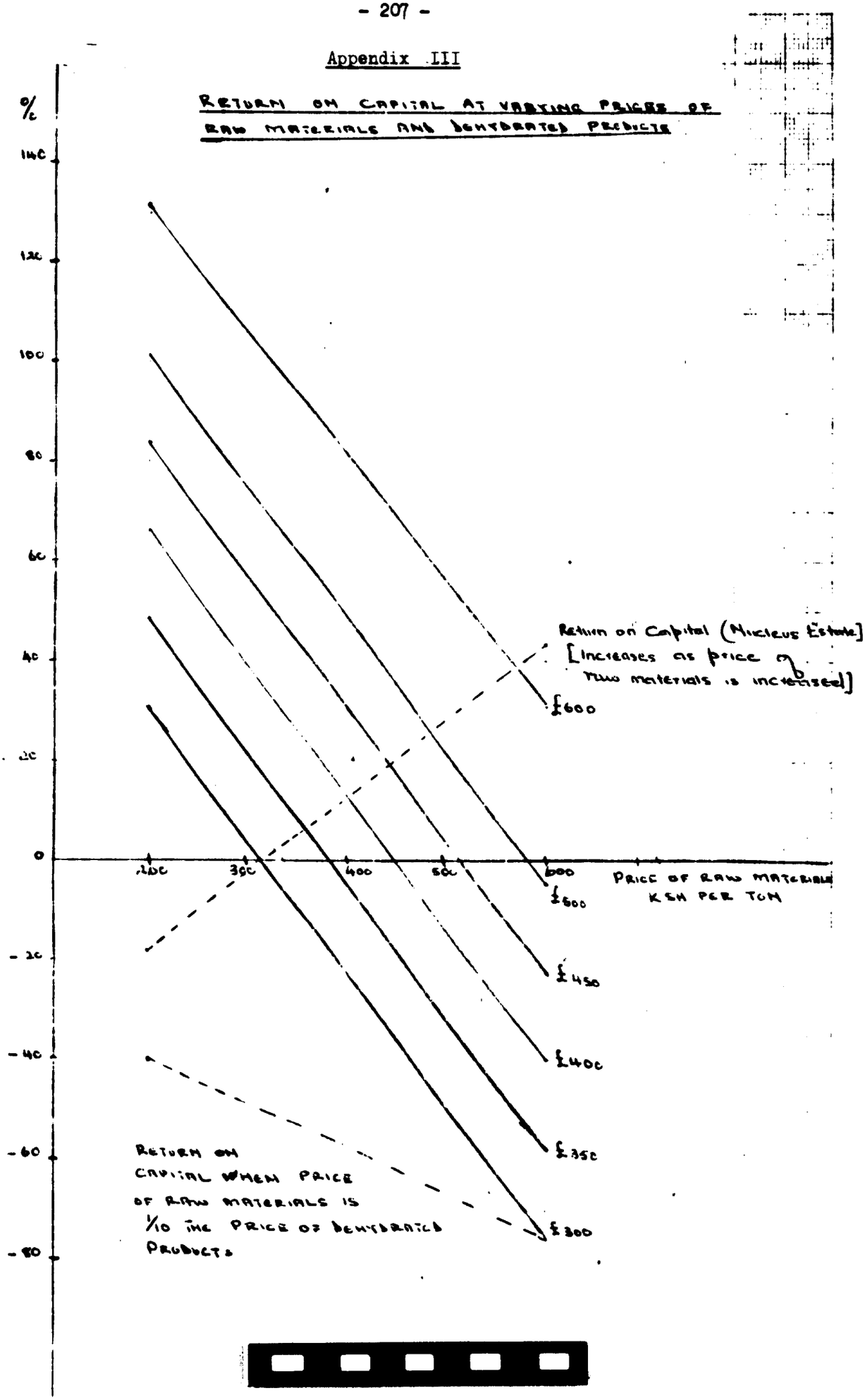
**Farmer A** does not invest any additional inputs in his potatoes. Therefore he makes a loss of 46/- per acre.

**Farmer B** applies good husbandry throughout as recommended by the extension service, but could not get certified seed. He gets 805/- gross margin after casual labour deducted.

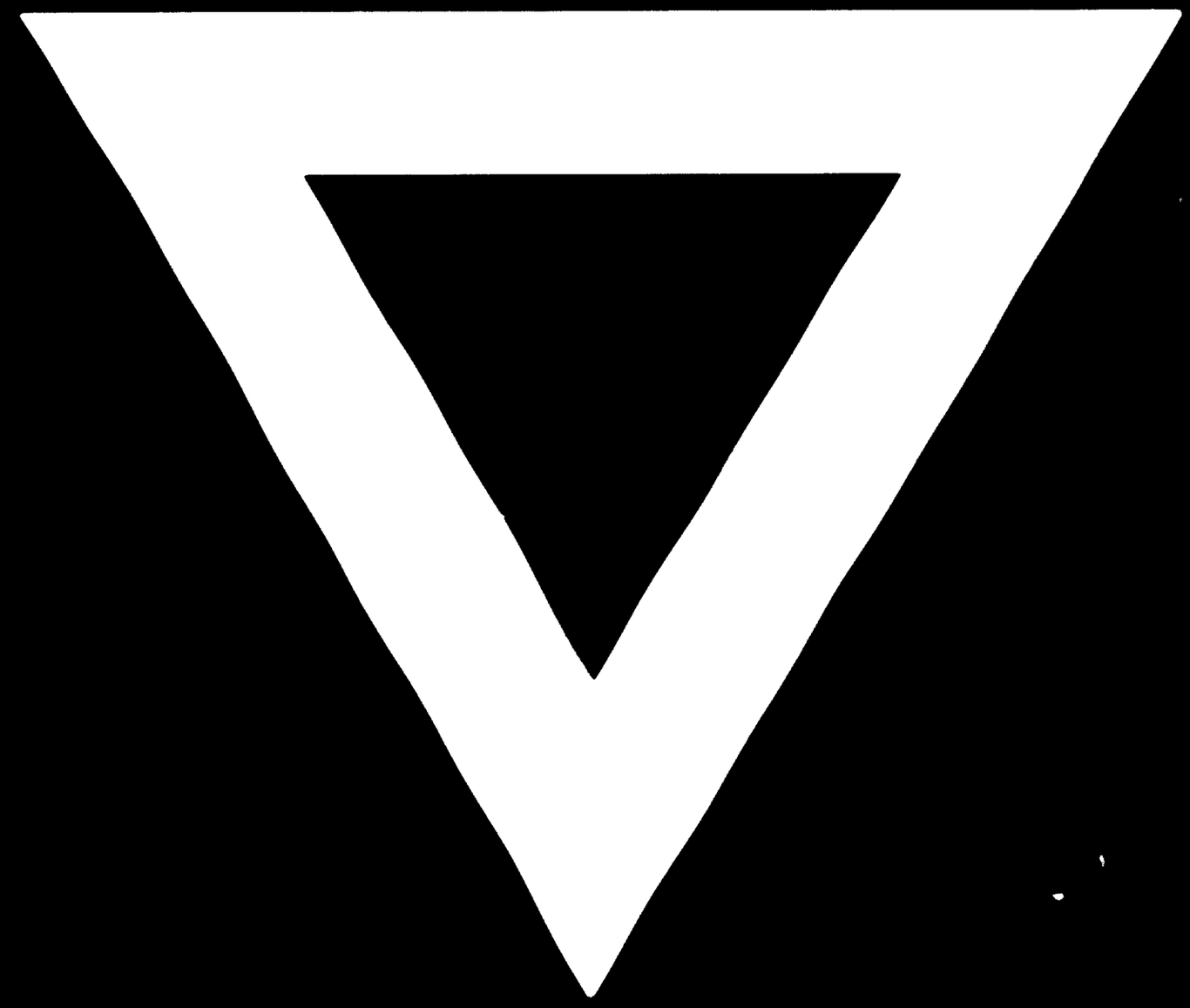
**Farmer C** applies all recommended inputs. He obtains 1,266/- per acre.

Source: German Agricultural Team 1974

Appendix III



# G-343



# 77.10.05