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ASSISTANCE FOR THE ESTABLISHMENT OF A PESTICIDE FORMULATION PLANT IN ETHIOPIA

UC/ETH/85/214

ETHIOPIA

Technical report: Design of pesticides formulation plants*

Prepared for the Government of Ethiopia
by the United Nations Industrial Development Organization

Based on the work of Gopal K. Handa, expert in the design of pesticides formulation plants

Backstopping officer: B. Sugavanam, Chemical Industries Branch

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EXPLANATORY NOTES

- The monetary unit in Ethiopia is the 'Birr'.
- Exchange rate used in the report is 1 US Dollar = 2.07 Birr
- References to Dollars ($) are to United States Dollars.
- Following abbreviations are used:

AFRD	-	Animal and Fisheries Resources Department
AISCO	-	Agricultural Inputs Supply Corporation
AMC	-	Agricultural Marketing Corporation
ARAD	-	Agricultural Research and Advisory Department
D	-	Dust Formulation
EC	-	Emulsifiable Concentrate
EDDC	-	Ethiopian Domestic Distribution Corporation
FPHARMECOR	-	Ethiopian Pharmaceuticals and Medical Supplies Corporation
ESC	-	Ethiopian Sugar Corporation
ETIMEX	-	Ethiopian Import Export Corporation
FC	-	Foreign Currency
Fl	-	Flowable Formulation
G	-	Granular Formulation
GDP	-	Gross Domestic Product
gai	-	grams active ingredient
IAR	-	Institute of Agricultural Research
IPS	-	Industrial Projects Service
Kg,Kgm	-	Kilogram
K.Lit	-	Kilo-litres
KV	-	Kilo Volt
KVA	-	Kilo Volt Ampere
KWH	-	Kilo W tt Hours
LC	-	Local Currency
MCTD	-	Ministry of Coffee and Tea Development
MOA	-	Ministry of Agriculture

MOH	-	Ministry of Health
MOI	-	Ministry of Industry
MS	-	Mild Steel
MSFD	-	Ministry of State Farms Development
NCC	-	National Chemical Corporation
PA	-	Peasants Association
PDPI	-	Pesticides Development Programme of India
PS	-	Peasant Sector
PPRD	-	Plant Protection and Regulatory Department
Q	-	Quantity
RRC	-	Relief and Rehabilitation Commission
SL	-	Soluble Liquid
SS	-	Stainless Steel
TYPP	-	Ten Year Perspective Plan
ULV	-	Ultra Low Volume Formulation
UNIDO	-	United Nations Industrial Development Organisation
UNDP	-	United Nations Development Programme
V	-	Value
WP	-	Wettable Powder Formulation
WSC	-	Water Soluble Composition
WSP	-	Water Soluble Powder

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ABSTRACTS

Towards the objective of establishing a pilot plant for formulation of pesticides in Ethiopia, the UNIDO project UC/ETH/85/214 was designed to assess the type of pesticides that should be formulated in the country; to prepare a basic design of the plant with estimation of cost of equipment, construction, utility and general services, in-plant training and other expenses; recommend a suitable location and provide the raw material and input requirements for one full year operation of the plant.

The report presents a detailed treatise on some of the special characteristics of pesticides market in Ethiopia, the current use of agrochemicals and potentials for specific individual product formulations based on a general projection of likely economic and agronomic developments in the light of agricultural development plans and Government policies. It analyses the structure of the market with respect to crop-chemical participants, potential customers and the marketing/distribution aspects. Crop-wise analysis of pests and crop protection measures has been brought out. Present day's market of pesticides and the demand projections have been drawn up.

Total annual imports of pesticides in Ethiopia in the present context is estimated as US Dollars twenty million. The country, however, has a much larger potential need for pesticides since the Government has focussed on agricultural development as its priority to achieve the primary goal of food self-sufficiency. Although, at present, an overwhelmingly larger share of pesticides usage is in state farms, it is expected that as agriculture develops the usage in the predominant peasant sector would eventually increase. With a fairly large consumption of pesticides as at present and a remarkably high potential, the concern on formulating pesticides locally has become apparant, hence the need for establishing local formulation operations. Setting up of multipurpose formulation facilities to process liquids, dusts and granules

for insecticides, based on utilization of local solvents and packaging materials to the extent feasible in the first phase has been recommended. In the light of this the report presents the raw material and packaging material requirements and their local availability and suitability; the technical inputs in terms of detailed list of battery limit plant and equipment, utilities and off-site services, civil construction and other project requirements and their costs. Locational aspects for siting the plant has been appropriately dealt with. Strengthening of planning and monitoring mechanisms concerning productions, consumptions, imports and other related issues at the national level for now and for the future have been recommended. Suggestions regarding approach to future planning of industry have also been made. Appropriate recommendations have been included for improving the input supply distribution system and for expansion of field activities required for promotion of the proper and judicious use of pesticides.

INTRODUCTION

A. Project Background

Agricultural sector dominates the economy of Ethiopia. Prosperity of the country is largely dependent on a productive and efficient agriculture. Ethiopia is not self-sufficient in food and in fact, has been subjected to chronic shortages of food. A high priority has been accorded in the Ten Year Perspective Plan (TYPP 1984-85 to 1993-94) of the country to improvements of the agricultural sector. Several programmes involving large investments have been embarked upon in the country aiming at a consistant and consolidated growth of this sector to make the country self-supporting in food and enhance export capacity. Amongst the strategies designed to attain these goals, specific programmes in research, extension services, improved supplies of agricultural inputs and farm services are expected to play pivotal roles.

Ethiopia can be said to have a peasant based economy. Ninety percent of its agricultural production comes from the predominant peasant sector using traditional methods of farming. The heavily mechanised state farms on the other hand use large amounts of inputs including plant protection chemicals making up for the rest of agricultural production. Plant protection measures in the peasant sector farming are grossly inadequate and the crop yields, therefore, are low.

The realization that the improvement of agricultural productivity for a sustained economic development of the country and the growing awareness to use agricultural chemicals including pesticides, has imparted a new dimension and an urgency to the country's search for improving the availability of pesticides and to

find a viable basis for the local manufacture of a variety of pesticide formulations, utilizing maximum indigenous raw materials as far as feasible.

Presently, the entire requirement of pesticides is met through imports which places a heavy burden on the national economy and an undesirable limitation on proper use of crop chemicals. Many of the raw materials are available within the country. To this end the Government has been considering the establishment of a pesticides formulation facility which could cater to local needs on selective basis.

The State Farm Authority had requested UNDP assistance to set up a pesticides formulation plant as early as June 1978. The National Chemical Corporation of the Ministry of Industry again in 1981 justified the establishment of such a facility based on the rising demand of agrochemicals used in the country. Meanwhile, during early 1986, an 'opportunity study' was carried out by East German experts recommending establishment of a pesticides liquid formulation plant in the country. Following this the Ethiopian Government requested UNIDO assistance to strengthen the GDR study in terms of providing additional inputs including technical data, raw materials, engineering costs etc. in order to upgrade the same to the level of a full fledged techno-economic feasibility study.

The aforesaid proposal was approved during early October 1986 and UNIDO agreed to field a pesticides formulation specialist to undertake the study in collaboration with National Project Counterparts to supplement the previously carried out study report. In particular the expert was expected to assess the following:

a) Type of pesticides that should be formulated in the country in addition to those mentioned in the report;

b) Detailed list of equipment, raw materials needed for one full year operation of the plant;

c) Confirmation on the choice of location with respect to transport/distribution of raw materials and finished products;

d) Cost of equipment, construction, utility services, in-plant training, consultants, laboratory equipment to be specified;

e) Suitability of locally available solvents and whether any test should be carried out in the future to include them in the formulation process;

f) Whether the pesticides formulated would cover both agricultural and public health outlets.

g) Look into the availability of local container facilities;

h) Submit a report on the findings and recommendations to the Industrial Projects Service for their financial and economic evaluation.

In approaching the assignment, it was deemed necessary to obtain background information on agriculture in general, important crops and pests in the country, pesticide use patterns and other ralated issues, importation trends, current formulation activity, if any, availability of local raw materials, and infrastructure and support facilities available. In order to obtain an overview of the situation and to

identify and short list some of the potential plant protection chemicals out of a myriad number of products being used in the country which could be considerd for specific individual formulations, a detailed market research was carried out covering all the sectors of pesticides importation and usage to establish the existing agro chemicals market, its size and future potential based on general projections of likely economic and agronomic developments in the light of agricultural improvement plans and Government policies. For this purpose, visits were arranged and extensive discussions were held with officials of various ministries, departments, institutions, parastatal enterprises as well as some private companies engaged in supplies of agrochemicals and the data/information collected through prepared questionaires and structured discussions from different sources forming the basis of this report have been appropriately incorporated in the main body as well as annexed to this report. List of the organizations contacted may be referred to in Appendix I. In addition, in reviewing the pesticides market and other connected issues, several relevant documents were used as reference.

The report in conformity with the terms of reference, contains a comprehensive review of the present pesticides market, of demand and supply and assessment of future trends, providing the framework for the selection of products, the type of formulations to be produced locally and the capacity to be installed for each type of formulation (chapters one and three). Materials and inputs, in the form of detailed list of equipment, raw materials needed for one full year of operation of the plant and other technological aspects have been assessed (chapters five and nine). Location of the formulation outfit in the light of transportation/distribution of raw materials and finished products and other

production factors, manpower requirements and plant layout aspects have been evaluated (chapters four and six). The report also presents the cost of main plant and equipment, construction, utility services, in-plant training, constultants, laboratory and other off-site equipment (chapters eight and nine). Availability and suitability of locally available solvents and other raw materials and containers have been dealt with (chapters two and five).

Main text of the report has been divided into nine chapters to ficilitate its perusal. Recommendations on each aspect, wherever appropriate, have been given in the main text and also outlined on a selective basis as a separate chapter ten. The relevant data referred to in the body of the report have been included in the appendices.

B. Official Arrangements

The project UC/ETH/85/214/11-02 was approved in early October, 1986 with a UNIDO contribution of US Dollars 21600 from UNIDF. Provision was made for the fielding of consultant to supplement the GDR experts' report and for a visit to Vienna by an official of the Ministry of Industry to participate in discussions on final report of the consultant.

The consultant arrived in Ethiopia on May26, 1987, and was assigned to the National Chemical Corporation Addis Ababa. Mr. Makonnen Tessema, Chemical Engineer, Mr. Sereke Berhan, Economist and Mr. Tesfaye Birmedge, Mechanical Engineer of the National Chemical Corporation have been associated during most part of the study and accompanied the consultant to various institutions in the country for data collection. Mr. Asrat Bulbula, Head of the Planning and Projects

Department oversaw and coordinated the various activities . The consultant has also been in touch with Industrial Projects Service (IPS) from time to time in order to frame the technical and financial inputs in accordance with the requirements of IPS for preparation of economic and financial analysis.

C. Objectives of the Project

The project was designed to serve the following economic goals:

Development Objective

To assist the Government in raising food production and health standards through increased availability of pesticides for agriculture and public health programmes.

Immediate Objectives

i) To determine the technical, economic and financial viability and to update the earlier feasibility studies to the establishment of pilot plant for formulation of pesticides

ii) To reassess the pesticides selected for formulation and the site chosen by the earlier studies and make suitable recommendations.

iii) To prepare a basic design of the plant with estimation of cost to include both local and foreign currency inputs.

iv) To assess the training needs for the Government counterparts for running and maintenance of the plant.

v) To assess the likely raw materials required with cost for one year operation of the plant.

Chapter One

AGRICULTURE AND PESTICIDES USAGE IN ETHIOPIA

A. Agriculture in Perspective

1.1 Ethiopia is situated in the north-eastern part of Africa sharing its frontiers with Sudan to the north and west, with Djibouti to the north-east, with Somalia to the south-east, and with Kenya to the south. In the north, it borders on the Red Sea with a 1,010 km coast line. The country, the tenth largest in Africa, covers a total area of 1,243,000 square km of which over 65 percent is potential agricultural land. Ethiopia's outstanding land feature is the extensive plateau and mountainous terrain which forms most of the central and northern part and the surrounding low lands, interspersed with number of streams and lakes. The interior highlands rise rapidly to more than 2000 meters and the coastal low lands sink to more than 100 meters below sea level. As a result the country is divided into regions, each characterised by different climates and distinctness.

1.2 Agriculture is the mainstay of the country's economy and would remain so in the foreseeable future: The agricultural sector accounts for over half of its gross demestic product (GDP), contributes nearly 90 percent to its export earnings and provides livelihood to an overwhelming proportion of the country's population. National prosperity is, therefore, highly vulnerable to achievements in this sector and its satisfactory growth is critical not only for improvement in the food situation but also for accelerating the growth of GDP, exports, and industrial production. The major food crops are teff (a locally consumed cereal), maize, barley, sorghum, wheat,

pulses and oilseeds. Coffee, the principal export crop, generates over 60 percent of the country's export earnings. Other export crops include oilseeds, pulses, cotton, sugarcane, fruits and vegetables. The country's main potential lies in agriculture, for which the natural condition of several areas are favourable. Ethiopia has a substantial potential for agricultural development owing to its relatively large areas of fertile and virgin land in the south and central areas of the country. Of an estimated 80 million hectares of agricultural land, only about 12 million hectares are used for crops and fallow. It is estimated that in 1983-84, about 5.7 million hectares were cultivated in the country excluding Eritrea and Tigray Administrative Regions in the north. A comprehensive classification of land on the basis of its use is given in Appendix II.

1.3 Ethiopia has different agro-ecological zones as a result of the wide range of altitudes and precipitation variation to permit a variety of food and cash crops to be grown both for local consumption and for exports. The country is divided into eight agricultural zones. Weather conditions are not equally volatile in all the regions of the country. The central highlands has a temperate climate where maximum temperatures rarely rise above 25-28°C. This region has a high rainfall (1200-1300 mm per year) from July to September and contrasts with the plains of the Ogaden and Denakil which are hot, dry and desert like. The transition zone towards Somali coast is semi-arid to arid with erratic rainfall totalling 250-500 mm per year. The coastal strips along the Red Sea have less than 100 mm per year and is exteremely hot.

1.4 In terms of population size, Ethiopia, with a population estimated at over 42 million in 1984 is the third largest country in Africa. The annual growth rate is estimated to be 2.6 percent; the population density is 29 per square km, and 88.7 percent of the population live in the rural areas. The country is divided into fifteen administrative regions (including Addis Ababa) for purposes of internal administration. These regions are sub-divided into 102 'awrajas' (districts) which are further sub-divided into 586 'woredas' (sub-districts).

1.5 Ethiopia is not self-sufficient in food and the domestic food supplies have remained far below requirements with the result that the country has to depend on foreign food aid and imports. The cost of compensating food imports into the country constitutes a sizeable portion of the total value of imports causing a heavy drain on its economy. This has been compounded by frequent droughts in some parts of the country. The drought and famine of 1973/74 and then its reoccurence in 1981/82 and again in 1983, 1984 and 1985 besides claiming a large toll of human lives and a substantial portion of livestock population, contributed to severe food shortages. Self-sufficiency in food has been the central objective of planning in the country and is a priority feature of the current Ten Year Perspective Plan (TYPP), 1984-85/1993-94 which provides a long term framework for the transformation and expansion of the economy. The targets and projections of this plan are to be elaborated through medium-term plans. The currently ongoing Three Year Development Plan extending to the mid term of the long term Plan lays emphasis on measures that would strengthen agriculture with specific objectives of increasing food production to alleviate food shortage, to expand production of agricultural raw materials for meeting the needs of local industries and to

increase production and improve quality of exportable commodities like coffee, sesame and other export crops. To this end, the main emphasis of current agricultural policy is to bring in qualitative changes by ushering in new strategies of improved farming through the introduction of high yielding varieties, improved seeds, chemical fertilizers, plant protection chemicals and other farm management services.

1.6 According to TYPP, the total cultivated area under major crops is to increase from 6.7 in 1985/86 to 7.6 million hectares by 1988/89 and to 8.1 million hectares by 1993/94, with 18 percent of the land expansion planned to take place within the selected surplus and potentially surplus producing districts. Almost all the agriculture depends on rainfall. Government estimates the total irrigable area to be around 2.25 million hectares of which only 141,800 hectares (or 6.3 percent) has been developed so far. Irrigation development programmes are underway to bring additional areas under irrigated cultivation. In some parts of the country, rainfall is so erratic and low that the threat of drought is ever-present. Crop failures due to drought have been an occasional feature in the past. Estimated area, production and yield of principal crops during 1983-84 may be referred to in Appendix III, while sectorwise details may be seen in Appendix IV.

1.7 Agricultural production in Ethiopia is derived from two sub-sectors, peasant agriculture and state farms. The peasant farms account for some 94.6 percent of cultivated land and produce over 90 percent of agricultural output - including most food crops (cereals, pulses and oilseeds) and coffee. Crops such as cotton and sugarcane are grown primarily on state farms - see Appendix V for areas under various agricultural products sectorwise. For cultivated

area under various crops now and for 1994 (planned), Appendix VI may be referred to.

1.8 At the start of the TYPP in 1984, a total area of 6.9 million hectares was planned to be brought under cultivation, 71.7 percent under cereals, 10.4 percent under pulses and 17.9 percent under other crops including oilseeds, cotton, coffee and sugarcane. Under the TYPP, total area under various crops is expected to increase by 17 percent with a marginal increase under cereal (3.6 percent) and 53 percent, 330 percent, 18 percent and 75 percent for oilseeds, cotton, coffee and sugarcane respectively. About 95 percent of the area under cereals, pulses and oilseeds will be under private farmers and only five percent under cooperatives and state farms. Practically all the cotton and sugarcane cultivation will be state owned. Coffee plantation will mostly be done by the peasant subsector. Under the TYPP, the producer cooperatives (with membership of individual farmers) subsector will assume a more significant role in terms of increasing its share in cereals, pulses and oilseeds from 1.4 in 1983-84 to 52.1 percent in 1993-94 (Appendix IV). At the same time state farming is also expected to expand its contribution from 3 to 6 percent during the Plan period. State farms and producer cooperatives are projected to extend their activities in coffee growing area as well.

1.9 The peasant subsector is operated by millions of small farmers, with an average holding of 1.5 hectares (ranging between 0.5 to 10 hectares) either individually or in cooperatives established under the auspieces of Peasant Associations (PAs) consisting of 200 to 400 farmers per PA. Crop production is generally subsistence oriented and peasants first concentrate on food production and then whatever cash crop is suitable and convenient to produce.

Agricultural practices followed, have remained traditional and in absence of the use of more modern techniques, productivity has been low. As in many parts of Africa, use of plant protection chemicals by smallholders in Ethiopia is a fairly recent introduction and only a few have come to realise the benefit of the use of agrochemicals. There has been a limited success in the introduction of plant protection measures. Increasing crop production will have to be achieved largely by a sustained rise in productivity of both food and cash crops through improved methodology combined with a reliable supply of agricultural inputs of which pesticides offer high economic benefits. The Government is looking increasingly to the peasant farming to ensure a long term growth of agricultural production and improve the pace of economy in terms of providing food for the growing population, employment and export earnings.

1.10 The state farm subsector, on the other hand, is rather well organized, heavily mechanized and uses large amounts of credit and inputs. Costs of production in this sector are substantially higher than those of small holders due to several reasons including heavy organizational costs. Under the TYPP, the Ministry of State Farms Development is expected to expand the cultivated area under different crops by an additional 300,000 hectares (upto 1993-94), out of which 115,000 hectares would be irrigated. Crop productions by the state farms are projected to grow at a rate of 19.4 percent per year rising from 420,000 tons in 1985-86 to 710,000 tons in 1988-89. The Ministry of Coffee and Tea Development is also expected to extend its cultivated area by an additional 32,600 hectares of which about 4000 hectares would be under irrigation.

1.11 The low level of crop yields, particularly in the peasant sector has been a great concern of the Government for a long time. In recent years serious efforts have been made by the Government to strengthen the agricultural sector by alloting increasingly sizeable portions of public expenditure to programmes aiming at the intensification of agricultural production and increasing the productivity and efficiency through a series of rural and agricultural development projects, and through diffusion of improved technology and increasing the supply of inputs and extension services. Agricultural research is one of the areas given priority in TYPP and the Ministry of Agriculture have launched specific programmes in research, training and extension services to improve the performance of agricultural sector. Major strategies to be adopted by the Government to achieve improvements in the agricultural sector include allocation of inputs, extension agents, implements and other farm services and supplies on priority to the surplus and potentially surplus producing 'awrajas' and 'woredas'; execution of settlement programmes of moving families to presently unoccupied fertile regions of the country to reduce vulnerability to famine; villagization schemes to regroup peasants in terms of providing dwelling units, feeder roads water and other services; expanding irrigable area; strengthening of agricultural research with development of existing as well as establishing new research stations for different agro-ecological zones; restructuring of research activities to meet real needs and problems of agriculture; strengthening of linkages between research, training and extension services; and expanding the state farm sector.

B. Magnitude of Crop Losses

1.12 The crops/plants in Ethiopia are affected by a wide spectrum of pests and diseases of economic significance which cause considerable losses both in the pre-harvest and post-harvest stages. Appendix VII lists more important pests of agriculture in Ethiopia which gives an indication of the extent of pestilence to which the cultivated crops are exposed to, as is usual in countries with temperate to tropical climates. As more and more land is brought under plough and with increased irrigation, pest problems are likely to assume greater proportions due to changes in the eco-system. To make the problem more difficult, the high yielding varieties are often seen to be more prone to attack by pests. Also, increased use of fertilizer, as envisaged in the various agricultural development programmes, is likely to enhance the susceptibility of crops to plant diseases in addition to increased problem of weed control.

1.13 Crop yield responses have been reported to be significantly higher in the state farms, where the use of agro-chemicals is given due recognition, as compared to the peasant farming using limited or no plant protection chemicals. That considerable loss in the yield of crops occurs due to ravages of pests in the field and in storage and that yields have been low is well recognised in the country and various authorities place the overall loss as between 30 to 40 percent every year. Data on the extent of cropwise damage is not available. Collection and compilation of such a data is recommended which will help to plan appropriate treatment schedules for different crops.

C. Adoption Levels

1.14 The acceptance and adoption of improved agricultural practices is related to the extent to which the farmers have become aware of the benefits. Majority of the peasantry is reported to lack pest perception and are not well conversant with the use of pesticides, except some of those who are in the vicinity of state farms who in addition to using insecticides to a limited extent as well look for herbicides for a more effective weed control. They appear to have little conception of potential crop yields and the economics of the agrochemicals usage. By and large, they tend to accept the established patterns of damage and yield loss. Inadequate extension and support services, low level of education and sophistication of the farmer, poor organization of production and problems associated with availability, marketing distribution of inputs are some of the reasons for low level of acceptance of crop chemicals. Wrong usage of plant protection chemicals, in-appropriate dosage, untimely applications, lack of awareness of safety measures, ineffective coordination of spray schedules, trial and error approach towards plant protection are some of the common observations on peasant farming. The problems are compounded, when in the absence of a local manufacturing facility, appropriate products in formulations and packaging suitable for the small farmers are not available. Another feature which deserves mention is the substandard materials often available in the market which are not efficacious in the field, either due to prolonged gap between its manufacture and usage (when the products are imported) or for reasons of poor quality, with the result that the farmer does not see his moneys worth in applying pesticides.

1.15 In the Ethiopian context, use of plant protection chemicals is extremely low and most imports are consumed by the state farm sector, which cultivates less than four percent of the land under agriculture. Pesticides are not freely available to peasant farmers due to limitations in supply and inefficient distribution system. A local pesticides formulation facility would go a long way in alleviating most of the aforesaid constraints.

D. Present and Potential Yields

1.16 Optimization of several inputs including fertilizers, plant protection chemicals, improved seeds, irrigation and improved farm practices would permit an increase in the yield of agricultural crops. It is of interest to note that the economic benefits are the highest in optimising the use of pesticides as compared to other inputs when considered individually. Furthermore, when viewed from investment and operational angle, establishment of a local pesticides manufacturing and formulation facility in developing countries like Ethiopia, (which offers benefits of improved availability, better quality products at lower prices) is far more favourable and easier in comparison to that of an economic size fertilizer unit which is highly capital intensive and requires a well established infrastructure in the country.

1.17 Institute of Agricultural Research (IAR) under the Ministry of Agriculture (MOA) has issued specific recommendations based on experiments at IAR and in the demonstration fields in respect of improving yield of various crops. The present and potential crops yields are as given in Table 1.1. The smallholder peasant sector yields are low and often fluctuate widely from year to year mainly in response to rainfall and use of inputs and remain below their technical

Table 1.1 Present and Potential Crop Yields (Tons/Ha)

Crop	IAR Station	Demonstration Fields	Peasant Sector
Cereals			
- Barley	5.7 - 6.0	4.0	1.0
- Maize	7.7 -12.0	5.0	1.6
- Sorghum	4.0 - 6.0	2.5 - 3.0	1.1
- Teff	1.2 - 2.8	1.0 - 2.2	0.8
- Wheat	3.0*- 5.3**	3.0 - 4.0	1.0
	* Durum Wheat	** Bread Wheat	
Oil Crops			
- Ground Nuts	4.0 - 5.0	3.5	0.4 - 0.5
- Sesame	2.0	1.0 - 1.2	0.3 - 0.4
Fibre Crops			
- Cotton	6.0	3.0	2.0***
	*** Yield as obtained in state farms.		
Pulses	1.5 - 2.5	-	0.8 - 1.0
Vegetables			
- Berbere	3.4	-	2.6
- Tomato	65	-	30 - 35
- Onions	60	-	30 - 35
- Cabbages	42	-	25 - 30
- Potato	28 - 30	-	15 - 20
- Sweet Potato	28 - 30	-	20 - 30
- Carrot	30	-	20
- Beet Root	30 - 35	-	18 - 20
- Green Bean	25	-	15

Source: Fertilizer Complex - Prefeasibility Study, Ministry of Industry.

potentials. With the availability of improved seeds and most importantly a steady increase in the use of fertilizers, pest control measures assume greater importance to ensure high crop yields and better economic returns. Emphasis should be on safeguarding of higher yields by improved crop protection and by improved post-harvest storage.

E. Plant Protection, Pesticides Procurement and Distribution

1.18 Plant protection activities are carried out independently by several organizations in the country in a decentralised set up with each carrying out its own planning, procurement, distribution and application. The Ministry of State Farms Development (MSFD) is totally independent in terms of planning and execution of plant protection operations in its entirety for the farms under its control. Similarly the Ministry of Coffee and Tea Development (MCTD) and the Ethiopian Sugar Corporation (ESC) are responsible for their own crops in the state sector. These Ministries and the parastate autonomous organizations procure their own requirements directly. For the peasant sector, the responsibility lies with the Ministry of Agriculture firstly to identify and recommend the types of products and formulations to be used and secondly arrange procurement and distribution through Agricultural Inputs Supply Corporation (AISCO), a parastatal under the Ministry of Agriculture responsible for handling agricultural inputs throughout the country. The Ministry of Agriculture through its Plant Protection and Regulatory Department also provides free plant protection services against migratory pests, epidemic plant diseases, and pest outbreaks, such as desert locust, grain eating birds, armyworms and rodents. Pesticides used for control of migratory pests are generally received as gifts from donor agencies.

The Ministry used 57,627 litres of liquid pesticides (including fenitrothion 50 EC, 95 ULV; endosulfan 35 EC; cypermethrin 5 EC and diazinon 60 EC) and 96,480 kgs. of dry formulations (including carbaryl 85 WP) against army worms last year. Over 500 litres of Fenitrothion 60 ULV was also used against grain eating birds. Currently pest control operations are on against locust using fenitrothion 95 ULV, diazinon 60 ULV and dieldrin 20 EC. MOre than 11,000 litres of these chemicals have been used.

1.19 MSFD, with its headquarters in Addis Ababa is responsible for developing and operating large scale farming in the country. It has under its control seven corporations, five of them engaged in production activities while two are service oriented. These corporation have been organised either on regional basis (Awash, Southern and North Western Development Corporations) or on the basis of product/service speciality (Livestock Development and Meat Corporation, Horticulture Development Corporation, Seed Development Corporation, Agricultural Machinery & Technical Services Corporation). Each corporation operates two to three enterprises located regionally. Under each enterprise there are farms with sizes such as 2000 hectares for irrigated horticultural crops, 4000 hectares for irrigated cotton and upto 6000 hectares for rainfed farming. The MSFD, the corporations, the enterprises and the state farms are adequately staffed for effective operation and control at various levels.

1.20 Agricultural Research and Advisory Department (ARAD), one of the seven in the MSFD headquarters, has been assigned the task of organising research activities for the state farms including plant protection. Each year before the onset of crop season, a workshop is organised by ARAD where subject

matter specialists from corporations, enterprises and the state farms are invited to review the previous programmes and in the light of results obtained, come up with new recommendations for coming season. Trial programmes for new season including the ongoing ones are discussed and finalised and sent to representative state farms for execution. Each state farm has separate experimental sites allocated for conducting trials. Concerning pesticides, a 'Technical Committee' consisting of MSFD experts from concerned departments and the crop protection managers from corporations, reviews the trial results of the previous seasons on the basis of reports received from various experimental stations and also analyses the past successes and failures crop by crop, pest by pest against the pesticides actually used in the field in past seasons. Based on these deliberations, the 'Committee' recommends the pesticides to be used in the coming season, their rates of application, the areas to be treated in different zones and the total quantities to be purchased. These recommendations, after formal approval, form the basis for issue of an international tender by the purchasing arm of the MSFD namely the Agricultural Machinery & Technical Services Corporation. Most of the products are purchased in bulk packaging of 200 kilograms or litres. The suppliers are required to undertake full responsibility for performance of the product they offer in respect of its efficacy and other characteristics in accordance with the results obtained with trial samples. Cropwise pests and list of products recommended for use on state farms for the period 1987-88 may be referred to in Appendix VII while Appendix VIII lists by quantity and value various pesticides purchased by the MSFD during the crop years 1982-83 to 1987-88. Bulk of the products used on state farms are purchased under trade names as liquid formulations. It

normally takes four years before a pesticide can be recommended for use in the state farms. Only those products approved and recommended by the MSFD may be allowed for importation and use by the Ministry. The MSFD carries out continuous research programmes and as a result, updates its recommendations on a yearly basis.

1.21 The MOA is the sole Government body responsible for all aspects of agricultural pest control in the peasant sector. This includes advice on control measures, provision of pesticides and equipment and conduct of emergency control operations, such as on migratory pests. To look after the pesticide requirements of the Peasant sector, including those in resettlement areas and those for coffee and tea production, the MOA, the MCTD and the Relief and Rehabilitation Commission (RRC) procure inputs for their specialised needs through the recently established Agricultural Inputs Supply Corporation (AISCO) a parastatal under the MOA. AISCO, through its widespread network of marketing centres (well over 600) throughout the country, organizes the sale and distribution of pesticides procured on behalf of MOA for the peasant sector while the materials imported on behalf of MCTD and RRC are handed over to the respective organizations for distribution. Based on recommendations of the Institute of Agricultural Research (backed by extensive research and small plot trials) with respect to choice of pesticides to be used and the assessment as to the quantities required by the extension staff and Plant Protection and Regulatory Department (PPRD) and taking into consideration availability of funds etc., the MOA indents the purchase through AISCO. The MCTD and the RRC also rely mainly on the recommendations of the Institute of Agricultural Research (IAR) on pesticide use and only procure those approved by IAR for use against particular pests. It takes an estimated six years research before a pesticide can be recommended for use by IAR. Organization structure of the MOA concerning plant protection is shown in Appendix IX. The responsibilities within the PPRD are divided into three heads namely Pesticides Registration and Control (currently in the development stage), Plant

Quarantine and Crop Protection, which in turn has five services, Plant Pathology, Entomology, Migratory Pests, Rodent Control and the Wheat Development Project.

1.22 Procurement of agricultural inputs, mainly fertilizers, in Ethiopia was started by Agricultural and Industrial Development Bank in the sixties. In 1972, the activity was passed on to Agricultural Inputs Marketing Share Company, a newly established subsidiary of the Bank. This marked the beginning of pesticides procurement and marketing, though in a small way, in Ethiopia. During 1977-78 cropping season, the function of agricultural inputs marketing was passed on to Agricultural Marketing Corporation (AMC), which was also involved with grain procurement. AMC handled it until 1983-84 when it was felt that the activity can best be accompalished if it is placed under the Ministry of Health (MOH) and as a result Ethiopian Pharmaceuticals and Medical Supplies Corporation (EPHARMECOR) was established. This company could not effectively handle the total pesticides business in the country particularly the large requirements of the MSFD resulting in decentralization of procurement and distribution with each organization independantly managing its own. To handle the requirements of the peasant sector, AISCO was established in 1985, as a purchasing and distribution arm of the MOA. AISCO also handles the input requirements of settlement schemes, MCTD, Department of Animal and Fisheries Resources Development of the MOA for vaterinary use and for other specific projects. For the peasant sector, the requirements of pesticides are aggregated through service cooperatives by the Development Agents (extension worker at the field level) for their respective areas, scruitinized and compiled by the subject-matter specialists at the 'Weredas', Awrajas', the regional headquarters and through the zonal offices, and received by

the MOA, where it is finally reviewed and compiled for procurement through AISCO. Pesticides are also procured for use by the MOH for anti-malaria services and by the Ethiopian Sugar Corporation (EPC) for sugarcane plantations. The Ethiopian Import Export Corporation (ETIMEX) is the Government Organization to import household pesticide products, also through international tenders. The distribution of the products is turned over to other Government bodies such as the Ethiopian Domestic Distribution Corporation (EDDC) or the Retail Corporation which handles all supermarket outlets in the country. Details of pesticides requirements for individual consumers have been presented in subsequent sections.

1.23 Practically all the activities concerning pesticides in Ethiopia - procurement, importation, distribution, sale, research, use recommendations, application, quality control, are in the hands of the Government. The private sector involvement is limited to that of supplier and technical advisor on special product lines. Some private companies however, are also importing small quantities of pesticides and selling through retailers. Shell chemicals is reportedly formulating lindane dust on a small scale and supplying to farmers for foodgrain storage. The activity is reported to be not very successful because of inadequate distribution arrangements and poor marketing efforts of the company. Many of the leading manufacturers of pesticides are represented in Ethiopia by their subsidiaries or appointed agents. Among these are Ciba Giegy, Hoechst, Bayer, Shell Chemicals, Makteshim, Sumitomo, Union Carbide, BASF, Monsanto, Dow Chemicals, Chevron, May & Baker, Montedison, Philips-Duphar, Schering AG etc.

1.24 Plant Protection activities in Ethiopia are being carried out in a highly decentralised and scattered style with each organisation going its own way. There is no plant protection unit, section, institute or the like with national scope in the country. At Ministry's headquarters,

the function of plant protection assigned to Plant Protection and Regulatory Department is more of an advisory nature without any clear line functional role and without being a discreet entity in itself. With the current momentum of agricultural development in the country coupled with the significant role pesticides are expected to assume, there is a need to strengthen the plant protection activity at the Ministry headquarters in order to infuse a greater depth in proper planning and promoting judicious use of crop chemicals in the peasant sector in particular and in some of the state farms in general. Effective coordination of plant protection work in the regions through field staff requires a national perspective which the Ministry's headquarter should provide. A regional network with plant protection stations in districts with responsibilities for plant protection activities in their respective areas, under the overall control of headquarters needs to be developed. The Plant Protection and Regulatory Department should be equipped to play a stronger and more effective role in improving the performance of the peasant sector, through more effective plant protection measures. Some of the functions which the PPRD could possibly cover are briefly outlined hereunder:

- Receipt and compilation of all data pertaining to pesticides importation, consumption, local production/formulation(if any), stocks etc. at the country level;
- Planning of pesticide requirements at the national level involving participation of all agencies connected with pesticides in one way or the other;
- Organise an effective surveillance system for important pests and plant diseases with a view to develop a forcasting and warning service;
- Implementation and administration of the legislation for regulation and control of pesticides importation, use, sale, packaging and labelling, disposal of wastes

and empty conta... etc. The PPRD, to an extent is already being equipped for this function;

- Arrange training programmes in plant protection in regions and districts for the benefit of farmers;
- Provide help in formulating import policy on crop chemicals and plant protection equipment and in regulating and promoting the production/formulation of indigenous pesticides and equipment.
- Guide the regions and district plant protection staff in formulating and coordinating their schemes on plant protection;
- Initiate establishment of parasites, predators and pathogens for the biological control of pests;
- Coordinate all field tests and trials of crop chemicals and development of practical methods and measures for plant protection;
- Provide assistance in the establishment of local standards for pesticides, plant protection equipment and related matters.
- To issue publications on important matters connected with plant protection work in the country.

The PPRD, through its suggested role is expected to provide a coherent structure, country-programme and plans for total crop protection measures. It is also expected to consolidate the useful work being done in this area at several places in the country and act as a repository for all the data and information. Management of plant protection effectively is far more complex and at the same time rewarding than any other agricultural input including fertilizers.

F. Marketing and the Peasant Sector

1.25 The peasant farmers get their input supplies mainly through the distribution channals of AISCO spread all over the country and to a limited extent get some assistance from

PPRD of the MOA in case of migratory pest outbreaks. No promotional or marketing activities by AISCO or by any of the pesticide companies are being undertaken for the benefit of the grower. Benefits of after-sales service, farm demonstrations and technical back up through field staff usually provided by pesticide suppliers are not available. Once a pesticide company wins an order against tender, supplies are made and there ends the marketing activity of the supplier. The formulation and its pack is not tailored to the needs of the small farmer. Complete reliance on imports makes the total adaptation unsuited to the peasant. Emphasis is on using high-value speciality products of relatively higher concentrations as against low - cost commodity pesticides as dusts, granules etc., which find favour with the traditional farmer. AISCO is ill-equiped with field marketing staff and most of its marketing centres are without Marketing Agents (AISCO's employees) and at these centres, the Development Agents (extension worker under the MOA) carry out the marketing activities. For a vast country like Ethiopia, the marketing centres numbering about 680 are not enough for proper distribution of inputs. Availability of pesticides at these centres is often poor. The farmer has often to travel long distances to buy his requirements of inputs. The present distribution system with all its limitations falls short of the demands and basic inputs cannot be said to be freely available to peasants. Development of pesticides usage is therefore severally restricted. Complete reliance on distribution through AISCO alone is not likely to improve the present trend and the smallholder will continue to be starved.

1.26 Ethiopia has a fairly large potential market for pesticides and efforts are needed to develop it. An effective system of distribution of agricultural inputs becomes more important with their increasing demand. The

efforts of extension staff, howsoever efficient and well organised it may be, shall be thwarted in absence of an efficient input distribution system. In addition to the need to strengthen AISCO's distribution net-work, distribution through other channels (like village retailers, cooperatives, extension staff and sales depots of pesticides supplier companies in Ethiopia) to make available the desired inputs in the interior close to the doorstep of the farmer should be encourged.

1.27 The farmer will use pesticides only when he is made aware of the benefits that will acrue to him through its use. To popularise the use of plant protection measures in the peasant sector, specific promotional programmes will have to be launched. The effective role of extension services in this is of great significance. Notwithstanding the limitations on resource availability, the Government is making priority allocations in terms of improved extension services, inputs, credit facilities in some of more potentially productive areas. One extension agent is expected to be assigned for every 800 farmers in the surplus producing woredas. Emphasis need also to be given on farmers' education and training. Plant protection demonstrations, mass meetings, distribution of extension leaflets and seminars need to be organised for the benefit of the farmer. Economic weakness of the farmer is often a serious factor to limit his use of inputs. In the matter of subsidies and credit facilities, therefore, an adequate coverage needs to be given. Creation of 'Equipment Banks' in the rural areas may be considered from where spraying/dusting equipment could be hired by the small-holder.

G. Pesticides Consumption - An Overview

1.28 Introduction of pesticides in Ethiopian agriculture, in its organized form, started with procurement and distribution activities of Agricultural Inputs Marketing Share Company in the early seventies, and the usage has been gradually picking up ever since. Among the essential inputs, traditional farmers have been familiar with the use of improved seeds, water and manure, followed by fertilizers and the pesticides were last to be introduced. Even in the present times, bulk of the pesticides consumption is in the state farm sector and typical traditional smallholder peasants, who form bulk of farming community, hardly use any pesticides. Compared with some of the other countries in this region, the consumption of pesticides in Ethiopia has been rather low. The role of chemical inputs has been receiving special attention of planners only in the recent phase of agricultural development.

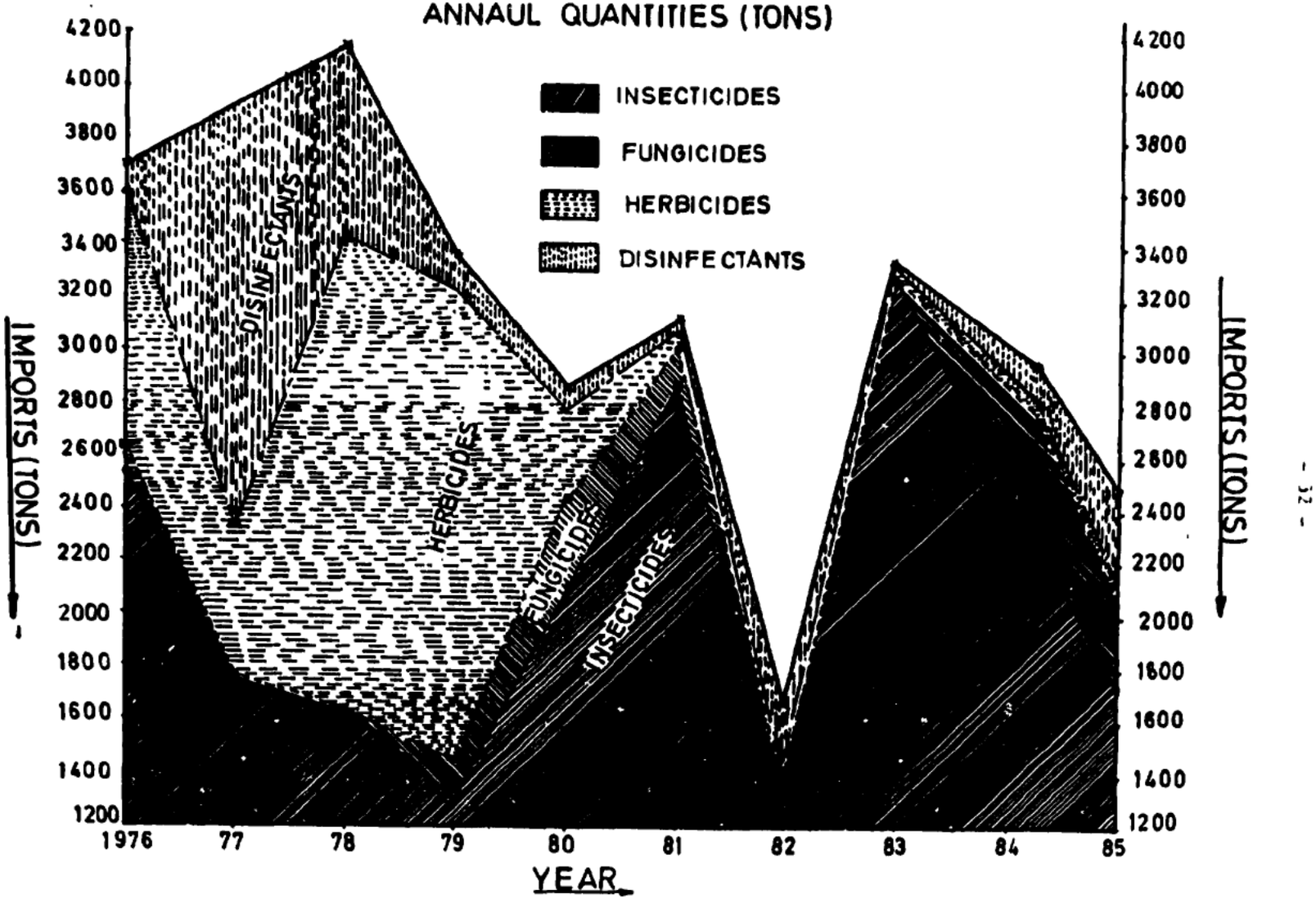
1.29 There is practically no local pesticides manufacturing, formulation or repackaging activity in Ethiopia, except for the dust formulation units, one belonging to Shell Chemicals formulating lindane dust and the other MOA for formulation of DDT dust, presently out of operation since last year. All importations, therefore, are as finished products, most of which are in bulk packaging. With the hazards involved with large packaging among the peasants who use small quantities at a time, pesticides in smaller packs of 5 and 10 kilograms/litres are now being imported for use in the peasant sector. Considering that even these sizes are rather unsuitable for the smallholders, a better proposal would be to import in bulk and repack locally in small ready-to-use packs of 100, 200 and 500 gms in particular the dry formulations which could be packed in heavy duty polythene bags, heat sealed, with clear instructions for use

and warnings printed conspicously in local language and in English. All imports are done by the Government except in limited cases when the private companies are allowed to import small quantities for supply to retailers.

1.30 Pesticides importation classwise, namely Insecticides, Fungicides, Herbicides and Disinfectants, quantity and value for the period 1976 to 1985 and 1986 (first half) are shown in Appendix X. To get ar idea of the importation trends, these figures have been ploted in Exhibit I - annual quantities, and Exhibit II - annual values of imports. During the ten year period under review, no clearly observable trend in Ethiopia's pesticide imports emerges. Indeed the time series of imports has been characterised by wide year-to-year fluctuations over this entire period. Looking at Exhibit II, a pattern of peaks and troughs in the value of imports is noticed, which could imply that the imports in the peak year (1978, 1981, 1984) were perhaps not fully consumed in these years and stocks were carried over to subsequent periods. Imports were particularly depressed during the year 1982. Exhibit I reveals that large quantities of herbicides have been imported into the country during the period 1976-81 and most of it not reflecting in the values of imports (Exhibit II) indicates that these products entered the country perhaps, as part of some aid package. The irregular jumps from year to year in the import figures is partly explained by the fact that the procurement of pesticides in Ethiopia, like in many other developing countries is not entirely need-based. Imports may be high when foreign finances could be set aside by the Government for the purpose or the materials may be supplied as part of an aid or grant from some bilateral or international source. Purchasing may also be influenced by certain specific objectives as a part of a campaign or a specific development programme.

IMPORTS OF PESTICIDES IN ETHIOPIA, 1976-1985

EXHIBIT 1

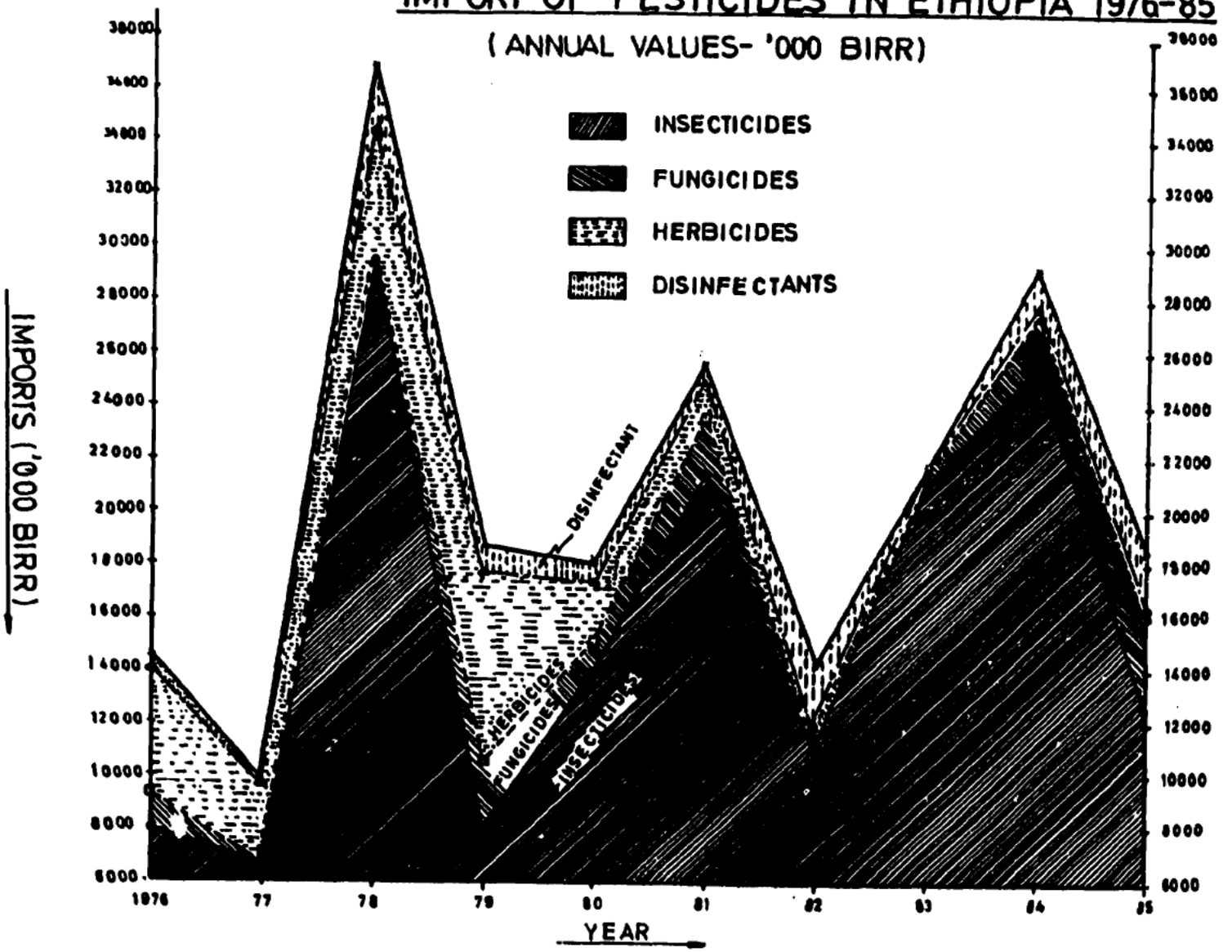


SOURCE: ANNUAL EXTERNAL TRADE STATICS

EXHIBIT II

IMPORT OF PESTICIDES IN ETHIOPIA 1976-'85

(ANNUAL VALUES- '000 BIRR)



SOURCE: ANNUAL EXTERNAL TRADE STATISTICS

The total imports ranged between the lowest of 1660 tons in 1982 to a maximum of 4137 tons during 1978, averaging about 3000 tons a year valued at 22.3 million Birr (about US Dollars eleven million). During the first half of 1986, 1759 tons of pesticides valued at 16.3 million Birr had been imported.

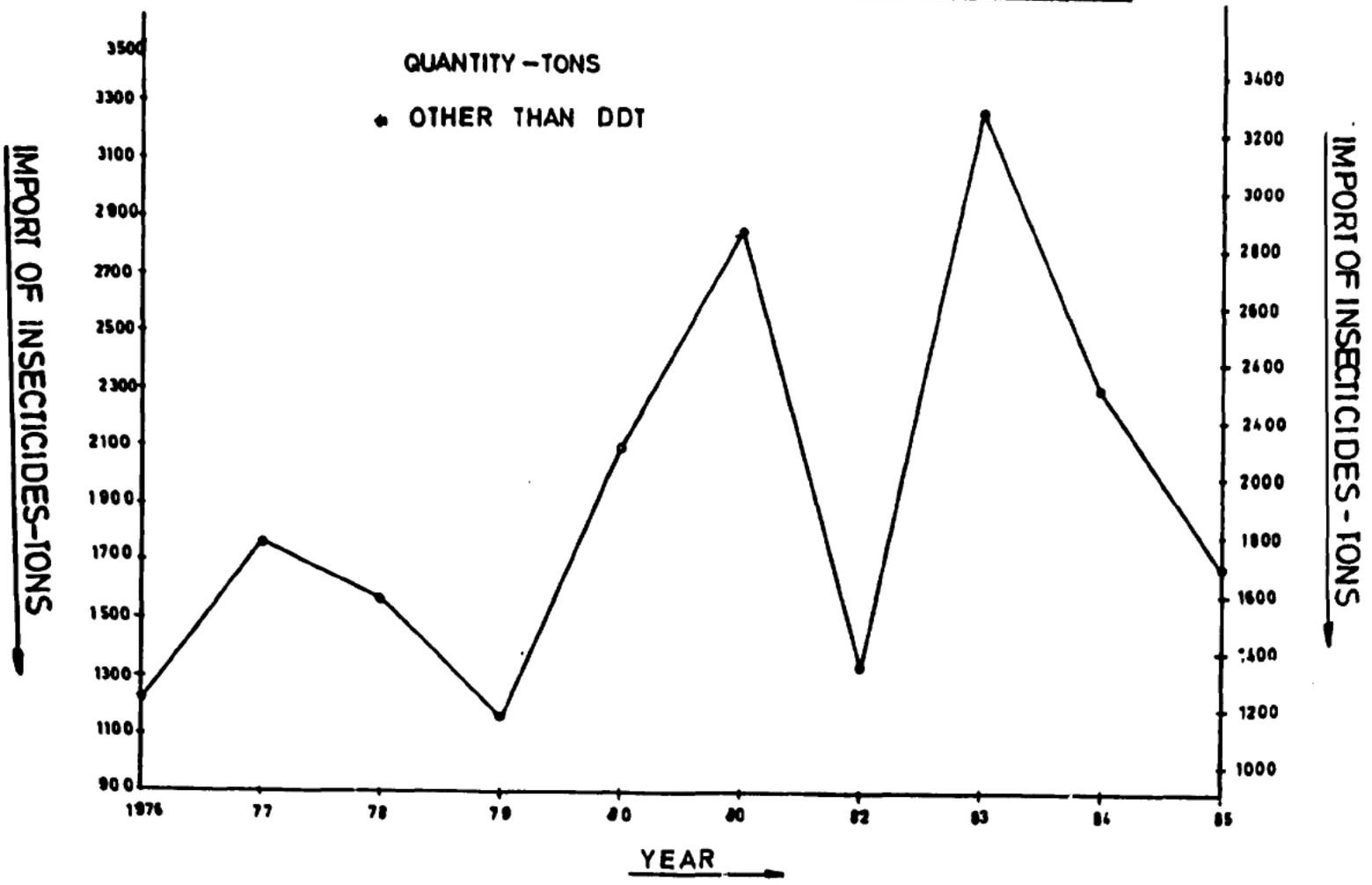
1.31 The ten year importation figures indicate that bulk of the pesticides imports comprised of insecticides. Included in the insecticide figures are DDT imports amounting to 1309, 45, 149 and 7 tons during 1976, 1978, 1979 and 1982 respectively. Setting aside these imports of DDT, the insecticide import figures (excluding DDT) are plotted in Exhibit III. Although the importation trend of insecticides is also characterised by wide variations from year to year, the peaks of 1977, 1981, 1983 (and the expected peak of 1986 since imports of insecticides for first six months amount to 1743 tons) indicate an overall rising trend in imports of insecticides. The average annual imports rose substantially from around 1430 tons for the period 1976-1979, to over 2250 tons during 1980-1985 period.

H. Major Crops and Pesticides Application

1.32 Wide range of altitudes and precipitation variation makes it possible to grow a variety of tropical and temperate zone food and cash crops in the country both for local consumption and for exports. Major food crops are teff maize, barley, sorghum, wheat, pulses and oilseeds. Coffee, the principal export crop, generates over 60 percent of country's export earnings. Other export crops include oilseeds, pulses, cotton, sugarcane, fruits and vegetables. Cereals dominate in area and production under the private, cooperatives and state farm subsectors followed by pulses

EXHIBIT III

ANNUAL IMPORT OF INSECTICIDES, 1976-1985



SOURCE: COMPILED FROM DATA OBTAINED FROM EXTERNAL TRADE STATISTICS

and oil crops. Under the TYPP, the total cultivated area is to expand by 1.174 million hectares by 1994, about 17 percent increase over 1984 level (Appendix VI). The state farms will add over 350,000 hectares which would mean an expansion by over 275 per cent. Where conditions permit, the land under private holding is cultivated twice a year in the main and belg (short rains) seasons. Average crop yields have been relatively low which is attributable mainly to inadequate agricultural services and poor standards of technology practiced on the farms. Use of crop chemicals, fertilizers and pesticides in the predominant peasant sector has been low. Production and yield of major crops for 1983-84 crop season may be seen in Appendix III while area under different crops at the national level and for state farms for 1984 and projected for 1994 may be referred to in Appendices VI and XI respectively.

Cereals:

1.33 Cereals have been primarily peasant subsector cultivation accounting for over 80 percent of the total cultivated area contributing close to 90 percent of the total agricultural production in the country (Appendix IV). Under the TYPP, area under cereals is projected to increase by about 181,000 hectares (four percent) over the 1984 level with producer cooperatives and state farms improving their shares to 52.1 and 6 percent of the total area respectively (Appendix V). In the state farms subsector, over 75 percent of the total area under cultivation is devoted to cereals production. An additional area of about 59,000 hectares is planned to be brought under cereals by 1994 in the state sector. Important cereal crops are briefly discussed hereunder:

Teff:

Teff is the major cereal crop of Ethiopia. It is grown in nearly all cultivable areas of the country. Total cropped area is around 1.4 million hectares with a production of nearly 1.09 million tons during 1983-84 representing 20 percent of total cereals production. It is generally regarded as resistant to most pests, however, in some areas it is attacked by smudge, a most serious disease. Rust and bunt are also known but do not cause heavy losses. The crop may also be attacked by bush cricket, barley fly, red teff worm and the African army worm. Malathion 50 EC, fenitrothion 50 EC and DDT 10% dust (D) have been used against these insect pests.

Maize:

Over 0.8 million hectares of maize are grown in Ethiopia, around 47,000 hectares of which in the state farms. During 1983-84, around 1.54 million tons of maize was produced in the country. The common insect problems are caused by the maize stalk borer, the spotted stalk borer, maize aphids and other sucking insects, African boll worm and the armyworm. The crop is also infected by leaf blight and rust, but neither disease cause serious losses. Pesticides being used are DDT 10% dust (mainly by the peasant sector); cypermethrin 25 EC, 5 EC/ULV, 2.5 ULV, endosulfan 35 EC, 25 ULV; phosphamidon 50 SCW; dimethoate 40 EC; diazinon 600 EC/ULV; methamidophos 600 soluble liquid (SL); thiometon 25 EC for various insects. Malathion 50 EC and primiphos-methyl are recommended for spray of surface areas; aluminium phosphide for storage pests; zinc phosphide for rodents control and atrazine, metolachlor, alachlor and glyphosate alone or in combinations as

herbicides. Most of the pesticides used on maize are in the state sector. DDT 10 D was being produced locally till last year under the charge of MOA which reportedly was quite popular with the smallholders for the control of maize stalkborers. AISCo is buying 20 tons and 10 tons of DDT 10 D and 5 D respectively for the current crop season in 5 and 10 kg packings. For control of migratory pests, MOA takes up full responsibility including cost of inputs. Pesticides used are fenitrothion 50 EC/95 ULV; endosulfan 35 EC; carbaryl 85 wettable powder (WP), cypermethrin 5 EC; diazinon 60 EC/ ULV and dieldrin 20 EC.

Barley:

Barley is a typical highland crop grown in about 0.9 million hectares, 6,000 hectares of which are on state farms. Production during 1983-84 was around 0.8 million tons. The main insect problems are the African army worm, the barley fly, aphids, and the soil insects. The more serious diseases are net blotch and eyespot or scald. Pesticides used, mostly on state farms are thiometon 25 EC, phosphamidon 100 SCW, dimethoate 40 EC (for aphids & other insect pests); chlorpyrifos -8 EC (for soil insects); cypermethrin 5 EC/ULV, malathion 50 EC, diazinon 600 EC/ULV, methamidophos 600 SL for complex insect pests. Several types of herbicides in small quantities are used for control of weeds on barley by the state farms.

Sorghum:

The most drought-resistant cereal, sorghum is grown in around 900,000 hectares (13,000 on state farms) mostly in the eastern and northern parts of Ethiopia. Production was around 1.2 million tons in 1983-84. It is attacked by

grain eating birds and also affected by African army worm, the boll worm, the spotted stalkborer and the aphids. The more serious diseases are covered kernel smut and loose kernel smut. The parasitic weed is also a serious problem on sorghum. Pesticides used are more or less same as on maize.

Wheat:

Dominantly a crop of highlands, wheat is grown in an area of 700,000 hectares between 1,800 and 2,200 meter altitude. National production was 0.666 million tons in 1983-84. Amongst cereals, wheat is a major crop on state farms, 63,879 hectares were cultivated during 1983-84 and 90,255 hectares of area are projected for 1994. Pests encountered and pesticides being used are similar to barley. Wheat consumes a sizable portion of the herbicides imported into the country.

Pulses:

1.34 About thirteen percent of the total cultivated area is under pulses with a contribution of about eleven percent to the total agricultural production in Ethiopia. The peasant subsector dominates in area and production of pulses accounting for almost 97 percent of the area under pulses and 98 percent of the total production. Major crops grown include horsebean, chicpea, haricot-bean, field pea, lentil, vetch and soyabean. Major expansion of area under cultivation in the state farms in envisaged for pulses under the TYPP - from 1,440 hectares in 1984 to 29,383 hectares in 1994 (Appendix XI). Major pests on pulses are leaf worm and sucking insects. Cypermethrin 5 EC/ULV, profenofos 250 EC/ULV and methamidophos 600 SL (for leaf worm) and phosphamidon 100 SCW, dimethoate 30 EC, and monocrotophos 40 SCW (for sucking insects) have been recommended for control of these pests.

Oilseeds:

1.35 Dominated by peasant subsector, oilseeds share about four percent of the total cultivated area in the country contributing about two percent of the total crop productions. Area under oilseeds totalled 256,000 hectares in 1983-84 producing 98,500 tons of oilseeds. Under the TYPP, another 330,000 hectares are projected to be brought under oilseeds. The state farms will expand from 4,324 hectares in 1984 to 75,682 hectares by 1994. Major pests are African boll worm, loop worm and aphids. Products being used are cypermethrin 5 EC/ULV (for the worms) and thiometon 25 EC for aphids.

Cotton:

1.36 Primarily a state sector crop, cotton is mostly grown in the lowlands of Tandaho, middle Awash and some other areas in the south and northwestern regions. During 1984, 31,600 hectares were under cotton and under the TYPP, 138,092 hectares are projected for this crop by 1994, entirely under the state farms. Cotton is attacked by a host of pests which include spider mite, sucking insects, spiny, pink and Sudan boll worms, African boll worm, white fly, leaf worm. Diseases are not very important, although wilt and bacterial blight do occur. Cotton is the heaviest user of pesticides accounting for in terms of value, over fifty percent of the total products consumed on MSFD state farms and of these over ninety percent are insecticides. During 1987-88 crop season, over 10 million Birr worth of pesticides are proposed to be used on cotton, out of which insecticides share will be 9.6 million Birr. Plant protection chemicals, recommended for use include amitraz 20 EC/ULV, dicofol 18.5 EC, 42 EC, tetradifon 18 EC and prothoate 40 EC for spider mite; phosphamidon 250 ULV, 50 SCW, 100 SCW, dimethoate 30 ULV,

40 EC for sucking insect pests; monocrotophos 40 SCW, 250 ULV, azinphos ethyl 400 EC/ULV for spiny, pink and Sudan boll worm; endosulfan 25 ULV, profenofos 250 EC/ ULV, cypermethrin 5 ULV, amitraz 20 EC/ULV, phoxim + azinphos ethyl combination 800 ULV, 600 ULV, monocrotophos + DDT comination 500 ULV and methidathion + DDT combination 400 ULV for African boll worm; amitraz 20 EC/ULV, profenofos 250 EC/ULV, chlorpyrifos 24 ULV, primiphos-methyl 50 ULV, triazophos 25 ULV, monocrotophos 40 SCW, endosulfan 35 EC 25 EC, decamethrin 5 EC, cypermethrin 25 EC, fenvalerate 20 EC for white fly; chlorpyrifos 24 ULV, profenofos 250 EC/ ULV, cypermethrin 5 ULV, methamidophos SL 600, methomyl 20 ULV fenvalerate 4 ULV, decamethrin 0.6 ULV for leaf worm; profenofos 250 EC/ULV, phoxim + azinphos ethyl combination 800 ULV, 600 ULV, cypermethrin 5 ULV, fenvalerate 4 ULV, decamethrin 0.6 ULV for African boll worm + leaf worm. Quantities of various pesticides purchased for use on cotton for the 1987-88 crop season by MSFD may be seen in Appendix VII.

Coffee:

1.37 Ethiopia is said to be the home of coffea arabica. It is the most important cash crop grown in the northwestern and eastern plateau. It contributes over sixty percent of export earnings and a sizeable revenue to the Government through surtax and cess. Coffee is also an important consumer good, drunk by most Ethiopians, with domestic consumption estimated to absorb more than half of total production. Coffee growing in Ethiopia is scattered and fragmented. In several parts of the country, coffee trees grow wild which accounts for a sizeable portion of total commercial production. Most of the remainder is of the plantation variety, planted on smallholder farms. Farmers generally attend to Coffee only during harvesting, yields,

therefore, are low ranging between 300 to 400 kg per hectare. In all coffee is grown on about 500,000 hectares. State farms under the MCTD have currently an estimated area of about 15,000 hectares under coffee and the projections are to expand it to 50,000 hectares by 1994. Yields are between 800 to 1000 kg. per hectare on the state farms. Over 95 percent of coffee production comes from the peasant sector. The most serious pest problem is the prevalance of coffee berry disease (CBD) which has affected upto 30 percent of the nation's trees and is a cause of some 15 - 20 percent loss of potential coffee production. Other diseases include brown eye spot, leaf blight and leaf rust. The only insect pest of coffee of any importance in Ethiopia is the antestia bug. The antestia bug is a vector of the fungi which gives rise to dry rot of beans. Weeds can also be a serious problem particularly when the crop is not grown under a shade. The most difficult to control is couch grass. Most of fungicides imported into the country have been used on coffee by the peasant farmers. Captafol 80 WP and dithianon 75 WP are the recommended products. The use of fungicides however, is now declining. The CBD is being contained through a programme to replace the old susceptible trees with disease-resistant varieties, started with state farms, producers cooperatives and then for the peasants. The MCTD is trying to take over the existing forest coffee and changing over to plantation coffee. Use of insecticides has been mainly confined to nurseries for control of termites and cutworms. Insect problems on the plantation have not been considered serious in the past and only small quantities of malathion 50 EC and fenitrothion 50 EC have been used for control of insect pests. However, the CBD-resistant varieties are known to favour the growth of insect pests, the MCTD for its state farms now expects to use about ten thousand litres of these products per annum. For control of weeds on coffee, glyphostate and paraquat are being used on state farms.

Sugarcane:

1.38 Sugar production in Ethiopia is an integrated large scale activity covering all operations from cultivation of sugarcane to the production of sugar. The two sugar establishments at Metahara and Wonji Shoa under the Ministry of Industry cultivate their own sugar plantations. The Metahara estate has an area of 9,000 hectares (under expansion to 10,300 by 1989) under sugarcane plantations all of it constituting the state farms. The Wonji Shoa, on the other hand cultivates 7,000 hectares (projected 11,000 by 1989) with about 1,000 hectares owned by peasants under the Peasant Associations. A third sugar project at Finchaa, now in the planning stage is expected to take off in 1988 with 6,000 hectares of sugarcane plantation in the first phase, adding another 4,500 hectares in the next phase. Out of an annual production of around 195,000 tons, Ethiopia manages to export about 30,000 tons of sugar. Beetle is a major pest on both the estates and assumes epidemic proportions when the temperature and humidity are high causing serious damage to the crop. Shoot borer and the stalk borer are the other two pests of significance. The main disease problem is smut although leaf spots can also cause losses. Pesticides used are lindane 25 WP or 25 EC. Aldrin is used to dip cane seeds prior to planting. All inputs for sugarcane plantations are procured directly by ESC through open tender. As an alternate to WP and EC, they are prepared to use lindane dust or granules if available locally. Present consumptions are around 5,200 litres of lindane 25 EC and 14,280 kgs. of lindane 25 WP. ESC also consumes about 4,000 litres of malathion 50 EC and 3,000 litres of methidathion 40 EC annually for use on citrus plantations in their estates.

Other Crops:

1.39 Other crops include a variety of fruits and vegetables, tobacco, pepper, sisal and kenafe. For details of pesticides

usage on these crops for the state sector, appendix VII may be referred to.

I. Sectorwise Pesticides Consumption

1.40 In view of Ethiopia's wide spectum of crops, complex pests and agroclimatic conditions, several types of pesticides are called for. In the absence of any local formulation capacity, a wide variety of compounds as finished formulations are imported in the country. An assortment of formulations, which include emulsifiable concentrates (EC), ultra low volume formulations (ULV), water soluble concentrates (WSC), soluble liquids (SL), flowables (Fl), wettable powders (WP), granules (G), and dusts (D) are brought into the country as ready products. Notwithstanding the overwhelming predominance of peasant sector in the Ethiopian agriculture, imports of low active ingredient formulations for use in the smallholder sector such as dusts and granules are very much restricted. Normally dust and granular formulations have a large consumption in countries (with small-farming practices) where they are locally formulated. Depending upon imports will be highly uneconomical since for small quantities of active materials, the country has to pay for that bulk of the inert carrier involving heavy transportation costs. A small dust formulation plant had been in operation in Tigray producing DDT 5 and 10 D using kaolin as a carrier obtained from a nearby source. Under the charge of MOA, the plant worked for almost fifteen years serving the peasant farmers and stopped last year for want of some vital spares, working capital and some organizational problems. The MOA has proposed the take over of the unit by the MOI. Depending upon the condition of the plant equipment and machinery, it may be worthwhile to revive the unit. Another deleterious effect on the total reliance on imports is the tendency to buy highly concentrated formulations to

save on long distance transportation costs and this restricts the usage to limited applications. For example, carbaryl 85 WP being imported by AISCO for use by the peasant sector, besides being highly concentrated and expensive, requires the use of spray equipments (which many of the farmers may not have) and adequate quantities of suitable water, which may not be available in remote places all the time. Dust and granular formulations using local carriers, formulated within the country which are relatively inexpensive and easy to apply can be more effective for the smallholders. As outlined in earlier sections, pesticides are being imported by several organizations for their individual specific needs. Discussed hereafter are the sectorwise consumptions.

State Farms of MSFD:

1.41 The largest user of pesticides in Ethiopia are the state farms. Appendix VII analyses productwise (alongwith type of formulations), the past consumption - quantity and value, of different pesticides of the MSFD during the period 1982-83 to 1986-87 and the proposed products for use during the current crop season of 1987-88. Classwise, the consumptions are as given hereunder in Table 1.2.

Table 1.2 Classwise Pesticides Consumption - MSFD
(Crop Season 1982-83 to 1987-88)

Q - Quantity in Tons; V - Value in '000 Birr
L - Liquids; D - Dry Formulations; T - Total

Type	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88
1	2	3	4	5	6	7
a) Insecticides:						
L - Q	614.3	569.4	774.3	1405.3	1212.6	1176.0
L - V	4619.1	4794.3	6463.8	10288.2	11012.3	11216.2
D - Q	92.4	18.7	47.7	0.2	5.5	32.4

1	2	3	4	5	6	7
Table 1.2 continued.....						
D - V	185.3	25.6	99.0	6.1	352.9	490.1
T - Q	706.7	588.1	822.0	1405.5	1218.1	1208.4
T - V	4804.4	4819.9	6561.8	10294.3	11365.2	11706.3
b)Fungicides:						
L - Q	1.3	1.2	43.2	-	0.6	29.8
I - V	15.9	21.8	971.6	-	14.7	219.8
D - Q	47.7	97.7	17.2	4.1	39.4	81.9
D - V	282.5	588.7	361.6	48.9	403.7	613.3
T - Q	49.0	98.9	60.4	4.1	40.0	111.7
T - V	298.4	610.5	1333.2	48.9	418.4	833.1
c)Herbicides:						
L - Q	200.8	241.2	339.8	364.8	481.0	429.4
L - V	2706.5	2315.5	4068.8	3936.6	6097.1	6280.4
D - Q	0.3	18.4	28.3	8.3	-	1.0
D - V	8.1	448.5	549.5	252.5	-	31.8
T - Q	201.1	259.6	368.1	373.1	481.0	430.4
T - V	2714.5	2764.0	-618.1	4189.1	6097.1	6312.2
d)Grand Total:						
Q	956.9	946.6	1250.5	1782.7	1738.5	1750.5
V	7817.3	8194.3	12513.3	14532.3	17880.6	18851.5

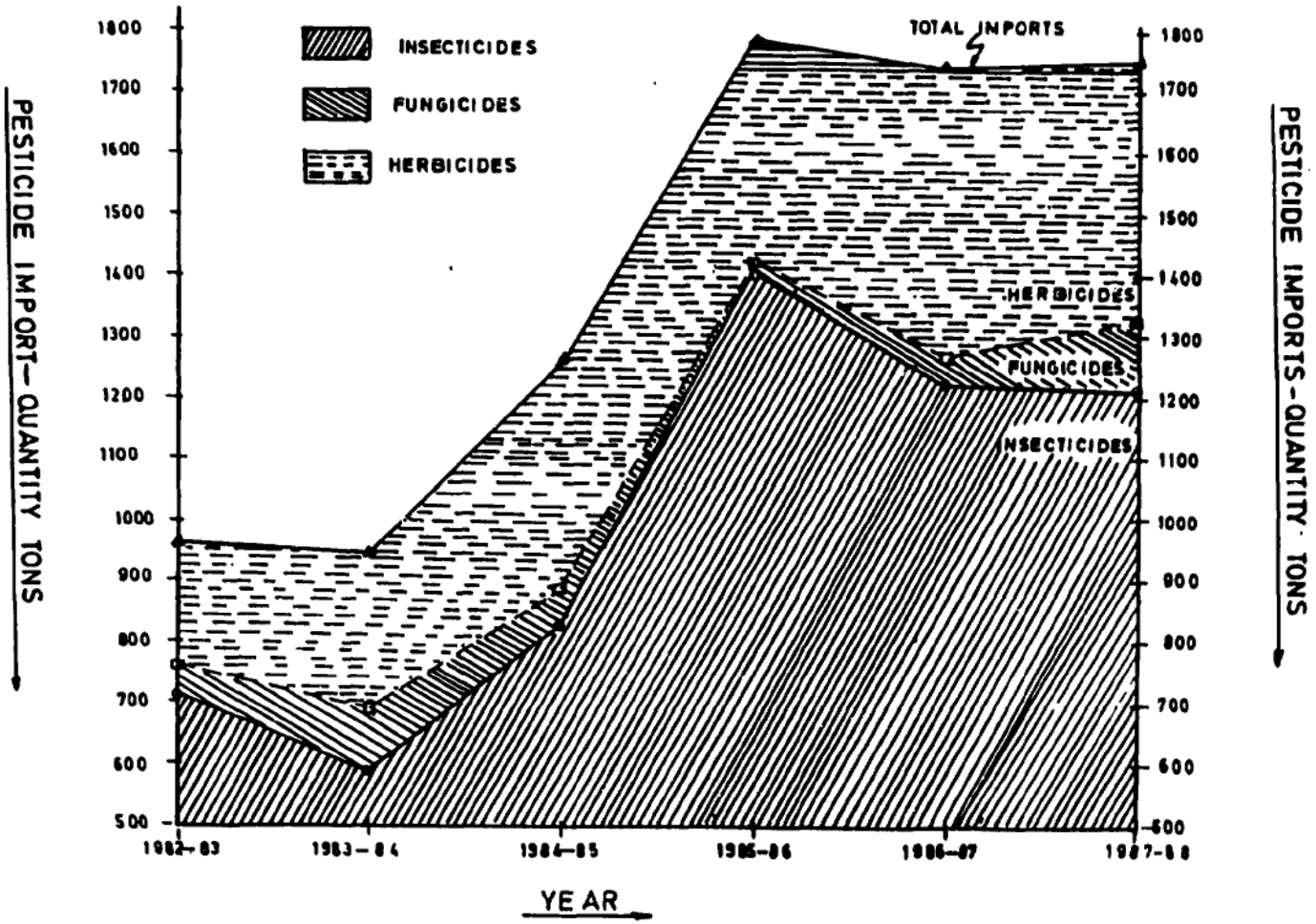
Source: Compiled from data given by MSFD, Addis Ababa

Pesticides usage on the state farms under the charge of MSFD during the period 1982-83 to 1987-88 has also been plotted in Exhibit IV - Annual Quantities and Exhibit V - Annual Values to have an observable view of the consumption trends. A

EXHIBIT IV

PESTICIDES CONSUMPTION MSFD, 1982–83 1987–88

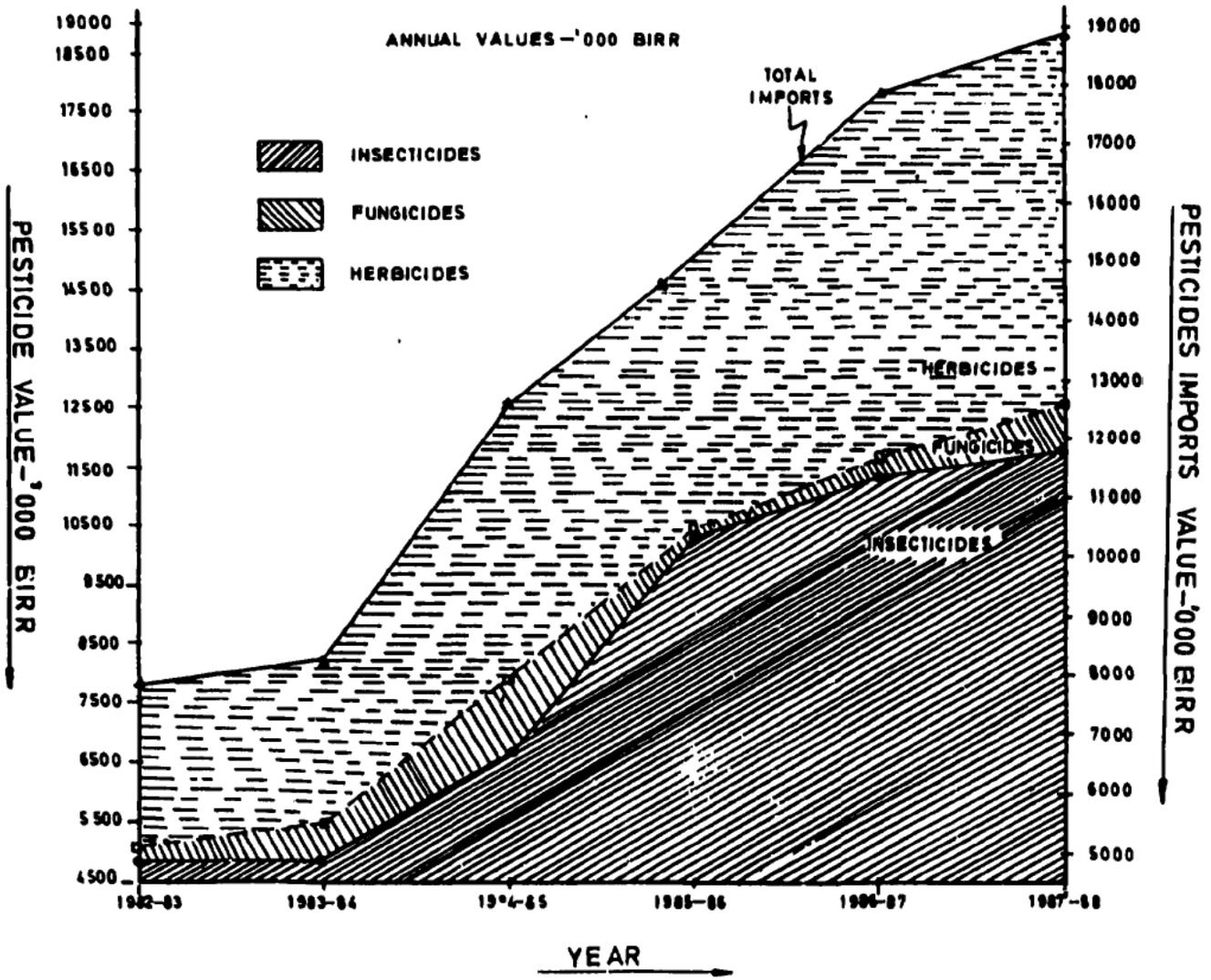
ANNUAL QUANTITIES – TONS



SOURCE: COMPILED FROM DATA GIVEN BY MSFD, ADDIS ABABA

EXHIBIT V

PESTICIDES CONSUMPTION MSFD, 1982-83 TO 1987-88



SOURCE COMPILED FROM DATA FURNISHED BY MSFD, ADDIS ABABA

relatively clear and consistent pattern of pesticides usage is seen in this sector. Consumptions have grown by over 140 percent in terms of annual value from a level of about 7.8 million Birr in 1982-83 to its present level of nearly 19 million Birr (1987-88). In terms of quantities, although there has been practically no increase in the volume of imports from the 1982-83 season to the 1983-84 season, and from 1985-86 to 1987-88 seasons, on an average the increase in importation can be estimated at over 16 percent per annum over the total period under review. Pesticides consumptions have more or less stablised since 1985-86 at a level of around 1800 tons. Insecticides constitute almost 70-75 percent of the total bulk, with herbicides ranking next at 17-20 percent and then fungicides at 6 - 8 percent. Other imports include rodenticides, termiticides, nematicides and some other speciality products, all adding upto about 1 percent of the total quantity. Cotton is the heaviest user of pesticides both in terms of quantity (60 percent) and value (over 50 percent). For list of state farms crops (under MSFD), pests and pesticides being used in the ongoing season, Appendix VII may be referred to. Amongst the type of formulations used on MSFD farms, a look at Table 1.2 would indicate that liquids are the most preferred ones both for insecticides and herbicides. This is for the reason that aerial spraying is used for application of pesticides wherever possible. The aircrafts belong to Admas Air Service, a subsidiary of Ethiopian Airways, an independent body working closely with the Ministry.

1.42 Productwise imports of pesticides for use on state farms for the period 1982-83 to 1987-88, quantity and value, have been presented in Appendix VIII. Table 1.3 summarises the quantities of major products consumed commulatively during the six year period and for the last two crop seasons.

Table 1.3 Productwise Pesticides Usage on MSFD Farms

Product	Formulations	Consumption K.Lit 1982-87	1985-87
1. Endosulfan	35 EC/25 ULV	1988.7	859.1
2. Profenofos	250 EC/ULV	653.8	374.0
3. Amitraz	20 EC/ULV	569.4	151.4
4. Chlorpyrifos	48 EC/24 ULV	543.5	254.8
5. Cypermethrin	2.5,5 EC; 5 ULV	415.4	183.60
6. Phosphamidon	50 SCW,100 SCW;25ULV	315.5	181.20
7. Azinphos-ethyl & in combination with phoxim	400 EC;600, 800 ULV	221.7	78.6
8. Dimethoate	40 EC/ULV	239.6	58.00
9. Monocrotophos & in combination with DDT	40 SCW, 500 ULV	176.4	20.2
10. Malathion	50 EC/ULV	90.4	43.0
11. DDT, toxaphene, methyl parathion combination	ULV	79.1	Nil
12. Decamethrin	2.5 EC, 0.6 ULV	72.7	Nil
13. Aldrin	48 EC	57.8	50.0
14. Methidathion	40 EC	47.0	29.0
15. Dicofol	18.5, 42 EC	45.2	19.6
16. Phenthoate	85 AS Liqd.	27.2	17.6
17. Diazinon	60 EC	26.4	22.6
18. Methamidophos	600 SL	24.8	5.2
19. Triazophos	25 ULV	21.6	Nil
20. Tetradifon	18 EC	16.0	2.8
21. Primiphos-methyl	50 EC/ULV	14.9	11.0
22. Thiometon	25 EC	5.8	5.8
23. DDT	10 D (Tons)	196	Nil
24. Aldrin	40 WP (Tons)	3.9	Nil
25. Aldicarb	15 G (Tons)	9.4	9.4
26. Trichlorphon	95 P	2.4	2.4
27. Zinc Phosphide	- (Tons)	43.1	35.0
28. Aluminium Phosphide	- (Tons)	6.5	1.9

Source: Data compiled from Appendix VIII.

In addition to the aforesaid insecticides, MSFD also imported some fungicides, thiram for seed dressing, mancozeb for use on vegetables, copper hydroxide for grapevines and vegetables and some other products as well as a sizeable quantity of herbicides which include alachlor, atrazine, metolachlor, paraquat, glyphosate and some other combination products. For details, Appendix VIII may be referred to. Amongst the insecticides, the most extensively used products have been the liquid formulations of endosulfan, profenofos, amitraz, chlorpyrifos, cypermethrin, phosphamidon, dimethoate, monocrotophos, malathion, aldrin, dicofol, diazinon and a host of others in relatively smaller quantities. Within the insecticides used there is so much overlap between the activity ranges of different products, that the product variety could possibly be reduced. Furthermore, an important feature of MSFD's procurement procedure is that the tenders are issued for control of specific pests on certain cropped areas and a fairly wide choice is given to the purchasing agency, namely Agricultural Machinery & Technical Services Corporation, for selection of appropriate products based on the considerations of application rate per hectare and the cost of application. Most economical products are ultimately selected for use on the state farms. This inter-se-substitution of products can offer some advantages to the local formulation activity in terms of reduction in the variety of products to be handled, producing relatively large quantities of a selected few.

The Peasant Sector:

1.43 The overall responsibility for all aspects of agricultural pest control in the peasant sector rests with the MOA. This includes advice on control measures, provision of pesticides and equipment and conduct of control operations for migratory pests throughout the country. The function of procurement and distribution of pesticides for the peasant

sector has not been well looked after end organised in the past since it has been frequently changing hands from one organisation to another until the establishment of AISCO in 1985, a parastatal under the MOA. On the basis of pesticides demand data collected and compiled through the district and zonal offices and a final scruitiny at the Ministry's headquarters, AISCO arranges procurement of plant protection chemicals and equipment for the peasant sector. The quantities to be procured, however, are guided by the allocation of foreign funds by the Government. All supplies of pesticides to the farmers are at Government subsidised prices. AISCO handles the storage and distribution through its over 680 centres spread all over the country in different zones and districts. In terms of staff and infrastructure, AISCO is still in the development stage. While no reliable data regarding consumption of pesticides was made available for the past, fairly sizeable quantities of a wide range of products and equipment against an allocation of 13.0 million Birr are being procured for sale and distribution to the peasant sector for the current crop season. Table 1.4 lists such products for use on the peasant farms for the current crop season.

Table 1.4 Insecticides for use on Peasant Farms - 1987-88

Product	Formulation	Packing	Quantity
1. Malathion	50 EC	5 and 10 Lit	121.2 KLit
2. Dimethoate	40 EC	5 and 10 Lit	75.0 KLit
3. Endosulfan	35 EC	5 and 10 Lit	75.0 KLit
4. Carbaryl	85 WP	5 and 10 Lit	80.0 Tons
5. Trichlorphon	95 SP	5 and 10 Lit	40.0 Tons
6. Aldrin	40 WP	5 and 10 Lit	80.0 Tons
7. Primiphos-methyl	2 D	5 and 10 Lit	210.0 Tons
8. DDT	10 D	5 and 10 Lit	20.0 Tons
9. DDT	5 D	5 and 10 Lit	10.0 Tons
10. Cypermethrin	1 G	5 and 10 Lit	75.0 Tons

Fungicides for control of following plant diseases are being procured (Table 1.5) for use of the smallholders.

Table 1.5 Fungicides for use of Peasant Sector

Plant Disease	Formulation	Packing	Quantity
1. Rust on Barley	EC	5 and 10 Lit	10.0 KLit
2. Rust on Wheat	EC	5 and 10 Lit	10.0 KLit
3. Early and Late Blight on vegetables	WP	5 and 10 Lit	10.0 Tons
4. Coffee Berry Disease	WP	2 and 5 Kg.	154.0 Tons

Amongst the weedkillers are 2,4-D amine salt 720 gai per litre in 1 and 5 litre packing - 100 kilolitres; atrazine+ metolachlor 50 FW in 1 and 5 litre packing - 50 kilolitres; bromoxynil + ioxynil + mecoprop esters 52.5 EC in 1 and 5 litre packing - 25 kilolitres and herbicides for perineal and annual weeds in coffee in EC formulation in 5 and 10 litres packing - 5 kilo litres. In addition to the above products 10 tons of rodenticides and a sizeable quantity of pesticide application equipments are also being imported. According to the information gathered, the procurement of pesticides for this year for the peasant sector is relatively improved in terms of allocation of funds and quantity purchased as compared to previous years. However, looking to the vast size of the peasant sector and its potential, particularly in comparison to that of state farms and their consumption of pesticides, the aforesaid quantities of pesticides will not meet even a fraction of the total requirement of the smallholders. In the matter of choice of formulation a blend of high and low active ingredient products are being imported to optimise on transportation costs. In the absence

of a local formulation activity, this is perhaps the only choice. However, low active ingredient dust and granular formulations are usually more popular with smallholders in terms of applicator's safety, environmental protection and for their ease of application. For this reason, the more expensive high active ingredient liquid formulations need also be substituted wherever possible, with dust and granular formulations, if locally produced, utilizing indigenously available inert carriers and diluents. For the dry formulations being imported namely one percent cypermethrin granules, 2 percent primiphos methyl and DDT dusts 5 and 10 percent, it may be noted that in 315 tons of these formulated products, over 300 tons of inert clays (available in Ethiopia in plenty) are coming into the country against expense of scarce foreign exchange. In conclusion, therefore, on the one hand high concentration liquid formulations are not suitable for use of the smallholder and on the other low active ingredient dry formulations for use of the peasants are not justified to be imported. The solution therefore, is to establish a local production facility based on indigenously available raw materials to make formulations in packs tailored to the needs of the peasant, backed by an effective system of distribution and adequate promotional activities in terms of effective after-sales service, farm demonstrations, farmers training and technical back up through field staff and extension workers. In this respect, agriculturally intensive areas need selectively greater attention. With the current emphasis on the peasant subsector and Government's efforts towards improved supplies of inputs for increasing the productivity and overall output of this sector, a local source for the supply of relatively in-expensive quality plant protection chemicals would greatly help in the performance of this sector.

Settlement Schemes:

1.44 Following the 1984-85 food crisis, the Government greatly accelerated the pace of settlement schemes to reduce vulnerability to famine and to address the degradation problems of the low potential cereal zones of the highland. The target is to settle 300,000 families comprising of 1.5 million people to more fertile regions. Eighty three settlement areas in different parts of the country including some regions of western and south-western Ethiopia have been identified. Help is provided by the Relief and Rehabilitation Commission (RRC) in the initial establishment of the settlers, usually for the first four years following which the RRC is expected to withdraw from these areas and MOA takes over and the farmers are brought together under PAs. Relief & Rehabilitation Commission(RRC) is procuring pesticides, fertilizers and equipments for free distribution to farmers under the settlement schemes. Requirement of pesticides is rather large, the resource availability, however, limits the procurements. Pesticides are being purchased mainly for control of stalk borers, army worms and other pests of maize, sorghum and teff, pulses and for the cotton pests. The total consumption of different products has been around 300 kilolitres per annum. However, most of the 10,000 hectares of cotton farms cultivated by the nomadic afars (an ethnic group living along Awash) have been recently turned over to the state sector leaving only 800 hectares with the settlers, and with this the requirements have come down. Amongst the products used under the settlement schemes are malathion 50 EC, fenifrothion 50 EC and endosulfan 35 EC - about 100 kilolitres put together, for the highland cereal crops and pulses and a host of insecticide liquids including endosulfan,cypermethrin, methamidophos, mono-crotophos,

prefonofos, dimethoate, phosphamidon, dicofol and others - around 200 kilolitres per annum.. The requirement of cotton pesticides, however, has now come down as a result of state farms taking over most of the cotton cultivation. The present requirement is estimated at around 120 kilolitres in terms of various products valued at about 1.2 million Birr. On the question of the type of formulations being used, the RRC authorities indicated their preference for the use of low active ingredient dry formulations if made available locally as against the highly concerntrated liquid formulations being used now to save on transportation costs from overseas.

MOA - Control of Migratory Pests:

1.45 Plant Protection and Regulatory Department (PPRD) of the MOA being responsible for the conduct of control operations for migratory pests such as desert locust, the African migratory locust and the two spieces of the tree locust prevalent in the western regions; the grain eating birds (quelea being the most damaging race); the army-worm and other epidemic pest outbreaks, maintains some stocks of pesticides and pest control equipment. These are generally received as gifts from international or foreign aid agencies and/or purchased out of the Ministry's budget, to be used against the aforesaid service only. On the basis of reports from the regional and district staff, the pest outbreaks are continuously monitored. When a serious outbreak is detected appropriate action is decided upon according to the availability of resources. All services are provided free of charge. Crop protection inputs distributed during 1984-86 are set out in Table 1.6 hereafter:

Table 1.6 Distribution of Crop Protection Inputs, MOA 1984-86

Item		Unit	1984	1985	1986
Insecticides:					
Diazinon	60 EC/ULV	KLit	3.9	-	46.6
Endosulfan	35 EC	KLit	52.7	0.7	2.0
DDT	25 EC	KLit	6.6	0.6	-
DDT	40 ULV	KLit	1.8	-	-
Thiometon	15 ULV	KLit	3.6	0.7	-
Malathion	95 ULV	KLit	59.7	-	-
Malathion	50 EC	KLit	91.2	-	-
Fenitrothion	50 EC	KLit	1.2	-	40.0
Fenitrothion	95 ULV	KLit	0.6	39.2	49.3
Dieldrin	20 EC	KLit	4.4	-	-
Aldrin	48 EC	KLit	-	5.6	1.6
Carbaryl	85 WP	Ton	78.9	39.2	5.1
Chlordane	5 D	Ton	6.7	-	3.1
DDT	10 D	Ton	138.5	-	9.6
DDT	5 D	Ton	10.0	-	-
Trichlorphon	95 SP	Ton	5.5	31.6	0.6
DDT	75 WP	Ton	3.7	-	-
Aldrin	40 WP	Ton	-	2.8	-
BHC	50 WP	Ton	35.3	-	-
Lindane	2.5 D	Ton	45.8	19.0	0.8
Total			550.1	139.4	158.7
Fungicides:					
Sulphur		Ton	-	0.2	-
Thiram	80 WP	Ton	-	2.5	1.3
Rodenticides:					
Zinc Phosphide		Ton	12.9	4.8	5.0
Warfarin		Ton	0.03	-	21.7
Racumin		Ton	0.03	-	0.2
Avicide:					
Fenthion	60 ULV	KLit	0.13	1.0	1.5

Source: Plant Protection and Regulatory Department, MOA

Major products consumed for the migratory pest operations by the MOA include malathion, diazinon, fenitrothion, endosulfan amongst the liquid insecticides, and carbaryl, DDT and BHC in powder formulations. Projections for requirement of crop protection inputs by the PPRD for the period 1987-91 are given in Appendix XII. Though malathion will continue to be used in future, it does not appear in the projected figures since enough stocks of this material are available with the MOA. Besic malathion, other major products to be used include fenitrothion, diazinon, dimethoate, endosulfan, cypermethrin. Carbaryl 85 WP, primiphos-methyl 2 D and cypermethrin 1 G are amongst the dry formulations to be used.

Pesticides for Public Health:

1.46 Malaria is considered as one of the major health problems in Ethiopia. It is endemic in areas below 2000 meters, which consists of 74 percent of the total land mass. About 64 percent of the population live in these malarial parts of the country and are considered at risk. Although there is no r ble morbidity data at present to state its rank among the ten principal diseasesin the country, localised and regional epidemics have occured every certain number of years. A 'National Programme for control of Malaria and other Vector-borne Diseases' was started in 1959 with the principal objective of reducing malaria prevalance and to put under control malaria outbreaks and to eradicate it in the long run. It is the largest programme in Africa with assistance from the World Health Organization. The Government has allocated fifteen million Birr during the current year - twelve million for operation and three million for the purchase of pesticides, for the control programme. The MOH employs over 2000 people for the conduct of various activities under the programme. According to the MOH, greater efforts and resources are needed to control this menace in the light of the resettlement schemes and the

agricultural extensions with new irrigation projects. The malaria control programme resorts to selective spraying with operational localities classified into two-round, one-round and zero-round spraying depending on the malariometric indices. Intradomiciliary spraying of DDT 2 gms per square meter (technical grade) is the major method of malaria control. Residual spraying may also be conducted in order to control the spread of an outbreak. In addition to the use of DDT 75 WP, malathion 50 EC has also been introduced recently. Out of a total of three million Birr allocation for pesticides, about one million Birr worth of malathion may be purchased this year which would mean over 200 kilolitres of the product. Past consumption figures were not readily available with the MOH. Under future programme, temephos, primiphos-methyl and pyrethroids are on the list of products which may be used for health sector. Recent emphasis has also been to adopt integrated methodologies in which pesticides as well as biological control methods will have their respective roles to play. Pesticides are also being used for demestic use against house flies, cockroaches, bugs, flees etc. These are mostly imported aerosols based on either synthetic pyrethroids or DDVP.

Veterinary Use of Pesticides:

1.47 The live-stock subsector in Ethiopia is next in importance to crop production which contributes about fifteen percent of the GDP. The country's livestock herd is the largest in Africa. At present, about 98 percent of the gross value of output in livestock sector is produced by the private sector and in the Three-Year Plan period, this is projected to be brought down to 95.3 percent raising the share of state sector to 4.7 percent. Ethiopian domestic

livestock population includes 27 million cattle, 24 million sheep, 18 million goats, 1 million camel, 7 million equines and 53 million poultry birds which are distributed throughout the country with the greatest concentration in the highland zone. Ethiopia is well placed to export live animals to the large markets of Middle East and to North and West Africa. Exports in 1985-86 were 251,400 sheep and goats and 10,000 cattle valued at 19.4 million Birr. Animal & Fisheries Resources Development Department (AFRD) of the MOA, organizes veterinary services throughout the country. Toxaphene as emulsifiable concentrate has been mainly used as an acaricide for treatment of animal ectoparasites either through dipping in dilute solution of the pesticide or spraying. A fair estimate of the requirement of this product as given by AFRD is 2400 kilo-litres annually assuming only 10 million animals are treated annually once in two weeks using on an average 10 ml of toxaphene 300 EC for each treatment. Past consumptions, however, have been low and in 1985 only 120,000 litres of the product could be imported. The budget for the years 1986 onwards for purchase of acarcides are as given hereunder:

Year	1986	1987	1988	1989	1990	1991
Amount('000 Birr)	622.9	685.2	719.5	755.4	.793.2	832.9

The entire requirement of veterinary drugs are imported through AISCO, the arrangement being similar to purchase of crop chemicals. AISCO distributes veterinary products in the country through its distribution centres. Peasants either make use of the paid treatment facilities available at the well-spread network of animal clinics or directly purchase the product. Acarcides are also used by the Dairy Development Agency, an enterprise under the Livestock

Development and Meat Corporation (under MSFD), which owns twelve live-stock farms in the state sector. There are also some state farms directly under the MOA. Under the TYPP, veterinary and other services are being stregthened and expanded for the peasant sector. With increasing population of cross-breed and exotic animals, more of acaricides may be needed in the near future. The MOA is, therefore, actively planning to establish a local formulation facility for acaricides to be located in Addis Ababa. The first phase of the project envisages establishment of a 'Storage and Repackaging Unit' to repack acaricides in smaller packages from inputs in bulk packs for convenience of the farmer. The first phase of the project has already been approved under the 'Fourth Livestock Development Project' with assistance being provided by World Bank. A sum of US Dollars 0.4 million has been budgeted for purchase of plant and machinery for the first phase. To best serve the national interest and to avoid duplication of efforts it is recommended that the requirement of acarcides in terms of local formulation and packaging be amalgmated with those of other liquid products being used in agriculture to be met by an integrated formulation unit as being proposed in subsequent part of this study. The MOA indicated its willingness to syphon off the funds already approved for their project in favour of MOI so that an integrated unit could be established to cover the broad requirements of liquid pesticides in the country.

Other Consumers:

1.48 In addition to the pesticides requirements for coffee and sugarcane, which have already been dealt with in para 1.37 and 1.38 respectively, the Tea Development Enterprise under the MCTD imports some pesticides, mainly herbicides, through AISCO for use on tea state farms. The only insecticide imported for the current crop season is aldrin 48 EC, 475 litres for control of termites in nursery. Herbicides include paraquat 20 EC, 9,000 litres; glyphosate 48 EC,

7,000 litres and dalapon 870 WSP. Another area which deserves mention is the post-harvest storage. Maize is the most vulnerable amongst cereals to suffer from insects, rats and mould problems. Teff being minute grain attracts no insect pests but suffer heavy contamination from birds and rats. Pulses suffer damage from bruchids and sorghum from insects and moulds in underground storage pits. Post-harvest losses are estimated as ranging between 10 to 60 percent in different regions, depending upon certain factors. Insecticides recommended for foodgrain storage are malathion, primiphos-methyl, lindane, fenitrothion, dichlorves, bromophos, pyrethroids. Amongst these malathion is the most widely known and the cheapest of organophosphorous insecticides used in storage. It may be admixed with grain as a dust or spray. Primiphos-methyl has a wide spectrum of activity against beetles, moths and mites. It is generally more persistant than malathion.

Present Consumption of Pesticides - Consolidation:

1.49 All consumers put togather, today's total purchase of pesticides in Ethiopia is estimated at over Birr forty million (approximately USD 20 million) broken down as hereunder in Table 1.7

Table 1.7 Present Consumption of Pesticides

Consumer	Estimated Total		Classwise		
	Value (in Birr)	Quantity (Tons)	Insecti- (Tons)	Fungi- (Tons)	Herbicides (Tons)
1. MSFD	19.5	1800	1260	110	430
2. P.S.(AISCO/MOA)	10.0	1100	770	180	150
3. PPRD (MOA)	5.0	550	440	50	60
4. RRC	1.1	120	120	-	-
5. Veterinary(MOA)	1.0	150	150	-	-
6. MOH	1.5	300	300	-	-
7. MCTD	2.0	100	15	35	50
8. ESC	0.4	40	40	-	-
Total	40.5	4160	3095 (75%)	375 (9%)	690 (16%)

Around 75 percent of the total pesticide consumption is in the form of insecticides, with herbicides ranking second at 16 percent and then fungicides at 9 percent. Among insecticides major products are as given hereafter (Table 1.8).

Table 1.8 Common Products of Consumption as Liquid Formulation, Estimated Yearly Consumption - Tons

Product

Liquids	MSFD	PS	MOA	RRC	MCTD	ESC	MOH	Vet
- Endosulfan	425	75	40	30	-	-	-	-
- Malathion	22	120	20	35	10	3	50	-
- Dimethoate	30	75	40	10	-	-	-	-
- Fenitrothion	-	-	50	35	10	-	-	-
- Diazinon	11	-	40	-	-	-	-	-
- Cypermethrin	90	-	40	-	-	-	-	-
- Toxaphene	-	-	-	-	-	-	-	150

Abbreviation used: PS-Peasant Sector; Vet - Veterinary.

There are several other products used in fairly good quantities particularly on cotton. In considering the local formulation activity, it may be desireable to restrict formulation to a small number of products, at least initially, to gain experience both in technical and marketing aspects. Inter-se-substitution of products may be considered wherever possible to facilitate local production of a selected few in large quantities.

J. Pesticides Registeration and Monitoring

1.50 At present no regulatory protocols to monitor and regulate importation, sale, distribution and manufacturing/formulation of pesticides are in operation in Ethiopia. The country has a large potential need for pesticides, since the present focus is on agricultural development as a priority

to achieve the primary objective of food sufficiency. At present, major usage of pesticides is in large state farms, it is expected that as agriculture develops, the usage in the peasant sector would increase. Third world countries are often the victims of substandard and ineffective agricultural chemicals being dumped by foreign suppliers due to weaknesses in their monitoring, inspection and quality control systems in international trade. Substandard/fake agrochemicals involving several million dollars having been supplied by European suppliers to several third world countries in the African continent was quoted in 'Chemical Age' April 3, 1981 issue under the caption 'Why Africans are Wary of Agrochemicals'. In one case the material was found to be substandard to the point where it could be ineffective. A long term consequence could be the resultant widespread distrust of agrochemicals and the reluctance of farmers to use pesticides, which in turn can seriously effect the overall agricultural scene. The importance, therefore, to have a well administered regulatory mechanism in the country. Keeping in view the existing conditions in Ethiopia, a 'Pesticide Registeration and Control Proclamation and Regulations' has been drafted by a committee of experts and is submitted before the Council of Ministers for approval of the proposed legislation. The proposed regulatory agency under the MOA is all set to implement the regulatory scheme as soon as the legislation is approved.

K. Demand Projections

1.51 Ethiopia is richly endowed with fertile land and a substantial agricultural potential. Significant areas of unused or inefficiently used arable lands are available and a fairly limited effort is required to make the country self-supporting in food. Future welfare of the nation lies in improved methodologies on the farm to increase productivity by application of appropriate technology combined with increased reliance on inputs. The Government's policy in the recent years has been geared to expanding the agricultural sector both on the state farms and peasant sector in terms of bringing additional areas under crops as well by increasing farm productivity through a series of measures. More resources are being provided to agriculture, with main focus on the peasant subsector. With the present emphasis on development of agriculture, crop chemical inputs are expected to play an important role to optimise results. Use of pesticides is very implicit in the integrated approach to agricultural production.

1.52 The growth of Ethiopia's consumption of pesticides, in the dominant peasant sector, has been constrained by a variety of factors, some on the supply side and others on the use side. Some of the supply constraints may be characterised as resource shortages, transportation and distribution difficulties, an

inadequate data base to facilitate decision making, non-availability of products consistent with the needs of the smallholder, and on the use side, low level of knowledge among the peasants, inadequate services in the matter of education and training of the farmer, poor extension services and absence of some of the promotional activities including suppliers/ distributor's aftersales service, farm demonstrations, lectures and seminars for the benefit of the farmer. In view of the recent rural and agricultural development programmes including the formation of a cooperative sector, villagization and the spread of literacy among the rural population, the past pattern of growth cannot be taken as a basis for any future projections Furthermore if the crop targets as projected in the TYPP are to be realised, the use of crop chemical inputs have to be strengthened.

1.53 Pesticides importation figures at the national level for the past ten years, presented in part G of this chapter do not indicate any observable trend and wide year-to-year fluctuations are noticed over the entire period. The imports, instead of being need-based, have been influenced by several factors, and these figures, therefore, do not represent the total market for agrochemicals in Ethiopia. Looking at the figures of insecticides alone, the average annual imports rose by nearly sixty percent during 1980-85 as compared to the earlier period. Several approaches are used to work out demand projections of pesticides which include extrapolation of the trend based on past data (time trend), or linking the consumptions to cropped areas or crop productions achieved in the past and the projected figures for the future. Pesticides consumption is also known to be related, though under optimal conditions, to fertilizer use. On the basis of past data, it is often possible to work out a linear relationship of the type, $P = a + bF$,

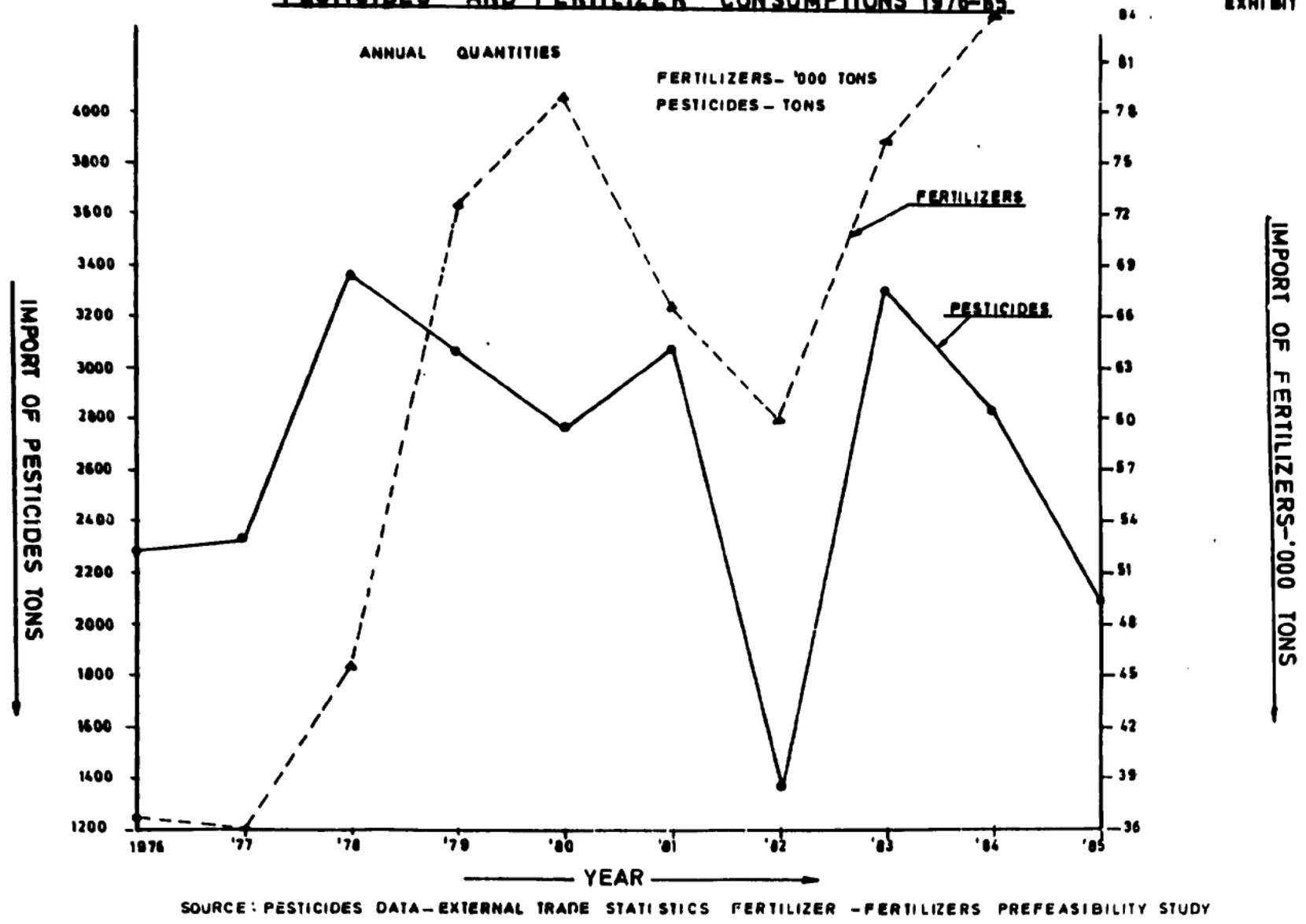
where 'P' is the pesticides consumption in gms per hectare, 'F' the fertilizer consumption in kgm per hectare and a, b are constants. The observation is that generally, the growth in consumption of pesticides and fertilizers over a period of time follow a straight line relationship. Comparing the past consumptions of fertilizers and pesticides in Exhibit VI, where importation figures of the two inputs have been juxtaposed, it is seen that fertilizer consumptions like pesticides have also been erratic and no clear trends are exhibited. Fertilizer imports hitherto have not been linked to the requirements in the country, instead depended upon resource availability. A corelation between fertilizer and pesticides usage, therefore, may not be tenable. Another useful functional relationship which is often developed for working out projections is between the yield per unit area and consumption of pesticides. It is known that the yield per unit area is a function of pesticides used under a given set of conditions in terms of other inputs. A relationship of the type

$$Y = a\,P^{n}$$

where 'Y' is weighted yield of all crops in kgm per hectare and 'P' the consumption of pesticides in gm per hectare, a and n are constants which can be determined on the basis of past data. All the approaches as outlined above are based on regression analysis using past data on cropped areas, crop productions, fertilizer consumptions or crop yields as the basis for future projections. The relationships thus developed suffer from the limitations imposed by the often sub-optimal conditions prevailing in real situations. In the case of Ethiopia, even in the best of import years, the total demand of pesticides has not been met and the past use has been so low and in-consistent

EXHIBIT VI

PESTICIDES AND FERTILIZER CONSUMPTIONS 1976-85



SOURCE: PESTICIDES DATA - EXTERNAL TRADE STATISTICS FERTILIZER - FERTILIZERS PREFEASIBILITY STUDY

that the assumption of a linear trend extra-polation and or regression approaches based on any of these parameters outlined earlier, to project the future pesticide consumptions may be totally unrealistic. To be close to actual situation prevailing in the country, a more workable and realistic approach should be considered. It is well known that well managed intensively cultivated areas take larger quantities of pesticides for crop protection and estimates based on cultivated areas multiplied by the dosage per hectarage using a higher coverage of crops in more intensive areas, are worked out. These indicative estimates together with a sound commercial judgement provide a decisive answer. Persuing this approach, future estimates may be assessed separately for the two sectors namely the state farms and the peasant sector with cooperatives included in it.

1.54 Amongst the insecticides used on MSFD state farms, cotton consumes the largest share, varying between 80 to 90 percent, with cereals, pulses and oilseeds accounting for 5 to 15 percent, fruits and vegetables 2 to 5 percent and others including tobacco about 1%. Cotton being practically an exclusive cultivation of state sector, the estimation of future requirements will be based on the TYPP targets in respect of the area under cultivation now, in 1989 and 1994 and the improvements in productivity to be attained. Over-looking the additional requirement of pesticide for improving the yields beyond the present levels, and assuming that the coverage ratio in terms of area covered by pesticides application for different pests, to the total area cultivated, to be the same as at present, the requirement of pesticides will increase in linear relationship with the cropped areas, i.e. 80 percent by 1989 and another 145 percent over and above the 1989 level

(Appendix XI). The same will be true for other crops to the extent of their share in the state sector. Taking the base figure as 1280 tons (average of last three years consumption, Table 1.2) of total insecticide consumption with share of cotton as 85 percent, the projected demand for 1989 and 1994 for this sector works out to 2280 tons and 5300 tons respectively. Adding the requirements of fungicides and herbicides, in terms of value, it may mean well over 35 and 80 million Birr worth of pesticides for the MSFD farms in 1989 and 1994 respectively. Insecticides in liquid formulations will continue to dominate the state sector, quantities of individual products, however, may vary. Of the total of over 25 insecticide formulations imported every year, many have similar usage and about ninety percent requirements of the state sector can be met by local operations by way of inter-se-substitution of products on acceptable basis.

1.55 The peasant sector has a dismal past record and a tremendous growth potential as far as pesticide usage is concerned. Cereals, pulses and oil seeds are the major crops in this sector. As emphasised earlier, the approach for meeting the needs of this sector requires a review. The peasant needs more of commodity products, relatively inexpensive, safe with broad-spectrum activity in formulations easy to apply in the field, in packs tailored to his needs. Present trend is to use more of high value new generation speciality products, which besides being inconsistent with the agricultural economics of the small farm in most situations, are often too short-lived particularly in tropical climates. The problem should also be viewed from the angle of safety to the applicator. More often the smallholder farmers cannot afford to own protective clothing

and even if some of them possess, it is often uncomfortable to wear them in the field. There should, therefore, be a definite preference for pesticides which are relatively safer. Wherever practical, dust and granular formulations of some of the commonly used pesticides - commodity as well as new generation products like pyrethroid, to be produced locally using indigenous diluents and carriers, in small packs be made available to the farmer. Products recommended are malathion, endosulfan, carbaryl, DDT, BHC/lindane, primiphosmethyl as dusts and endosulfan, diazinon, BHC/ lindane, cypermethrin as granules. Marketing of these dry formulations may be supplemented by liquid formulations of dimethoate, phosphamidon, thiometon, chlorpyrifos and others in accordance with the market needs. All these products are being currently used for control of different pests of cereals, pulses and oil-seeds. AISCO has imported cypermethrin 1 G, primiphos-methyl 2 D and DDT 10 D and 5 D in sufficient quantities for the current crop season to feed the peasant sector, although such products become too expensive when imported from overseas. The recommendation is to gear the formulation and pack to suit the needs of the end-user. With this approach, a beginning can be made to open up the huge potential of the peasant sector in terms of crop inputs usage to improve farm productivity. Working out demand projections for the peasant sector may not be an easy exercise. However, using a conservative approach, some figures can be arrived at. Based on the area under maize and sorghum as at present and using the recommended dosages of pesticides, it is estimated that to cover just five percent of the total cultivated area, over 2500 tons of endosulfan 3 percent dust (or granules) would be needed to control African boll worm, 430 tons of cypermethrin 1 percent granules for treatment against stalk borer and

another 520 tons of cypermethrin 1 G for the complex insect pests. If DDT ten percent dust is used against stalk borer, the quantity works out to over 850 tons to cover just five percent of the total area under cultivation presently. Projecting these figures to 1989 and 1994 based on TYPP targets, the requirements will swell manifolds. With the present range of products in high concentrations and their restricted availability and the level of acceptance in the peasant sector, the growth is not expected to be appreciable. This trend may, therefore, continue till the time plant protection measures get better organised with improved marketing infrastructure and better availability of locally formulated, relatively inexpensive, commodity products.

1.56 Health sector requirements of pesticides based on imports are not expected to increase substantially. A local production facility may contribute to improved consumptions, besides supply of quality products. During discussions with officials of the MOH it was revealed that the quality of products being imported from different sources is not upto the mark and variation in active ingredient content from container to container is often observed. MOH welcomes the idea of a local formulation plant.

1.57 Requirement of acaricides for use against ectoparasites is projected to increase in the future. As outlined in para 1.47, MOA is planning to establish a local formulation plant to formulate and pack acaricides locally. An average growth of about 10 percent is estimated for the next five years.

1.58 Coffee, tea and sugar in the state sector is not expected to contribute substantially to growth in the consumption of pesticides in the immediate future, although the plantation variety of coffee being encouraged now is more susceptible to pestilence and therefore, may need more pesticides. Similarly requirement of pesticides for the settlement schemes may stay at its present level. The projections for the MOA, migratory pest requirements have already been discussed in para 1.45 (Appendix XII).

1.59 Examples of other countries show that while increase in pesticide usage in industrially developed countries has showed a slow down as approaches the point of saturation, in developing countries, the rate of increase is much higher, actually in some countries it even almost doubled each year (e.g. Brazil, Egypt, Thialand). Being agricultural based economy and with tremendous potential and scope in improvement, growth in pesticides consumption in Ethiopia can be much pronounced in future due to increasing adoption of improved agricultural practices and farmers realising the economic advantage in using pesticides. It is expected that with the establishment of local pesticide formulation facilities, there will be an overwhelming increase in the consumption of traditional commodity pesticides with higher overall economic benefits. Classwise insecticides will continue to have a higher share.

L. Pesticides Data

1.60 For planning an assured, need based availability of crop inputs in the country, basic statistics concerning imports, consumption and local production, if any, of various products, are vital. Presently there is no system operating in Ethiopia, whereby such data/information could flow to a

central source. Data collection and compilation is well organised in the MSFD, from where information concerning all aspects of pesticide usage including statistics could be obtained rather easily. It has been difficult to get accurate statistics regarding past consumptions from other sources. It may be useful to introduce a system whereby vital information concerning imports, sales, stocks, local production/formulation etc. for different crop chemicals, productwise, is received by the PPRD under MOA. For this purpose, the pesticides importing, using, supplying and distributing organizations be asked to furnish relevant information at regular intervals in standardised performae, which could form the basis of planning the short and long term requirements of pesticides in the country.

M. Long Term Perspective - 'The Pesticides Review Committee'

1.61 For an orderly and rationally planned approach to long term increase of consumption and imports of pesticides, assessment of demand, creation of local production, formulation capacity and to suggest a policy framework for achieving future targets on the basis of country's periodic plans, it is recommended that a 'Pesticides Review Committee' be constituted, comprising of representatives from amongst MOA, MOI, MSFD, RRC, MCTD, ESC, MOH, ARI, Office of the National Committee for Central Planning, AISCO and National Chemical Corporation. The Committee is expected to carry out the following tasks:

- Recommend long term targets of consumption based on anticipated endusers requirements, imports and the need for creation of local production capacity taking into consideration the desired level of indigenization.

- Review the planning mechanism at the zonal and central level from time to time, taking into account the limitations in the same, the need and recommendations for strengthening the planning and monitoring mechanism for effective implementation of the plant programmes.

Chapter Two

RAW MATERIALS

2.1 The success of pesticide formulation depends upon well-selected raw materials, efficient analytical control and standardization of important characteristics. The ready availability of relatively inexpensive ingredients of consistent quality, solvents and inert carriers in particular, is an important pre-requisite for establishment of a local formulation plant. Import of these materials may substantially influence the economics of the local formulation activity. Similarly, the local availability of packaging materials including small pack containers is highly desirable.

A. Active Ingredients

2.2 The manufacture of technical pesticides involving highly sophisticated and extensive chemical technologies often with heavy capital investments, are usually not within the reach of developing countries, as also the small tonnages required may not justify economies of scale. Long term supply arrangements with foreign reputed suppliers covering such aspects as price, quality and scheduled deliveries, may be entered into. Under such arrangements, the suppliers readily provide back-up assistance in terms of formulation development work based on utilization of local raw materials, analytical methods, both for active materials and formulated products, safety requirements in handling and formulation and recommendations concerning application.

B. Solvents

2.3 Many types of solvents are used in the production of liquid formulations. The choice is based on several considerations including solubility of the active material, phytotoxicity of the solvent, its toxicology, inflammability and volatility. Solvents could be conveniently classified as non-polar (aliphatic and aromatic hydrocarbons and petroleum distillates) and polar (ketones, esters, glycols, glycolethers and acid amides). The hydrocarbon solvents and petroleum distillates normally used in pesticide formulations are mixtures of hydrocarbons, each of which has its own boiling point. Aliphatic hydrocarbon solvents are primarily of the kerosene type with density value ranging between 0.76 to 0.79 and distil in the range from 190° C to approximately 475° C, and are used in large quantities. Typical aromatic hydrocarbon solvents used are the Xylene-type solvents having density values between 0.85 to 0.88 distilling over a range from approximately 133° C to 165° C. The heavy aromatic naphthas normally distil, in the range from 117° C to approximately 287° C with density between 0.92 to 0.97. Polar solvents, on the other hand, are usually of high purity as compared to the hydrocarbon solvents and their distillation range is seldom greater than 12° C. In selecting a polar solvent, those with boiling points higher than the range 94° C to 99° C are preferred. In specific cases involving solubility or phytotoxicity, materials with lower boiling points may be used with caution. Solvency generally increases in the order of aliphatic, aromatics to polar compounds. Amongst the aromatic hydrocarbons, the solvency power of the solvent increases as the aromatic content increases and so does the cost of solvent. The aromatic content of Xylene-type solvents and heavy aromatic naphthas range from 85 percent to more than 95 percent. In preparing emulsi-

emulsifiable concentrates (ECs) it is important to choose solvents which are relatively immiscible with water. The aliphatic and aromatic hydrocarbon solvents meet this requirement, however the problem becomes more acute when the polarity of the solvent is increased, since it is usually accompanied by increasing miscibility with water. Polar solvents of comparatively lower water miscibility such as cyclohexane, isophorone are used in mixtures with hydrocarbon solvents and of increasing polarity (such as glycol ethers and amide solvents) are used sparingly in mixtures with hydrocarbon solvents. Miscibility of the polar solvents (glycoethers, isopropanol etc) with water render them more useful for the formulation of water soluble concentrates (WSCs) for pesticides which are soluble in water e.g monocrotophos, phosphamidon. Solvents also affect the degree of phytotoxicity of pesticidal compositions. Hydrocarbon solvents are generally more phytotoxic than other solvent types. The higher boiling hydrocarbons are more phytotoxic than the lighter solvents. Another criteria in the choice of a solvent is the flash point - the one with highest flash point consistent with other desirable properties is chosen. Development of an EC starts with estimation of solubility of the toxicant in suitable solvents - from each of the following classes; kerosene, xylene-range solvents, heavy aromatic naphtha and cyclohexanone. Oil concentrates and ultra low volume (ULV) formulations, usually containing high concentration of active ingredients also use aromatic hydrocarbons such as xylene or heavy aromatic naphtha. For compounds which have limited solubility in these aromatics, more powerful solvents such as cyclohexanone or isopropanol are used. Important requirement of the solvent here is that the concentrate should be miscible with the diluent oil (such as kerosene, fuel oil or diesel oil). Oil and

emulsifiable concentrates have similar concentrations. While emulsifier is an important constituent of ECs, oil concentrates do not have any emulsifier.

2.4 At present there are mineral oil resources in Ethiopia although prospecting is on. Local refining operations for imported crude, under Ethiopian Petroleum Corporation at Asseb, however exist with a capacity to process one million tons of crude per annum. Various fractions obtained from the distillation of crude and the blended products from the refinery are set out in Appendix XIII. Some of the distillation cuts and or blended products from the refinery operations (kerosene, white spirit, gasoils, fuel oil, diesel oil) could possibly be tried for use as solvents or as diluent in preparation of oil concentrates/ULVs either alone or in combination with other more powerful imported solvents. Distillates of slightly different characteristics could also be produced from the refinery to suit specific needs. However, it has to be ensured that all the key characterstics of the local solvents such as distillation range, aromatics content, flash point, solvency, water miscibility, water content etc. are within the defined specification limits. In addition, emulsifier balance with respect to the local solvent should also be determined before making any substitution. Though small quantities of ethanol are produced in the country, the entire production is meant for captive consumption of the Ethiopian Beverage Corporation. A proposal to establish a new plant to produce power alcohol for use in mixture with motor gasoline is under consideration of the Government. With a good production of oilseeds in the country, some of the non-edible oils may also be

available locally for possible use as diluent in formulation of ULVs. At the start of operations, the entire requirements of solvents may have to be met through imports with gradual switching over to local solvents to the extent feasible. The suitability of local solvents would need to be thoroughly checked on a laboratory/ pilot plant scale and in the field before any large scale production is organised.

C. Auxiliary Materials for Liquid Formulations

2.5 In liquid formulations, surface active agents of the non-ionic and the anoinic types are used as emulsifiers to reduce interfacial tension between immiscible liquids. Water insoluble pesticides could form stable emulsions if an appropriate emulsifier is added and then diluted with water. Surface active agents are also added in WSC formulations to give the spray liquid sufficient wetting power. Other adjuvants, which may be added to improve quality or performance characterstics include stabilizers, thickners, dyes and similar agents. Selection of an emulsifier must be done systematically and laboratory trials are indispensable. On the world market, paired emulsifiers are available and it is not difficult to find out the right combination, producers being the best source of advice. Full requirements of auxiliary materials including emulsifiers may have to be met through imports since these are currently not available in the country.

D. Solid Carriers

2.6 One of the key criteria leading to the decision of establishing a local dry formulations facility is whether or not there is a continued and assured supply of carrier

or diluent from an indigenous source. The most important dry carriers and diluents used in pesticide formulations are inorganic materials principally of natural origin. They include minerals such as diatomite, vermicullite, attapulgite, montmorillonite, talc, pyrophyllite and kaolinite. Carriers having relatively high sorptivity are necessary when liquid or low melting pesticidal chemicals or solutions to be formulated as dust bases, wettable powder concentrates or for making granualar formulations. For granular formulations, carriers used may be materials of mineral or vegetable origin. Among the organic carriers, wood flour, ground tobacco stem, corn cobs, rice hulls, cotton seed meal can be used, while the inorganic carriers often tried are granular clays such as attapulgite and montmorillonite. Silica sand, grains of limestone, brick chips, gypsum and granulated fertilizers are also used in some cases. Apart from having all the required characteristics such as particle size, sorptivity, flowability and abrasivity, it is essential that the local carriers and diluents are also compatible with the active ingredients concerned. Ethiopia has a fairly vast mineral potential and a wide variety of minerals are available for use as carriers and diluents for making dry formulations. Some of the more important minerals which have been located in the country having potential use in the formulation of pesticides are kaolinite, diatomite, bentonite, limestone, dolomite. Kaolin is already being mined. A DDT dust formulation pland had been in operation under the MOA for over fifteen years in Tigray using kaolin as the base, mined from a nearby source. The plant is reportedly out of operations since last year for lack of spares, working capital and some organizational problems. In addition Shell chemicals is currently formulating lindane dust

based on local kaolin available around Addis Ababa. In addition, two large deposits of kaolin have been reported in district Bombawoha on the highway from Addis Ababa to Awassa, about 200 kms beyond Awassa in the south. Huge deposits of diatomite have been found in district Adamitulu, about 160 kms from Addis on way to Awassa. Over two million tons of bentonite deposits have been located in district Gewane around 375 kms from Addis Ababa on the main highway to Hararge. Studies are underway for a micronization project to produce micronized fillers from some of these minerals for paints and other applications. Four cement plants, one each in Addis, Diredawa, Massawa and Mugher are already operating in the country under Ethiopian Cement Corporation with limestone obtained from nearby quarries. Depending upon crystalline and molecular structure, composition, particle size and sorptivity, these materials could be used for production of dry formulations.

2.7 Suitability of local carriers and solvents to be used in pesticide formulations and the final composition of these products need to be thoroughly checked on a laboratory and pilot plant scale and also in the field before any large scale production is organised. Training of local staff for carrying out pesticide formulation developmental work could be organised through UNIDO's assistance. One such place recommended for training is the PDPI (Pesticides Development Programme of India) centre at Gurgaon in India which has been developed with extensive assistance from UNIDO and has excellent facilities for assessment of raw materials, development of formulation know-how and recipes, quality control, registration and monitoring, and other safety and operational aspects of pesticides formulation. The PDPI centre could also provide assistance in terms of assessing the suitability of locally available raw materials intended for use in pesticides formulation.

E. Auxiliary Materials for Dry Formulations

2.8 In dry formulations of pesticides, surfactant characteristics of interest are the wetting and dispersing of wettable powders (WP) in water during spraying in the field. The most commonly used wetting agents are sodium salts of alkyl benzene sulphonates, while dispersants may be the lignosulphate type or the sodium or calcium sulphonate of polymeric phenols. Anionic surfactants of the alkyl benzene sulphonate type having an active content of 40 percent and above and dispersing agents based on olyl cetyl alcohol with an active content of 25 percent and above are well suited for WP formulations. Other special materials used are anticaking agents (usually hydrated calcium silicates, micronised silica having low bulk density, high surface area and oil absorption) to prevent the formation of lumps or solid mass in storage and in some cases deactivators, stickers, structuring agents, antifoam agents etc. Such materials, used in small quantities, will have to be imported.

F. Packaging Materials

2.9 Safety remains an important consideration throughout the manufacture of pesticides. Not only safety precautions be followed by factory workers, but the packages themselves must be durable and corrosion resistant to prevent breakage and leakage during subsequent storage and transportation. From the safety point of view, therefore, stringent precautions are necessary regarding packing and labelling. Also packaging should be done in sizes that can be used conveniently by farmers thus enabling direct sales without repackaging. Packing materials may consist of glass, metal

or plastic containers. Metal containers are usually lined with protective coatings, which are mixutres of phenolic and epoxy resins. Plastic containers are frequently ideal for water-based products, but for non-aqueous products,compatibility often is a problem. Packaging materials generally recommended for dry formulations are mild steel or tin platecontainers usually lined with polythene liners or protective lacquers, polythene lined hessian bags, wooden, fibreboard containers lined with polythene liners and multiliner paper bags. For retail packing of solid pesticides, thick polythene bags are used which are further packed in cardboard cartons followed by wooden cases secured with strappings. Dust/granular formulations are also retail-packed in plastic bottles often with built-in sprinkling arrangement for ease of operation in the field. In view of safety considerations and because of high value of some of todays agrochemicals, selection of suitable containers and efficient quality control is absolutely essential. Ethiopian Petroleum Corporation has installed facilities at Asseb to produce 450 steel drums of 160 litre capacity per 8 hours shift against their captive requirement of 675 drums per day which gets satisfied through operations of a shift and a half. With some additional facilities, the spare capacity can be utilized for making tin or aluminium containers with arrangements for coating the drums to suit specific needs of pesticides packaging. For plastic containers, adequate facilities exist at Addis Ababa Foam and Plastic Factory and at Ethiopian Plast to produce plastic containers of sizes upto twenty litres from high density polyethylene, polypropylene, styrene acronolytril copolymer or malamine. Addis Ababa Foam and Plastic Factory have both blow and injection moulding units and can make any type of plastic containers. For making plastic bottles, some balancing equipments may be needed. Ethiopian Plast are making low density polyethylene products which are suitable for packaging of dry formulations. In addition to these two units, there are quite a number of other units scattered in other parts of the country. Glass bottles are being made at Addis Glass and Bottles Factory in Addis Ababa primarily for meeting the requirements of beverages The unit has a furnace capacity of 40 tons of glass per day. Corrugated cardboard cartons are locally available and adequate

printing facilities exist to meet the requirements of labels, cartons and shippers. Trials are essential to select suitable medium for different packaging duties. Compatibility and storage tests for shelf life and transport trials need to be conducted.

G. Testing of Raw Materials

2.10 In all cases, it is essential that the suitability of local solvents, carriers, adjuvants as well as packaging materials to be used in pesticide formulations and the final composition of the formulated products, is thoroughly ascertained through laboratory, bench scale and field tests before any commercial production is undertaken. Following the completion of these tests satisfactorily, the specifications for all the ingredients and packaging materials are established and defined to ensure that the quality of future supplies stays within the defined specification limits. For such developmental work, the backup services of the collaborators/ suppliers may be utilized in the initial periods. Assistance could also be sought through UNIDO for testing the suitability of local materials at PDPI, India in addition to training of local staff there as suggested in para 2.6. Subsequently, in-house expertise may be developed with a well equipped laboratory for undertaking development work in all its aspects. This is of utmost importance since a variety of pesticides are used in Ethiopia and the endevour should be to meet the wider and changing requirements of the users the soonest possible.

Chapter Three

ESTABLISHING LOCAL FORMULATION FACILITIES

3.1 Any developing country with a reasonably sufficient size of market has a potential to formulate pesticides with locally available raw materials as much as possible. It is estimated that at present nearly ninety percent of pesticides used in developing countries are formulated within the country of use. From an economic and logistic point of view it is more beneficial to import relatively small tonnages of active materials and some adjuvants as compared to substantially larger tonnages of finished formulations. The entire requirement of pesticides in Ethiopia is met through imports, the lead time for procurement as also the transportation costs therefore, are high. E ablishment of a domestic pesticides formulation outfit, providing for agricultural and health needs of the country, using local resources, would therefore go a long way in improving agriculture, reducing the foreign exchange requirements, and in cost of product to the user by saving in transportation costs and above all in supplying standard products at the right time. Such a local plant offers flexibility in designing various facilities and the production programme to synchronise more readily to local needs. For many of the well established products, local production of formulations can provide real savings. Furthermore a better adaptation to the market requirements is possible in terms of labelling, container types and sizes and local recipes. In planning a local formulation facility, internal consumptions within the country as well as export potentials need consideration.

A. Domestic Market

3.2 The following guiding parameters are taken into consideration while planning a formulation outfit in

Ethiopia:

- The needs to maintain efficient standards of agriculture will continue to be at the centre of Government policies.

- Continuity of the tempo of development of agriculture i.e. advantage being taken of introduction of improved farm practices e.g. high yielding varieties, improved seed and fertilizer package programme for the benefit of the farmer incorporating appropriate plant protection measures.

- The planning for pesticides and the distribution system will improve.

- An efficient extension and other farm services for plant protection will continue to be available to demonstrate the use and benefits of inputs.

- Agricultural credit and finance will be available at reasonable terms for extending the scope of pesticides usage.

- Appropriate subsidies will continue to be extended for optimising the use of plant protection chemicals.

- The market and the prices of produce will be at a level to provide economic incentives for increased agricultural productivity to the peasants.

- The Government will give due consideration to allow imports of technical pesticides and other raw materials duty free to encourage local formulations.

- The Government may also consider phasing out imports of those products which could be formulated locally.

The growing establishment of agriculture on firm footing through several Government plans and projects, the emphasis on improving farm productivity coupled with sizable expansion of area under cultivation and ever-increasing willingness of the cultivators to take help of various inputs to maximise production promise a growing trend for the usage of pesticides in Ethiopia. Bearing in mind the targets established under the TYPP to meet challenges of the future, projections for Pesticides consumption have been worked out on a rather conservative basis in section K of Chapter one. State farms will continue to have a dominant share in the total consumption of pesticides in the country. The peasant sector, with its vast potential,is also expected to pick up to contribute effectively towards food self-sufficiency once the low-cost commodity products with high benefits and a broader applicability are made available.

B. Export Potential

Agriculture is the mainstay of economy of most of the African countries. It provides between 30 to 60 percent of Gross Domestic Product and 85 to 90 percent of employment in most countries in this continent. Subsistance farming is the basis of African agriculture and over 60 percent of the land is devoted to subsistence production in this continent. Cash crops are African countries main source of hard currency. For an adequate food supply to an increasing population, and for an increased export earinings the countries of Africa look to a developing agricultural sector, based on higher levels of productivity. Improved farming practices are being adopted for efficient utilisation of agricultural potential, which require expanded usage of inputs such as pesticides. Some of the countries in this region with no formulation facilities of their own (Uganda, for example), therefore, could be potential

export markets. Export of pesticides is possible only with a good knowledge of market conditions, with products of high quality of competitive prices and by establishing good links with marketing organisations. Notwithstanding the potential that exists for export of agrochemicals to some of the East and Central African countries, no export should be taken into consideration at initial stages of the operational phase. However, as the production operations stabilise and some experience is gained in the formulation and handling of pesticides, export possibilities could be explored in some of the adjoining/PTA countries. Tanzania and Kenya are already exporting some of their locally produced materials in this region.

C. Identifying Areas of Operation

3.4 Table 1.7 in section I of Chapter One summarises the present consumption of pesticides classwise and on the basis of sectoral use. Insecticides have a share of 75 percent amounting to about 3100 tons of different products shared mainly by the state sector, the peasant sector, PPRD of the MOA and others. About 70 percent (equivalent to nearly 2150 tons) of the total insecticides are consumed as liquid formulations, with 1250 tons shared by MSFD, 275 by the peasant sector, 210 by Plant Protection & Regulatory Department for epidemic pest outbreaks, 120 for settlement schemes, 150 for the veterinary sector, 100 by MOH, and the balance by MCTD and ESC. These figures however, do not necessarily reflect the actual potential in the country as already detailed in Chapter One. Demand forecasts (Section K, Chapter One) indicate that MSFD alone is expected to increase its consumption of insecticides to 2280 tons by 1989. Adding the requirement of other users, even at the existing consumption levels, total liquid formulations required may be over 3000 tons. For the peasant sector, dry

formulations in the form of dusts and granules of some of the commonly used materials have been suggested (Section K, para 1.55, Chapter One), which will be supplemented with liquid formulations to cover the entire range of products for the peasant sector. With AISCO's importation of some of the dry formulations (cypermethrin 1 G, primiphos-methyl 2 D and DDT 5 and 10 D, for the current crop season, in fairly large quantities, a beginning in this direction has already been made. Pesticides formulation activity, with its relatively low capital investment in plant and machinery and remarkably high value-added feature, invariably offers an excellent economic and financial viability. However, this requires a good marketing infrastructure, with a strong field force to develop its full potential. The nature and size of crop-chemicals market and the style of business coupled with poor support and infrastructural facilities available in the country did not, perhaps very much favour venturing into setting up a local formulation plant in the past. Now with the emphasis being put on the improvement of agricultural sector and a fairly big market of the present size of over USD 20 million per annum, penetration into this activity is highly justified to ensure availability of quality productsat the right time and at more economical prices.

3.5 With the indepth analysis of special characteristics of the pesticides market in Ethiopia, the use of agrochemicals and a general projection of likely economic and agronomic developments, as has been outlined in Chapter One, when viewed with the availability of local carriers, some of the solvents, packaging materials and other infrastructural facilities adequately justifies establishing a modern multipurpose integrated formulation plant with facilities to process liquid, dust and granular formulations of some of the widely used insecticides, incorporating adequate measures for industrial hygiene, safety and environmental consideration to meet the rising demands of the state farms as well as the peasant sector. A wettable powder formulation outfit using local carriers for insecticides and fungicides to meet the requirements of MOH, ESC and the coffee sector as also to substitute some of the liquid formulations since based on solvents to be partly imported, and a herbicide dilution and packaging (liquids only

from imported concentrates) are suggested to be added at a later stage as indicated in the phased programme given below:

Phase I:

Setting up facilities for the formulation of:

- Insecticide liquids. Product mix could be selected from among the following chemicals depending upon prevailing market demands : Endosulfan, Malathion, Dimethoate, Fenitrothion, Cypermethrin, Profenofos, Chlor-pyrifos, Monocrotophos, Methamidophos, Dicofol, Toxaphene and any other according to the dictates of the market.
- Insectidice granules with potential products as Endosulfan, Diazinon, BHC/Lindane, Cypermethrin, Aldicarb and any other product according to the market demand.
- Insecticide dusts. Selection could be made from amongst, Malathion, Primiphos-methyl, DDT, BHC/Lindane Carbaryl, Endosulfan, Aldrin, Dieldrin and any other required by the consumers.

Phase II:

Establishing facilities for the manufacture of:

- Insecticides and Fungicides wettable powder formulations using locally available carriers. The products which could be taken up include DDT, BHC/Lindane, Aldrin, Copper fungicides, Carbaryl, Endosulfan.
- Herbicide liquids dilution and packaging from imported concentrates to include water solutions, solvent solutions and flowables of products in accordance with market demands. A wet grinder unit could be added later to facilitate formulation of herbicide flowables from active ingredients locally, as and when adequate demand develops.

The proposals as above caters to the broad requirements of the whole country in the present context and in the long run. Phased implementation of formulation activity with relatively simpler operations in the first phase has been suggested keeping

in mind the immediate market needs on the one hand and the present stage of infrastructural develcpment in the country on the other. For the formulation of liquids, part of the requirement of solvents can be met from local resources and some of the packaging materials are also available in the country. Similarly for the dry formulations, meant for the smallholder sector, local carriers and packaging materials are available. Of the total of over 25 insecticide formulations imported every year, many have similar application and usage and through inter-se-substitution of products, it should be possible to meet a sizable portion of the country's requirements by formulating some of the common products of usage. During discussions at various stages with the National Project Counterpart officials, it was indicated that the liquid formulation facility is to be established immediately to meet the assured demand of the state sector, as has also been proposed in an earlier 'opportunity study' on the subject. Accordingly, the aforesaid recommendations may be implemented in stages, the first phase being divided into two stages with liquid formulation plant coming into stream as early as possible followed by dust and granulation units. Subject to a favourable economic and financial viability and approval of the Government, planning of the first phase should commence immediately so that the plant is on stream sometimes in 1989/90. The first activity for the liquid insecticides could be to import in bulk packaging and repack in smaller smallholder packaging; for dusts, to import dust concentrates, dilute & pack and for granules also to repack in smaller sizes from imports in bulk packaging. This will help develop the market. This would also take care of the proposed project of the Fisheries and Animal Resources Department of the MOA to import acaricide (toxaphene) in bulk, store and repack in smaller packs locally (Para 1.47 of chapter one.) The implementation of the second phase could be taken up after the operations of the first phase get stabilised and the market parameters get further crystalised as also the local staff gains experience of this activity. Wettable powder plant involves relatively high investment and a greater degree of skill and knowledge to operate hence its implementation in the second phase. For herbicides, there are so many, the triazines

bipyridilium compounds, urea derivatives, phenoxy acid salts and several others and most of them used in small quantities that local formulation may not be justified, therefore only a dilution and packaging unit has been suggested in the second phase. Wet grinding facilities including a wet grinding mill, a slurrying device and a cooling unit could be integrated later with this plant should there be enough local offtake coupled with export possibilities. Amongst cereals, particularly wheat and in coffee plantations, the use of herbicides is quite prevalent in the country. Use of herbicides in coffee plantation is necessitated on account of two reasons, firstly that the labour is scarce on the coffee farms and secondly the coffee trees get damaged during mannual weeding. The MCTD forecasts an increased use of herbicides on coffee. The formulation of herbicides in a common facility with insecticides is not recommended for fear of intermixing and its serious consequences in the field. The second phase implementation should follow at an opportune time when the market forces and other factors justify the operations.

3.6 As reported earlier, a dust formulation plant has been in operation for over a decade under overall charge of the MOA producing DDT dusts with Kaoline as a carrier. The plant has since been out of operation for about one year for want of essential spares and organizational problems. As reported by MOA, an offer has already been made for take over of the facility by MOI. It is recommended that the facility may be examined and depending upon the condition of the machinery, the complete plant may be shifted to the new site of the proposed pesticides project,. overhauled and balancing equipment, if any, added to put it into operation for formulation of dusts as proposed in the first phase programme.

3.7 A market oriented approach coupled with current availability of inputs required for making the local formulation operations successful has been adopted in formulating the aforesaid recommendations. Product mix from these units is to be chosen in a manner so as to cover the wider needs of state sector and the peasant sector agriculture, both for pre-harvest and post-harvest treatments, livestock, public health and for special requirements of migratory pest control, settlement schemes etc.

Household Pesticides:

3.8 Another area which could be of interest is the formulation of household pesticides. The active ingredients used mainly are pyrethrum the synthetic pyrethroids, dichlorvos, propoxur, dioxacarb, etc. The aerosoles contain an active ingredient, usually 0.2 to 0.5 percent, a carrier, usually kerosene, a little perfume and a propellant like piperonyl butoxide which also acts as a synergist blocking the detoxification mechanism in insects thus enhancing the activity of the insecticides. In some cases, the use of piperonylbutoxide is eliminated and a simple mixture of active ingredient (say dichlorvos 0.4 percent, pyrethrum 0.1 percent), perfume (0.02 percent) and kerosene (over 99 percent) as carrier, is marketed in small glass bottles or other suitable containers. Such products have to be sprayed manually. Household products are also marketed as powders in small sachets, usually formulated using dioxacarb (3 to 4 percent) with a carrier. This activity does not require much investment and infrastructure and can be organized in conjunction with the main formulation activity.

D. Defining Capacities

3.9 Keeping in view the gestation period of three years for execution of the project from grass root stage and the domestic requirements of agriculture, public health and veterinary, the following capacities are proposed for the first phase operations to be implemented in two stages.

Type of formulation	Capacity per year	Basis
Stage I		
1. Liquids	1500 K.Lit	1,8 hour shift/day 250 days per year
Stage II		
2. Granules	750 Ton	1,8 hour shift/day 250 days per year.
3. Dusts	1000 Ton	1,8 hour shift/day 250 days per year.

The above capacities have been proposed taking into consideration two months maintenance and vacation time. A month is calculated as an average of 21 working days, taking into account holidays, planned maintenance and unprogrammed interruptions. The daily capacities, therefore, of the three formulation units would be 6 Kilo-litres for liquids, 3 tons for granules and 4 tons for dusts and single shift operations. List of potential products which could be formulated locally is contained in Section 3.5 of this chapter. The outputs and the product mix could be geared to market demands from time to time. Similarly the active ingredient content could be varied as dictated by plant conditions and the consumer requirements. Should the market off - take increase, the plants can be worked for more than one shift and the plant running can also be increased upto 330 working day in a year.

3.10 Low investment in formulation outfits and varying seasonal demands for formulated products, are the two main features which normally dictate installation of excess capacity in such units. However, the capacities proposed are modest and would conform to the requirements of the country. During peak seasons, the plants can be run more than one shift to meet the dead-lines. Confining activities to a selected few compounds having overwhelmingly larger shares in the market requirements, initially would be desirable and product range could be expanded as more and more experience is gained and the dormant market factors get unfolded. As detailed in Chapter Two, it is important that the final composition of formulations using local raw materials must be elaborated on a laboratory/pilot plant scale and field trials undertaken before venturing into large scale operations.

3.11 Depending upon the product mix and the active ingredient content in the formulations, the local material content is estimated to be anything upto 30 percent for liquids, between 85-99 per cent for dusts and granules. The value added in taking up formulations locally is remarkably high in dusts and granules, often above 60 per cent, which could mean heavy savings in foreign exchange. With possibilities of

developing exports to some of the neighbouring countries (like Uganda) the plant can generate foreign exchange earnings. Implementation of the project will result in following benefits to the country.

- Substantial savings in foreign exchange spent on diluents, transportation and processing costs. For liquid formulations, local solvents could be used to an estimated 25 percent of the total requirements whereas, for dry formulations, the share of locally available carriers, would be nearly 95 percent of the end products. On a total annual production of 1750 tons of dry formulations as proposed the carrier would amount to about 1660 tons.
- Adequate and timely availability of formulated pesticides possibly at more economical prices to the farmer.
- A stimulation to secondary associated industries connected with pesticide formulations including local production of certain carriers, fillers, packaging materials.
- Reduction in risk of product degradation, because of speedier deliveries.
- Development of technological skills and ability to formulate any product locally.
- A stimulant to improved use of plant protection inputs with better availability.
- Reduction in dependence on foreign suppliers.
- Reduction in local distribution and transportation costs through strategic location of the plant.

This unit could also serve as a training centre for personnel involved in handling pesticides including extension staff.

E. Production Programme

3.12 The proposed pesticides formulation plant is intended to be a multipurpose facility with sufficient flexibility in terms of plant design to formulate a variety of insecticides. While the use of pesticides may show a particular

pattern when averaged over a certain period of time, usage of individual product formulations may fluctuate considerably in particular season or year because demand is dependent on a number of uncontrollable factors, in particular the following; prevailing climatic conditions, degree of pest incidence, continued effectiveness of the product an. special seasonal factors. A wide variety of insecticides are being used on state farms, many of which have overlapping ranges of activity. For the local formulation operations to be economica', it is important that the activities are confined to only a few broadspectrum insecticides which are common to different consuming sectors. The product mix in a given year would be guided by the sales forcasts. In accordance with the discussions held with the National Counterpart Officials, following pesticidal formulations in quantities specified against each, will be taken into consideration for carrying out the financial and economic analysis for the proposed project.

Product	Formulation	Annual Production (K.Litre)
1. Endosulfan	35 EC	400
2. Endosulfan	25 ULV	350
3. Malathion	50 EC	450
4. Dimethoate	40 ULV	100
5. Dimethoate	40 EC	100
6. Fenitrothion	50 EC	50
7. Diazinon	60 EC	50.

The aforesaid mix in the quantities specified represents the most commonly used products in the present context of pesticides usage in Ethiopia and therefore, considered as a guideline for the purpose of preparing the feasibility study. The plant, in terms of design and capacity however, is sufficiently flexible to formulate any of the liquid insecticides. Product range and quantities to be produced each season will be guided by the sales programme in consultation with various buying and consuming agencies.

Chapter Four

PLANT LOCATION

4.1 This report does not purport to identify any specific site for the proposed pesticides project for which detailed investigations (which inter-alia, include soil survey, ground levels, water analysis, availability of infrastructural facilities around the site, approach roads, nearness to a railway siding etc.), will be necessary. Main objective here is to establish regional location which satisfies most of the conditions for an acceptable site for the viability of the project. Some of the considerations which have varying degree of importance with respect to choice of location are enumerated hereunder.

- Nearness to sources of raw materials;
- Proximity to consumption areas;
- A reliable source of power supply;
- Availability of water of suitable quality;
- An efficient network of transport facilities both for raw materials as well as end products;
- Good infrastructure including housing, health centres, shopping centres, educational facilities, communication systems, repair and maintenance facilities etc;
- Free from natural calamities like floods, earthquakes etc;
- Facilities for waste product disposal;
- Availability of labour;
- Favourable climatic conditions;
- Availability of port facilities.

The traditional considerations for location of a chemical plant particularly a pesticides unit are the resultant of two major and two minor forces. The major ones are proximity to the market and factors of production while the minor forces are waste and bye-product disposal and the infrastructural facilities. However, in view of the social obligations of minimising disturbance of the physical environment, the element of environmental protection or what is generally referred to as ecological consideration, is assuming significance in the location of pesticide projects. In the case

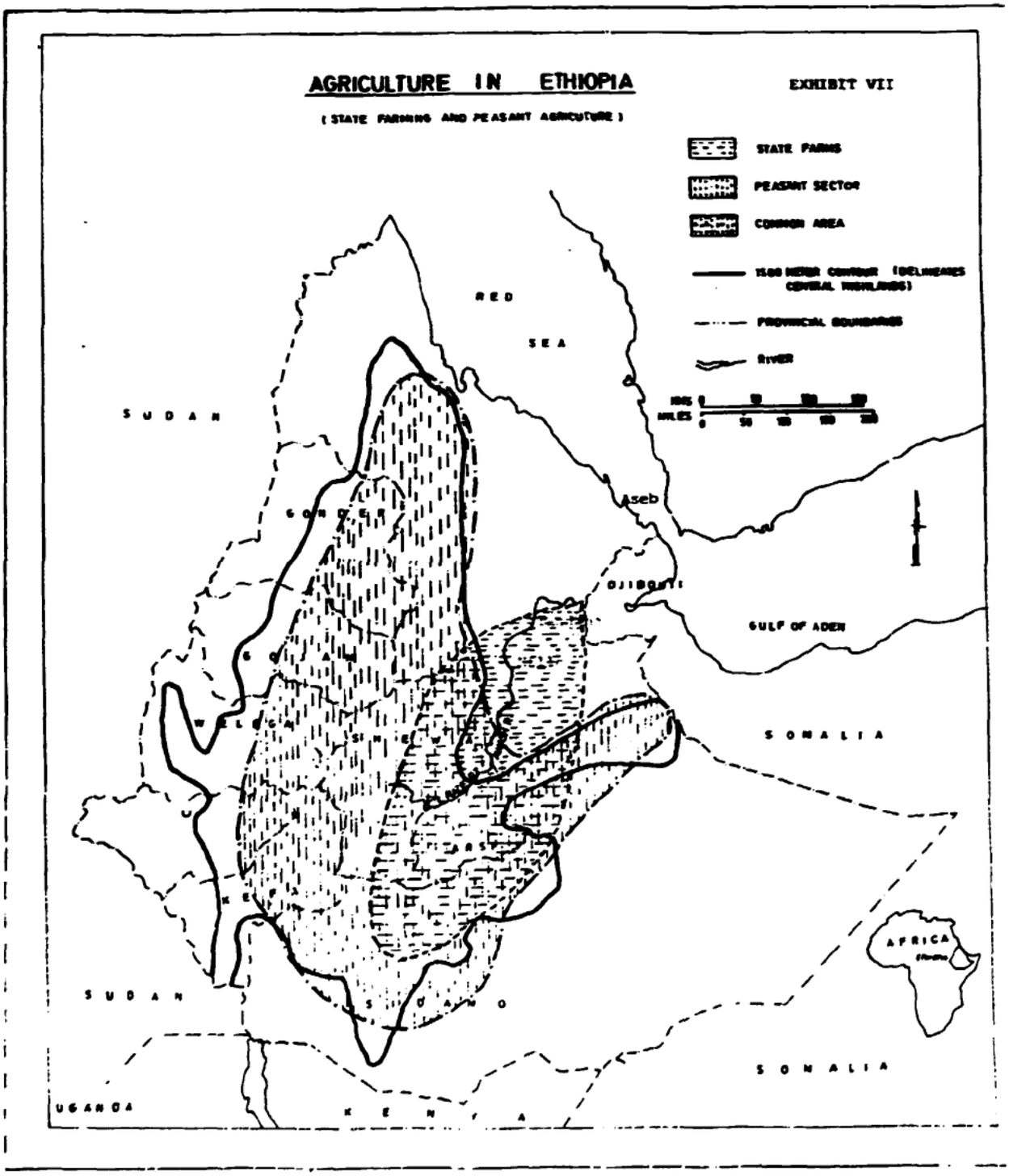
of proposed project, there are practically no trade effluents from the formulation unit. The over-riding considerations, therefore, are the proximity to consumption areas and the factors of production. In fact, formulation is regarded as primarily a market oriented operation and therefore formulation plants, including filling and packaging facilities are generally located in or near the major markets. As a general rule, it is less costly to transport raw materials for manufacture of pesticides rather than to move substantially larger tonnages of finished goodsover considerable distances which have to be carried in smaller packaging.

A. Alternatives

4.2 Keeping the above factors in view, five possible alternative locations could be considered for siting the pesticides project namely Asseb, Tendaho, Mille, Awash, Nazret.

Proximately to Consumption Areas:

4.3 As mentioned earlier, state farms are the largest consumers of insecticides. State farm cultivation is organised on regional basis under three separate corporations. Awash Agricultural Development Corporation, operating mostly irrigated state farms in areas following the Awash river- the Upper Awash with farms in Nure Era near Metehara specialise in cotton and horticultural crops; the Middle Awash cultivating Melda Werer, Ami Bara, Geware, Dofen-Bolhamo farms produce cotton and banana; and the Lower Awash around Tendaho mainly cultivating cotton. The Southern Agricultural Development Corporation looks after all the state farms in the southern region producing wheat, barley, maize, cotton and some oil crops. Cotton farms in the southern region include Bilate, Abaya, Aribaminch and Sille Wajifo. The third, North-western Agricultural Development Corporation is engaged mostly in rainfed agriculture producing maize, sorghum, beans, oilcrops, fibre crops and spices. In the peasant sector, the high potential areas are located mostly in Shewa, Gojam, Arsi, Gonder, Sidamo, Welega and Kefa (Exhibit VII). There are about 31 Awrajas out of a total of 102 in these areas which have about one-half of the


AGRICULTURE IN ETHIOPIA
EXHIBIT VII
(STATE FARMING AND PEASANT AGRICULTURE)
STATE FARMS
PEASANT SECTOR
COMMON AREA
PROVINCIAL BOUNDARIES
RIVER
RED
SEA
SUDAN
Aseb
DJIBOUTI
GULF OF ADEN
SOMALIA
AFRICA
SUDAN
SOMALIA
UGANDA
KENYA

country's fertile land and in which the pattern of rainfall is relatively stable. These high potential areas contain 60 percent of Peasant Association membership (and probably of peasant population), produce about 55 percent of cereals, supply over 90 percent of the grains procured by Agricultural Marketing Corporation, and account for most of the fertilizers used by the peasant sector. The proposed unit is intended to meet the requirements of both the state as well as the peasant sectors, a more central location therefore would be preferable to shorten the distribution lines, to promptly respond to market demands and to save on transportation costs. Nazret, therefore, appears to be the prefered choice for establishing an integrated facility to produce both liquid insecticides as well as dry formulations at one location to cover a larger portion of the country's requirements, in view of the following added advantages:

- Central location with respect to consumption areas;
- Easy availability of inert carriers, diluents and some of the packaging materials from nearby sources (Chapter Two);
- Well connected through rail and road. Nazaret is connected through a railway line via Awash and Dire Dawa to the port of Djibouti. All the imported raw materials could be transported through this facility. Alternatively, imported raw materials could be transported from Asseb by road which is a highway, although it will be more economical to get the imported materials through Djibouti to be transported by rail, the distance being shorter as compared to Asseb-Nazaret.
- Easy availability of power, water and infrastructural facilities being already an industrially developed town. Except Awash, the power at all other locations is either not available (Mille) or scarcely available (Asseb and Tendaho). From the point of view of infrastructural facilities, all locations other than Nazaret are poorly placed.
- Favourable temperate climatic conditions, with temperature ranging between 20° to 30°C and an average relative humidity of fifty percent. Compared to another locations, Nazret is best placed with

respect to climatic conditions.

- Fairly good availability of manpower at wages comparable with normal standards prevailing in the country;
- Good working conditions compared to other sites.

In the matter of storage of active materials and some of the formulated products, as also in the processing of certain type of formulations, surrounding temperatures and humidity are important considerations. Nazaret being relatively a cooler and dryer place has inherent advantages to support a pesticide formulation plant. Wettable powder formulations of low melting products like endosulfan, DDT are easier to process in locations where humidity as well as atmospheric temperatures are low. Looking to all the aforesaid considerations, Nazret is proposed for siting the project.

4.4 A second alternative is to split the formulation facilities into two seperate entities based on the type of formulation namely liquids and the dry products and site them differently at two locations close to the consumers. Under this approach, the liquid insecticides plant could be located around Tandaho in close proximity to the state farms of Awash Agricultural Development Corporation in Lower Awash mainly concentrating on cotton consuming a sizable portion (estimated to be well over sixty percent of the total state farms consumption of insecticides at present) of liquid insecticides. The facility for dry formulations, on the other hand could be located at Nazret close to the peasant sector agriculture. Under this approach, besides an increased initial investment of about forty percent the overhead costs would also be higher being two seperate establishments. However, this would result in savings on transporation costs, the two units being close to the consumption areas. Ethiopia being new to the formulation activity, an integrated unit at Nazret would be more appropriate at this stage and a second liquid formulation unit could be considered exclusively for Tandaho at a later stage, when the consumptions pick up further to justify setting up an independent unit there.

Chapter Five

TECHNICAL ASPECTS

A. Description of Project

5.1 Based on an indepth analysis of today's market and future projections of pesticide requirements in Ethiopia, it has been concluded (Chapter Three) that there is a definite scope for establishing the following formulation capacities in the country.

Table 5.1:

Proposed Formulation Capacities

Type of Formulation	Capacity/Year	Basis
1. Liquid Formulations of Insecticides	1,500 Kilo ltrs.	1,8 hour shift/ day250 days per year.
2. Dust Formulations of Insecticides	1,000 tons	1,8 hour shift/ day 250 days per year
3. Granular Formulations of Insecticides	750 tons	1,8 hour shift/ day 250 days per year.

Daily capacities for the three formulation units as above are evisaged to be 6 kilolitres for liquids, 4 tons for dusts and 3 tons for granules. As mentioned in Chapter Three, the liquid formulation plant will be set up in the first stage. The technical inputs and economic and financial study, therefore is being confined to the establishment of liquid formulation facilities only at this stage.

B. Liquid Formulation Types

5.2 Within the liquid formulation types, there are a number of varying formulations which include the most commonly used emulsifiable concentrates, oil concentrates including ultra-low volume preparations, water soluble

concentrates, suspension concentrates (also called flowables), aqueous concentrates, oil solutions etc.

Emulsfiable Concentrates (ECs):

5.3 ECs are solutions of one or more water insoluble active ingredients in an organic non-water-miscible solvent which contains one or more emulsifiers. In addition, as the need may be, a stabilizer may also be added. Thanks to the emulsifier, the insoluble active material can be diluted with water to the desired spraying concentration to form an emulsion in the spray tank. Flash point and phytotoxic characteristics are some of the factors considered before selecting the solvent. The most generally used solvents are the xylene type, the heavy aromatic naphtha type or occasionally when the solubility of the pesticide is sufficient, aliphatics of the kerosene range. The shelf life of an EC depends on mutual compatibility of pesticide, emulsifier and other additives and can be increased by using stablizers such as epichlorohydrin, glycol etc. Among the liquid formulations, ECs are the preferred form for its convenience to the user.

Oil Concentrates and ULV Formulations

5.4 These products are solutions of active ingredient in low volatile solvents. They usually contain no emulsifiers. Basically all insecticides can be formulated into ultra low volume (ULV) products, provided they have a reasonably high solubility in the commonly used solvents. ULV spraying operations require the use of very fine sprays and as a consequence the solvent used must have a low evaporation rate. It is also necessary for the atomization process. Evaporation would cause a decrease in temperature and this added to the evaporation of the solvent, might cause crytallization on the atomizer, especially on the gauze of rotary atomizers. Liquid active materials may sometimes be sprayed without the use of a solvent. This is however often not possible since for thorough coverage

of the target an amount of spray liquid is required that in some cases may be higher than the amount of liquid active material. The coverage requirements depend on many factors such as the type and mobility of the pest to be controlled, the density of the vegetation and the mode of action of the pesticide. Besides, many of the liquid pesticides are rather viscous, which is a disadvantage when atomization into very small droplets is required. For solid active materials, the use of solvent will always be necessary. Some of the requirements for a ULV solvent are summarised as under:

The solvent must
- have a low votality;
- have a high dissolving power for the pesticide;
- have a low viscosity;
- be non-phytotoxic;
- be compatible with the pesticide.

Several types of solvents including the low boiling aromatic hydrocarbons, e.g. xylene and solvent naphtha; high boiling aromatic hydrocarbons e.g. Iranolin KEB; aliphatic hydrocarbons e.g. white spirit, kerosine; high boiling alcohols e.g. nonanol; ketones e.g. cyclohexanone; special solvents e.g. pine oil and tetralin; vegetable oils e.g. cotton seed oil and castor oil; glycol ethers and glycols are considered for the oil concentrates. However, xylene and solvent naphtha type of solvents are not commonly used for ULV formulations because of their high volatility.

Water Soluble Concentrates (WSCs or SCWs)

5.5 This is the preferred product form for active ingredients which are easily soluble in water. They usually are just a solution of the active material in water-soluble solvent. For stability reasons, water cannot usually be used as a solvent. Surface active agents are sometimes added to give the spray liquid sufficient wetting power. Examples of this type of formulation are the insecticides monocrotophos and phosphamidon.

Suspension Concentrates (SCs)

5.6 SCs or flowables (F) as they are often called stand for ultrafine and stable dispersion of water-insoluble solid active ingredients in water. To achieve a stable suspension, suspending, wetting and structure building agents are added. A good cold stability is obtained by addition of an antifreezing agent. These are diluted in the field with additional quantities of water to bring it to the desired fielf strength. SCs are made by wet milling in relatively sophisticated and expensive equipment. The principle involved for particle size reduction is to grind weighed amounts of pesticide and adjuvants in a medium of water, usually through a two stage wet grinding process. The mills are agitated cylindrical vessels filled with ceramic media which crush the toxicant particles into a finely suspended slurry. Weighed amounts of water and solid ingredients are added to the coarse grinding unit and milled batchwise. Amongst insecticides carbofuran F is an example of a flowable formulation containing 12 percent carbofuran. Triazine (atrazine, ametryne, terbutryne) and amide herbicides (metolachlor) are also being marketed as flowables.

Aqueous Concentrates:

5.7 These are concentrates of pesticidal chemicals dissolved in water. The main requirement, apart from the solubility of the active material, is chemical compatability with water. Examples of this type of formulation are the solutions of salts of phenoxy herbicides.

Oil Solution:

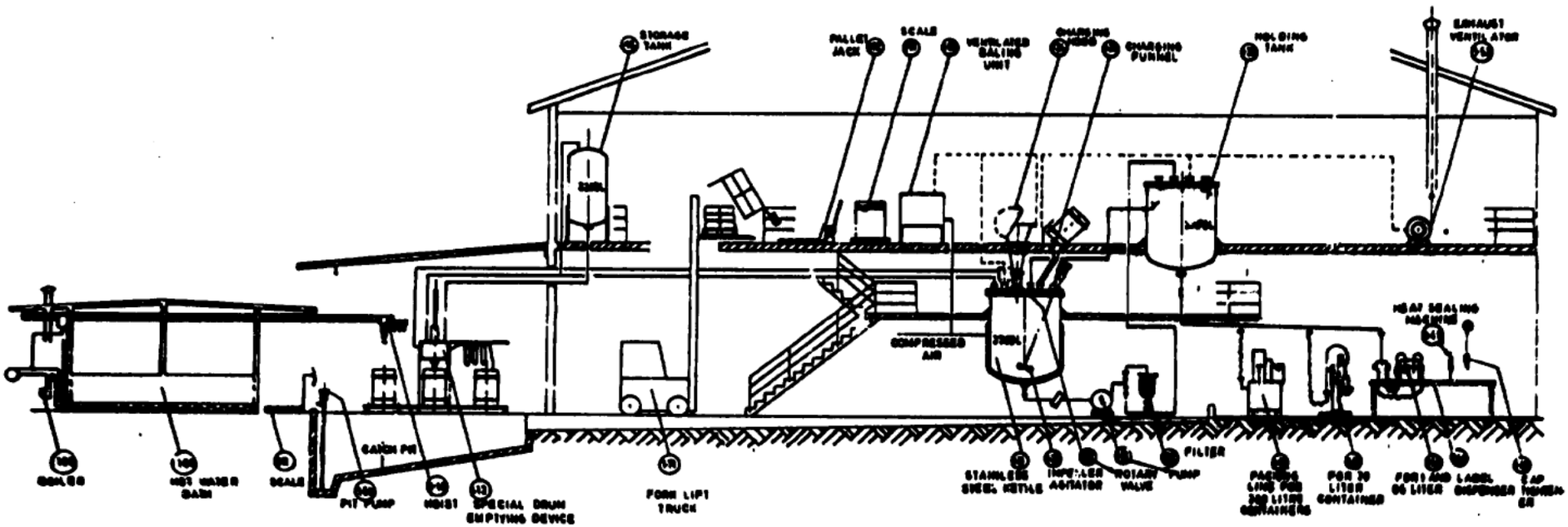
5.8 These are ready-to-use formulations containing generally, a low odour, colourless solvent of the kerosene type and a pesticidal chemical in low concentration. Oil solutions of insecticides are generally used for household insect control.

C. Liquid Insecticides Plant

5.9 Out of the several types of liquid formulations described above, the proposed unit will be capable to process ECs, oil concentrates/ULVs, WSCs, and oil solutions of a variety of insecticides. The installation proposed for the formulation of liquid insecticides is shown in Exhibit VIII. The central feature of the processing unit is a 3750 litres stainless steel (or glass-lined) jacketed vessel (1.21) with a bottom run-off valve, two speed stirring gear and an impellor agitator (1.22), where the mixing of various ingredients is carried out. For liquid active ingredients, the drums containing the material are weighed on the scale (1.11) and then placed on a special drum emptying device (1.12) from where the contents are transferred to the stirring kettle (1.21) by means of a built in pump. The empty drums are flushed with the solvent used for formulation which has been pre-weighed into the overhead solvent batch tanks (1.15 and 1.16)each with a capacity of 2250 litres. The solvent used for flushing is then transferred to the stirring kettle. Small amounts of liquid raw materials can also be directly added to the kettle through the charging funnel (1.25). Semi-liquid, highly viscous or low-melting active ingredients are melted or fluidified before they are charged into the kettle. This operation is carried out in a water bath with a capacity of eight drums which is heated by means of a hot water coil. The hot water is generated in a thermo-regulated electric boiler (1.08) and circulated in a closed circuit by means of a hot water pump. The same pump is also used for circulating hot water in the jacket of the mixing kettle (1.21) whenever required. A hoist (1.10) is provided for the handling of drums. The solid active materials, on the other hand, are lifted to the charging platform by means of a fork lift (1.71), weighed on the scale (1.51) and dumped into the ventilated charging hood (1.24). A rotary valve (1.23) transfers the solid raw materials

PESTICIDE FORMULATION PLANT – ETHIOPIA

EXHIBIT VIII



FLOWSHEET FOR

LIQUID INSECTICIDES PLANT

from the hopper into the kettle (1.21). The empty bags are compacted in a ventilated bailing unit (1.52). A pallet jack (1.72) is used to move the solid raw materials on the charging platform level. In the mixing kettle the raw materials are stirred to obtain a homogeneous solution. If required, the contents of the kettle may be heated by circulating hot water in the jacket. The temperature is not recommended to be increased beyond 60°C. After finishing of a batch, the contents of the kettle are pumped into the 3750 litres stainless steel holding tank (1.33) by means of a centrifugal pump (1.31). If required the product can be passed through a cartridge filter (1.32). The stirring kettle is then ready again for the formulation of next batch. From the intermediate holding tank the finished product is conveyed to the various packaging lines by gravity. The solvent storage facility will be located outside the plant building . Local solvents will be stocked in two steel tanks (1.01,1.02) each having 15,000 litres capacity. Solvents are transferred by means of centrifugal pumps (1.05-1.06) via a flowmeter (1.07) into the preset metering solvent batch tanks (1.15, 1.16). Imported solvents can be charged to the mixing kettle (1.21) by means of the drum decanting device (1.12) or by a separate drum decanting pump (1.13), which is also used for charging preweighed quantity of emulsifiers. The equipment and pipelines in the entire plant are provided with adequate earthing arrangements to prevent accummulation of static electricity. For change over from one product to another all the processing equipment will be cleared of left over liquids and then thoroughly flushed with solvents, which will be collected in drums for reuse later.

D. Packaging Unit

5.10 The proposed packaging plant has three different packaging lines:

- for 200 litre containers (1.41);
- for 20 litre containers (1.42);
- for containers of 500 ml and 1 litre (1.43).

Labelling and packaging will basically be carried out manually, however, using mechanical aids such as a label dispenser (1.44), a heat sealing machine (1.45) and a cap tightener (1.46).

E. Safety and Hygiene

5.11 The following measures are foreseen to provide good safety and occupational hygiene conditions:

- All places where raw materials and finished goods are openly handled are connected to an efficient ventilator (1.53) which extracts possible flammable or noxious fumes.
- The formulation and packaging area drains into a 8000 litres catchpit (1.61) which would prevent contamination of the environment in case of a major accidental spill. A pump (1.59) is provided to empty the catchpit.
- Because of the flammability of the solvents handled in the formulation plant, the entire electric installation is of flame-proof and explosion-proof design.

F. Measures for Environmental Protection

5.12 A formulation and packaging plant is by its nature not a significant risk as far as the ecology is concerned. The main areas of potential environment problems will be dealt with as follows:

- Chemical contamination of effluents will be avoided by recycling of cleaning liquids.
- Accidental spills in the formulation plant will be collected in catch-pit for recycling.

The effectiveness of environmental protection measures depends largely on the attitude of the management and

the working personnel towards this problem. Creating ecology-mindedness amongst the plant personnel by means of continuous training should be another major contributory factor to the protection of the environment.

G. Raw Materials

5.13 Pesticide formulation is a physical mixture of one or more biologically active chemicals with inert ingredients which render the formulation to be applied in the field for effective control of pests. The functional properties and characteristics of the materials to be used have already been covered in Chapter Two. The basic raw materials for the formulation of liquids are active ingredients, solvents, emulsifiers and some special adjuvants.

Active Ingredients

5.14 All the active ingredients as technical materials will have to be imported. Most of the pesticides commonly used in the country are available from more than one source. Quality, price, reliability of supply and technical back-up services are some of the factors to be weighed from commercial angle. Supply arrangements should be tied up directly with companies of International repute requesting their assistance in developing local compositions and even in the training of local staff. Basic information with respect to each product to be purchased, is as follows:

- Chemical, physical and toxicological properties;
- Analytical methods both for active materials and formulated products, including spot tests, if any for production control;
- Guidelines for formulation;
- Safety data and special precautions to be followed during formulation and use;
- Recommendations regarding field use in agriculture, public health, livestock etc.

Solvents:

5.15 As mentioned in Chapter Two, main considerations for the choice of a solvent are the solubility of active material, phytotoxicity of the solvent, its toxicology, volatility and the flash point. A wide range of solvents among aliphatic and aromatic hydrocarbons, petroleum distillates and polar compounds are available for formulation of liquids. The most widely used are the xylene type of solvents. Several chemical/oil/petrochemical companies market blended solvents, tailor made for a variety of products. For example, 'Aromax' (specific Gravity - 0.90/30°C) a product from Bharat Petroleum, India, is a versatile relatively inexpensive solvent used in different proportions for a wide variety of pesticidal compounds including endrin, aldrin, toxaphene, dieldrin, chlordane, lindane, DDT, trithion, endosulfan, malathion, ethyl parathion, methyl parathion, DDVP, tetradifon, fenitrothion and others. Similarly solvent C-IX (specific Gravity - 0.86/25°C) from Indian Petrochemicals Corporation is used for the formulation of cypermethrin EC 25 as well as 5 percent. Compared to some of the polar and other solvents, these products offer sizable cost savings, since these are basically blends of petroleum distillates with high aromatic content. For formulation of products like dimethoate and diazinon a mixture of two solvents in suitable proportions to give most economical formulation is used. For dimethoate EC for example, xylene and cycl -hexanone in 80:20 ratio is used. Heptachlor 20EC uses 50 percent of each. The idea is to work out a formulation with optimum costs in terms of solvents and emulsifier economics without sacrificing the desired characteristics of the formulation. Dimethoate EC can also be formulated using xylene alone as against a xylene + cyclohexanone 80:20 combination. However, emulsifier requirements become more than double when using xylene alone. Methamidophos being soluble in water, needs a water-miscible solvent (like butanol) so do monocrotophos and phosphamidon. Use of local solvents will have to be developed on these lines, using imported solvents in as low quantities as possible.

Emulsifiers:

5.16 Emulsifiers are key components of EC formulations rendering good emulsion properties. Several companies all over the world such as Tensia (Belgium), Atlas (Belgium), Hoechst (FRG), Swastik(India), Indian Explosives (India), Dai-ichi kakaria (India) and several others offer tailormade products to suit different pesticides. For the formulation of endosulfan 35EC for example, Noigen CC-360-S from Dai-ichi; Swascofix EX-40 or ES-36 from Swastik or Crislox 3433 from ICI are recommended products. Similarly for malathion 50EC, Noigen CT-330 Crislox 3403, 3409, 3460 and Swascofix M-21 are being used. For the formulation of cypermethrin 25EC, typical emulsifiers in use are Creslox AE-1, AE-2 and AE-3', all originating from ICI. Emulsifiers suggested for dimethoate and fenitrothion are 'Swanic E200' and 'Swascofix FN-17 or FN-12'. The emulsifier quantity to be used is standardised by the manufacturers against specified solvents and normally varies between 3 to 5 percent for most of the insecticides depending upon the strength of EC formulation and the type of solvent used. For dimethoate, when xylene alone is used as solvent, 12 percent of Swascofix M-21 is required as against 5 percent only using 80:20 mixture of xylene and cyclohexanone. For the proposed project, emulsifiers will have to be imported and the most economical products of acceptable quality will be procured.

Stabilizers:

5.17 Many organic active materials are sensitive against several factors such as moisture content of the solvent. Such properties may cause incompatibility with the active ingredient. Stabilizers are used to overcome this problem wherever necessary. For example, in the formulation of endosulfan and malathion ECs, epichlorohydrin in small quantities is used as a stabilizer. Selection of the appropriate stabilizer/deactivator for each product and

the quantity to be used should be carried out under advice of the supplier of active material and a proper stability study (shelf life) of the formulation should support the selection.

Packaging Materials:

5.18 The output from the proposed plant is expected to meet the requirement of state farms, MOH, MOA/PPRD, settlement schemes, veterinary sector and the peasant agriculture which means pack sizes ranging from bulk pack of 200 litres to say half litre. It is important to market products in sizes close to the quantity needed by the different consumers, particularly the peasant farmer, who should not be compelled to buy excess quantity over his actual need thus avoiding prolonged storage of unused materials and the hazards involved in drawing the products from large packs in terms of spillage, contamination etc. The breakup proposed therefore, is 75 percent - 200 litres; 15 percent - 20 litres; 7 percent - 1 litre and 3 percent in 0.5 litre sizes. For relatively larger sizes mild steel containers internally protected suitably with corrosion resistant lacquer will have to be used. In some cases, particularly for the medium sizes tin or aluminium containers with or without internal protection can be used. For endosulfan EC formulation, tin plate or aluminium containers internally quoted with corrosion resistant lacquer is recommended. Malathion could be packed in mild steel or tin plate containers again with internal protective lining. Diazinon EC can be packed in tin plate containers as such, fenitrothion 50EC in mild steel containers lined with phthalic, phenoxy or expoxy resin. Cypermethrin EC is packed in anodised aluminium bottles for smaller sizes and sheet metal containers lacquer protected for larger sizes. Glass and suitable reclosable plastic bottles are also recommended for relatively smaller sizes. Initially the entire bulk packaging medium except for some plastic bottles available locally will have to be imported till local facilities are developed. Part of the drums (say 30 percent) could be recycled to cut down on imports.

H. Utilities

Water System:

5.19 There is practically no process water requirement. Small quantity of water, however, may be required for jacket heating of the mixing kettle and to make up for any evaporation losses in the hot water bath meant for heating of semi-liquid, highly viscous or low melting solid materials before drum decanting. The main requirement of water is for the plant service, cleaning, showers, sanitary use, laboratory and drinking purposes. Water connection, therefore, will be provided in office block, laboratory, workshop, plant and social buildings. It is estimated that the daily replenishment of water will be about 15,000 litres which will be met from local supply sources. The main storage tank is proposed to be of reinforced concrete cement having a capacity of 50,000 litres. This will be so located at the ground level as to provide positive suction to the pumps. The water from this tank will be pumped, through a filter to the overhead storage tank, which will hold about a day's requirement in addition to a dead level of about 25,000 litres for fire fighting. The overhead tank will also be of reinforced cement concrete and will be placed on a raised structure on the top of one of the buildings. From this tank both service water as well as for fire fighting will be distributed by gravity through suitable headers to various points within the factory premises.

Electrical System:

5.20 The maximum power requirement of the plant is estimated to be around 80 KW, connected load. On the basis of an improved power factor of 0.9, a 120 kva connection is proposed. It is presumed that power will be available at 11 kv through a single circuit overhead line from the electric supply company. This will be terminated on 11Kv/440 v transformer primary through an isolator mounted on a two pole structure located in the transformer yard within the factory premises. Power would then be supplied

at 440V(± 5 percent), 3 phase, 4 wire from the transformer secondary side to the power and motor control centres, located at a suitable place near the process buildings. From here, the power will be further distributed to different motor control centres and distribution boards located in various areas.

Fire Fighting:

5.21 A hydrant system laid over the plant area and portable fire extinguishers for fire protection will be provided. A dead level storage of 25,000 litres of water will always be maintained in the overhead water storage tank for fire fighting, with the help of two seperate discharge connections at different levels. The overhead tank will be located at a suitable elevation to supply water under gravity head to various hydrant points at strategic locations in the factory premises. Sufficient number of the required type of fire extinguishers will be kept at various locations in factory buildings.

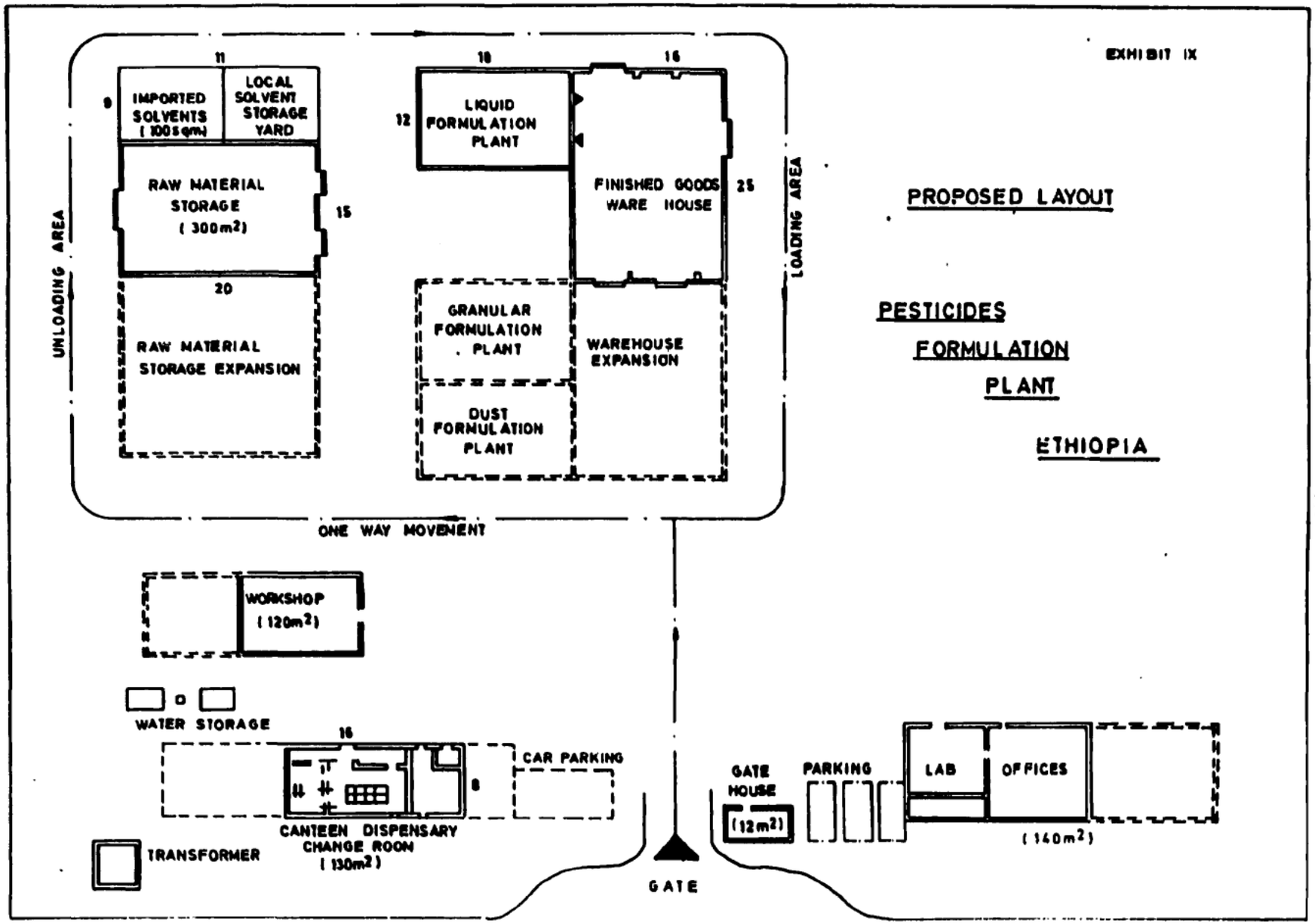
Tank Farm Storage:

5.22 For storage of local solvents, a separate storage yard has been recommended, provided with dyked wall all around. This dyke will isolate the area in case of leakage or fire. Two mild steel horizontal cylinderical tanks of 15,000 litre capacity each will be placed on concrete supporting sleepers. Steel structure walkway over the tanks will be provided.

I. Civil Works

5.23 The total requirement of land for the proposed project, taking into consideration the phased expansion of activities, is about 20,000 sq.meters (two hectares). A preliminary plot plan, indicating the relative positions of various buildings, facilities, structures has been shown in Exhibit IX. The orientation of the plant building should take into consideration the prevailing wind directions so that the exhaust from the ventilator fan is drawn away from the factory. The plant buildings for the liquid formulation facility and the two dry

EXHIBIT IX



PROPOSED LAYOUT

PESTICIDES FORMULATION PLANT

ETHIOPIA

formulation units proposed for next stage implementation have been housed in three seperate buildings alongside the warehouse. Raw material storage godowns are located on one side while finished goods warehouse on the other side of the process buildings in order to minimise material movements. The packing areas in the three formulation units are proposed to be located at the end of the buildings nearest to the warehouse. Storage of inflammable materials have been suggested in one block keeping necessary safety distance between local solvent storage tank yard and imported materials in drums, at the same time keeping shortest distance from the liquid formulation plant. The administration block has been located near the main gate, while the laboratory is housed in one wing of the administration building. Other buildings including canteen, change room, gate house, workshop and mechanical stores have been laid out at convenient locations as shown in Exhibit IX. The proposed layout of the manufacturing installation, packaging lines and storage facilities allow a further increase of capacity and extension. Suitable land-scaping could be provided in the premises. Adequate provision for expansion of plant operations are incorporated in the layout.

Process Buildings:

5.24 The formulation and packaging section of liquid formulation plant will be housed in a 18x12m (216 sq.meters) building with a concrete floor at +0.2 meter level with a clear height of 6 meters. The building will have steel columns with side masonary wall upto 2.5 meters height. Above this there will be AC louvers upto truss level. This will ensure good natural ventilation. The building will have light-weight saddle roof with ventilation, overlapping the walls for protection against sun; access through ramps and gates suitable for movement of fork lift. Electrical wiring and fittings will be explosion proof with fuses and mains located outside the building in a central panel. Adequate protection against lightning will be provided. There will be operating platforms

at 2.5 meter and 4 meter levels.

Warehousing:

5.25 The warehousing activity will be under four sections. Active ingredients and auxilliary materials will be stored in a 15x20m (300 sq.meters) building, with concrete floor at + 0.2 m level with a clear height of 4 meters, side walls, light-weight roof with ventilation, overlapping the walls for protection against sun, access through ramps and gates suitable for movement of forklift, pallet trucks, with windows in the side walls. This building will also be fitted with flameproof wring and electrical fittings. Two seperate rooms (5x4 m each) with suitable shelves for keeping spares and reserves and other consumable items for the plant will be provided inside the store. Imported solvents in barrels will be kept in a covered storage space with sides open, but fenced, 11x9 m with concrete floor, +0.1m level, with a light weight roof at 3.1m overlapping the floor area, access through ramps for forklift from all sides. For the storage of local solvents, two horizontal cylinderical tanks are provided in the tank yard. Storage of finished goods will be adjoining the plant building on the other side in a 16x25m building similar in construction to active ingredient storage building. The warehouse buildings will be provided with roller-shutters to ensure security.

Adminstrative/Laboratory Building:

5.26 This block will be conventional office building located near the main gate with a total floor area of 140 sq.meters including the laboratory (60 sq.meter).

Other Buildings:

5.27 These include canteen, dispensary, change room, showers, toilets with a total floor area of 130 sq.meters; workshop building of 70 sq.meters; electrical substation 16 sq.mts., gatehouse 12 sq.meter. Car parking will be in the open shelter covering with light weight roof.

Miscellaneous Civil Works:

5.28 The entire plot will be enclosed by a compound wall of 2.5 meters height. The front of the plot, however is provided will 1 meter wall with fencing upto 2.5 meters to enable a good view of the factory. For security reasons only one entrance will be provided. Suitable internal roads, drainage and outside lighting are also incorporated.

J . Quality Control Laboratory:

5.29 A well equipped laboratory has been incorporated for quality control of raw materials, intermediates and finished goods. Besides quality control, formulation development work will also be carried out here. More expensive instruments will be kept in an airconditioned room. Major items and apparatus envisaged to be provided are listed in the annex to this chapter.

K. Safety Aspects within the Plant:

5.30 Pesticides are toxic compounds and therefore the safety of the personnel working in the pesticides plant needs special care. Since the process involves extensive material handling operations, some of which may be manual, the operational staff is provided with protective clothing, rubber boots, rubber gloves, helmets, filter type masks, goggles etc. Workers in the packaging section must wear a face shield, mask, neoprene gloves, apron, boots to protect against splashes resulting from leakage or breakage. Sufficient number of showers and taps are provided at convenient locations in the process building, to enable quick access for the operatives in the event of an emergency. Smoking and carrying of matchboxes in the process plants, warehouses are strictly prohibited in view of the inflammable nature of some of the materials handled. No naked flame, electric welding are allowed inside the vulnerable areas. Periodic drills and classes are held to educate the employees in the use of fire-fighting and first-aid equipment.

L. List of Equipment

5.31 Lists of equipment with broad specifications for the liquid formulation plant and of utilities and auxilliary items are presented in Schedule V/1 of this Chapter.

Schedule V/1

List of Equipment

A. Liquid Formulation Plant

Capacity: 1500 kilo-litres per annum, 1-8 hour shift operation per day, 250 operating days a year.

Item	Denomination and Broad Specifications	No.off
1.01	- Storate tanks, mild steel, capacity 15000	2
1.02	litres each with inspection man hole, sampling and measuring hole at the top, flanged connections for inlet, outlet and bottoms outlet, fitted with explosion-proof ventilation, painted with metallic silver paint.	
1.03,1.04	- Strainers in the outlet line of each tank	2
1.05	- Centrifugal pump, cast iron with	2
1.06	Mechanical seal, leakproof, capacity 200 litres per minute, with flame and explosion proof motor.	
1.07	- Flowmeter with digital delivery, accuracy 0.1 litre, stainless steel parts and teflon packings, flanged connections.	1
1.08	- Electric boiler, capacity 500 litres per hour, with thermo-regulator, maximum temperature 60°C, provided with temperature indicator dilation tank capacity 50 litres, heater rating 3.5 KW	1
1.09	- Hot water circulation system complete with 30 meter steel coil, circulation pump and valves.	1
1.10	- Hoist, capacity 500 kg. complete with explosion-proof motors, starters.	1
1.11	- Weighing scale 0-300 kg	1
1.12	- Drum emptying device, capacity 75 litres	2
1.13	per minute, stainless steel and teflon, leak proof, explosion proof.	

Schedule V/1 contd..

Item	Denomination and Broad Specification	No. off
1.14,1.15	-Measuring tanks mild steel, capacity 2250 litres with level indicator, flanged connections for inlet, outlet and ventilation.	2
1.21	Stainless steel kettle, capacity 3750 litres	1
1.22	with jacket at lower half, four inlet	
1.23	openings at top and a temperature indicator	
1.24	pocket, together with a charging hood (1.24)	
1.25	charging funnel (1.25) a rotary valve (1.23) and an impellor agitator (1.22) driven by a flame & explosion proof totally enclosed fan cooled motor.	
1.31	Centrifugal pump, stainess steel, capacity 200 litres/minute with flame proof, explosion proof motor complete with starter.	1
1.32	Cartridge filter, special duty, stainless steel	1
1.33	-Holding tank, stainless steel, capacity 3750 litres with manhole and flanged connections for inlet and outlet.	1
1.41	Packaging line for 150-200 litre containers complete, capacity 8 containers per hour	1
1.42	-Packaging line for 10-20 litre containers complete, capacity 20 packs per hour minimum	1
1.43	-Packaging line for 0.5-1 litre bottles, cans, complete, capacity 40 bottles per hour	1
1.44	-Labelling machine capacity 500 lables per hour	1
1.45	-Heat sealing machine capacity 500 per hour	1
1.46	Cap tightener capacity 500 pieces per hour.	1
1.51	Beam scale, capacity 0-100 kg	1
1.52	Ventilated Bailing Unit capable of handling 20 bags at a time	1

Schedule V/1 contd..

Item	Denomination and Broad Specification	No. off
1.53	-Exhaust ventilator, capacity 1000 cu.m. per hour, mild steel, with explosion proof motor.	1
1.59	-Pit pump, stainless steel, capacity 60 litres per minute.	1
1.71	-Forklift truck, 3 ton capacity with charger	1
1.72,1.73	-Pallet Jacks, capacity 1000 kg	2
-	-Instruments - temperature and pressure indicators	12
-	-Interconnecting pipes ducts, valves, fittings partly in stainless steel(20 percent) and balance in steel	1 set
-	-Electric equipment including cables, switches etc.	1 set
-	-Supporting steel structure with steel platforms	1 set
-	-Set of spare parts for two years requirement	1 lot
	B. Utilities and Auxiliary System	
1	-Water transfer pumps, cast iron/bronze capacity 300 liters per minute	2
2	-Piping and valves for water system	1 set
3	-11 KV, oil immersed, 2 pole structure circuit breaker suitable for 40 Amps HT Load fitted on a pannel having copper bus bars with necessary instruments.	1
4	-11 KV/440V, 120 KVA transformer	1
5	-LT switch gear unit	
6	-Electrical cables including requirement of bringing power from supply source to the site.	1 set
7	-Lighting fixtures	1 set
8	-Flame proof and non-flame proof push button stations	1 set
9	-Lighting panels	6
10	-Cable trays and accessories	1 set

Schedule V/1 contd.

Item	Denomination and Broad Specification	No. off
11	- Earthing and lightning protection materials	1 set
12	- Portable fire extinguishers (Dry powder, foam type, CTC type)	30
13	- Piping system, valves, hydrants and fire fighting hoses	1 set
	C. Laboratory Equipment	
1	Analytical balance, Mettler single Pan - 160 gm, least count 0.0001 gm	1
2	Analytical balance, double pan - 150 gm least count 0.00001 gm	1
3	Physical balance, double pan--1000 gms	1
4	Spectrophotometer - 350 to 950 mu	1
5	Karl-Fischer Apparatus	1 set
6	Digital PH/MV meter, ranges 0 to 14 pH. 0 to 1999 MV, 0 to 100°C	2
7	Distilled water still - 2 litres/hour	1
8	Magnetic stirrer - 600 rpm constant speed with 25 mm polypropylene coated stirrer bars	1
9	Magnetic stirrer and hot plate, continuously variable stirring speed range 50-1300 rpm, with energy regulator for the hot plate.	1
10	Variable speed stirrer (5500 rpm max.)	1
11	Mantle Heater - suitable for 2 litre flask	2
12	Mantle Heater - suitable for 0-5 litre flasks	2
13	Electric Heater - 1000 W	2
14	Hot plate - 2000 W	1
15	Water Bath, 10 Litre capacity	1
16	Electric Oven 40-200°C	1
17	Mechanical stirrer 0.25 HP, 0.125 HP	2
18	Vacuum pump - 0.001 Torr Vacuum	1
19	Stop watch, accuracy 0.1 second	1

Schedule V/1 contd..

Item	Denomination and Broad Specification	No. off
20	Timer alarm 0-10 minutes, accuracy 1 second	1
21	Viscometer	1
22	Thin layer chromatography kit	1 set
23	Muffle furnace, max. temperature 1000°C	1
24	Flash point apparatus, Abel Pensky	1
25	Flash point apparatus, 'open cup'	1
26	Refractrometer, refrective index scale, 1.300-1.700 x 0.001, temperature range 0-75°C	1
27	Fume cupboard 1500 mm wide x 775 mm deep x 2100 mm high.	1
28	Refrigerator 110 litres capacity	1
29	Assortment of glass apparatus including beakers, flasks, cylinders, pipetts, burettes watch glasses, buchner filter flask, filter tube, filter cone, test tubes, Liebig condensor, Soxhlet condenser, extractor extraction thimbles, filter and seperating funnels, desicator, crucibles, morter and pestle, Dean and Stark apparatus, reagent bottles, glass rods, burette clamps, flask clamps, laboratory stand, cork borer set, spatula, rubber tubing, thermometers, safety apparatus, filter pump crucible tong, etc.	1 set
	D. Workshop Equipment	
1	Welding transformer 3 amps, 3 phase, 12 KVA	2
2	Drilling machine, dia. 1"	1
3	Bench grinder, dia 8", width 1"	1
4	Gas cutting set	1
5	Miscellaneous hand tools	1 lot
6	Miscellaneous tools and tackles	1 Lot
7	Anvil measuring instruments	1 Lot
8	Chain and Pulley Block, capacity 5 tons	3

Schedule V/1 contd..

Item	Denomination and Broad Specifications	No. off
	E. Transport and Material Handling Equipment	
1	Counter balanced fork lift truck capacity 1 ton	1
2	Fork lift hand trolleys	4
3	Standard pallets	200
4	Wheel barrows	6
	F. Stores Equipment	
1	Platform scale, 1000 kg	1
2	Platform scale, 250 kg	1
3	Lot Number printer	2
4	Steel Racks	1 Lot
	G. Miscellaneous Items	
1	Protective clothing	1 Lot
2	Office equipment-typewriter 4, photocopier-1, calculators 3, furniture 1 lot, safe and cash locker 1.	1 lot
3	Medical services	1 lot
4	Change room lockers	1 lot
5	Furniture for canteen and other buildings	1 lot

Chapter Six

ORGANIZATION STRUCTURE, RECRUITMENT & TRAINING

A. Organization and Staffing

6.1 Staffing arrangements will have to be made for the following areas of activities:

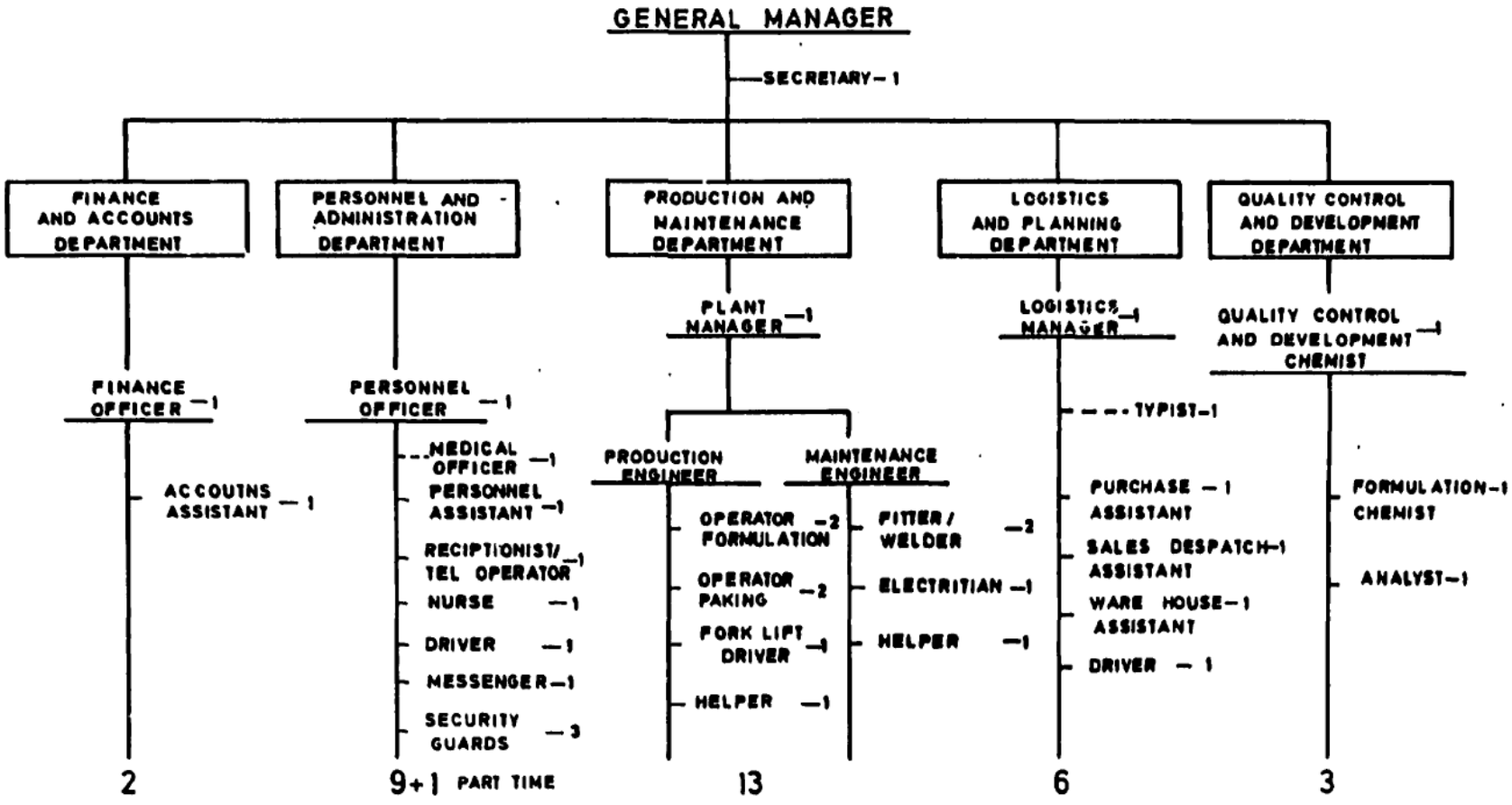
- Plant Management;
- Administrative and Finance Departments;
- Plant Operations; Production Engineer, team of plant operators for the formulation and packaging lines;
- Plant Maintenance Department;
- Quality Control and Technical Support for Marketing;
- Logistics Department; Production Planning, Stocks, Warehouse, Purchasing, Sales and Distribution.
- Security and Medical services.

A typical organization structure for the proposed liquid formulation plant is presented in Exhibit X. The total manpower requirement for the operation and maintenance of the proposed unit including the administrative and finance staff is estimated to be 36 from the General Manager's level to the operatives and staff level. Services of a part-time medical officer have been provided for who would oversee the safety and health aspects of the employees. A full time nurse has been provided to maintain the factory dispensary and first aid kits in the plant area and provide medical aid during emergencies. Being a relatively small capacity single formulation unit, the functions of production and maintenance have been placed under Plant Manager who would be assisted by a Production Engineer responsible for the produccion activity and a Maintenance Engineer to look after the maintenance function of the entire outfit. The logistics department carries the responsibility of production planning (in

PESTICIDE FORMULATION PLANT– ETHIOPIA

EXHIBIT X

ORGANIZATION STRUCTURE



close co-operation with the Plant Manager) through periodic sales forcasts, purchase of inputs, warehousing and sales. The Logistics Manager will assess the demand for finished products based on the requirements of MSFD and AISCO and taking into consideration the stock position, prepare a production plan for the Plant Manager to organise production. He will also be fully accountable for timely procurement of needed active materials, raw materials and the packaging items. On the warehousing side, he will control inventories of finished products, active ingredients, raw, auxilliary and packaging materials and spares for the plant & machinery. For the aforesaid activities he will be assisted by a Purchase Assistant and a Stores Assistant. Since most of the production is meant for MSFD, no sales force has been provided for except for a sales/despatch assistant who will look after despatches. For the peasant sector, marketing is proposed to be done through AISCO and perhaps by appointing some distributors in some of the more agriculturally intensive areas. At a later stage some field staff may be appointed to organise field demonstrationsand training of farmers in cooperation with the extension staff of MOA. A sales Assistant has been provided to look after sales and despatches. The tasks of developing new compositions, testing indigenous raw materials for import substitution and/or to bring down cost of formulation, handling field complaints if any, as well as to provide technical backup services, have been assigned to the Quality Control and Development Department headed by a Chemist. Responsibility as to meeting the obligations as provided in the protocols of regulatory mechanism as and when it comes into force will rest with this department. Liason with outside bodies like Ethiopian Standards Institute, MOH, MOA and others, for all technical matters will also form a part of the work of Quality Control and Development Department. A Formulation chemist and an Analyst have been provided to help carry out the different functions

as aforesaid. A list of total operational, maintenance, administration and other personnel and staff alongwith salary structure of each employee has been given in Table 6.1.

Table 6.1 : Manpower Requirement for the Project

S.No.	Category	No.off	Salary Birr Monthly	Salary Birr Yearly
(1)	(2)	(3)	(4)	(5)
A.	General Administration			
1.	General Manager	1	1,500	18,000
2.	Personnel Officer	1	1,000	12,000
3.	Medical Officer (Part-time)	1	500	6,000
4.	Personnel Assistant	1	450	5,400
5.	Secretary to General Manager	1	450	5,400
6.	Receptionist-cum-telephone operator	1	150	1,800
7.	Medical Nurse	1	600	7,200
8.	Drivers	3	200	7,200
9.	Messenger	1	85	1,020
10.	Security Guards	3	85	3,060
B.	Finance and Accounts Department			
11.	Finance Officer	1	1,000	12,000
12.	Accounts Assistant	1	450	5,400
C.	Production and Maintenance Department			
13.	Plant Manager	1	1,200	14,400
14.	Production Engineer	1	900	10,800
15.	Maintenance Engineer	1	900	10,800
16.	Operator Formulation	2	600	7,200
17.	Operator Packaging	2	450	10,800
18.	Fitter cum Welder	2	500	12,000
19.	Electrician	1	400	4,800
20.	Helpers	2	250	6,000

Table 6.1 Contd...

(1)	(2)	(3)	(4)	(5)
D.	Logistics and Planning Department			
21.	Logistics Manager	1	1,200	14,400
22.	Purchase Assistant	1	450	5,400
23.	Sales/Despatch Assistant	1	450	5,400
24.	Warehouse Assistant	1	450	5,400
25.	Typist	1	350	4,200
E.	Quality Control and Development Department			
26.	Quality Control and Development Chemist	1	1,200	14,400
27.	Formulation Chemist	1	600	7,200
28.	Analyst	1	400	4,800
		36		2,22,480
	Other Benefits-15% of salaries (includes medical, old-age pension and other fringe benefits)			33,372
	Total annual wage bill			2,55,852

Say Birr 255,900 or USD 123,600.

B. Programme for Recruitment

6.2 As soon as the decision to go ahead with the project is taken, necessary personnel required to manage the project should be immediately put in position. Such a project management cell is necessary to steer the activities of the project as also to coordinate and supervise the work of consultants or the contractors. To oversee the project activities, the assistance of an international expert through UNIDO

is strongly recommended. Initially one project manager and one project engineer may be recruited, who will form the nucleus for implementation of the project. The project manager should be a fairly senior person who could take over the position of General Manager when the plant goes on stream. As the project activities pick up momentum, the project team be further stregthened by inclusion of multi-discipline project staff. The recruitment of the supplementary staff for operation and maintenance of the plant may be phased in a manner so as to synchronise with training activities, erection and commissioning of the project (See Exhibit XI).

C. Training

6.3 Managing and operating a formulation plant safely and efficiently is a fairly complex task requiring its own special expertise. The senior level personnel need to be qualified professionals with experience in formulation operations. The intermediate level staff, such as quality control analyst, production engineer etc. must have a good level of education, training and expertise. At lower levels, plant operators and maintenance staff must be well trained. For carrying out operations and maintenance of plant and facilities, particularly in-process plants, it is essential that the manpower in the operational and maintenance cadres, are well versed in the process, equipment and machinery complexities as otherwise there can be frequent operational difficulties, and successful production may not be achieved. Intensive in-plant training, in all aspects of technical manufacturing and maintenance fields of senior and middle level operational and maintenance staff in similar units either at the premises of know-how/ plant and equipment suppliers, collaborators, joint venture partners or at some training centre through UNIDO's assistance requires special attention. The recruitment of senior and middle level personnel should be phased

in a manner that their training needs are fully provided for while the plant erection is in progress. These personnel will be called upon to impart training to the junior staff with the help of plant manuals and operating procedures obtained from the know-how/equipment suppliers which will ensure a well-knit and trained team of operatives at the time of trial runs/commissioning. The manpower planning programme should incorporate constant feed back on its effectiveness and should be flexible to be adjusted to the needs of the project. The recruitment and training programme running concurrently with the physical progress of construction and erection phases of the project may be referred to in Exhibit XI. UNIDO assistance is strongly recommended in training of the local staff for the proposed project. The UNIDO programme in cooperation with the Government of India at PDPI (Pesticides Development Programme of India) Centre in Haryana, India has excellent facilities to assist developing countries in training their professionals in the area of raw material assessment, development of formulation know-how, quality control procedures and in meeting the protocols of regulatory mechanism i.e. registration etc. Other places for the proposed training could be the premises of some of the leading pesticide manufacturers/formulators in Europe, India or elsewhere.

Chapter Seven

PROJECT IMPLEMENTATION

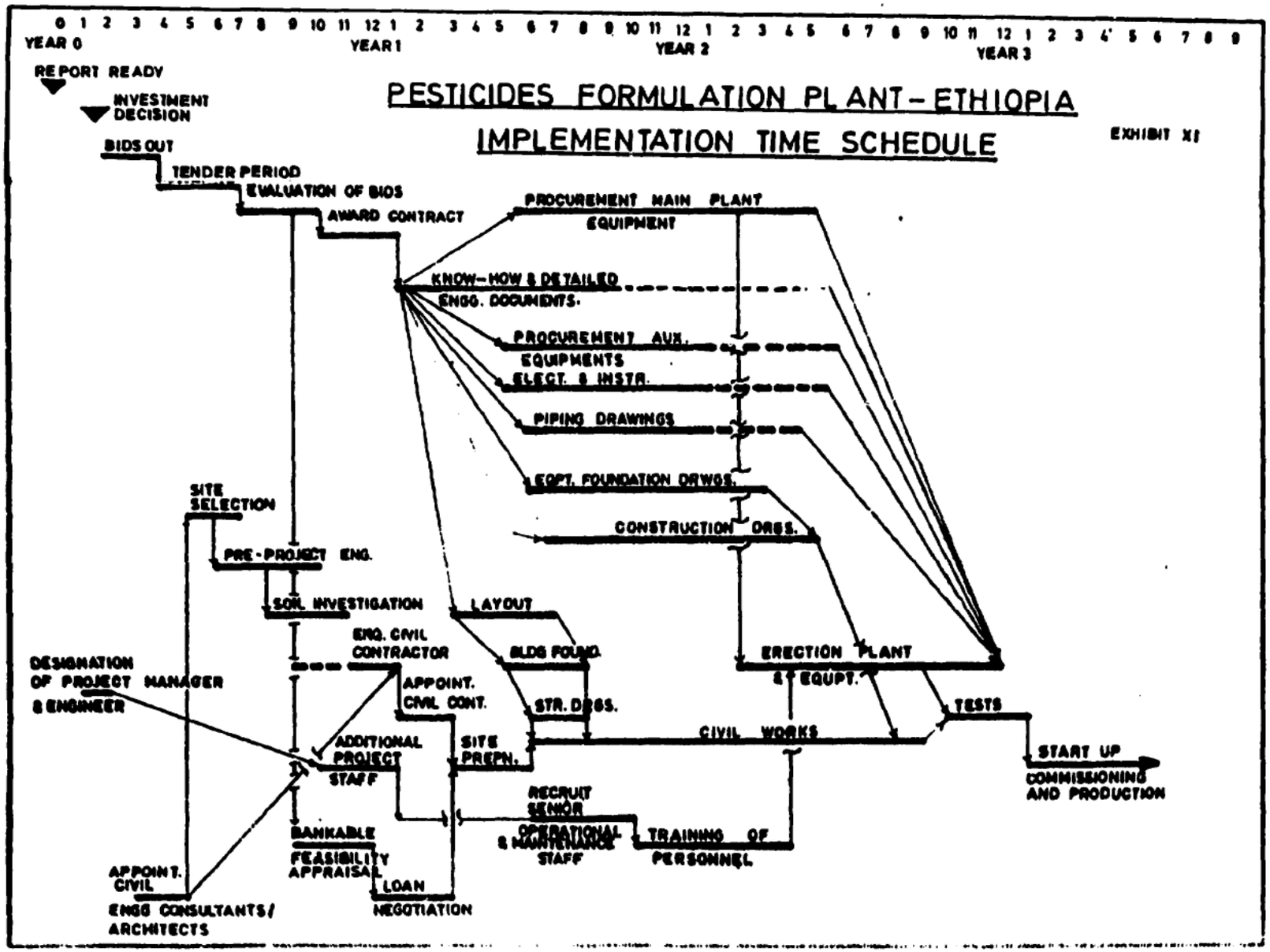
A. Project Time Schedule

7.1 An estimated time schedule covering all the major activities concerned with the implementation of the project, showing time required from submission of the feasibility study to start-up of production and the inter-linkages of various activities, including recruitment and training of staff, is presented in Exhibit XI.

7.3 Submission of feasibility study for the project marks the beginning of the schedule i.e. time zero. On the assumption that the project parameters are firmed up and investment decision taken by the Government in about two months time, activities for the project implementation could start immediately thereafter. It is estimated that the project will be completed in about three years from the date it is cleared for implementation. The time phasing of various activities as shown in Exhibit XI has been worked out in line with the requirements of such projects in developing countries. Almost one full year is spent in finalization of the collaborator/know-how supplier. Net execution period for the project, therefore, works out to about two years, reckoned from the date of signing the collaboration agreement with the know-how supplier. The critical activities in the time schedule are selection of know-how/plant and equipment supplier, delivery of equipments,civil works, erection and trial runs to the start-up of production.

B. Mode of Implementation

7.4 The project passes from the initial stages of conception, various studies and approvals etc to the execution stage comprising preliminary engineering, selection of know-how, plant and equipment supplier,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YEAR 0
YEAR 1
YEAR 2
YEAR 3
REPORT READY
INVESTMENT DECISION
PESTICIDES FORMULATION PLANT - ETHIOPIA
IMPLEMENTATION TIME SCHEDULE
EXHIBIT XI
BIDS OUT
TENDER PERIOD
EVALUATION OF BIDS
AWARD CONTRACT
PROCUREMENT MAIN PLANT EQUIPMENT
KNOW-HOW & DETAILED ENGG. DOCUMENTS.
PROCUREMENT AUX. EQUIPMENTS
ELECT. & INSTR.
PIPING DRAWINGS
EQPT. FOUNDATION DRWGS.
CONSTRUCTION DRGS.
SITE SELECTION
PRE-PROJECT ENG.
SOIL INVESTIGATION
LAYOUT
ERG. CIVIL CONTRACTOR
BLDG FOUND.
ERECTION PLANT & EQUPT.
DESIGNATION OF PROJECT MANAGER & ENGINEER
APPOINT. CIVIL CONT.
STR. DRGS.
TESTS
ADDITIONAL PROJECT STAFF
SITE PREPN.
CIVIL WORKS
START UP COMMISSIONING AND PRODUCTION
RECRUIT SENIOR OPERATIONAL & MAINTENANCE STAFF
TRAINING OF PERSONNEL
BANKABLE FEASIBILITY APPRAISAL
APPOINT. CIVIL ENGG CONSULTANTS/ ARCHITECTS
LOAN NEGOTIATION

procurement, construction and commissioning and finally into operational phase when commercial production is established. The execution process involving all these activities has to be carefully planned and executed so as to realise a plant built to the best of industrial standards, in the contemplated time schedule and at minimum costs. There are more than one modes of implementing the project. It can be executed on a turnkey basis wherein a reputed firm is selected and entrusted with the total responsibility of implementing the project starting from site preparation through engineering, procurement, shipment, construction, erection and commissioning. The responsibility may be extended to the initial years of operation when the teething troubles are sorted out and stable production is established. This mode of implementation may reduce the owner's burden of implementation of the project, but the obvious disadvantages are that the owner will have very little involvement and will be deprived of the valuable execution/ construction experience. Cost-wise also the turnkey approach is more expensive. An alternative approach is to avail the services of an engineering contractor for design, engineering and supervision of the main process plant only. For execution of procurement, civil construction, erection of various facilities, the Promotor may form a Project Management cell of its own or appoint a project consultant to render these services in close association with the Promotor's project personnel team earmarked for the purpose. The project consultant will act on behalf of the consultant and an indentity of interests is ensured. This mode of implementation enables the owner's personnel to gain valuable experience of execution of industrial projects and invariably has cost advantages over the turnkey method. For the proposed project, it is recommended that the know-how, plant and machine[illegible]pply be covered under turnkey arrangemen[illegible] super-

vision being provided for erection and commissioning by the collaborator and all other activities including civil construction, erection etc. be executed by the Promotor's team. The project team may coordinate the entire project work with assistance of an international expert to be provided by UNIDO/UNDP. The project implementation schedule (Exhibit XI) has been based on this approach.

C. Project Promotion

7.4 The project could be put up with 100 percent state ownership or it could be established as a joint venture, with Government participating with one of the reputed international companies operating in the pesticides field. While the prerogative of making a final choice rests with the Government, there are some obvious advantages in establishing the outfit as a joint venture, forming an independent company under the overall control of National Chemical Corporation. Specialist expertise is required not only during the design and construction phase of a formulation plant, but in particular once the plant starts operating, in order to provide specialist technical back up services. Through a joint venture operation, this requirement is adequately met. The joint venture partner, through his principals, would be expected to bring in know-how, preliminary and detailed engineering packets for the battery limit plants with detailed sizing of offsites and utilities. He will also assist in the selection of plant and equipment supplier, procurement of machinery and provide specialised supervision during construction, erection and commissioning stages. All these services could become a part of his equity contribution in the project. While specialised equipment could be procured through international bidding, depending upon the local substructure, some of the simple equipment, utilities and general facilities could be obtained from within the country. Local resources should be

deployed as far as possible for civil engineering, plant construction and erection activities with expert supervision provided by the collaborator's specialist staff. Unbiased international expertise and assistance would be indispensable to oversee the project activities to ensure that the total outfit is built to best suit the interest of the country within reasonable costs, for which UNIDO's assistance is strongly recommended. The UNIDO advisor would also be expected to play a promotional role and undertake in-service, on the job training activities. In case the Government decides to implement the project with 100 percent state ownership, franchise arrangements may be entered into with leading suppliers of active ingredients who would then willingly provide assistance in terms of developing compositions using local raw materials and to offer other backup services.

Chapter Eight

COST OF PROJECT

A. Capital Cost Estimates

8.1 The total capital outlay for completion of the project as per scope described in Chapter Five and as per time schedule given in Chapter Seven has been estimated as USD 1.548 million (Birr 3.205 million) including capitalised interest for debt capital. In accordance with the prevailing practice of 100 percent financing of working capital by local banks, no margin money (normally financed through equity) has been taken into account. A ten percent allowance on the total cost of plant and machinery as well as buildings has been provided to meet contingencies. Summary of capital investment is given in Schedule VIII/1. The foreign exchange requirement has been estimated at USD 0.573 million (Birr 1.86 million). Detailed breakup showing estimates of cost against different heads are given in Schedule VIII/2. The project economics has been based on 250 working days a year in order to take care of the time required for planned maintenance, unprogrammed interuptions, holidays as well as for change over from one product to another. Running of the unit can conveniently be raised to 330 working days a year with better planning and preventive maintenance schedules, thus increasing the capacity by 32 percent. Further, should the market off-take increase, the plant can be worked more than one shift by adding additional staff and operatives. In both cases the project economics will appreciably improve. The plant has a capacity of 1,500 kilo-litres per annum and the service and off-site facilities have accordingly been rated and designed. No provision for staff housing is made since Nazret is an industrially developed town and houses are expected

to be available. Land has been taken to be available free of cost. Ideally the terrain should be of rectangular shape of approximately 150x130 meters. Cost of site development including site grading and preparation has been taken at two percent of total building costs. The pattern of capital spending by year of expenditure, broken down in foreign and local currency against each major head of expenditure has been presented in Schedule VIII/3. A total of 36 months have been estimated for completion of the project from the date a go-ahead decision is made. About one year out of this is expected to spent on fixing up an appropriate collaborator for the supply of know-how, basic and detailed engineering (Exhibit XI).

B. Basis for Project Cost Estimates.

Equipment Cost:

8.2 The cost estimates of equipment and machinery for all the major units have been prepared on the basis of preliminary designs and sizing of various facilities and quotations obtained from reputed know-how, plant and equipment suppliers. The cost of paints, insulations and all other ancilliary materials required for the main plant, utilities and off-sites havebeen included in these estimates. The know-how, design and engineering expenses and ten percent of the total CIF cost of plant and machinery have been assumed to be spent in the second year of the project implementation and the remaining costs in the last year of the execution period.

Freight, Insurance and Local Transportation :

8.3 Ocean freight and insurance charges have been taken at 10.5 percent of the FO B cost of imported items to be expended in local currency since goods are usually brought by the country's own shipping lines.

Goods are expected to be received at Djibouti port from where these will be transported by rail to Nazret. A provision of twelve percent on the CIF cost of goods has been made for local transportation and wharfage etc. Freight charges equivalant of 0.5 percent for transporting goods from Djibouti port to rail point have been provided in foreign currency.

Civil Works:

8.4 The cost of civil works has been based on prevailing unit prices as given by the National Counterpart Officials and is estimated as Birr 1.174 million equivalent of USD 0.567 million including 10 percent contingencies. A provision of five percent on the cost of buildings has been made to cover the local contractor's engineering charges etc. Approximately 20 percent of the total civil costs and the entire civil design and engineering fees will be expended in the second year of preproject period and the remaining costs in the third year.

Electrical System:

8.5 Cost estimates of power receiving and distribution system includes cost of HT switch, transformer, main fixtures, flame proof and non-flame proof push button stations, earthing and lightning protection materials, cables, fittings etc. These estimates also include the approximate cost of bringing power to site and of the construction power.

Erection and Commissioning:

8.6 Erection charges include site fabrication work, wherever required. Cost of supervision for erection has been included. The entire erection and commissioning expenses have been provided for in the

third year of construction.

Services and off-sites:

8.7 The cost estimates for services and off-sites include a water storage and distribution system, power receiving and distribution system, laboratory facilities, maintenance workshop, a fire fighting system and a communication system. Adequate provision has been incorporated for services and other facilities in the various sections of the factory. Costs involved in getting the water connection to site as well as water required during construction have been provided for. Storage for raw materials and finished products have been adequately provided.

Preliminary and Pre-operatives:

8.8 The preliminary and preoperative expenses incurred on the project from its inception to commissioning have been included. These include the following expenses:

- Project office establishment, administration and running expenses including internal travel costs;
- Preoperative salaries and wages;
- Training costs for local operating personnel;
- Startup expenses;
- Tendering and contracting costs for lining up the know-how equipment supplier;
- Cost of pre-project studies and other miscellaneous expenses.

Interest During Construction:

8.9 While computing the interest during construction, following assumptions have been made:

- Loan/Equity ratio 60:40
- Interest on term loan 10%
- A project schedule of 36 months.

The total expenses of first two years of pre-project period will be met from promotor's equity contribution and the loan will be drawn in the third year. As such term loan interest accrual (amounting to USD 92,910) will be only for one year. In Ethiopia, general practice is not to provide for such an interest burden in the capital cost of the project since in most cases, 100 percent financing is from the Government.

Provision for Project Cost Increase:

8.10 A ten percent contingency has been provided to compensate for unpredictable events such as price changes, design changes and for some unforseen expenses. This is applicable to costs under all heads of expenditure.

Domestic and Foreign Costs:

8.11 The costs are divided according to origin into foreign and local components. Most of the plant and machinery would be of foreign origin. It has, however, been assumed that fabrication of some of the structural work, plate work, piping, ducting and simple tanks etc. could be carried out either on site or through local contractors/fabricators. The equipment erection will be carried out under the direction and guidance of the collaborator's representatives using local subcontractors and local labour, and reimbursement of some of the local expenses of the collaborator staff could be made in local

currency thus raising the domestic share of erection cost. Cement would be obtained locally. Construction materials including gravel, lumber, bricks and some prefabricated elements would be obtained locally.

Schedule VIII/1

LIQUID INSECTICIDES FORMULATION PLANT-ETHIOPIA

SUMMARY OF PROJECT INVESTMENT

Plant Capacity - 1500 Kilolitres per annum

('000 US Dollars)

Item	FC	LC	Total
1. Battery Limit Plant & Machinery	220.9	89.3	310.2
2. Water System Machinery	25.2	15.7	40.9
3. Power Receiving & Distribution Equipment.	106.7	24.5	131.2
4. Laboratory Equipment	25.7	5.9	31.6
5. Workshop Equipment	12.0	3.5	15.5
6. Safety and Fire Fighting Equipment	7.5	1.0	8.5
7. Communication System	1.5	1.5	3.0
8. Transport and Materials Handling	35.5	2.0	37.5
9. Stores and Miscellaneous Equipment	10.5	3.5	14.0
10. Total Landed Cost of Machinery & Equipment	445.5	146.9	592.4
11. Know-how, Design and Engineering Services.	35.0	-	35.0
12. Total Cost of Machinery & Equipment.	480.5	146.9	627.4
13. Erection and Commissioning	31.4	39.8	71.2
14. Inspection Fees	1.7	-	1.7
15. Total Erected Cost of Plant and Equipment	513.6	186.7	700.3
16. Land, Land Development and Preliminary Engg. Expenses.	-	9.1	9.1
17. Civil Works including Internal Roads, Boundary Wall, Fencing, Street Lighting, Sanitary and Drainage.	-	473.6	473.6

Schedule VIII/1 cont'd..

('000 US Dollars)

Item	FC	LC	Total
18. Civil Design and Engineering Fees.	-	22.7	22.7
19. Construction Power and Water Costs.	-	10.0	10.0
20. Total Cost of Civil Works.	-	515.4	515.4
21. Furniture, Fixtures, Office, Canteen and Dispensary Equipment.	4.5	15.0	19.5
22. Preliminary and Preoperatives	3.0	85.0	88.0
23. Total Project Cost	521.1	802.1	1323.2
24. Contingencies - 10% of Total Cost.	52.1	80.2	132.3
25. Total Cost including 10 percent Contingencies	573.2	882.3	1455.5
26. Interest During Construction.	-	92.9	92.9
27. Total Project Cost including Interest during Construction.	573.2	975.2	1548.4
28. Total Project Cost expressed in '000 Birr	1186.4	2018.7	3205.1

FC: Foreign Component of Project Cost.

LC: Local Component of Project Cost.

Schedule VIII/2

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

PROJECT COST ESTIMATES

Plant Capacity: 1500 Kilolitres per annum

('000 US Dollars)

Item	FC	LC	Total
1	2	3	4
1. Battery Limit Plant Cost			
a. Plant and Machinery			
(i) FOB Cost of Equipment	219.4	38.7	258.1
(ii) Insurance and Ocean Freight	-	23.0	23.0
(iii) Local Transportation, Wharfage etc.	1.5	27.6	29.1
Sub Total (a)	220.9	89.3	310.2
b. Design and Engineering Services	21.9	-	21.9
c. Civil Works			
(i) Plant Building 216 sq.m. @ USD 435 per sq.m.	-	94.0	94.0
(ii) Civil Design and Engineering Fees	-	4.7	4.7
Sub Total (c)	-	98.7	98.7
d. Installation			
(i) Erection of Equipment	10.3	15.5	25.8
(ii) Trials and Commissioning	15.5	15.5	31.0
Sub Total (d)	25.8	31.0	56.8
Total (a + b + c + d)	268.6	219.0	487.6
2. Utilities			
A. Water System:			
a)Machinery			
(i) FOB Cost of Pumps, Motors, Pipes and Pipe Fittings	25.0	10.0	35.0
(ii) Insurance and Ocean Freight	-	2.6	2.6
(iii) Local Transportation, Wharfage etc.	0.2	3.1	3.3
Sub Total (a)	25.2	15.7	40.9

('000 US Dollars)

1	2	3	4
b) Design and Engineering Services	2.5	-	2.5
c) Civil Works			
(i) Pump House, Ground and Overhead Storage Tanks with Structure	-	20.0	20.0
(ii) Civil Design and Engineering Fees	-	1.0	1.0
Sub Total (c)	-	21.0	21.0
d) Erection and Commissioning	1.4	2.1	3.5
e) Provision for Construction Water including Cost of bringing Water Connection to Site	-	6.0	6.0
Total (a + b + c + d + e)	29.1	44.8	73.9
B. Power Receiving and Distribution:			
Maximum Demand 89 KVA			
Connected Load 120 KVA			
a) Equipment*			
(i) Receiving Station	38.0	-	38.0
(ii) LT Control Gears	25.0	-	25.0
(iii) LT Cables including Earthing, Lightning Protection & Lighting etc.	43.0	-	43.0
(iv) Insurance and Ocean Freight	-	11.1	11.1
(v) Local Transportation, Wharfage etc.	0.7	13.4	14.1
Sub Total (a)	106.7	24.5	131.2
b) Design and Engineering	10.6	-	10.6
c) Civil Works			
(i) Transformer Building 16 sq.m. @ USD 340 per sq.m.	-	5.4	5.4
(ii) Civil Design & Engineering Fees	-	0.3	0.3
Sub Total (c)	-	5.7	5.7

Schedule VIII/2 Contd..

('000 US Dollars)

1	2	3	4
d) Erection and Commissioning	4.2	6.4	10.6
e) Provision for Construction Power	-	4.0	4.0
* includes estimated costs of bringing power to site.			
Total (a + b + c + d + e)	121.5	40.6	162.1
3. General Services			
A. Laboratory Facilities:			
a) Equipment			
(i) Cost of Equipment, Glass-ware, Instruments etc.	25.5	-	25.5
(ii) Insurance and Ocean Freight	-	2.7	2.7
(iii) Local Transportation, Wharfage etc.	0.2	3.2	3.4
Sub Total (a)	25.7	5.9	31.6
b) Civil Works			
(i) Laboratory Building covered under Administration Building	-	-	-
(ii) Furniture and Fittings	1.0	4.0	5.0
Total (a + b)	26.7	9.9	36.6
B. Maintenance Workshop:			
a) Cost of Workshop Equipment CIF	12.0	3.5	15.5
b) Cost of Furniture, Working Benches etc.	-	1.5	1.5
c) Civil Works			
(i) Building 70 sq.m. @ USD 340 per sq.m.	-	23.8	23.8
(ii) Civil Design and Engineering	-	1.2	1.2
Sub Total (c)	-	25.0	25.0
d) Erection and Commissioning	-	0.3	0.3
Total (a + b + c + d)	12.0	30.3	42.3

Schedule VIII/2 Contd..

('000 US Dollars)

1	2	3	4
C. Safety and Fire Fighting			
a) Equipment Lump sum	7.5	-	7.5
b) Structures etc.	-	1.0	1.0
Total (a + b)	7.5	1.0	8.5
D. Communication System, Lump sum	1.5	1.5	3.0
E. Transport and Materials Handling			
a) Fork Lift for Warehouse	11.0	-	11.0
b) Passenger Car	9.0	-	9.0
c) Van/Pick Up	12.0	-	12.0
d) Pallet Jacks, Wheel Barrows etc.	3.5	2.0	5.5
Total (a + b + c + d)	35.5	2.0	37.5
F. Stores and Miscellaneous Items			
a) Racks, Standard Pallets etc.	-	2.5	2.5
b) Platform Scale	4.5	-	4.5
c) Protective Clothing	4.5	-	4.5
d) Lot Number Printer and other Miscellaneous Items	1.5	1.0	2.5
Total (a + b + c + d)	10.5	3.5	14.0
4. Non-Plant Buildings			
A. Gate House:			
a) Cost of Civil Works 12 sq.m. @ USD 340 per sq.m.	-	4.1	4.1
b) Civil Design and Engineering	-	0.2	0.2
Total (a + b)	-	4.3	4.3
B. Administration/Laboratory Building			
a) Cost of Civil Works 140 sq.m. @ USD 340 per sq.m.	-	47.6	47.6
b) Civil Design and Engineering Fee	-	2.4	2.4
c) Furniture, Fixtures, Office Equipment etc.	2.0	5.0	7.0
Total (a + b + c)	2.0	55.0	57.0

('000 US Dollars)

1	2	3	4
C. Canteen, Dispensary, Change Room			
a) Cost of Civil Works 130 sq.m. @ USD 340 per sq.m.	-	44.2	44.2
b) Civil Design and Engineering Fee	-	2.2	2.2
c) Furniture, Equipment for Dispensary, Canteen and Change Room	1.5	4.5	6.0
Total (a + b + c)	1.5	50.9	52.4
D. Warehouse Buildings			
a) Raw Materials Storage Shed 300 sq.m. @ USD 290 per sq.m.	-	87.0	87.0
b) Imported Solvent Storage Covered Space, 100 sq.m. @ USD 100 per sq.m.	-	10.0	10.0
c) Local Solvent Tanks Foundations etc.	-	1.5	1.5
d) Finished Goods Warehouse 400 sq.m. @ USD 290 per sq.m.	-	116.0	116.0
e) Civil Design and Engineering Fee	-	10.7	10.7
Total (a + b + c + d + e)	-	225.2	225.2
5. Other Costs			
A. Land, Land Development and Preliminary Engineering Services	-	9.1	9.1
B. Internal Roads Boundary Wall, Fencing, Street Lighting, Sanitary & Drainage etc.	-	20.0	20.0
C. Preliminary and Pre-Operative Expenses			
a) Preparation of Feasibility Study	-	-	-
b) Pre-operative Expenses			
(i) Total personnel requirement for the organization has been estimated at 36. Implementation period is three years including tendering and contracting time of about one year.			

Schedule VIII/2 Contd..

('000 US Dollars)

1	2	3	4
For the purpose of calculating preoperative expenses in terms of project administration and execution, on an average five officers and staff have been assumed to man the Project Cell throughout the duration of the project implementation phase. With a total average annual salary bill of about USD 17,500 per annum, the total expenses for the three year period amounts to USD 52,500. Adding office running expenses, the total project administration expenses are estimated at equivalent of USD 63,000.			
- Project Administration Expenses	-	63.0	63.0
(ii) Lump sum provision for office equipment, stationery, postage, including costs involved in tendering and selection of know-how, equipment supplier.	-	20.0	20.0
(iii) Training of local operational Staff:			
Training of some of the senior level and middle level executives will be arranged through UNIDO, with most of the expenses provided for. However, a provision of USD 5,000 is made to meet additional expenses, if any, of training.			
- Training Expenses	3.0	2.0	5.0
(iv) Trial Runs, Commissioning and Start-up Expenses:			
These expenses have already been adequately covered under individual heads in the project costing	-	-	-
Total (a + b)	3.0	85.0	88.0
D. Inspection Charges @ 0.5% of total FOB cost of Plant, Equipment and machinery	1.7	-	1.7
6. Total Project Cost	521.1	802.1	1323.2

Schedule VIII/2 Contd..

('000 US Dollars)

1	2	3	4
7. Contingencies - 10% of the total costs	52.1	80.2	132.3
8. Total Cost including 10% Contingencies	573.2	882.3	1455.5
9. Interest during Construction:			
Being a public sector project, the capital cost is expected to be financed through 100 percent promotors equity. However, in the event of project being financed partly through term loans from financial institutions, the interest element on the loan capital during the construction period will be capitalised. Assuming a debt equity ratio of 1.5:1 and an interest rate of ten percent (the prevailing rate in Ethiopia), the interest for one year works out to USD 92,910. It is expected that during the first two years of project, expenses will be met from promoters' equity contribution and only during third year, the term loan will be drawn. There are no commitment charges on term loans in Ethiopia. The total interest element will be in local currency since the loan disbursement would be in local currency and foreign exchange allocation would be arranged through central bank.			
- Interest during construction	-	92.9	92.9
Total project cost including interest during construction	573.2	975.2	1548.4
Total Project Cost expressed in '000 Birr	1186.3	2018.7	3205.0

Schedule VIII/3

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

CAPITAL SPENDING

Project Cost Head	Year 1			Year 2			Year 3			TOTAL		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
1. Land, Land Development and Preliminary Engineering Expenses	-	6.6	6.6	-	3.4	3.4	-	-	-	-	10.0	10.0
2. Plant and Machinery includes Main Plant, Utilities, Service Equipments.	9.9	-	9.9	93.7	15.5	109.2	426.8	146.1	572.9	530.4	161.6	692.0
3. Erection and Commissioning	-	-	-	-	-	-	34.5	43.8	78.3	34.5	43.8	78.3
4. Building and Civil Works	-	-	-	-	135.4	135.4	-	421.5	421.5	-	556.9	556.9
5. Furniture and Fixtures	-	-	-	-	-	-	5.0	16.5	21.5	5.0	16.5	21.5
6. Preliminary and Preoperatives	-	29.7	29.7	-	29.7	29.7	3.3	34.1	37.4	3.3	93.5	96.8
7. Interest during Construction	-	-	-	-	-	-	-	92.9	92.9	-	92.9	92.9
8. Total Spending	9.9	36.3	46.2	93.7	184.0	277.7	469.6	754.9	1224.5	573.2	975.2	1548.4

FC : Foreign Component

LC : Local Component

Chapter Nine

FINANCIAL AND ECONOMIC EVALUATION

A. Products Considered for Financial Evaluation

9.1 The proposed pesticide formulation plant will be a multi-product unit with sufficient flexibility in terms of plant design and equipment versatility to formulate a variety of insecticides as emulsifiable concentrates, oil concentrates, ultar-low-volume preparations, water soluble concentrates and oil solutions. The product mix in a given year would be based on sales forecast. Within a total of over 30 insecticidal formulations being imported in the country, there is so much of overlap in the activity ranges, that the product variety could possibly be reduced and through these inter-se-substitutions, it should be possible to cover a sizable portion of the country's requirements by formulating products of common usage having broad-spectrum activity. For the purpose of financial analysis of this study, following product mix (Table 9.1) has been considered, which also reflects the present most commonly used items by different sectors in Ethiopia.

Table 9.1 Products Considered for Financial Analysis

	Product	Type of formulation	Annual output (K.Lit)
1.	Endosulfan	35 EC	400
2.	Endosulfan	25 ULV	350
3.	Malathion	50 EC	450
4.	Dimethoate	40 ULV	100
5.	Dimethoate	40 EC	100
6.	Fenitrothion	50 EC	50
7.	Diazinon	60 EC	50
	Total Liquid Formulations		1500

* In accordance with the terms of reference as outlined in the UNIDO Job Description for this study, the consultant inter alia,"is expected to assess raw materials needed for one full year operation of the plant", only and accordingly the relevant information is being offered in this chapter.

B. Raw Material Requirements & Value

9.2 Schedule IX/1 presents the requirement of active materials, solvents, emulsifiers and auxiliary materials per unit production of each insecticide formulation. Based on a capacity utilization of 75 percent, 90 percent and 100 percent in the first, second and third years of operation following commencement of production operations respectively, Schedule IX/2 gives the annual productions and the total raw material requirements, while Schedule IX/3 works out the annual quantity and value for each raw material for the first three years of operation. Solvents have been broken down in three categories, first the high power, high cost solvents mostly polar compounds (ketones, glycols, glycolethers etc); solvent II, the most commonly used products amongst aromatic hydrocarbons such as xylene and mixtures and the solvent III consisting of products containing higher aliphatic portions such as gas oils, kerosene and white spirit. Over a period of time, it should be possible to increase the local component of solvents upto 50 percent. The financial analysis is based on about 40 percent utilization of locally available solvents and diluents. The prices for active ingredients and other raw materials have been obtained from different sources including some foreign companies and the Chemical Marketing Reporter, published in USA. A provision of one percent has been made for process and handling losses.

C. Utilities

9.3 Utilities requirement and costs have been given in Schedule IX/4. Fifteen percent of the total power consumption and twenty five percent of water consumption have been assumed as fixed while the rest are related to capacity utiliz-ation of the plant.

D. Working Capital

9.4 Schedule IX/5 lays the norms* for arriving at the working capital requirement for the project. From third year onwards, 100 percent capacity utilization is foreseen and therefore the increase in working capital will be limited to the first two years only. No margin money is proposed to be set aside since 100 percent requirements of working capital are expected to be financed through short term commercial bank loans.

E. Packing Cost for Finished Goods

9.5 Schedule IX/6 offers annual packing cost of products. Seventy five percent of the total output would be packed in 200 litres metal drums suitably treated from inside against corrosion, for supplies to MSFD. These drums will have to be imported initially till the existing facility at Ethiopian Petroleum Corporation is suitably strengthened to produce drums of required specifications. It is expected that about 45 percent of the total packaging requirement in 200 litre size will be met through recycling of old drums as well as by using some of the empty raw material drums. Possibilities of getting some of the solvents in special drums (to be reused for filling finished products) as against the usual unquoted steel drums could be considered. Fifteen percent of the total annual output will be packed in 20 litre plastic bottles, while 7 percent and 3 percent is proposed as one and 0.5 litre respectively in plastic bottles.

* Only minimum days coverage and coefficient of turn-over against each head of current assets and current liabilities is being furnished as desired by IPS counterpart officials.

The requirement of wooden and cardboard boxes and labelling can be adequately met from local resources.

F. Sales Revenue

9.6 There are seven products for production considered in this analysis. None of these products is produced in the country and complete requirements are met through imports. It would, therefore, be more realistic to work out the sales revenue based on the current delivered prices of these products to MSFD or AISCO. Based on the data as given in the enclosed schedules, cost of production will be computed on ex-factory basis. To this must be added distribution expenses to get delivered prices of materials. No selling and marketing expenses have been envisaged at this stage since the products are going to MSFD, AISCO, MOH, MOA (PPRD), RRC and to Animal and Fisheries Resources Department of the MOA, for their own consumption or further distribution. In case it is decided to appoint distributors, a sales commission of fifteen percent is normally ear-marked in the expense account. In addition to this, a provision of about 2.5 percent is made for sales promotion work which includes farm demonstrations, training programmes and travel costs with respect to marketing of products.

Schedule IX/1

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

RAW MATERIAL REQUIREMENT PER UNIT PRODUCTION

(Kilogram per cubic meter of final product)

	Raw Material	Endosulfan		Malathion	Dimethoate		Fonitrothion	Diazinon
		25 ULV	35 EC	50 EC	40 ULV	40EC	50 EC	60 EC
1.	Active Materials, Technical (Min active content,%)	263 (95)	368 (95)	526 (95)	421 (95)	421 (95)	526 (95)	628 (95.5)
2.	Solvent I (Imported)	270	-	-	515	115	-	150
3.	Solvent II (Imported)	-	329	270	120	460	222	136
4.	Solvent III (Local)	499	296	214	-	-	194	-
5.	Emulsifiers (Imported)	-	30	40	-	50	80	80
6.	Special Adjuvants	10	10	5	-	-	5	30
	Total	1044	1033	1055	1056	1046	1027	1024

Schedule IX/2

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

ANNUAL PRODUCTIONS AND RAW MATERIAL REQUIREMENTS (Tons)

Operations: I year - 75%; II year 90%; III year onwards; 100%

	Items	Year of Activity	Endosulfan		Malathion	Dimethoate		Fenitrothion	Diazinon	Total
			25 ULV	35 EC	50 EC	40 ULV	40 EC	50 EC	60 EC	
1.	Productions	I	262.5	300	337.5	75	75	37.5	37.5	1125
		II	315.0	360	405.0	90	90	45.0	45.0	1350
		III	350.0	400	450	100	100	50.0	50.0	1500
2.	Active Ingredients (Imported)	I	69.0	110.4	177.5	31.6	31.6	19.7	23.5	463.3
		II	82.8	132.5	213.0	37.9	37.9	23.7	28.3	556.1
		III	92.1	147.2	236.7	42.1	42.1	26.3	31.4	617.9
3.	Solvent I (Imported)	I	70.9	-	-	38.6	8.6	-	5.6	123.7
		II	85.1	-	-	46.3	10.3	-	6.7	148.4
		III	94.5	-	-	51.5	11.5	-	7.5	165.0
4.	Solvent II (Imported)	I	-	98.7	91.1	9.0	34.5	8.3	5.1	246.7
		II	-	118.4	109.3	10.8	41.4	10.0	6.1	296.0
		III	-	131.6	121.5	12.0	46.0	11.1	6.8	329.0
5.	Solvent III (Imported)	I	131.0	88.8	72.2	-	-	7.3	-	299.3
		II	157.2	106.6	86.7	-	-	8.7	-	359.2
		III	174.6	118.4	96.3	-	-	9.7	-	399.3
6.	Emulsifier (Imported)	I	-	9.0	13.5	-	3.7	3.0	3.0	32.2
		II	-	10.8	16.2	-	4.5	3.6	3.6	38.7
		III	-	12.0	18.0	-	5.0	4.0	4.0	43.0
7.	Adjuvants (Imported)	I	2.6	3.0	1.7	-	-	0.2	1.1	8.6
		II	3.1	3.6	2.0	-	-	0.2	1.3	10.2
		III	3.5	4.0	2.2	-	-	0.3	1.5	11.5

Schedule IX/3

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

RAW MATERIAL REQUIRED AND COSTS

Operations: I year - 75%; II year - 90%; III year onwards - 100%

Q - Quantity, Tons; V - Value, '000 Birr

	ITEM	PRICE BIRR/TON	YEAR 1		YEAR 2		YEAR 3		LOCAL (L)/ FOREIGN (F)
			Q	V	Q	V	Q	V	
1.	Endosulfan Tech.	12,990	179.4	2,330.4	215.3	2,796.7	239.3	3,108.5	F
2.	Malathion Tech.	5,325	177.5	945.3	213.0	1,134.3	236.7	1,260.4	F
3.	Dimethoate Tech.	6,282	63.2	397.0	75.8	476.2	84.2	528.9	F
4.	Fenitrothion Tech.	8,860	19.7	174.5	23.7	210.0	26.3	233.0	F
5.	Diazinon Tech.	14,530	23.5	341.5	28.3	411.2	31.4	456.2	F
6.	Solvent I	1,760	123.7	217.7	148.4	261.2	165.0	290.4	F
7.	Solvent II	890	246.7	219.6	296.0	263.4	329.0	292.8	F
8.	Solvent III	475	299.3	142.2	359.2	170.6	399.3	189.7	L
9.	Emulsifiers	6,875	32.2	221.2	38.7	265.9	43.0	295.4	F
10.	Adjuvants	7,520	8.6	64.7	10.2	76.7	11.5	86.5	F
	- Total		1,173.8	5,054.1	1,408.6	6,066.2	1,565.7	6,741.8	
	- 1% Provision for Process Losses			50.5		60.7		67.4	
	- Total Value			5,104.6		6,126.9		6,809.2	
	- Foreign Component			4,961.0		5,954.6		6,617.6	
	- Local Component			143.6		172.3		191.6	

Schedule IX/4

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

UTILITIES REQUIREMENT AND COST

Q - Quantity : V - Value in Birr

ITEM	YEAR 1		YEAR 2		YEAR 3	
	Q	V	Q	V	Q	V
1. Electricity						
- Units, KWH	102,000	21,318	146,400	30,598	160,000	33,440
2. Water Cu.m	2,906	1,453	3,469	1,735	3,750	1,875
		22,771		32,333		35,315

1. Fifteen percent of the total power consumption has been taken as fixed and the balance 85 percent as variable.

2. Twenty Five percent of the total water consumption has been assumed as fixed while the rest is variable.

Schedule IX/5

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

WORKING CAPITAL REQUIREMENTS

ITEM	Coverage (Days)	TURN-OVER	YEAR 1	YEAR 2	YEAR 3	YEAR 4
1. Raw Materials						
(i) Indigenous	30	12				
(ii) Imported	120	3				
2. Utilities	30	12				
3. Wages and Salaries	30	12				
4. Spares	360	0.5				
5. Packing Materials						
(i) Local	15	12				
(ii) Imported	90	4				
6. Selling Expenses	15	12				
7. Finished Goods	10					
8. Outstanding Debtors	30	12				
Total						
9. Accounts Payable	30	12				
- Net working capital						
- Increase in working capital						
-- Net working Capital - Local						
" " " - Foreign						

Note: In view of 100% bank overdraft facilities to meet the requirements of working capital, no margin money is being set aside for contribution from the promoters.

Schedule IX/6

LIQUID INSECTICIDES FORMULATION PLANT - ETHIOPIA

ANNUAL PACKING COST FOR FINISHED GOODS

	Mode of Packing	Net Filling Litres	No.of Packs per K.Litre	No. of Packings per annum	Cost per Packing (Birr)	Annual cost of Packing (Birr)	Foreign or Local Cost
1.	Metal Drums internally lacqured	200	5	3000*	50	150,000	Foreign
2.	Plastic Cans	20	50	11,250	12.5	140,625	Local
3.	Plastic Bottles	1	1000	105,000	2.0	210,000	Local
4.	Plastic/Glass Bottles	0.5	2000	90,000	1.5	135,000	Local
5.	Wooden Boxes for 20 L Containers with strapping	For 6 Cans of 20 L each	-	1875	10.0	18,750	Local
6.	Heavy duty corrugated cardboard box for I L bottles	For 12 bottle of IL each	-	8750	2.0	17,500	Local
7.	Heavy duty corrugated cardboard box for 0.5 L bottles	For 24 bottles of 0.5 L each	-	3750	3.5	13,125	Local
8.	Lables	-	-	230,000	0.10	23,000	Local
	Total cost of packing per annum					708,000	

* It is assumed that about 55% of total packaging in 200 litres size will be in new drum only. For the rest, empty drums of raw materials will be used together with recycling of old drums.

Chapter Ten

ASSESSMENTS AND RECOMMENDATIONS

A. Summary of Assessments

10.1 Ethiopia is predominantly an agricultural country and its economy largely depends upon the agricultural production of its hundreds of thousands of peasants. The country is not self-sufficient in food and has been subjected to chronic food shortages in the past due to vagaries of nature and relatively low productivity on the farm field. The country is richly endowed with fertile land particularly in the south and in some of the central areas with substantial agricultural potential. The unique highland physiography of much of Ethiopia and its priviledged exposure to favourable climates have led to cultivation of a variety of both food and cash crops. Additional requirements of food will have to be met through improvements in production technologies at the farm and by expanding the areas under cultivation. The main thrust of the Government is on improvement of agriculture. More resources accordingly are being provided to agriculture, with emphasis on peasant sub-sector.

10.2 In the past, application of plant protection measures has not been given due emphasis in the dominant peasant sub-sector, which account for over 90 percent of the total agricultural production. No pesticides are produced locally and the country is import dependent in respect of all of its pesticides requirement. Today's pesticides consumption in Ethiopia is estimated to be more than USD twenty million which is yet considered to be grossly inadequate to cover the country's real needs. Imports have been restricted owing to a series of economic and financial constraints. An overwhelmingly large

portion of pesticides imported into the country are consumed on the state farms as liquid formulations. Remarkable potential exists in the smallholder sub-sector for improvement in yields and productivity for which use of inputs need to be optimised. Like in any other developing country, a vast number of unanswered questions surround the use and distribution of pesticides in Ethiopia. While the low consumption of agro inputs in Ethiopian agriculture is but one among many dimensions of agriculture modernization, intensification of agricultural production is going to require a steady supply of relatively in-expensive but effective pesticides which are adapted to the needs of Ethiopian farming practices. As more and more farmers come to employ modern agricultural methods, the demand for pesticides is expected to increase rapidly.

10.3 Marketing of pesticides for the smallholder peasant sub-sector is limited to only a few products in high concentrations which are often too expensive and do not adequately serve the interest of the smallholder. Crop chemicals are not freely available due to inefficiency of the distribution system. Due to lack of local formulation operations, products in the form of dusts and granules, which are often more suited for the smallholder have not been made available. Some of the solvents, inert carriers and packaging materials are available within the country which could be suitable for supporting local formulation activities.

10.4 The legislation to regulate manufacture,importation, sale, transportation, distribution and use of pesticides with a view to prevent risk to human beings, animals or environment in a draft form is before the council of Ministers for approval and enactment. This summary of some of the important observations with respect to plant protection activities, while by no

means comprehensive, illustrates the tremendous potential in the usage of pesticides in Ethiopia, justifying immediate establishment of local pesticides formulation facilities to meet the requirements of the state farms as well the peasant sub-sector.

B. Recommendations

10.5 Conclusions and recommendations have been stated in each of the sections, where appropriate. A brief outline of some of the more important recommendations is given hereafter. It is, however, emphasised that the subjects dealt with are several and that an outline of recommendations given here can only be selective and indicative. Those with particular interest might persue them in the main text of the report, where adequate background and justification has also been provided.

Establishing Local Formulation Facilities:

10.6 With the intensification of the agricultural production coupled with the need to bring down the foreign exchange spending on pesticides, there is an immediate need for establishing pesticides formulation facilities in the country to manufacture a variety of pesticidal formulations based on indigenous raw materials to the extent feasible, which will give an impetus to the increased usage of pesticides much to the fulfilment of the country's objectives of attaining food self-sufficiency and to boost exports. The study recommends the following phased programme of implementation:

Phase - I:

- 1,500 kilolitres per annum of liquid insecticides formulation.
- 750 tons per annum of granular insecticides formulation
- 1000 tons per annum of dust insecticides formulation.

Phase - II:

- Insecticides and fungicides wettable powder formulations.
- Herbicides liquid dilution and packaging from imported concentrates to include water solutions, flowables and solvent solutions.

The capacities for the second phase programme will be governed by the future market trends in the country. The local formulation activity as proposed above envisages utilization of indigenous carriers, some of the solvents and packaging materials already available in the country. UNIOD's assistance in the implementation of the project with a component of training in foreign plants is strongly recommended. Through the unbiased international expertise of consultants from UNIDO, project activities could be overseen effectively to ensure appropriate technologies, plant and equipment to build the outfit to the best of international standards in line with the interests of the country. The project may be implemented with 100 percent state participation or as a joint venture with involvement of a well-established chemical company in the crop-chemical business having good back-up facilities.

10.7 Given the close links of cooperation between the producing and consuming sectors and bearing in mind that the project itself would present a potential for increased agricultural productivity and improvements in the public health and livestock sector, it is desirable that the project has the participation of MSFD and MOA through AISCO.

10.8 The production programme of the formulation plant should engulf a variety of products. This should be decided in close cooperation with the MSFD and the MOA/AISCO.

10.9 It is essential that the suitability of local solvents, carriers and packaging materials to be used in pesticide formulations and the final composition of these products are ascertained on a laboratory/pilot plant scale, and in the field before any large scale production is taken up. UNIDO assistance is recommended for this developmental activity. Assistance should also be sought from the suppliers of active materials in terms of checking suitability of local raw materials and locating appropriate and most economic imported inputs.

10.10 To encourage and develop the local industry the following measures are recommended:

- Active ingredients in commercially pure form imported into the country for the purpose of local formulation be exempted from import duties and taxes.

- Import of finished products, which can be formulated within the country should be phased out when the project becomes operational.

- Adequate allocations of foreign exchange for import of raw materials and spares are made periodically for continued and successful operations of the installed units.

In most of the developing countries, special incentives for local production with imposition of tariff barriers to the import of finished products which can be formulated locally, are given important

considerations for encouraging the growth of local formulation plants. The Government of Ethiopia may like to review the policies and programmes to provide better incentives with a view to promoting the indigenous industry to effect foreign exchange savings, better utilization of country's resources and generating employment.

Long Term Perspective - 'The Pesticides Review Committee'

10.11 Constitution of a 'Pesticides Review Committee' comprising of representatives from amongst Ministry of Agriculture, State Farm Development, Industry, Health, Central Planning, Institute of Agricultural Research, Agricultural Inputs Supply Corporation, the National Chemical Corporation and possibly Ministry of Coffee and Tea Development is recommended to carry out the following tasks:

- Recommend long term targets of consumption (based on anticipated endusers requirements), imports and the need for creation of local production/formulation capacity taking into consideration desired level of self-sufficiency of crop-chemicals.

- Review the planning mechanism at the central and regional levels from time to time taking into account the limitations in the same, the need and recommendations for strengthening the planning and monitoring mechanism for effective implementation of planned programmes.

Appendix I

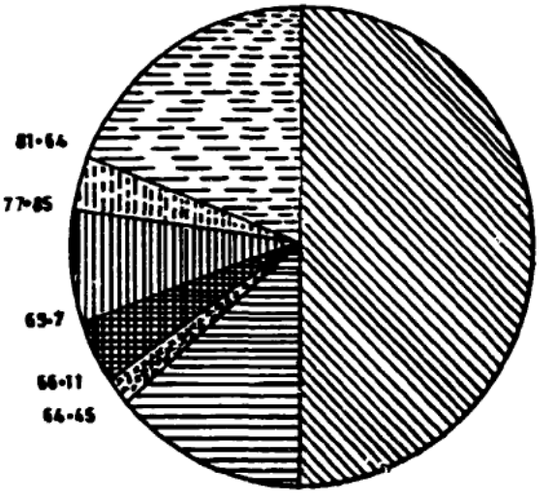
LIST OF ORGANISATIONS CONTACTED

1. Addis Ababa Foam and Plastic Factory, Addis Ababa
2. Agrucultural Inputs Supply Corporation, Addis Ababa.
3. Bayer Ethiopia Limited, Addis Ababa.
4. Ethiopian Petroleum Corporation, Addis Ababa.
5. Ethiopian Sugar Corporation, Addis Ababa.
6. Food and Agricultural Organisation of the United Nations, Addis Ababa
7. Hoechst Ethiopia Limited, Addis Ababa.
8. Industrial Projects Service, Addis Ababa.
9. Mineral Resources Development Corporation, Addis Ababa.
10. Ministry of Agriculture, Addis Ababa

    - Agricultural Development Department.
    - Animal and Fisheries Resources Development Department.
    - Crop Protection Laboratory.
    - Plant Protection and Regulatory Department.

11. Ministry of Coffee and Tea Development, Addis Ababa.
12. Ministry of Health, Addis Ababa.
13. Ministry of Industry, Addis Ababa.
14. Ministry of State Farms Development, Addis Ababa.
15. National Chemical Corporation, Addis Ababa.
16. Relief and Rehabilitation Commission, Addis Ababa.
17. United Nations Development Programme, Addis Ababa.
18. World Health Organisation Representatives Office, Addis Ababa.

CLASSIFICATION OF LAND IN ETHIOPIA BY MAJOR TYPE OF USE
(1972-1976)



	MAJOR TYPES OF LAND USE	AREA—m Ha	%PROPORTION
1	Grazing and Browing	63.5	51.25
2	Annuals	16.4	13.20
3	Perennials	2.1	1.66
4	Natural Forests	4.5	3.59
5	Other Woody Vegetation	10.1	8.15
6	Currently unproductive land	4.6	3.79
7	Unutilizable land	23.1	18.73
8	Total land	124.3	100.00
9	Cultivated land (2+3)	18.5	14.36
10	Agricultural land (1+2+3)	82.0	66.11
11	Woody vegetation (4+5)	14.6	11.74
12	Potentially productive land (6+10+11)	101.5	81.66

Source:- Compiled from information given in Pre-feasibility Study - Fertilizer Complex, Ministry of Industry.

AREA, PRODUCTION AND YIELD OF MAJOR CROPS, 1983-84

CROP	AREA ('000 Ha)	PRODUCTION ('000 Quintals)	YIELD (Quintals/Ha)
CEREALS	4715.6	55268.2	11.72
'Teff'	1318.0	10902.4	8.27
Barley	796.3	8143.4	10.23
Wheat	625.6	6660.5	10.65
Maize	820.9	15392.5	18.67
Sorghum	913.6	12016.3	13.15
Millet	215.3	1993.6	9.26
Oat	25.9	222.5	8.58
PULSES	761.2	7117.4	9.35
Horsebean	350.4	3886.5	11.0
Chickpea	172.8	1085.0	6.28
Haricot-bean	46.9	460.1	9.80
Field Pea	123.1	1194.3	9.70
Lentil	40.2	252.9	6.30
Vetch	27.7	234.0	8.44
Soyabean	0.09	0.2	2.22
OTHERS	256.2	985.0	3.85
'Neug'	154.7	589.2	3.81
Linseed/Flax	93.4	355.2	3.80
Fenugreek	4.7	18.1	4.44
Rape seed	2.15	15.1	7.03
Sunflower	1.8	6.7	3.72
Groundnut	0.11	1.03	9.36
Total	5733.0	63370.9	11.05

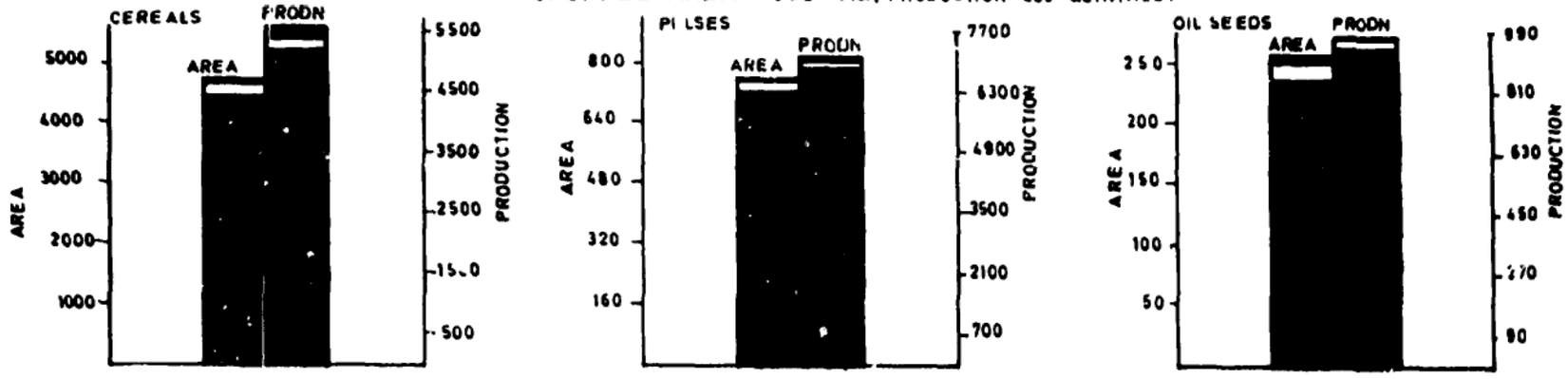
N.B: The above figures exclude Eritrea and Tigray Administrative Regions.

Source: Fertilizer Complex - Prefeasibility Study Ministry of Industry.

CEREALS, PULSES, OIL SEEDS - TOTAL AREA AND PRODUCTIONS, SECTORWISE, 1983-84

APPENDIX IV

(CROPPED AREA- '000 Ha; PRODUCTION-'000 QUINTALS)



CROP	NATIONAL ESTIMATES		PRIVATE HOLDINGS SEASON MAIN		PRIVATE HOLDINGS SEASON BELG *		COOPERATIVES		STATE FARMS	
	AREA	PRODN	AREA	PRODN	AREA	PRODN	AREA	PRODN	AREA	PRODN
Cereals	4715.6	55268.2	4421.7	52174.9	243.9	2684.1	162.5	1086.8	131.2	2005.5
(%)	(82.3)	(87.2)	(82.1)	(86.8)	(95.2)	(98.7)	(79.0)	(87.1)	(96.0)	(99.0)
Pulses	761.2	7117.4	737.1	6974.9	11.3	32.7	22.7	137.8	1.35	4.04
(%)	(13.3)	(11.2)	(13.7)	(11.6)	(4.5)	(1.2)	(11.0)	(11.0)	(1.0)	(0.2)
Oilseeds	256.2	985.3	231.7	945.7	0.81	1.48	20.4	23.1	4.13	16.5
(%)	(4.5)	(1.6)	(4.4)	(1.6)	(0.3)	(0.05)	(9.9)	(1.9)	(3.0)	(0.8)
Total	5733.0	63370.9	5390.5	60095.5	256.0	2679.3	205.6	1247.7	136.7	2026.6
(%)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

* BELG - Season of short rains from February to April

■ - PRIVATE HOLDINGS ; □ - COOPERATIVES ; ■ - STATE FARMS

Source: Compiled from information given in Pre-feasibility Study, Fertilizer Complex, Ministry of Industry.

Appendix V

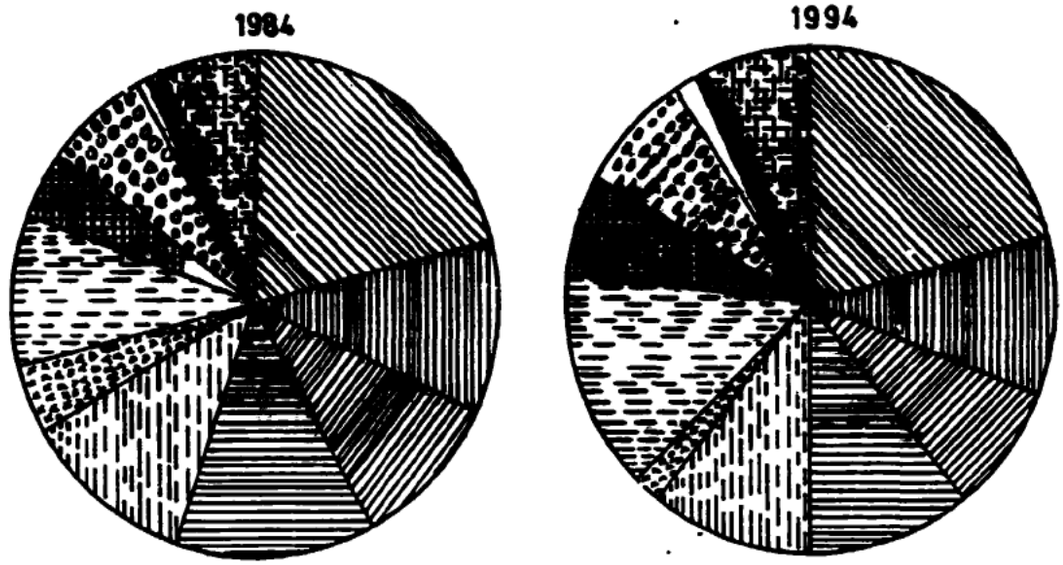
AREAS UNDER VARIOUS AGRICULTURAL PRODUCTS SECTORWISE ('000 Ha)

	CEREALS, PULSES & OILSEDS		COFFEE		TEA		COTTON		SUGARCANE	
SECTOR	1983-84	93-94	1983-84	93-94	1983-84	93-94	1983-84	93-94	1983-84	93-94
State Farms	202.8 (3.1)	451.1 (6.0)	17.7 (3.8)	47.8 (8.7)	0.9 (100)	3.4 (100)	31.6 (100)	93.5 (100)	16.0 (100)	21.6 (100)
Producer Cooperatives	88.7 (1.4)	3938.8 (52.1)	3.7 (0.8)	57.3 (10.5)	-	-	-	-	-	-
Private Farms	6136.8 (94.9)	3048.2 (40.3)	446.3 (95.4)	442.7 (80.8)	-	-	-	-	-	-
Settlement Farms	39.6 (0.6)	121.8 (1.6)	-	-	-	-	-	-	-	-
Total	6467.9	7559.9	467.7	547.8	0.9	3.4	31.6	93.5	16.0	21.6
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

N.B. Figures in bracket indicate percentage area under each sector.

Source: Fertilizer Complex - Prefe sibility Study, Ministry of Industry.

CULTIVATED AREA UNDER VARIOUS CROPS 1984 AND 1994



CROP	CROP AREA 1984 '000Ha	1984 %	1994 '000Ha	1994 %
-TEFF	1401	20.2	1572	19.4
-BARLEY	881	12.7	873	10.8
-WHEAT	706	10.2	708	8.7
-MAIZE	806	11.6	848	10.5
-SORGHUM	889	12.8	1003	12.4
-OTHER CROPS	291	4.2	151	1.9
- CEREAL TOTAL	4974	71.7	5155	63.7
-PULSES	721	10.4	1101	13.6
-OILSEEDS	270	3.9	589	7.3
-COFFEE	468	6.8	548	6.8
-COTTON	32	0.5	138	1.7
-SUGARCANE	16	0.2	28	0.4
-OTHER CEREALS	458	6.5	552	6.5
— TOTAL	6937	100	8111	100

Source : Compiled from data given in Prefeasibility Study, Fertilizer Complex.

Appendix VII

CROPWISE PESTS AND PESTICIDES RECOMMENDED FOR USE STATE FARMS, 1987 - 88

	CROP	PEST	PESTICIDE TO BE USED		AREA TO BE TREATED ('000 Ha)	RATE PER Ha (Lt, kg)	QUANTITY PURCHASED (K.Lt, T)	OTHER PRODUCTS RECOMMENDED (ALTERNATE)		RATE PER Ha (Lt, kg)
	(1)	(2)	(3)		(4)	(5)	(6)	(7)		(8)
1.	Cotton	Spider Mite	-Amitraz	20 EC/ULV	4.89	3.0	14.4	-Dicofol	42 EC	2.0
			-Dicofol	18.5 EC	3.10	3.0	9.2	-Prothoate	40 EC	1.5
			-Tetradifon	18 EC	1.83	1.5	2.8			
2.	Cotton	Sucking Insect Pests	-Phosphamidon	250 ULV	44.85	1.6	71.8	-Phosphamidon	50 SCW	0.8
			-Phosphamidon	100 SCW	51.34	0.4	20.6	-Dimethoate	L 40	1.0
								-Dimethoate	30 Al	1.33
3.	Cotton	Spiny, Pink & Sudan Boll Worm	-Monocrotophos	40 SCW	5.12	2.0	10.2	-Monocrotophos	250 ULV	3.22
			-Azinphos-ethyl	400 EC	3.14	2.0	6.7	-Azinphos-ethyl	400 ULV	
4.	Cotton	African Boll Worm	-Endosulfan	25 ULV	97.40	3.0	303.8	-Phoxim+Azinphos ethyl Combi	800 ULV	2.5
			-Profenofos	250 EC/ULV	9.30	3.0	28.0	"	600 ULV	3.0
			-Cypermethrin	5 ULV	19.92	1.68	33.4	-Monocrotophos+DDT	400 ULV	3.0
			-Amitraz	20 EC/ULV	5.23	2.5	13.2	-Methidathion+DDT Combi	400 ULV	3.0
5.	Cotton	White Fly	-Amitraz	20 EC/ULV	41.23	3.0	123.6	-Triazophos	25 ULV	2.0
			-Profenofos	250 EC/ULV	10.56	3.0	31.6	-Monocrotophos	40 SCW	1.5
			-Chlorpyrifos	24 ULV	10.05	3.5	35.2	-Endosulfan	35 EC	1.78
			-Ofunak	40 ULV	5.54	3.0	16.6	-Endosulfan	25 EC	2.50
			-Primiphos-methyl	150 ULV	5.54	2.0	11.0	-Decamethrin	5 EC	0.30
								-Cypermethrin	5 EC	0.80
								-Cypermethrin	25 EC	0.16
								-Fenvalerate	20 EC	0.60

Abbreviations Used: Lt - Litres; K.Lt - Kilo-litre; Kg - Kilogram; T - Tons; Combi - Combinations
EC - Emulsiable Concentrate; ULV - Ultra Low Volume; Fl - Flowable
SCW - Water Soluble Concentrate; SL - Soluble Liquid; Tab - Tablets; G - Granules

Continued.....

	(1)	(2)	(3)		
6.	Cotton	Leaf Worm	-Chlorpyrifos	24	ULV
			-Prefenofos	250	EC/ULV
			-Cypermethrin	5	ULV
7.	Cotton	African Boll	-Profenofos	250	EC/ULV
		Worm+Leaf Worm	-Phoxim+Azinphos ethyl Combination	800	ULV
			-Cypermethrin	5	ULV
8.	Cotton	Defoliant	-Thidazuran	50	WP
9.	Cotton	Complex Weed	-Metolachlor	400	EC
10.	Tobacco	African Boll Worm	-Endosulfan	35	EC
			-Cypermethrin	5	EC/ULV
11.	Tobacco	Sucking Insect Pests	-Phosphamidon	100	SCW
12.	Tobacco	Leaf Miner	-Monocrotophos	40	SCW
13.	Maize & Sorghum	Stalk Borer	-Cypermethrin	25	EC
14.	Maize & Sorghum	Aphids & Other Sucking Insects	-Thiometon	25	EC
15.	Maize & Sorghum	African Boll Worm	-Cypermethrin	5	ULV
			-Endosulfan	35	EC
16.	Maize & Sorghum	Complex Insect Pests	-Cypermethrin	5	EC/ULV

Appendix VII Continued.

(4)	(5)	(6)	(7)			(8)
28.01	4.5	126.0	-Methamid phos	SL	600	2.50
3.53	3.0	10.4	-Methomyl	20	ULV	2.25
23.88	2.0	47.8	-Fenvalerate	4	ULV	4.00
			-Decamethrin	0.6	ULV	3.08
14.97	3.0	44.8	-Phoxim+Azinphos-ethyl Combi	600	ULV	3.00
14.97	2.5	37.4	-Fenvalerate	4	ULV	4.00
18.97	2.0	38.0	-Decamethrin	0.6	ULV	3.08
7.00	0.3	2.1	-		-	-
1.40	6.5	9.2	-Oxadiason/Diuron		Fl	3.00
1.32	2.0	2.7	-Endosulfan	25	EC/ULV	2.50
0.33	1.68	0.6	-Fenvalerate	20	EC	0.6
			-Decamethrin	2.5	EC	0.6
0.83	0.4	0.4	-Phosphamidon	50	SCW	0.8
			-Dimethoate	L	40	1.0
			-Dimethoate	30	AS	1.33
1.65	1.5	2.4	- -		-	-
13.16	0.2	2.6	-DDT	10	D	10.0
0.88	1.0	0.8	-Phosphamidon	100	SCW	0.4
			-Phosphamidon	50	SCW	0.8
			-Dimethoate	L	40	1.0
4.89	1.68	8.2	-Cypermethrin	2.5	ULV	3.36
1.18	2.5	2.9	-Endosulfan	25	ULV	3.0
11.18	1.2	13.4	-Malathion	50	EC/ULV	2.0
			-Diazinon	600	EC/ULV	1.0
			-Methamidophos	SL	600	1.0

Continued.....

	(1)	(2)	(3)		(4)
17.	Maize & Sorghum	Complex Weed (Pre-emergence)	-Atrazine + Metolachlor	250+ 250 Fl	16.48
			-Atrazine + Metolachlor	330+ 170 Fl	1.00
			-Alachlor + Atrazine	350+ 200 EC	15.48
			-Alachlor	48 EC	7.49
			-Atrazine	500 Fl	7.49
18.	Maize & Sorghum	Storage Pests	-Aluminium Phosphide		$21x10^4$Q
19.	Maize & Sorghum	To spray Surface area	-Malathion	50 EC	1.0
20.	"	Seed Dressing	-Thiram	40 WP	24.29
21.	Maize & Sorghum	Farm Side Area Weeds	-Glyphosate	48 EC	0.2
22.	Maize & Sorghum	Rodents in Store & Field	-Zinc Phosphide		2.5
23.	Sorghum, Maize, Wheat & Barley	Soil Born Insect Pests	-Chlorpyrifos	48 EC	2.0
24.	Wheat & Barley	Aphids & other Insect Pests	-Thiometon	25 EC	3.0
25.	Wheat & Barley	Complex Insect Pests	-Cypermethrin	5 EC/ULV	1.5

Appendix VII Continued.

(5)	(6)	(7)	(8)
4-5	78.9	- -	-
5.0	5.0		
5.0	77.8		
4.0	30.0		
1.7	12.8		
3 gm/Q	0.63	- -	-
0.002	2.0	-Primiphos-methyl 50 EC 0.002 Lit per sq m	
0.2	4.86	-Thiram 25+BHC 25 50 WP	0.2
5.0	0.96	-Paraquat 20 EC	3.0
3 g/Q	7.5	-Chlorophacinon 0.025%	9 g/Q
3.0	6.0	- -	-
1.0	3.0	-Phosphamidon 100 SCW	0.4
		-Dimethoate L 40	1.0
1.2	1.8	-Malathion 50 EC	2.0
		-Diazinon 600 EC/ULV	1.0
		-Methamidophos SL 600	1.0

Continued.....

	(1)	(2)	(3)			(4)
26.	Wheat & Barley	Complex Weed	-Bromoxynil Octanoate	52.5	EC	31.22
			-Brominal	24	EC	14.0
			-Swipe	560	EC	1.0
			-Starane		EP 720	.0
			-2,4-D			.0
27.	Wheat & Barley	White Oats & Other Grasses	-Dicolofop-methyl	28	EC	20.0
			-Grasp	10	EC	1.0
			-Barbar	2	E	2.0
			-Difenzoquat methyl sulfate	250	EC	1.0
28.	"	Stored Products	-Aluminium Phosphide		Tab	$5x10^4$
29.	"	Min Tillage	-Glyphosate	48	EC	3.4
30.	Wheat & Barley	Seed Dressing	-Thiram	60	WP	88.7
			-Carbofuran	350	ST	3.0
31.	"	Rodents	-Zinc Phosphide			2.1
32.	Pulses	Leaf Worm	-Cypermethrin	5	EC/ULV	2.7
33.	Pulses	Sucking Insects	-Phosphamidon	100	SCW	1.2
34.	Sesame	Grass Weed	-Fluazifop-butyl super	12.5	EC	2.6
35.	Rape Seed	Grass Weed	-Fluazifop-butyl super	12.5	EC	2.4
36.	Rape Seed	Aphids	-Thiometon	25	EC	2.0

Appendix VII Continued.

(5)	(6)	(7)	(8)
2.5	78.0,	-Mecoprop 600 Aq. Sol.+ 2,4-D 720 Aq. Sol.	2.5 +1
2.0	28.0		
3.0	3.0		
2.0	4.0		
3.5	3.6		
2.5	50.0		
3.5	3.6	- -	-
1.75	3.5		
3.0	3.0		
3 g/0	0.15	- -	-
5.0	17.3	-Paraquat 20 EC	3.0
0.3	26.6	-Thiram 25+BHC 25 WP	0.4
1.4	4.2	-Vitaflo 280	0.25
3 g/0	6.3	-Chlorophacinon 0.025%	9 g/0
1.68	4.4	-Profenofos 250 EC/ULV	2.5
		-Methamidophos SL 600	2.0
0.4	0.4	-Dimethoate L 40	1.33
		-Dimethoate 30 AS	1.0
		-Monocrotophos 40 SCW	1.0
3.0	7.6	-Fusilade 25 EC (Fluazifop-butyl)	3.0
2.0	4.8	-Fusilade 25 EC (Fluazifop-butyl)	2.0
1.0	2.0	- -	-

Continued.....

	(1)	(2)	(3)			(4)
37.	Rape Seed	African Boll Worm & Loop Worm	-Cypermethrin	5	EC/ULV	3.46
38.	Citrus	Scale Insects, Orange Dog etc.	-Methidathion	40	EC	5.94
			-Phenthoate	85	AS	3.78
			-Diazinon	60	EC	4.28
			-Hadopas Spray Oil			1.71
39.	Citrus	Complex Weeds	-Glyphosate	48	EC	1.25
40.	Citrus	Foot Rot & Brown Rot	-Metalaxyl	5	G	0.6
			-Mercuric Oxide	5	M	0.2
41.	Grape Vine	Downy Mildew	-Copper hydroxide	50	WP	2.77
			-Metalaxyl M2	63.5		0.58
42.	Banana	Nematodes	-Aldicarb	15	G	0.57
43.	Pepper & Veg.	Sucking Insects	-Phosphamidon	100	SCW	3.78
44.	"	African Boll Worm	-Endosulfan	35	EC	10.64
			-Cypermethrin	5	EC/ULV	0.20
45.	"	Leaf Worm	-Methamidophos	SL	600	1.57
			-Cypermethrin	5	EC/ULV	0.74
46.	Onion & Veg.	Cut Worm	-Trichlorphon	95	SP	1.60
47.	Onion	Thrips	-Monocrophos	40	SCW	1.07
48.	Tomato. Potato	Leaf Spot, Early & Late Blight	-Mancozeb	80	WP	12.89

Appendix "II Continued

(5)	(6)	(7)		(8)
1.68	5.8	-	-	-
3.0 3.5 3.0 2.0	17.8 13.2 12.8 3.4	-	-	-
5.0	6.7	-Paraquat	20 EC	3.0
8.2 2.0	4.9 0.4	-	-	-
2.5 2.5	6.9 1.5	-	-	-
15.0	8.6	-	-	-
0.4	1.6	-Same as in S.No. 11		-
2.0 1.7	21.2 0.4	-Same as in S.No. 10		-
2.0 2.0	3.2 1.4	-Chlorpyrifos -Fenvalerate -Decamethrin	4 EC 20 EC 2.5 EC	2.0 0.6 0.6
1.5	2.4	-	-	-
1.5	1.6	-Endosulfan -Phenthoate	35 EC 50 L	2.0 3.4
3.0	36.7	-Maneb	80 WP	3.0

Continued.....

Appendix VII Continued.

(1)	(2)	(3)		(4)	(5)	(6)	(7)		(8)
49.	Pepper & Vegetables	Powdery Mildew	-Thiophanate M 70	0.92	0.7	0.6	-Buthiobate -Triademefon	10 EC 25 WP	0.5 0.2
50.	"	Bacterial Disease	-Copper hydroxide 50WP	7.43	2.5	18.6	-Cobox	50 WP	2.0
51.	Onion	Purple Blotch & Downy Mildew	-Mancozeb 80 WP -Copper hydroxide 50 WP	1.40 0.95	3.0 2.0	4.2 1.9	-Manob	80 WP	3.0
52.	Onion & Vegetable	African Boll Worm	-Endosulfan 35 EC	0.30	2.0	0.6	-Cypermethrin -Fenvalerate -Decamethrin	5 EC/ULV 20 EC 2.5 EC	1.68 0.60 0.60
53.	Potato	Leaf Miner	-Monocrotophos 40 SCW	0.09	1.5	0.2	-	-	-
54.	Fields	Termites	-Aldrin 48 EC	1.51	2.5	3.8	-Chlordane -Chlordane -Dieldrin	48 EC 40 WP 48 EC	2.5 3.0 2.5

Total Crop Area to be treated during 1987-88 1060270 Hectares

Total Quantity of pesticides purchased for 1987-88 ..... 1745.23 Tons

Source: Data compiled from information given by the Ministry of State Farms Development, Addis Ababa.

Appendix VIII

MINISTRY OF STATE FARMS DEVELOPMENT-RESEARCH AND ADVISORY DEPARTMENT

(PLANT PROTECTION DIVISION)

PESTICIDES CONSUMPTION 1982-83 TO 1987-88 (CROP SEASONS)

(Q - Quantity, Tons/Kilolitres; V - Value, '000 Birr)

	PRODUCT	1982-83		1983-84		1984-85		1985-86		1986-87		1987-88		APPLICATION
		Q	V	Q	V	Q	V	Q	V	V	V	Q	V	
	INSECTICIDES													
1.	Actellic 50EC/ULV (Primiphos-methyl)			3.5	50.4	0.4	4.7	-	-	-	-	11.0	122.3	Stored products
2.	Aldrin 40WP	3.9		-	-	-	-	-	-	-	-	-	-	Soil
	Aldrex 40EC (Aldrin)	-	-	2.4	18.9	2.3	18.2	3.1	23.5	46.2	428.4	3.8	42.6	Insects/ Termites
3.	Basudin 60EC (Diazinon)	-	-	-	-	3.8	51.9	-	-	9.8	104.1	12.8	140.7	Citrus
4.	Cidial 85AS (Phenthoate)	-	-	1.0		3.6	46.2	5.0	64.1	4.4	62.9	13.2	221.1	Citrus
5.	Curacron 250EC/ULV (Profenofos)	53.0	674.7	56.2	674.7	62.8	682.6	107.8	1122.2	259.2	2923.8	114.8	1524.5	Cotton
6.	Cymbush/5EC	14.8	138.5	-	-	0.4	3.7	-	-	25.8	208.7	27.8	160.4	Cotton
	Ripcord 5ULV	-	-	73.6	804.5	-	-	54.0	331.6	-	-	127.4	838.3	Beans
	(Cypermethrin)2.5EC	84.8	465.1	1.6	50.1	2.6	99.4	-	-	-	-	2.6	78.4	
7.	DDT 10D	90.0	110.2	14.5	17.7	46.0	55.2	45.5	54.5	-	-	-	-	Maize Sorghum
8.	Decis 0.6ULV	-	-	-	-	70.4	402.7	-	-	-	-	-	-	Cotton
	Decis 2.5EC	-	-	2.3	65.0	-	-	-	-	-	-	-	-	Pulses
	(Decamethrin)													

Continued.....

	PRODUCTS	1982-83		1983-84		1984-85	
		Q	V	Q	V	Q	V
9.	Dimecron 25ULV	-	-	-	-	-	-
	Dimecron 100SCW	6.1	93.9	17.7	233.3	12.7	165.3
	Dimecron 50SCW (Phosphamidon)	2.0	18.6	-	-	-	-
10.	Dursban 24ULV	24.2	175.3	16.8	116.8	80.5	610.2
	Dursban 48EC (Cholorphyrifos)	-	-	-	-	-	-
11.	Ekatin 25EC (Thiometon)	-	-	-	-	-	-
12.	Hostathion 25ULV (Triasaphos)	5.4	67.7	-	-	16.2	157.0
13.	Malathion 50 EC/ULV	14.6	55.9	12.0	58.6	20.8	82.6
14.	Mitac 20 EC/ULV (Amitras)	-	-	18.0	212.4	98.2	1158.8
15.	Mitigan 18.5EC	-	-	-	-	-	-
	Mitigan 42 EC (Dicofol)	-	-	3.0	21.7	-	-
16.	Nuvacron 40SCW	6.9	75.7	10.1	111.3	34.9	389.8
	Nuvacron ULV Combi C500 (Monocrotophos + DDT)	16.0	109.0	53.0	360.9	35.3	237.5
17.	Ofunak 40ULV	-	-	-	-	-	-
18.	Rogor 40EC/ULV (Dimethoate)	33.6	178.8	44.6	230.8	41.6	224.2
19.	Tamaron 600SL (Methamidophos)	12.8		7.6		12.0	144.2
20.	Tedion V-18EC (Tetradifon)	-	-	-	-	7.0	48.2

Appendix VIII Continued.

1985-86		1986-87		1987-88		APPLICATION
Q	V	Q	V	Q	V	
96.3	448.9	76.8	387.1	71.8	398.5	Vegetable
-	-	9.6	139.0	23.0	396.5	Maize, Sorghum
-	-	-	-	-	-	Tobacco
						Cotton
167.2	1212.2	87.6	669.3	161.2	1191.3	Cotton
-	-	-	-	6.0	83.4	
-	-	-	-	5.8	40.0	Maize
						Sorghum
-	-	-	-	-	-	Cotton
-	-	41.0	205.5	2.0	8.5	Maize Sorghum
						Cereals
						Oilseeds
301.8	3244.4	-	-	151.4	1807.7	Cotton
22.6	108.5	10.4	47.1	9.2	37.2	Cotton
-	-	-	-	-	-	
-	-	5.8	55.9	14.4	160.0	Onion,
-	-	-	-	-	-	Tobacco,
						Cotton
-	-	-	-	16.6	182.3	Cotton
61.8	332.5	58.0	372.9	-	-	Cotton
-	-	2.0	28.3	3.2	46.9	Vegetables
6.2	29.0	-	-	2.8	16.3	Cotton

Continued.....

	PRODUCT	1982-83		1983-84	
		Q	V	Q	V
21.	Thiodan 35EC	6.0		-	-
	Thiodan 25ULV (Endosulfan)	206.7	1581.0	223.0	1601.8
22.	Torbidan ULV (DDT+Toxaphene+ Methyl Parathion)	79.1	579.2	-	-
23.	Ultracide 40EC (methidathion)	-	-	10.0	176.0
24.	Volaton+Gusathion 800ULV (Phoxim+ Azinphos Ethyl)	-	-	-	-
	Gusathion AM 400	-	-	7.4	78.5
	" 600 AVL	28.1	403.5	-	-
25.	Detia Gas EX-T (Aluminium Phosphide)	808 ('000 Tab) (2.44T)	75.1	86.8 ('000 Tab) (0.26T)	7.4
26.	Dipterex 95.5P (Trichlorphon)	-	-	-	-
27.	Temik 15 G (Aldicarb)	-	-	-	-
28.	Zinc Phosphide	-	-	0.15	0.5
29.	Other Insecticides	14.8	66.7	0.8	5.4
	Total Insecticides	705.2	4868.9	579.5	4896.6

Appendix VIII Continued.

1984-85		1985-86		1986-87		1987-88		APPLICATION
U	V	U	V	U	V	U	V	
4.5	31.2	14.9	93.8	39.2	297.1	27.4	210.2	Cotton, Maize,
226.8	1493.3	447.7	2437.0	488.7	3508.9	303.8	2463.8	Sorghum, Tobacco, Vegetable
-	-	-	-	-	-	-	-	
3.8	66.9	4.2	69.6	11.2	208.4	17.8	417.6	Citrus
20.5	255.8	70.1	731.3	41.2	591.7	37.4	531.9	Cotton
8.8	101.5	2.0	20.1	-	-	6.2	78.3	Cotton
-	-	-	-	-	-	-	-	
1.7	42.8	0.23	6.1	1.05	290.0	0.8	18.6	Stored Products
-	-	-	-	-	-	2.4	30.4	Vegetables
-	-	-	-	-	-	9.4	115.3	Banana Cotton,
-	-	7.9	95.1	21.2	179.9	13.8	165.6	Rodent Control
7.0	12.7	0.4	7.0	-	-	4.0	9.2	Miscellaneous
824.6	6565.6	1418.7	10431.4	1239.3	10709.0	1203.8	11569.8	

Continued.....

	PRODUCTS	1982-83		1983-84		1984-85	
		Q	V	Q	V	Q	V
	FUNGICIDES						
30.	Agrosan/BHC	-	-	-	-	-	-
	Agrosan/Heptachlor	6.6	89.5	-	-	-	-
31.	Bayleton 25WP (Triadimefon)	0.1	4.4	1.0	39.2	-	-
32.	Captafol 80WP (Difolatan)	-	-	2.4	40.7	-	-
33.	Fernasan D (Thiram)	-	-	6.0	49.6	-	-
34.	Kocide 101 50WP (Copper Hydroxide)	6.4	37.2	36.1	209.9	0.2	1.2
35.	Mancozeb 80 WP	12.3	56.0	40.0	180.5	0.5	2.1
36.	Mistral 750EC (Fenproprimorph)	-	-	-	-	15.0	438.6
37.	Ridomil 5G	0.1	1.2	2.6	31.5	7.9	94.3
	" MZ 63.5	-	-	-	-	-	-
	(Metalaxyl)						
38.	Other Fungicides	24.7	114.7	17.6	57.5	4.6	38.2
Total	Fungicides	50.2	303.0	135.7	608.9	23.6	574.4
	HERBICIDES						
39.	Alanex 48EC (Alachlor)	-	-	-	-	-	-
40.	Atranex 500FW (Atrazine)	2.7	34.3	7.2	37.3	6.4	31.9
41.	Brittox 52.5EC (Bromoxynil octanoate + ioxynil octanoate + dichlorprop - iso	50.0	860.1	60.0	1032.1	76.2	1159.0

Appendix VIII Continued.

1985-86		1986-87		1987-88		APPLICATION
U	V	U	V	U	V	
-	-	10.5	242.1	-	-	Seed Dressing
-	-	-	-	-	-	Cotton Seeds
7.5	249.3	-	-	-	-	Wheat, Vegetable Pepper
-	-	-	-	-	-	Coffee
-	-	-	-	31.5	278.8	Seed dressing Wheat, Barley
-	-	-	-	27.4	149.7	Fruits Vegetables
-	-	25.1	111.7	42.9	203.1	Vegetables
-	-	-	-	-	-	Wheat
4.1	48.9	3.4	45.0	4.9	80.3	Citrus
-	-	-	-	1.5	40.5	
-	-	3.4	30.3	9.2	284.9	Miscellaneous
11.6	298.2	43.40	429	113.40	1037.3	
27.2	197.2	45.6	310.5	30.0	189.3	Maize Sorghum
11.9	57.8	19.3	93.2	12.8	63.5	Maize Sorghum
85.0 octyl)	1056.6	81.0	1111.3	78.0	1086.5	Wheat, Barley

Continued.....

	PRODUCT	1982-83		1983-84		1984-85	
		Q	V	Q	V	Q	V
42.	Bromacil 80WP	0.3	8.1	-	-	3.1	102.7
43.	Brominal 24EC (Bromoxynil Octanoate)	10.0	149.7	6.0	71.9	16.0	177.3
44.	Codal 400EC (Metolachlor)	8.8	126.8	-	-	17.2	214.2
45.	Dropp 50WP (Thidiazuran)	-	-	-	-	-	-
46.	Fusilade W25EC	1.2	58.1	-	-	1.5	65.9
	Super 12 5EC (Fluazifop-butyl)	-	-	-	-	-	-
47.	Gramaxone 20EC (Peraquat)	0.6	4.1	1.5	10.4	9.7	67.1
48.	Illoxan 28EC (Dichlofop-methyl)	-	-	12.1	244.7	23.9	440.5
49.	Lasso/Atrazine 350/200	-	-	13.7	142.1	46.5	483.6
	Lasso 48EC (Alachlor)	-	-	-	-	-	-
50.	Maloran SP 500FW	-	-	-	-	9.0	130.4
	" 500EC (Chlorogororuron)	0.3	49.7	-	-	-	-
51.	Primagram 250/250 FW (Atrazine 250 + Metolachlor 250)	98.5	1182.6	44.0	482.7	113.8	1224.1

Appendix VIII Continued

1985-86		1986-87		1987-88		APPLICATION
Q	V	Q	V	Q	V	
4.4	149.9	-	-	-	-	Citrus
36.0	359.3	26.0	615.6	28.0	354.8	Wheat, Barley
11.7	133.3	4.4	56.1	9.2	150.7	Cotton
-	-	0.5	75.2	2.1	425.6	Defoliant on Cotton
-	-	-	-	-	-	Sesame,
1.4	56.2	4.0	149.8	12.5	384.9	Rapeseed
-	-	-	-	-	-	Maize, Citrus Sorghum
15.5	258.1	71.3	1412.1	50.0	1200.0	Wheat, Barley
-	-	-	-	77.8	535.0	Maize, Sorghum
-	-	-	-	1.9	19.7	Rapeseed
-	-	-	-	-	-	Sesame
-	-	-	-	-	-	
177.5	1874.4	112.9	1274.0	78.9	1047.8	Maize, Sorghum

Continued.....

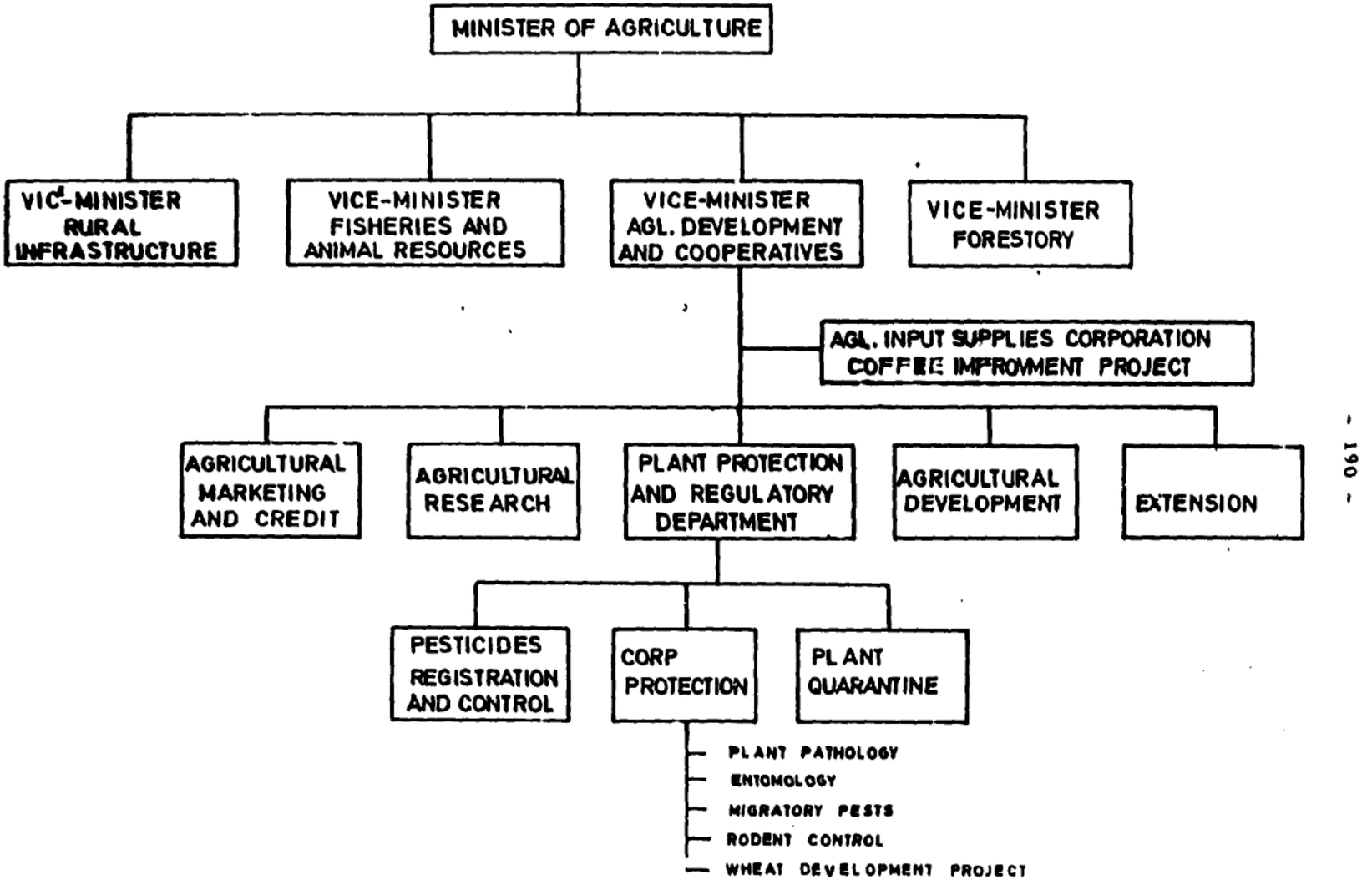
Appendix VIII Continued.

	PRODUCT	1982-83		1983-84		1984-85		1985-86		1986-87		1987-88		APPLICATION
		U	V	U	V	U	V	U	V	U	V	U	V	
52.	Prim-extra 330/170FW (Atrazine 330+ Metolachlor 170)	-	-	-	-	-	-	-	-	38.1	437.5	5.0	67.0	Maize Sorghum
53.	Roundup 48EC (Glyphosate)	0.3	11.9	12.0	413.1	13.5	479.5	-	-	18.2	604.1	25.0	826.7	Maize Sorghum
54.	U46 KV Fluid 600 gai (Mecoprop)	-	-	90.9	442.4	33.3	169.3	-	-	40.3	173.4	-	-	Wheat Barley
55.	U46D Fluid 720 gai (2,4-D)	8.0	31.6	-	-	9.4	32.5	-	-	17.6	72.9	-	-	Wheat Barley
56.	Other Herbicides	12.5	197.7	12.2	163.4	15.9	358.6	3.9	102.7	4.2	116.4	18.1	385.7	Miscellaneous
Total	Herbicides	198.2	2714.7	259.6	3040.1	395.4	5136.6	374.5	4245.5	483.4	6202.1	429.3	6738.0	
Grand	Total	253.6	7886.6	241.8	8518.7	1241.6	12276.6	1804.8	14975.1	1765.5	17340.2	1746.5	19345.1	

Source: Data compiled from information given by Ministry of State Farms Development, Addis Ababa.

APPENDIX IX

MINISTRY OF AGRICULTURE ORGANIZATION STRUCTURE



SOURCE: MINISTRY OF AGRICULTURE, ADDIS ABABA

Appendix X

CLASSWISE IMPORT OF PESTICIDES IN ETHIOPIA, 1976-1986

(Q - Quantity in Tons; V - Value in '000 Birr)

	INSECTICIDES		FUNGICIDES		HERBICIDES		DISINFECTANTS		TOTAL	
YEAR	Q	V	Q	V	Q	V	Q	V	Q	V
1976	2,528	7,986	92	1,311	971	4,704	100	562	3,691	14,563
1977	1,768	6,632	-	-	550	3,023	64	275	2,382	9,930
1978	1,617	29,580	-	-	1,804	4,796	716	2,468	4,137	36,844
1979	1,299	8,019	138	2,615	1,780	7,027	128	852	3,345	18,513
1980	2,080	13,909	436	1,128	255	2,217	96	727	2,867	17,981
1981	2,854	21,349	152	3,225	65	308	45	635	3,116	25,517
1982	1,323	10,996	32	300	13	33	292	2,789	1,660	14,118
1983	3,279	21,163	3	48	17	163	20	145	3,319	21,519
1984	2,298	25,660	476	1,779	51	293	121	1,403	2,946	29,135
1985	1,702	12,424	364	3,594	9	67	415	2,394	2,490	18,479
1986*	1,743	16,199	4	24	12	6	-	-	1,759	16,229

- Importation of DDT (included under insecticides in the above data)

Year	1976	1978	1979	1982
Q	1,309	45	149	7
V	1,462	50	545	61

*First Half only

Source: Annual External Trade Statistics, Customs and Tax Administration, Addis Ababa.

Appendix XI

AREA UNDER DIFFERENT CROPS ON STATE FARMS

CROP TYPE	CROP AREA - HECTARES 1984	1988	1994
MSFD FARMS			
- Maize	47,347	61,414	69,480
- Sorghum	13,350	13,000	19,350
- Wheat	63,879	73,665	90,255
- Barley	5,667	10,000	10,000
- Rice	-	300	0,000
- Haricot	1,353	9,750	14,242
- Soya beans	87	9,950	15,141
- Sesame	2,001	15,000	40,500
- Sunflower	2,004	3,710	8,210
- Rape Seed	214	4,742	6,722
- Groundnut	105	5,700	20,250
- Cotton	31,760	56,390	138,092
- Sisal	8,000	1,000	1,000
- Kenafe	110	5,000	12,000
- Tobaco	663	1,900	3,200
- Vegetable	1,592	3,906	5,742
- Pepper	2,496	8,750	10,650
- Teff	937	-	-
Total	174,365	284,179	470,834
MCTD - COFFEE PLANTATIONS			
- Coffee	11,710	23,060	48,560
ESC - SUGAR PLANTATIONS			
- Sugarcane	14,860	27,300	31,800

Source: Data compiled from information given by ESC, MCTD and from Prefeasibility Study, Fertilizer Complex, Ministry of Industry.

Appendix XII

PLANT PROTECTION AND REGULATORY DEPARTMENT - MOA
CROP PROTECTION INPUT REQUIREMENTS FOR 1987-91

(Q - Quantity in Tons, Kiloliters or '000 Pieces: V - Estimated Value '000 Birr)

PRODUCT			1987		1988		1989		1990		1991	
			Q	V	Q	V	Q	V	Q	V	Q	V
Insecticides												
-Fenitrothion	95	ULV	50	518	55	569	60	621	65	673	75	776
-Diazinon	60	EC	40	331	45	373	50	414	55	455	65	538
-Cypermethrin	2.4	ULV	40	414	45	466	50	518	55	569	65	673
-Dimethoate	40	EC	40	331	45	373	50	414	55	455	65	538
-Endosulfan	35	EC	40	331	45	373	50	414	55	455	65	538
-Carbaryl	85	WP	50	414	55	455	60	497	65	538	75	621
-Cypermethrin	1	G	50	207	55	228	60	248	65	269	75	311
-Primiphos-methyl	2	D	75	155	80	166	85	176	90	186	100	207
-Aldrin	40	WP	50	518	50	518	50	518	50	518	50	518
Total			435	3219	475	3521	515	3820	555	4118	635	4720
Fungicides												
-Metalaxyl + Mancozeb			20	373	20	373	25	466	25	466	30	559
-Copper oxychloride			20	166	20	166	25	207	25	207	30	248
-Flutriafol + thiabendazole			20	331	30	497	30	497	35	580	40	662
Total				870		1036		1170		1253		1469
Rodenticides												
-Zinc Phosphide	80%		3	37	3	37	3	37	3	37	3	37
-Brodifacoum			50	414	50	414	50	414	50	414	50	414
Total				451		451		451		451		451
Avicide												
-Fenthion	60	EC	5	104	5	104	5	104	5	104	5	104
Total				104		104		104		104		104

...Continued

PRODUCT	1987		1988	
	Q	V	Q	V
Equipment				
-Knapsack sprayers	2	207	2.2	228
-ULV sprayers	1	62	1.2	75
-Overalls	1	41	1.1	46
-Boots	1	31	1.1	34
-Goggles	1	12	1.1	14
-Gloves	1	12	1.1	14
-Syphon Pump	1	21	1.1	23
-Cylinder	1	10	1.1	11
Total		396		445
Grand Total (Value)		5040		5557

Source: Plant Protection and Regulatory Department, MOA.

Appendix XII Continued

1989		1990		1991	
Q	V	Q	V	Q	V
2.4	248	2.5	269	3.0	311
1.4	87	1.5	93	2.0	124
1.2	50	1.4	58	1.5	62
1.2	37	1.4	43	1.5	47
1.2	15	1.4	17	1.5	19
1.2	15	1.4	17	1.5	19
1.2	15	1.4	29	1.5	31
1.2	12	1.4	14	1.5	16
	489		530		629
	6034		6456		7373

Appendix XIII

ETHIOPIAN PETROLEUM REFINERY - ASSAB

DISTILLATION AND BLENDED PRODUCTS

1. Atmospheric Distillation Unit:

Feed - Crude Oil

Products	Boiling Range°C	Feed To
-LPG	-	-
-Light Naphtha	28-50	
-Heavy Naphtha	50-160	HDS Unit
-Light Kerosene	160-200	HDS Unit
-Heavy Kerosene	200-240	-
-Atmospheric Gas Oil	240-360	-
-Atmospheric Residue (Mazut)	-	Vacuum Unit

2. Vacuum Unit:

Feed - Atmospheric Residue (Mazut)

Products	Boiling Range°C	Feed To
-Light Vacuum Gas-Oil	360-400	-
-Heavy Vacuum Gas Oil	400-500	-
-Vacuum Residue (Coudron)	-	Asphalt Unit

3. Hydrosulfurization Unit:

Feed - Atmospheric Unit Cuts 50 - 240

Products	Boiling Range°C
-HDS 1	50-160
-HDS 2	160-240
-Gas and LPG	-

4. Reformer Unit:

a) Feed - HDS 1, 50-160
   Products - Reformate and LPG
b) Feed - HDS 2, 160-240
   Products - Reformate and LPG

.. Continued

5. Asphalt Unit:

Feed - Vacuum Residue (Goudron)

Products - Asphalt Penetration 8/100, 180/200
- Black Oil
- Liquid Asphalt MC-30
- Liquid Asphalt MC-3000

BLENDING OF PRODUCTS

1. Motor Gasoline Regular:

	Blend of	Percentage by Weight
-	SR 28-50	10
-	HDS 50-160	10
-	Reformate	80

Specific Gravity: 0.7196; Price: Birr 1229.85/Ton

2. Motor Gasoline Premium:

-	SR 28-50	4
-	Reformate	96

Specific Gravity: 0.739; Price : Not available.

3. JP-4

-	HDS 50 - 160	63
-	HDS 160 - 240	37

Specific Gravity: 0.7884; Price : Not available

4. AF - 301 Inland Fuel Oil: (Flash Point: 150°F)

-	SR 160 - 200	9
-	SR 360 - 400	5
-	SR 400 - 500	18
-	SR Mazut	68

Specific Gravity: 0.9304; Price : Birr 413.80/Ton

..Continued

Appendix XIII Contd.

	Blend of	Percentage by Weight
5.	AF - 800 Export Fuel Oil: (Flash Point: 150°F)	
	- SR 160 - 200	9
	- SR 360 - 400	5
	- SR 400 - 500	18
	- Mazut	68
	Specific Gravity: 0.9300; Price: Birr 159.39/Ton	
6.	ADO - Automotive/Marine Diesel Oil: (Flash Point 150°F)	
	- SR 240 - 360	73
	- SR 160 - 200	7
	- SR 200 - 240	20
	Specific Gravity: 0.85; Price (Export): Birr 375.61	
7.	IDO - Industrial Diesel Oil:	
	- AF 800	10
	- ADO	90
8.	MC 30 - Liquid Asphalt	
	- Asphalt	60
	- SR 200 - 400	40
9.	MC 3000 - Liquid Asphalt	
	- Asphalt	90
	- SR 200 - 240	10
	Specific Gravity: 1.00; Price: Birr 400/Ton	

Source: Ethiopian Petroleum Corporation, Addis Ababa.