ACTION PROGRAMME FOR IMPROVED PLANT PROTECTION

ETHIOPIA

REPORT OF SURVEY ON PLANT PROTECTION

7 April - 2 May 1981

UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

AGP:IPP/81/12

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Rome, 1982

FOREWORD

The Survey covered by this Report was undertaken as part of the Action Programme for Improved Plant Protection and in accordance with the recommendations of the FAO Committee of Experts on Pest Control made at its First Session held in Rome, 6-7 March 1980 (Ref. AGP:1980/M/I). At that Session it was agreed that under the Action Programme FAO should collect comprehensive information on the state of plant protection in the countries concerned, identify the shortcomings, and determine the requirements for improvement. This would be with a view to stimulating support and to promoting effective coordination of international assistance in the field of plant protection under the Programme.

The Survey team consisted of two consultants, G.B. Popov and the late G. Mitchell; it was accompanied by M.A. Farah, FAO Regional Plant Protection and Locust Officer for Eastern and Southern Africa. The Survey was conducted from 7 April to 2 May 1981.

FAO and the Survey team wish to acknowledge the valuable assistance extended to them by the officers of the Ministries of Agriculture, Coffee and Tea Development and State Farms Development, the Relief and Rehabilitation Commission, the Institute of Agricultural Research and the Desert Locust Control Organization for Eastern Africa. In particular they wish to thank Hadera Gebremedhin, Head, Crop Protection and Regulatory Division, and Akalu Sahlu, Senior Plant Pathologist, MoA; Tedesse Gebremedhin, Senior Entomologist, IAR; and M.M. Jaeger, Project Manager UNDP/FAO Project, ETH/77/022, who between them accompanied the members of the team throughout the Survey and considerably facilitated its work.

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ACRONYMS AND ABBREVIATIONS USED IN THIS REPORT

AAU	Addis Ababa University, Ethiopia
ADC	Agricultural Development Corporation
ADE	Agricultural Development Enterprises
AMC	Agricultural Marketing Corporation
CAB	Commonwealth Agricultural Bureaux
CBD	Coffee Berry Disease
CIBC	Commonwealth Institute of Biological Control
CIDA	Canadian International Development Agency
CIE	Commonwealth Institute of Entomology
CMI	Commonwealth Mycological Institute
COPR	Centre for Overseas Pest Research
CPA	Crop Protection Agent
DA	Development Agent
DLCO-EA	Desert Locust Control Organization for Eastern Africa
EEC	European Economic Community
EPID	Extension, Production Information Department (now defunct)
FAO	Food and Agriculture Organization of the United Nations
FFHC	Freedom From Hunger Campaign
GTZ	German Agency for Technical Cooperation (Fed. Rep. Germany)
HDA	Horticultural Development Agency
IAR	Institute of Agricultural Research
ICP	Institute of Crop Protection
IRAT	Institut des Recherches Agronomiques Tropicales et des Cultures Vivrières (France)
JCA	Junior College of Agriculture
MCTD	Ministry of Coffee and Tea Development

MoA	Ministry of Agriculture
MoI	Ministry of Industry
NCIC	National Crop Improvement Committee
ODA	Overseas Development Administration (UK)
PA	Peasants Association
PC	Producers Cooperative
RAO	Regional Agricultural Office
RRC	Relief and Rehabilitation Commission
SC	Service Cooperative
SF	State Farm
SFDM	State Farms Development Ministry
SIDA	Swedish International Development Authority
SPL	Scientific Phytopathology Laboratory of the Ministry of Agriculture of the USSR in Socialist Ethiopia

1. BACKGROUND INFORMATION

1.1 PHYSICAL AND CLIMATIC FACTORS

Ethiopia lies within the tropics but its wide range of altitude produces a variety of climatic conditions. The total area is 122 190 000 ha and the land area 110 100 000 ha. Approximately 13 730 000 ha (11 per cent) of the land area are under cultivation as arable land (13 000 000 ha) or permanent crops (730 000 ha). Permanent pastures occupy an additional 64 500 000 ha and forest and woodland 8 860 000 (Table 1). Considerable areas of natural forest have yielded to encroachment by itinerant nomadic cultivators and some areas have been extensively commercially exploited.

The altitude ranges from 100 m below sea level near Massawa (Dallol Depression) to a number of mountain peaks in excess of 4 000 m. This range of altitude produces temperature conditions reflected in the traditional zonation of the country, i.e. Dega — the temperate plateaux with its lower boundary at approximately 2 400 m, with an average annual temperature of about 16° C; Woina Dega — an intermediate frost-free zone lying between 2 400 m and 1 700 m, with an average annual temperature of about 22° C; and Kolla — the hot low-lands, with an average annual temperature of at least 26° C.

The main rainy season over most of the country occurs during June, July and August. Recent climatic events show the extreme vulnerability of Ethiopia to drought conditions, particularly in the low-lying pastoral areas and along the eastern rift escarpment. Climate can generally be described, allowing for significant variations, in terms of well-watered highlands and uplands mostly receiving 1 000 mm rainfall per annum (with the exception of Eritrean and Tigrean Plateaux) and dry lowlands with generally less than 500 mm rainfall per annum (with the significant exception of the Baro and Akobo River plains, in the south-west, which lie in the path of summer rain-bearing winds).

1.2 AGRICULTURAL POPULATION

No population census has ever been carried out. Population estimates shown in Table 1 are based on the national sample surveys of 1964-67 and 1968-70.

In 1980 the total population was estimated at 32 601 000 of whom 25 800 000 were directly or indirectly involved in agriculture, i.e. 80 per cent of the economically active segment. Generally the distribution of population in Ethiopia reflects the relief. The highlands, having good rainfall, are the home of settled agriculturists. The presence of malarial mosquitos and tsetse flies below 2 000 m contributes to the non-occupation of lowlands otherwise suitable for farming. It can be assumed that approximately 10 per cent lives between 1 000 m and 1 800 m and 70 per cent lives above the 1 800 m contour. In the lowland areas of the east and south-east there are approximately two million nomadic pastoralists.

The population is increasing by two or three per cent per annum, infant mortality is high and life expectancy very low, less than 40 years at birth.

There is widespread rural poverty. Urban literacy is around 34 per cent but nationally it is very low, approximately 7 per cent.

1.3 PATTERNS OF AGRICULTURE

1.3.1 General patterns

A number of factors including drought, secessionist wars, land reform and nationalization make it difficult to accurately assess either the GNP or the contribution made to it by agriculture. However, the World Bank estimate for 1978 placed the GNP at US$ 3 640 000 000, or US$ 110 per capita, and it is reasonable to assume an agricultural contribution of approximately 50 per cent of these figures.

Reports suggest that the total area under cultivation has decreased since the overthrow of the imperial government in 1974. Causes of this drop involve both the civil disruption caused by war and the release of the peasants from the responsibility of paying rent for the use of land. Between 1974 and 1977 wheat production declined by 39 per cent and barley production by approximately 50 per cent. Coffee, the main cash crop, increased in terms of net value due to higher world coffee prices, though not in terms of production.

Contribution of Agriculture to Export Earnings

In 1979, total external trade exports were valued at US$ 334 400 000 of which agriculture contributed US$ 295 993 000. As a percentage, the chief agricultural crop earnings came from the following:

Green coffee	82.0%
Dried Beans and Peas	2.6%
Sesame Seed	1.3%

As a percentage, the chief agricultural imports, valued at US$ 40 417 000, comprised the following:

Wheat	38%	Malt Barley	5%
Jute	6%	Milled Rice	4%
Tea	6%	Tobacco (manuf.)	4%

These figures do not, however, take into account the substantial amount of food supplied as aid.

The recent dominant trends in agriculture have been a shift from export to food crops especially the cultivation of teff. Marketed grain production has declined. This trend is probably due to the increase in food consumption following land reform and the conversion of former commercial farms into state or cooperative farms. There are also serious transport problems which hamper the marketing of produce and the transfer of crops from surplus-producing rural areas to the towns.

1.3.2 Farming Systems

The organization of agricultural production and protection is based on the existing administrative boundaries. The country is divided into 14 regions (Fig. 1). Each region is divided into several "awrajas" or provinces. Finally,

each awraja is divided into several "woredas" or counties. The precise numbers of units in each division have changed over the years but the present totals are as follows:

Regions	14
Awrajas	101
Woredas	580

About 440 woredas are actually agriculturally productive, 30 of these being predominantly coffee growing.

Within the Ministry of Agriculture (MoA), there are plans to modify this arrangement by combining two or three regions into zones as follows:

zone 1	Gondar, Gojam (centred on Bahar Dar)
zone 2	Eritrea, Tigre, Welo (centred on Dessie)
zone 3	Harar, Shoa, Arusi (centred on Nazareth)
zone 4	Illubabor, Kefa, Welega (centred on Jimma)
zone 5	Gemu Gofa, Sidamo, Bale (centred on Awasa)

Land Tenure

The system of land tenure prior to the Revolution was very complex, but since the Land Reform Proclamation of 1975 the landlord tenant system which predominated in the south of the country has been abolished. It is estimated that tenants constituted about 55 per cent of the rural population in the southern provinces before the land reform and farmed more than half the land. The main features of the Land Reform Proclamation were:

- all rural land (except forest and mineral land) is the collective property of the Ethiopian people;
- land may not be sold, exchanged, mortgaged, rented, leased or inherited;
- land is to be equally distributed within any one area, as far as possible, on a usufructuary basis with a ceiling of 10 ha on holding size. Hiring of labour by individuals is prohibited;
- tenancy relationships are abolished and all debts to landlords are cancelled;
- former commercial farms were nationalized with compensation for movable assets and permanent improvements only.

This land reform has increased the incentive to farm more productively, it has given the rural population more access to land and has facilitated the mobilization of peasants for development. All farmers and tenant farmers must now register with the Government. At present the number of registered farmers (as represented by heads of households) is about 7.5 million.

State Farms

It is the long-term objective of the Government to organize agricultural production on the basis of State Farms and cooperatives. Many State Farms already exist and come directly under the control of the State Farm Development Ministry (SFDM).

Cooperatives

Cooperatives come under the control of the Ministry of Agriculture and form by far the most important agricultural sector in terms of numbers of workers, area of land cultivated and volume of agricultural produce.

The first stage in the development of cooperatives is the formation of a Peasant Association (PA). At present there are some 23 000 PAs, each based very loosely on an average area of 800 ha each throughout the country. It is assumed that within this 800 ha there will be some waste land and some residential land so that a typical PA would probably farm about 300 ha of agriculturally productive land. Each woreda probably supports 10-15 PAs.

The second stage of development is the Service Cooperative (SC). The MoA provides financial and managerial support for the provision of inputs to the SCs of which there are 3 000 at present.

The third and last stage of cooperative development is the Producers Cooperative (PC). At present there are some 544 PCs, mostly involving livestock. Under this system, the MoA provides financial and managerial support, and both land and facilities are shared as are the products and/or profits.

Since its foundation in 1979 (see 3.3) the Relief and Rehabilitation Commission (RRC) has established over 800 settlement areas each covering about 400 ha. The RRC policy is to subsidize the settlements for a period of four years, after which it is hoped they will become self-sufficient. Some of the settlements have similar structure to State Farms.

1.4 CURRENT AGRICULTURAL DEVELOPMENT PLANS

In 1978 the Government of Ethiopia launched its first National Revolutionary Development Campaign (the 'Zemecha') in an attempt to revive the economy. The objectives of the plan were to: (i) reduce current food shortages by intensifying efforts in the organizations dealing with the peasant sector, and by doubling State Farm area; (ii) help drought-affected highland areas by strengthening afforestation, rehabilitation and resettlement programmes; (iii) eliminate current shortages of consumer items; (iv) improve the efficiency of Government agencies and businesses, and (v) increase foreign exchange availability by promoting export.

The overall strategy of the 'Zemecha' is principally designed to increase the productivity of peasant, cooperative and State Farms, so as to provide an urban food supply and to meet the objectives of import substitution.

The current agricultural plan calls for a growth rate rising to 8 per cent. Over 80 000 ha of new land is being brought into cultivation in such farming schemes as the Awash Valley (see 3.3).

Another programme is the so-called 'minimum package' proposal to extend the country's agricultural infrastructure and services. This will involve rural water systems, grain storage and marketing, livestock development and coffee processing.

2. MAJOR CROPS AND PEST PROBLEMS[1/]

2.1 MAJOR CROPS AND THEIR PESTS[2/]

2.1.1 Cereal Crops

Teff

Eragrotis teff, grown on an estimated area of over 1.3 million ha, accounts for more than 35 percent of the total cereal production in Ethiopia; it is generally regarded as resistant to most insects and diseases and is very easily stored (see 2.3). It is a favoured cereal crop of the local population, although rather low-yielding. In Shoa, western and south western regions, it is attacked by smudge, Helminthosporium miyakei the most serious disease. Rust, Uromyces eragrostidis and bunt, Tilletia baldratii, are also known but do not cause heavy losses. They are a topic of research at the Scientific Phytopathology Laboratory (SPL) at Ambo (see 5.2.3). The Welo bush cricket, Decticoides brevipennis known locally as 'degeza' can cause serious damage at the milk grain stage to teff and other late sown cereals. The crop is also attacked by the African Armyworm, Spodoptera exempta, the barley fly, Delia arambourgi (whose control is the subject of research at IAR Holetta) and the red teff worm, Metaxya ignicollis, a serious pest of crops grown on black deeply-cracking clay soils.

Barley

Hordeum sativum is a typical highland crop, grown mainly between 1 900 and 2 100 m. It is the third most widely grown crop after teff and maize. The main insect problems are caused by African Armyworm, Spodoptera exempta, the barley fly, Delia arambourgi which is a topic of research at the Institute of Agricultural Research (IAR) Holetta (see 5.1.1) and the maize aphid, Rhopalosiphum maidis. This aphid, originally from eastern Europe has become an important pest of barley since 1977. Its control is the subject of a research project at Debre Zeit Junior College of Agriculture (see 6.2.1). The most serious diseases are net blotch, Pyrenophora teres f.sp. hordei and eyespot or scald, Rynchosporium secalis.

Maize

Zea mays does not grow well above 2 400 m, but below that altitude over 1 100 000 ha are grown. The crop is infected by leaf blight, Helminthosporium turcicum, and rust, Puccinia sorghi, but neither disease causes serious economic loss. The serious insect problems are caused by African Armyworm, Spodoptera exempta; the maize stalk borer, Busseola fusca (above 1 200 m); the spotted stalk borer, Chilo partellus, which can be very damaging at lower altitudes and the maize aphid, Rhopalosiphum maidis, which is also a serious pest of wheat.

1/ Pest in this document refers to any living organism which decreases the quantity and/or quality of agricultural produce during the growing cycle and/or after harvest.

2/ A full list of crops and their pests is given in Appendix III, only those of major importance are discussed here.

The Entomology Section of the SFDM are working on maize pests (see 4.2.1) and the lecturer in charge of plant protection at Awassa Junior College of Agriculture is working on B. fusca (see 6.2).

Sorghum

Sorghum spp. are grown extensively in the eastern and northern regions up to altitudes of 2 500 m. The best production areas are around 1 500 m. Sorghum is the most drought-resistant cereal grown, its most serious pest problem is attack by grain-eating birds (see 2.2.4). It is also affected by the African Armyworm, Spodoptera exempta; the American bollworm, Heliothis armigera, and the spotted stalk borer, Chilo partellus, on crops grown below 1 200 m. It is affected by several diseases (see Appendix III) of which the most serious are covered kernel smut, Sphacelotheca sorghi, and loose kernel smut, S. cruenta.

The parasitic weed Striga sp is a very serious problem on sorghum crops particularly in the Setit Humera area where it is virtually out of hand and not being satisfactorily controlled. Losses due to weeds or all types in sorghum can reach 35 percent, and expenditure on herbicides for sorghum are one of the major items in the SFDM budget (see 4.2.1.3).

Wheat

Triticum spp. are mainly cultivated between 1 800 and 2 200 m. The crop is affected by a wide range of pests (see Appendix III). The main insect pests are the African Armyworm, Spodoptera exempta, and the maize aphid, Rhopalosiphum maidis, whose outbreaks may be so severe that ULV sprays are necessary to prevent heavy crop losses. The main diseases are rusts; leaf rust, Puccinia recondita which is endemic in most areas; stem rust, P. graminis f. sp tritici which causes severe damage below 2 300 m and stripe rust P. striiformis above 2 100 m.; stinking smut or bunt, Tilletia foetida; leaf blotch, Septoria tritici, and bacterial blight, Xanthomonas translucens.

IAR are working on the production of resistant varieties and these are being tested by the Plant Pathology Section at SPL Ambo (see 5.2.3).

Weeds are a serious constraint to high yields of all cereals in highland areas, particularly wild oats, Avena fatua whose seeds contaminate cereal crop seeds and can also live in the soil for up to seven years. Wild oats also carry ergot disease caused by the fungus Claviceps purpurea and their presence in cereal crops led to an outbreak of ergotamine disease in recent years.

2.1.2 Sugar and starch crops

Sugarcane

Ethiopia is usually an exporter of sugar, although the amount produced varies from year to year. The FAO estimate for 1980 production of Saccarum offininale is 1 320 000 t from 8 200 ha (see Table 2). Sugarcane is considered an industrial crop and is dealt with by the Ministry of Industry (MoI) in Ethiopia, (see 3.5). The main disease is smut, Ustilago scitaminea, although leaf spots caused by Cercospora longipes can also cause losses.

Potatoes

Solanum tuberosum accounts for one third of the total production of roots and tuber crops in Ethiopia. The major disease is bacterial wilt caused by Pseudomonas solanacearum.

2.1.3 Oil crops

Noug

Noug, or Niger seed, Guizotia abyssinica, is the most widely grown oil seed crop in Ethiopia; it is cultivated on over 100 000 ha (see tables 2 and 3), yields are low, but the crop requires few inputs, disease problems are insignificant and there are only two insect pests considered damaging, i.e. plusia worms, Diachrysia orichalcea, and noug fly, Dioxyna sororcula, which can be a serious pest in the Bako area.

Sesame

The sesame seedbug, Elasmolomus sordidus, can cause serious problems in northwest Ethiopia but has not yet been recorded in the Awash or Webe Shebele Valleys. Bacterial blight, Pseudomonas solanacearum, is a very important disease and may cause total crop losses.

Groundnuts

The main diseases affecting Arachis hypogea are the leafspots, Mycosphaerella spp., and rust, Puccinia arachidis which has only recently begun to spread throughout the groundnut growing areas of Africa, emphasizing the need for adequate plant quarantine.

2.1.4 Cotton

Cotton, Gossypium sp, is mainly grown on State Farms in Ethiopia, although there are several potential production areas (see Fig. 2). The main pest problems are caused by the American bollworm, Heliothis armigera; the cotton leafworm, Spodoptera littoralis; the cotton aphid, Aphis gossipii; the tobacco white fly, Bemisia tabaci, which is usually a minor pest but may cause severe infestations in northern areas; the cotton jassid, Empoasca lybica, which is a serious pest throughout Ethiopia particularly if attacks occur early in the growing season; the pink bollworm, Pectinophora gossypiella, which may develop in very large numbers if a closed season between crops is not carefully observed; and the red cotton mite, Tetranychus spp., on late-sown cotton maturing after the main rains have finished.

Diseases are not very important, although wilt caused by Verticillium sp. and bacterial blight, Xanthomonas malvacearum, do occur. IAR developed blight resistant varieties which are used on State Farms. There have also been reports of a non-parasitic wilt known as the Dubti Syndrome affecting crops. Pest control is carried out usually by the SFDM on State Farm crops (see 4.2). Mainly ULV sprays using aircraft are applied. Six to ten applications per season are made, the whole operation being conducted under a spray contract put out to international tender. Endosulfan was the most widely used chemical, but following indications of resistance, dimethoate, azinphos-methyl (Gusathion),

methamidophos (Tamaron) and chlorpyrifos (Dursban) are also used. Spraying is often excessive because State Farm Managers are expected to produce high yields of cotton and, for fear of failure, spray when the pest level is well below the threshold.

2.1.5 Fruit

Citrus

Citrus spp. are widely grown in Ethiopia. Although no FAO figures for the total area harvested are available, production in 1980 was estimated at around 22 100 t. The SFDM have development plans for citrus crops in the Upper and Middle Awash Valley areas. The citrus crops face a very serious disease complex of viruses and mycoplasmas on which no action is being taken by IAR and for which there is no suitable programme for propagation of disease-free planting stock. SFDM Plant Pathology Section have started work on the development of resistant varieties and have found that if trees are surrounded by two ridges of soil, so that water reaches the roots but is prevented from accumulating around the trunk, the incidence of foot rot or gummosis caused by the fungus Phytophthora citrophthora can be reduced. The other major diseases include greening, a mycoplasma transmitted by the citrus psyllid, Trioza erytreae, and tristeza virus, transmitted by the citrus aphid, Toxoptera citricidus.

The main insects attacking the crop include the false codling moth, Cryptophlebia leucotreta, a major pest throughout Ethiopia; the Orange Dog, Papilo demodocus, and several scale insects (see Appendix III). The red scale, Aonidiella aurantii, is being worked on at IAR Nazareth where the possibilities of biological control are being investigated. The SFDM Entomology Section are also working on the control of red scale and black scale, Parlatoria zizyphus.

Enset (False Banana)

Enset, Ensete ventricosum, is the staple diet of some 6-7-million Ethiopians who live in the southern part of the country. The crop is mainly grown south of Addis Ababa. Both corn and pseudostem are used as food, and the leaves are used as food wrappers. The leaf sheaths hold water which is a breeding site of the yellow fever mosquito. In the Sidamo area the crop is affected by enset wilt, caused by the bacterium Xanthomonas musacearum. The crop is also affected by mole rats which burrow under the stems, eat the roots and cause the plant to fall down.

2.1.6 Vegetables

Pulses

Grain legumes, in decreasing order of importance in terms of area grown are horse beans, chickpeas, field peas, lentils and haricot beans. The main insect pest problems are caused by the American bollworm, Heliothis armigera, which is very important; the bean aphid, Aphis fabae; the groundnut aphid, Aphis craccivora; the beanfly, Ophiomyia phaseoli; and bruchid beetles, Bruchus spp. which infest crops in the field and continue to cause damage in store. The most severe disease problems are caused by anthracnose, Colletotrichum lindemuthianum, on haricot beans; chocolate spot, Botrytis fabae, on horsebeans if the rains are late; rust, Uromyces fabae, on horse beans at low

altitudes; and ascochyta blight, Ascochyta rabeii, which has recently been introduced to Ethiopia, has caused trials on haricot beans and cowpeas to be suspended and is now a major threat to chickpea culture.

Tomato

Lycopersicon esculentum is grown in all parts of the country. The crop is attacked by the American bollworm, Heliothis armigera, which is its main insect pest, and also by the tobacco whitefly, Bemisia tabaci, which transmits virus diseases. Late blight, Phytophthora infestans, and leaf spot, Septoria lycopersici, are both important fungal diseases which affect production.

Peppers

Capsicum spp. are grown in many forms in Ethiopia, as chillies, paprika, bell peppers and sweet peppers. Like tomatoes they are affected by Heliothis armigera and Bemisia tabaci, but their main problems are from diseases, including a Phytophthora sp. recently introduced into the country through lack of adequate plant quarantine and now causing very serious crop damage (see 4.1.2.3). Bacterial spot, Xanthomonas vesicatoria; soil rot, Thanatephorus cucumeris; wilts, Fusarium spp., Verticillium spp. and powdery mildew, Leveillula taurica, are all serious as is bleaching disease, probably caused by a fungus associated with Heliothis armigera.

Vegetable crops in general are subject to attack in their seedling stages by termites, Macrotermes spp., cutworms, e.g. Agrotis segetum, and the Gojam red ant, Dorylus sp, which is a very serious pest of high altitude vegetable crops, especially those grown under irrigation and in the presence of compost or manure.

2.1.7 Coffee

Coffea arabica is the most important cash crop in Ethiopia. In 1977/78 the earnings from the crop reached an all-time high of US$ 290 million. The net value of the crop has fallen since, but production and processing still involve up to 25 percent of the employed population in Ethiopia. Half the production is consumed domestically. Ninety percent of the crop is grown in the highland areas, i.e. the uplands of Kefa, Sidamo, Welega, Ilubator and Harar regions. The export sales account for 30 percent of Ethiopia's total exports and 80 percent of the agricultural export earnings, which is equivalent to 4-5 percent of the total world production of Arabica coffee. The present area is estimated at 690 000 ha and 12 percent of this is uncultivated.

Ethiopia is the home of C. arabica, and as such there is an enormous genetic diversity within the country. Some 80 percent of the crop still grows under very low management, the majority of the crop being produced by small farmers grouped into PAs and PCs while the remainder is produced on seven State Farms under the aegis of the MCTD (see 3.4).

The most serious pest problem is coffee berry disease (CBD) (Colletotrichum coffearum) which first appeared in 1970/71 and spread to all regions, except Harar, by 1975; in Harar it was found in 1978. 20-25 percent of the crop has been lost and thus the entire economy of the country is threatened.

without damage - around 10/tree - since the bug does not seem to transmit the fungi. Nevertheless, antestia is regarded as a potential threat, and there is much debate as to whether to extend chemical control and risk adverse effects on the natural control agents. External expert assistance on this subject would be appreciated.

Many other insects of major importance elsewhere, e.g. the coffee leaf miners, Leucoptera spp., coffee leaf skeletonizer, Epiplema dohertyi, and coffee berry borer, Hypothenemus hampei, are known to occur in Ethiopia but appear to be kept in check by natural control agents.

Storage pests are not important, but weeds can be a serious problem when the crop is not grown under shade. The most difficult to control is couch grass, Digitaria scalarum, because of the problems of applying herbicides in the plantations.

IAR Jimma also has a Coffee Diversification Programme to evaluate crops which can be grown in conjunction with coffee. The crops include cereals (maize/sorghum/teff), pulse crops (soya bean/lima bean/haricot bean), roots and tubers (sweet potato/Irish potato/yam/cassava) and fruits (pineapple/ papaya/ passion fruit). Particular interest is shown in spice crops (ginger/tumeric/fenugreek etc.) which are profitable but extremely site-specific.

2.2 PESTS OF GENERAL IMPORTANCE

2.2.1 Locusts, grasshoppers and crickets

Several species of locusts are found in Ethiopia. Swarms of the Desert Locust, Schistocerca gregaria, have been recorded throughout the country in 55 years out of the 103 between 1860 and 1973, and the species has outbreak areas along the Eritrean coast. The African Migratory Locust, Locusta migratoria migratorioides, is present throughout Ethiopia during plagues; outbreaks occur on the Eritrean Coast and swarms were recorded in 8 years between 1928 and 1942. The Red Locust, Nomadacris septemfasciata, was not recorded in Ethiopia during the last major plague (1927-45) although it has been recorded in the country.

Two species of Tree Locusts are regularly found, Anacridium melanorhodon throughout the country and A. wernerellum only in western Ethiopia.

Many species of grasshoppers, e.g. Aiolopus simulatrix, cause severe local damage to seedlings; often more than one species is involved in the same outbreak. Work at SPL (see 5.2.3) has shown that 15-17 percent of young maize seedlings from early sowings may be lost in grasshopper attacks. Crickets , e.g. the Welo bush cricket (see teff) and Gryllus bimaculatus which feeds at night on seeds and seedlings, especially of cotton crops can cause considerable damage.

2.2.2 Armyworm

Outbreaks of African Armyworm, Spodoptera exempta, can cause serious damage; for instance, in 1980, 13 000 ha of State Farms were infested.

The MoA has an Armyworm Forecasting Sub-Section in its Crop Protection Section (see 4.1.2). Farmers are advised to report all outbreaks of Armyworm to the MoA and the MoA are responsible for conducting control campaigns jointly with the State Farm Development Ministry (SFDM).

Ethiopia is a member of the Regional Armyworm Programme which is based in Kenya and is assisted by the Centre for Overseas Pest Research (COPR), ODA, UK. Consultants from COPR visit Ethiopia and the whole programme is closely associated with the DLCO-EA. The DLCO-EA radio network is used to transmit reports of outbreaks to the forecasting station at the Kenya Agricultural Research Institute. There are 23 light and pheromone traps strategically located throughout Ethiopia as part of this Regional Programme. The traps are operated by various bodies including MoA and the Institute of Agricultural Research (IAR). However, very few of the traps supply regular and accurate information. The ones at the IAR stations are probably the best maintained, but these are not well situated for the prediction of outbreaks.

At the national level the work is coordinated through the MoA and it is expected that trap operators will receive training in future from MoA with assistance from the Regional Programme.

2.2.3 Rodents

Six species of rodents have been identified as causing damage to field and stored crops in Ethiopia. These include four Arvicanthis spp., particularly A. abyssinicus, and two Praomys spp., particularly P. natalensis.

The MoA has a Rodent Laboratory at its Sholla site where a Soviet expert is assisting with the work. Surveys are conducted on distribution and damage and advice is given on cultural, mechanical, chemical and biological methods of control.

The most usual methods advised are the manipulation of planting dates to avoid field damage to cereals, the construction of rodent-proof storage facilities and the monitoring of population levels so that chemical control can be applied at the most appropriate time.

A problem specific to Ethiopia is that of the mole rat which attacks enset plants by feeding on their root system below ground level. The control measures taken consist of digging tunnels to locate and kill the rats in their underground nests, blocking some tunnels and killing the rats as they emerge from the others, and fumigating the tunnels with phosphine gas (Phostoxin).

The IAR has a small Rodent Group consisting of two senior staff and two technicians who work in temporary accommodation adjacent to the MoA Central Store in Addis Ababa. The Group works on surveys on rodent distribution and the evaluation of control methods.

2.2.4 Grain-Eating Birds

Ethiopia is a member of the FAO/UNDP Regional Project RAF/77/042, now in Phase II as RAF/81/023, Coordination of Cooperative Action to Reduce Bird Damage to Crops in Eastern Africa. This project was launched in 1978 with Nairobi as headquarters; it involves five member countries: Kenya, Tanzania, Ethiopia, Somalia and Sudan. The objectives are to:

- improve present methods of bird damage control and to introduce new methods where possible through cooperation with the USAID Denver Wildlife Research Centre Project in the Sudan, a GTZ project in Tanzania, and the FAO-assisted National Projects in Kenya, Ethiopia, Somalia and Tanzania;

- assist in planning bird damage control activities through the development and implementation of a granivorous bird reporting service.

The project staff monitor the two most damaging races of quelea, Quelea quelea intermedia and Q. q. aethiopica whose migrations are complex and cross the national frontiers of the project member countries. A standardized reporting system has been developed and is now approved for use in the region.

Since the start of RAF/77/042 in 1978, information has been exchanged in a monthly newsletter which summarizes reports from member countries. Technical meetings are held annually and information is circulated on, for example, the quantitative assessment of crop damage by birds in the region. In-service training and workshops are held and there is active cooperation with research workers in the UK, USA and the Federal Republic of Germany.

All local bird control activity in Ethiopia is at present coordinated through the UNDP/FAO National Project ETH/77/022, Control of Grain-Eating Birds, whose objectives are to:

- strengthen the national MoA bird control service by organizing an operational unit, training its staff and providing the necessary equipment;
- define the problem in terms of cereals affected, quantitative estimates of losses, and areas in which to concentrate protection efforts;
- define the scope of control efforts in terms of pest species, and suitable techniques;
- advise cereal producers of bird damage problems and how to avoid them.

The project was due to terminate in December 1981, but the Survey team were informed of plans to extend it, and to combine its activities with rodent control groups to form a Vertebrate Pest Group within the MoA.

The objectives of the present project (essentially to have an effective quelea control strategy, self-sufficient and fully operational under the control of local staff by the end of 1981) were virtually complete at the time of the Survey. In Ethiopia, only about five Quelea roosts each year are likely to inflict economic damage, a very different situation from Tanzania where the number of roosts may be as high as 40. Certain details of distribution and migration patterns have yet to be fully evaluated. It was hoped that these details would become clear using helicopter flying time still available to ETH/77/022 from FAO Technical Cooperation Projects (TCPs).

Actual control operations are carried out in cooperation with the DLCO-EA (see 4.3.1). Results obtained on the physical and chemical aspects of spraying by RAF/81/023 are of great value in determining control strategies in Ethiopia.

2.2.5 Primates

It is understood that Ethiopia has problems with primates, e.g. monkeys and baboons which attack growing crops, but at present no work is being undertaken on their control.

2.2.6 Weeds

Weeds are a limiting factor to crop production in many parts of Ethiopia. The severity of the problem is realized and work has been conducted on research and practical methods of control for several years.

The main centre of activity is at IAR Holetta where the Weed Section aims to identify the extent of the problem in Ethiopia, catalogue the species concerned and evaluate methods for their effective control.

Collection and evaluation

So far, more than 400 weed specimens have been identified and catalogued by staff members. In each case, five samples are taken, one is sent to the Herbarium at Kew,UK, for confirmation of identification, one to the

National Herbarium, one to the IAR field station at or near the point of collection, one is placed in the IAR Central Herbarium at Holetta and one is retained by the collector. The National Herbarium is attached to AAU (Addis Ababa campus) and includes all Ethiopian plants, whereas the IAR Central Herbarium includes only weeds. Other weed collections are held at the IAR field stations, at MoA Sholla Laboratories and at SFDM Headquarters. A collection of plants of importance in livestock raising, particularly grasses and pasture weeds, is maintained at the International Livestock Centre for Africa (ILCA) which is situated close to MoA Sholla Laboratories and the DLCO-EA Headquarters in Addis Ababa. IAR are currently also preparing a guide giving advice on the preparation of botanical specimens.

Research

At IAR research is carried out on three main groups, i.e. parasitic weeds, aquatic weeds and highly competitive weeds.

The weed control problem in general has several inherent difficulties, which include: the problems and cost of treating large areas, the lack of labour, the repeated re-contamination of irrigated areas by water-borne weeds, and poor quality crop seeds often contaminated by weed seeds, e.g. wild oats in wheat.

(a) Parasitic weeds

The parasitic weed Striga is a very serious problem on sorghum crops, particularly in the Setit Humera area where it is virtually out of hand and is not being satisfactorily controlled.

The Striga problem currently affects some 15 million people spread over seven regions and is spreading very rapidly. Each plant produces around 500 000 microscopic seeds which are readily dispersed by wind and water and which can lie dormant for up to 20 years unless stimulated into growth by the presence of a suitable host. Chemical control has proved ineffective and the most promising line of defence appears to be the use of resistant varieties. IAR and the Faculty of Science, AAU, have been cooperating in this respect but it now seems likely that the work will have to be discontinued as the AAU greenhouse facilities are required for other purposes. This is disappointing, as similar work on related species in India and the USA has produced good results. Another species of Striga is important on sugarcane grown at Wonji.

Three species of the parasitic genus Orobanche are important on horticultural and oil crops in four regions of Ethiopia and infestations may very occasionally result in total crop loss. Crops affected include tomato, cabbage, linseed and sunflower. As with Striga, the problem is an abundance of small, readily dispersed seeds and a long dormancy period, in this instance 12 years.

Dodder, Cuscuta sp, though present in Ethioipia, is relatively unimportant.

(b) Aquatic weeds

Water hyacinth, Eichhornia crassipes, is potentially a very serious threat to the rivers and waterways of Ethiopia; parts of the Awash River are now infested and some disruption of electric power and irrigation programmes has

occurred. Perhaps the main danger, however, is the risk of extensive damage to the aquatic environment. An even greater risk exists with respect to the River Baro on the Sudanese border where any restriction of navigation would be a serious threat to the livelihood of the Gambella people. At the present time, mechanical control methods are used, but there is a danger of reinfestation if weeds that are dredged out of the river are not dried and destroyed by burning. Research is confined to survey work, particularly in locating the origins of infestation, though it is hoped to cooperate with neighbouring countries on projects involving chemical control or the use of fish and insects in biological control.

At least two species of insects have now been established on water hyacinth in Sudan and a third has been introduced. If these insects could be established at Gambella (upstream for the Sudan White Nile infestation) it would be of great mutual benefit to Sudan and Ethiopia.

(c) Highly competitive weeds

A major problem in growing highland cereal crops is wild oats, Avena fatua. Each Avena plant produces around 300 seeds which may remain dormant for up to seven years. Avena also carries ergot disease (see 2.1.1) and one method of reducing its incidence is to plant only clean seed. It is hoped that Ethiopian Seed Enterprises who are responsible for seed production will be able to improve the quality of seed available to farmers in the future, because as the number of State Farms increases and more cereals are planted the problem is likely to become even more widespread.

The other main problem involving perennial weeds is that of Digitaria sp in coffee grown under shade-free conditions (see 2.1.7).

Control

The main government institutions involved with plant protection are all involved in weed control by various methods. MoA has a weed laboratory at Sholla (see 4.1.2). The SFDM have a Weed Control Section (see 4.2.1) and RRC, although they have no staff working specifically on weeds, do help their farmers to control all pests (see 4.2.2). MCTD are concerned with weed control in coffee (see 2.1.7) and MoI with weed control in sugarcane and tobacco (see 3.2.4).

It is interesting to note that the main general control recommendations are for handweeding by the MoA and for chemical measures by the SFDM and RRC. This is because MoA consider herbicide application and costs to be as yet beyond the skills and financial range of the average farmer.

2.3 POST HARVEST PEST PROBLEMS AND STORAGE

2.3.1 Stored products pests

The pests in Ethiopia are similar to those found in many tropical countries. The main problems are caused by rodents, insects, e.g. Sitophilus sp and Tribolium sp and fungal moulds which can be very serious when grain is stored in unlined underground pits.

2.3.2 Post harvest losses

Detailed information on actual storage losses is not available, although by extrapolation of data from neighbouring countries losses are estimated to be aproximately 10 percent overall and higher (up to 30 percent) in the Kefa and Sidamo regions. Storage losses are probably lower than 10 percent in the highland areas where teff is grown. Teff grain is almost insect-proof and only rodent damage is significant. The moisture content of wheat and barley is very low at harvest time (November) and remains low until April or May by which time most of the stored grain has been consumed. Fungal infestation and spoilage is thus less common than in regions where grain with a higher moisture content is stored.

The highest losses from moulds are most likely to occur in the Harar region where underground storage is common.

2.3.3 Responsibilities for stored produce

Grain Storage Section (MoA)

This Section has a small office space at MoA Headquarters but no laboratory facilities. Its role is to gather information on post harvest storage losses at the farm level and to provide advice on the reduction of these losses to acceptable levels. Larger stores, i.e. those at PA and regional level holding in excess of 1 000 quintals (100 t) are generally of reasonable construction and suffer few problems. Lindane dust for insect control is available through DAs and is widely used. Phosphine is also used to fumigate large stores and silos.

Agricultural Marketing Corporation (AMC)

The AMC is responsible for the storage of grain at national level. The AMC employ experts on grain handling who also take care of routine pest control problems.

State Farms Development Ministry (SFDM)

Within the Plant Protection Division of the SFDM is an Entomology Section responsible for advising the State Farm Managers on grain storage problems (see 4.2.1).

SFDM have several large stores where grain is held for the workers, or retained before delivery to the AMC. Seed grains are also stored. Pest problems due to insects and rodents in these stores are serious. SFDM have little knowledge of how to deal with storage problems but are testing rodenticides and other control techniques.

Relief and Rehabilitation Commission (RRC)

The RRC is responsible for the post harvest protection of crops which are stored communally at settlement level (see 3.2.2 and 4.2.2).

2.3.4 International Assistance

The recent history of the grain storage problem in Ethiopia is interesting. Considerable efforts were made to reduce losses under the Freedom From Hunger Campaign (FFHC) of the early 1970s. As a result of detailed work by expatriate and local counterpart staff, a Handbook on Grain Storage, edited by R.O.S. Clarke, was published through the Extension and Project Implementation Department (EPID), which is now defunct; this very useful handbook is still in use today. It recommended a crib-style grain store with rat baffles which was constructed on demonstration sites throughout the country. In some regions it has not been generally adopted simply because little or no grain is produced in excess of immediate requirements (e.g. Welo, Tigre). In other regions, where surplus grain is produced (e.g. Arusi, Gojam), this 'improved storage' has still not been generally adopted, except in localized areas where rodents are a major problem.

The FFHC project was really active only in two regions: Kefa, a maize-growing area where the improved crib became quite popular, and Harar where underground storage in traditional pits under houses is common.

The rat baffles are now prohibitively expensive for most farmers due to a dramatic rise in the price of metal sheet. Other reasons for a failure to adopt the new design may be: shortage of suitable construction materials, e.g. clay, cow dung or bamboo; fear of fire or theft; or a reluctance to advertise personal resources to neighbours or to the Government. Of the original project counterpart staff, only one remains, based at the SFDM Headquarters in Addis Ababa.

For the past five years the MoA have been seeking assistance with storage problems through the provision of a Grain Storage Expert.

The RRC has two FAO projects in the pipeline which relate to grain storage (see 4.2.2).

3. ORGANIZATIONAL RESPONSIBILITIES IN CROP PRODUCTION

Central control of agricultural production is fragmented in Ethiopia, being shared between the following:

Ministry of Agriculture (MoA)
State Farm Development Ministry (SFDM)
Relief and Rehabilitation Commission (RRC)
Ministry of Coffee and Tea Development (MCTD)
Ministry of Industry (MoI)

All these bodies are under the direct control of the Supreme Council.

Seed production comes under the control of the Ethiopian Seed Enterprises which produces, cleans, certifies and sells its own seed. There is no separate quality control body.

3.1 MINISTRY OF AGRICULTURE (MoA)

The MoA is divided into seven departments (Fig. 3). The Cooperative Development Department is concerned primarily with the organization of Peasant Associations and their transformation into Service Cooperatives and Producers Cooperatives (see 1.4.3). The Agricultural Development Department is more concerned with the actual process of crop protection and is itself divided into five divisions: Agronomy, Crop Protection and Regulatory, Farm Management, Home Economics and Farm Implements. However, with the increase of awareness in the need to strengthen plant protection, it is proposed that the Crop Protection and Regulatory Division should be upgraded to the status of a separate Department with effect from September 1981.

3.2 STATE FARM DEVELOPMENT MINISTRY (SFDM)

The SFDM was originally part of the MoA and has been given independent status since the Revolution. It currently accounts for about six per cent of the agricultural production from two to four per cent of all the cultivated land or some 1 - 200 000 ha. A simplified organogramme of the structure of SFDM showing the position of the plant protection services is given in Fig. 4.

The Agricultural Production Department of the SFDM comprises seven Agricultural Development Corporations (ADC): the Southern, Northern, Eastern, Western, Horticultural, Animal and Fisheries, and Agricultural Equipment Corporations. All but the last two have their own plant protection components. Each ADC is, in turn, divided into smaller units, the Agricultural Development Enterprises (ADE). For instance the Eastern ADC consists of two parts, the Tousand and the Awash; the latter is divided into two enterprises, Tendaho ADE and Middle Awash ADE.

Each ADE comprises a number of State Farms (SFs) each consisting of about 3 000 ha of irrigated and 6 000 ha of rainfed land. These State Farms may be divided into smaller administrative units.

The Research and Development Department of SFDM has a Plant Protection Division whose principal functions are applied research, training and advisory services for the benefit of the ADCs.

The principal crops raised on State Farms are cereals, oil crops, vegetables, tree crops and cotton. The proportion of the different crops is not altogether representative of the country as a whole, for instance very little teff is grown on State Farms, but SFDM and RRC (Relief and Rehabilitation Commission) between them account for 90 per cent of the cotton grown in Ethiopia.

When maize is grown on State Farms, it is mostly of the hybrid type imported from Kenya. Small holders usually grow maize obtained through the Peasant Associations, or use their own crop for seed.

3.3 RELIEF AND REHABILITATION COMMISSION (RRC)

The RRC is an autonomous body established in December 1979. Its main aims are the coordination of relief, distribution of aid, and the rehabilitation and resettlement of disaster-affected people.

There are now over 80 settlement areas in the country, each covering about 400 ha, spread between eight regions mostly in the highlands. There are essentially two types of settlement: (a) those producing highland food crops (teff, wheat, barley, maize, sorghum) and (b) those producing cotton, the largest of these (8 000 ha) being the Awash Valley. Settlements are run on similar lines to State Farms. Food crops are raised by farmers themselves, but cotton cultivation requires extra labour which must be hired. The acreage of the various crops grown is decided by the management. Grain is stored communally at the settlement level. The RRC is responsible for its own crop protection services.

3.4 MINISTRY OF COFFEE AND TEA DEVELOPMENT (MCTD)

The MCTD (see Fig. 5) is a development from the earlier Coffee Board which was the responsibility of the MoA. Its status as a full Ministry is due to the value of coffee, by far the most important cash crop amounting for 82 per cent of Ethiopia's agricultural export earnings. Up to 25 per cent of the total employed population is involved with coffee production, processing and marketing.

Currently some 450 000 ha of Coffea arabica are grown, about 12 per cent of which is uncultivated, mainly in the Kefa and Sidamo regions (see Figs. 1 and 2). About half the total production is consumed domestically.

Tea is by comparison of relatively minor importance and most of the tea consumed in Ethiopia is imported.

Some coffee is grown on seven of the State Farms (see 3.2) but the majority of the crop is produced by individual small growers grouped together in Peasant Associations (PAs) or Producers Cooperatives (PCs). Shortage of labour is a major constraint to the expansion of coffee production, but in the Jimma region the crop is being planted on common holdings where the existing farmers work for two or three days each week away from their own land.

3.5 MINISTRY OF INDUSTRY (MoI)

In Ethiopia sugar and tobacco are regarded as industrial crops and their production and marketing are under the control of the MoI. There was insufficient time for the Survey team to investigate either crop, but it is understood that each has ongoing research programmes mainly on agronomic problems.

The MoI is also responsible for pest control operations. The main pest problems in sugar-cane are smut disease, Ustilago scitaminea, and the parasitic weed, Striga spp. Nematodes are a major problem in tobacco cultivation. IAR have, in the past, provided assistance to the MoI on these problems, but have not been able to do so recently because of shortage of staff and funding.

4. ORGANIZATIONAL RESPONSIBILITIES IN CROP PROTECTION

4.1 MINISTRY OF AGRICULTURE (MoA)

4.1.1 General function and organization

Plant protection activities within the MoA are carried out by the Crop Protection and Regulatory Division. The following comments refer to the structure of the Division at the time of the Survey but it should be noted that it was proposed to upgrade the Division to the status of a separate Department with effect from September 1981. This upgrading should result in easier access to the Permanent Secretary and hence to policy makers, stronger representation at meetings, more voice in budget decisions and more control of vehicles.

At Headquarters the Crop Protection and Regulatory Division is divided into five sections: Crop Protection, Plant Quarantine and Regulation, Quelea Control, Spray Maintenance and Distribution, and Grain Storage (see Fig. 3).

Ethiopia spends approximately US$ 9.6 million per annum on crop protection; this figure includes the MoA's total crop protection budget of US$ 2.9 million or 6 million birr per annum.

At the field level each region is in theory staffed by two Junior Crop Protection Experts (JCPEs) of graduate standard. In practice, the complement is rather less than this and the standard is often mixed graduate/diplomate. In either case, the regional staff are generally young and inexperienced. Although appointed by the Head of the Crop Protection and Regulatory Division, staff are answerable in the first place to the Regional Agricultural Officer. This means that many reports from field staff never reach divisional Headquarters.

At the time of the Survey there were 26 JCPEs supported at the awraja level by 100 Assistant Junior Crop Protection Experts (AJCPEs), i.e. about one per awraja. AJCPEs are supposed to be of diplomate standard, but the actual standard may be rather lower, and, again, they are usually young and inexperienced. The AJCPEs duties include pest surveys, identification of pest problems, collection of specimens and giving advice on control measures.

At the woreda level, the 'contact point' between the farmer and the MoA are the Development Agents (DAs). These are multi-purpose extension staff covering all aspects of agronomy and animal husbandry, totalling in all some 1 230, although only about 440 of these have received six months specialized training in crop production and protection in addition to their 12th grade schooling (roughly equivalent to UK General Certificate of Education, Ordinary level). It is likely that the number of partly specialized DAs will be increased in future, particularly if the Division is elevated to the status of a Department when they will become known as Crop Protection Agents (CPAs).

The actual point of contact on plant protection problems is between the DA and the crop protection representative or representatives of the PA (Peasant Association). The DA is expected to advise on the recognition and control of pests, essentially by actual demonstration. The DA is kept up-to-date by the AJCPE, the AJCPE is kept up-to-date by the JCPE and the JCPE

is kept up-to-date by two to three weeks annual in-service training provided by staff from Headquarters.

Until recently, the DAs were responsible for marketing and credit facilities for the PAs. This responsibility was to be taken over by the Agricultural Marketing Corporation (AMC) in September 1981.

The DAs do not have motor-transport, but own or hire mules and bicycles depending on the type of area they cover.

The Survey team was informed that under the Government's Minimum Package 2 Proposal, funds have been set aside for in-service training of up to 4 000 existing DAs and the recruitment and training of an additional 2 000 new DAs, to be spread throughout the entire MoA.

4.1.2 Responsibilities and work of individual sections

4.1.2.1 Crop Protection Section

The role of this Section is to gather information on pest problems and to advise farmers, through the PAs and cooperatives, as to their control. In addition the Section provides operational support, in the form of mobile control teams and spray equipment, specifically for the control of migratory or national pests, viz, locusts, quelea, armyworm and aphids. It includes three sub-sections:

a) the Field Group
b) the Laboratory Group
and c) the Migratory Pests.

Until late 1980, the Field and Laboratory Group Sub-Sections worked independently of each other but they are now fully integrated. A further Sub-Section, an Information and Statistics Unit, is proposed.

A. FIELD GROUP SUB-SECTION

The role of the Field Group is to assist farmers, through the PAs and cooperatives, on problems relating to insects, diseases, weeds and rodents. Work consists of:

- surveys and loss assessment studies of field and storage pests;
- coordination of control measures against serious or widespread insect and disease outbreaks;
- organization of orientation training of new staff (two to three days), and in-service training of regional field staff (two to three weeks each year);
- preparation of annual reports describing the insect and disease situation at regional level;
- preparation of leaflets, booklets and posters in Amharic to facilitate the recognition and control of insects and diseases at field level;
- collection and identification of new pest species and the subsequent distribution of examples of these for teaching and training purposes;
- supervision of crop protection activities by providing guidelines at regional level and advice at the PA level;

- liaison with other ministries (SFDM, RRC, MCTD, MoI, etc.) and other research and/or training organizations (JAR, SPL, AAU, etc.).

B. LABORATORY GROUP SUB-SECTION

This Group is based at the Sholla Laboratories which were built and equipped by FAO in 1975. Their short-term programme includes:

- provision of technical support to field staff including the identification of unknown pests;
- preparation and distribution of examples of pest specimens;
- systematic surveys;
- advice on possible uses for unlabelled and/or old pesticides including their disposal;
- checking up the level of active ingredients in pesticides for the purposes of quality control, legislation and usability.

The long-term programme includes:

- intensive and extensive surveys of pests throughout the country, based initially on the five zones described in 1.3;
- preparation of zonal maps of host plants, pest damage, distribution and migration paths;
- selection of single, multiple, simple or complex control measures depending on precise circumstances;
- collection of economic pest specimens for laboratory study;
- preparation of specific project proposals for possible international assistance.

The Crop Protection Section carries out its work at various laboratories which include: Pesticide Laboratory, Entomology Laboratory, Plant Pathology Laboratory, Rodent Laboratory, and Weed Laboratory.

a) Pesticide Laboratory

The Laboratory is engaged in pesticide control work, which includes the need to determine the levels of active ingredients in old and/or unlabelled pesticides and to check the quality of newly acquired stocks as a safeguard against fraud.

There are basic facilities for clean-up procedures and the determination of levels of active ingredients in pesticide formulations by volumetric, gravimetric, colorimetric and titration methods. There are no facilities for spectro-photometric nor for gas liquid chromatographic analysis. This lack does not exclude the possibility of conducting residue studies.

b) Entomology Laboratory

This Laboratory has basic facilities for the collection, identification, rearing and preservation of insect pests. There is a small but well-housed and well-maintained reference collection in an adjacent office. The more important economic pests are represented to a greater or lesser extent

depending on the particular order, e.g. Coleoptera are well covered, Diptera are poorly covered. The most complete collection is of Orthoptera since it is this collection that was recently rearranged and expanded under the guidance of a visiting expert from the Centre for Overseas Pest Research, ODA, London.

c) Plant Pathology Laboratory

In this Laboratory facilities exist for the identification and preservation of diseased plant material. These facilities are essentially restricted to fungal pathogens since bacterial and virus pathogens have to be referred to SPL Ambo. The Laboratory also houses a herbarium collection prepared by a former Soviet expert.

d) Rodent Laboratory

Rodent pests are collected and identified in this Laboratory which is assisted by a Soviet expert. Surveys of pest distribution and damage are conducted. Advice is given on chemical, cultural and biological methods of control.

e) Weed Laboratory

This Laboratory has basic facilities for the collection and identification of weed species. Weed surveys have been carried out over the past five years and about 400 species have been collected, about half of which remain to be identified. It is important to note that this Laboratory, unlike its counterparts in SFDM and RRC, recommends hand-weeding rather than chemical control. This is because the necessary technical skills are thought to be beyond the reach of small farmers at the present time.

The Laboratory claims to work in close collaboration with IAR on all aspects of weed control, including the problem of water hyacinth, Eichhornia crassipes on the Baro and Awash Rivers.

C. MIGRATORY PESTS SUB-SECTION

This is an operational group which in theory has eight mobile teams each with a Land Rover equipped with a mobile radio, a supervisor, a driver and spray equipment. At present these mobile teams are based at MoA Headquarters, but it is likely that they will be redistributed on a zonal basis. The role of the teams is to attempt to survey and control serious pest outbreaks and they are regarded as 'Fire brigade' units. They are the first line of defence outside the DAs in combatting attack by locusts, armyworm and widespread aphid infestations. In theory, the DLCO-EA will assist only when these mobile teams are unable to cope. At the present time locusts are a danger in only a few areas and armyworms are tackled only when they are a threat or a potential threat to crops, hence the teams are, indeed, able to cope. The teams are not responsible for rodent control.

A communications network for migratory pests does exist; it was originally for national locust control and had radio sets provided by FAO. Since 1973 efforts have been made to replace old equipment with new SSB 130 instruments, establish a radio workshop and train staff to repair and maintain sets.

Each regional office of the MoA is theoretically linked by radio through the Sholla Laboratory at Headquarters where there is a permanent radio operator, who should also coordinate reports from the mobile radios of the Migratory Pests Group. However, due to lack of continuity of operators, national interest in other projects, frequent changes in local staff due to the emigration of trained and qualified operators and mechanics to better opportunities, and lack of standardization of equipment, the existing equipment is not being utilized to its full potential.

4.1.2.2 Spray Maintenance and Distribution Section

This Section is concerned with the provision and maintenance of spray equipment, and the provision and storage of pesticides, for the control of national pests including locusts, armyworm and high density aphid infestations.

Various types of spraying equipment are held in the MoA central store in Addis Ababa including several unused, 20-year old, exhaust nozzle sprayers, many unused Mark 1 Turbair ULV sprayers and large numbers of defunct knapsack sprayers suitable only for cannibalisation. However, the bulk of the operational spray equipment is out on loan to the PAs for use when required or held in regional stores. In the event of an outbreak of a national pest, each PA is required to provide around five spray teams, each comprising a leader (trained by the DA in spray techniques) and four farmer assistants. Protective clothing is provided by the MoA for the spray teams.

Mobile repair teams visit the regions checking and repairing defective spray equipment. At the time of the Survey there were four spray repair men in the field, i.e. two mechanics and two drivers.

Pesticides are also made available by the MoA, free of charge, for use against national pests. This is not a recommended procedure since free pesticide availability encourages misuse of pesticides. Application and safety measures are very difficult to control under this system.

The pesticide central store in Addis Ababa is acknowledged to be totally inadequate, having already fallen down on several occasions. The floor is uneven and composed largely of bare soil. A wide variety of pesticides are held in stock, randomly stacked and, for the most part, in rusting containers.

Many pesticide drums have lost their labels and so present problems as regards possible use and/or disposal. The MoA is well aware of these deficiencies and is attempting to rectify them through a programme of improved stock control. Funding is apparently available for building a new store, but there are problems with location and design.

Regional stores are generally of more sound construction, but are equally unsuitable since insufficient space often requires pesticides, fertilizers and agricultural produce to be stored in close proximity.

4.1.2.3 Plant Quarantine and Regulatory Section

This Section comprises the Plant Quarantine Headquarters which has a small office, located in Addis Ababa, but no laboratory facilities, and seven Plant Quarantine Stations (with small offices and rudimentary laboratory facilities) located at Dire Dawa, Assan, Massawa, Asmara, Nazareth, Moyale and Addis Ababa, the main ports and border crossing points from neighbouring countries.

Each of the Plant Quarantine Stations has two graduates (or one graduate and one diplomate) serving as Inspectors, examining imports and exports and issuing phytosanitary certificates and export licenses, e.g. for horse beans to Djibouti. The importation list in current use is essentially that produced by Kenya. Inspections are made of buildings and ships. Samples are examined by spear sampling or sieving. If fumigation is required, this is carried out by the private sector though further checks are carried out before clearance is given. These checks should be made by the Government Inspectors, who should also supervise fumigation procedures. As a member of the OAU Phytosanitary Commission, Ethiopia is obliged to give notice of any new or serious pest outbreak.

Plant Introduction

At present, no centralized post-entry plant quarantine facilities exist in Ethiopia. Legally, however, the Plant Protection Decree, 1971, is still in force. This document covers the importation and distribution of plants, plant produce and plant pests within Ethiopia and, quite clearly, places the responsibility for these activities with the MoA. For some years now, this acknowledged deficiency of the MoA has led to a proliferation of temporary measures whereby those with legitimate reasons for importing plant material have made their own arrangements. Thus MoA, IAR, SFDM, RRC, SPL and others have acted independently. The General Manager of IAR for example, has the authority to issue import permits. The IAR has internal importation procedures which are effective in preventing disease importation, but these do not apply to all importers. SFDM are large importers of seeds, bringing in sesame from the Sudan and large consignments of seeds which may have been at the origin of the introduction of the fungus Phytophthora on peppers. The National Crop Improvement Committee (NCIC) has brought in maize and sorghum varieties. There have been some difficulties, particularly where emergency aid situations have arisen and the concepts of swift passage and long-term safety have been in conflict. Certainly all concerned with plant production and plant health, including the importers and the MoA, would welcome a solution to this problem. The main concern is the almost total reliance on phytosanitary certificates issued by other countries, many of which have little or no expertise.

Of the existing Plant Quarantine Stations it is considered that the Asmara/Massawa unit is very efficient, but the others are not so reliable. There is also some concern about possible spread of pest problems within the country. Soil-borne diseases are now far more widely distributed than previously. There is particular concern over the need to prevent the spread of ergot. However, although in theory the mechanism to control the movement of produce within the country exists, in practice insufficient manpower is available to maintain control by all the organizations involved. However, the Horticultural Development Agency (HDA) is well aware of the problems of internal spread of horticultural pests and is very careful about moving citrus plants (which may be carrying armoured scales) and pineapples and bananas (which may be carrying the mealybug Dysmicoccus brevipes).

4.1.3 Library

The Library is small but well appointed. There are, however, very few up-to-date text books and virtually no journals except Tropical Pest Management.

4.1.4 Dissemination of Information

The MoA produces booklets in Amharic on field pests, grain storage and pesticide safety. There are plans to produce others on locusts, armyworm, Heliothis and maize pests, but the limiting factor is the time of the staff qualified to prepare the texts rather than money for printing, etc.

The MoA publishes a magazine in Amharic entitled 'News from the Ministry', which is mimeographed and distributed to staff.

Although the Ministry of Health makes extensive use of radio programmes to transmit information to the public, as yet the MoA do not use this medium to pass information to their staff or to farmers.

4.1.5 Specific Deficiencies of the MoA

(a) Lack of suitably qualified staff at senior levels. Many senior experienced staff have gone to industry, to senior administrative positions in other Ministries or failed to return from overseas training. Expatriate experts and counterpart staff are not always synchronised. Posts remain unfilled through lack of suitable candidates rather than lack of funds for payment of salaries.

(b) Lack of basic field and laboratory equipment, e.g. rodent traps, cages and autoclaves. This is partly due to lack of foreign exchange and partly due to the centralized purchasing system for glassware, chemicals etc. No microscopes or rearing equipment are available for regional staff. Little effective protective clothing is provided for spray teams. Spray repair teams need tool kits and siphons for decanting pesticides from leaking drums.

(c) Lack of transport. The main difficulty is that, unless provided for specific projects, all transport is supplied from a central government vehicle pool located in Addis Ababa. Since this pool has severe financial and operational limitations, the effect of this restriction is twofold. Firstly, vehicles may not be available as and when required, especially as there are many claimants for priority treatment. Secondly, vehicles entering the workshops for quite simple repairs may be off the road for long periods. The combined effect of these two factors is that vehicles are rarely sent in for routine servicing at the appropriate time and breakdowns become more frequent. There is shortage of heavy trucks for long distance transportation of pesticides and smaller, four-wheel drive trucks, for distribution to stores at awraja level. Vehicles based in the provinces are less vulnerable since it appears feasible to have these maintained by local commercial operators. Vehicles supplied for earlier projects, e.g. 24 Land Rovers and 11 Toyotas from USAID, have been placed in the central pool.

At the field level, transport for JCPE s and AJCPE s is limited to a part share in a MoA Land Rover, or a motorcycle shared between three to six people. DAs rely upon bicycles and mules or go on foot. Regional offices generally have one general purpose heavy lorry to meet all requirements. Four-wheel drive vehicles tend to be ageing and prone to failure, e.g., the MoA Awassa Regional Office has a total of 40 Land Rovers and Toyotas: 10 at Headquarters, 10 in the awrajas and 20 awaiting spares for repairs.

(d) Lack of confidence. The failure of mobile teams to respond in time to armyworm outbreaks means that regional offices are less likely to request assistance in future emergencies. Grain storage staff would like guidance on loss assessment, primarily to convince policy makers of the need for action.

(e) Lack of aircraft. Although the service provided by Admas Air and DLCO-EA is of acceptable quality, the main problem in both cases is the availability of aircraft and pilots for unscheduled operations or the withdrawal of these facilities from scheduled operations because of greater priorities.

(f) Lack of facilities. There are no greenhouses for Plant Quarantine Stations or the Sholla Laboratories. There are no screenhouses or insectaries. The pesticide stores are inadequate or structurally unsound.

(g) Lack of suitably qualified junior staff. The training of DAs is insufficient and they are too few to cover the large areas involved.

(h) Lack of petty cash. Ready cash is not available for essential day-to-day expenses and this causes delays and frustration.

(i) Lack of standardization in the available spraying equipment and a chronic shortage of spare parts. This means it is not possible to cannibalize sprays because their parts are not compatible.

(j) Lack of small quantities of pesticides. There are no facilities for supplying suitably packaged and labelled pesticides to farmers.

(k) Lack of roads. Vast areas of the central highlands are only accessible by mule or helicopter.

4.2 STATE FARM DEVELOPMENT MINISTRY (SFDM)

SFDM at present play an important role in the decisions made on pesticide importation. Formerly, each Ministry imported its own pesticides, but there is now a government proposal that the Ethiopian Import-Export Corporation should take over the importation of all pesticides and fertilizers.

4.2.1 Plant Protection Division

The Plant Protection Division (PPD) of the Research and Development Department of SFDM operates under a Director responsible for the overall coordination of the Division which is composed of four sections: Entomology, Plant Pathology and Nematology, Herbology, and Pesticide Application. In each Section the staff consists of:

- a Section Head (a graduate specialist, e.g. entomologist)
- a Soviet Counterpart Expert, usually with an interpreter
- an Assistant (graduate or junior college diplomate)
- a Laboratory Technician.

The main functions of the PPD are:

- developmental research, i.e. testing of IAR research results and materials under field conditions;
- advisory work to the seven Agricultural Development Corporations (ADCs) of the Ministry on all aspects of crop protection;
- training of local crop protection technicians under the ADCs;
- organization of plant protection activities of ADCs;

- policy formulation, e.g. on control methods, and strategies, pesticide and equipment purchases and other guidelines for ADCs.

During discussions with the various sections of the Plant Protection Division, the Survey team were informed of the problems which SFDM considered of major importance, these are discussed in Section 2 under the relevant crop.

4.2.1.1 Entomology Section

This Section is responsible for advising the State Farm managers on all aspects of insect control, they also conduct pest control campaigns in conjunction with the MoA (see 4.1.2.1) and deal with grain storage problems (see 2.3).

4.2.1.2 Plant Pathology and Nematology Section

Plant diseases were reported to be causing serious problems on State Farm crops, losses may be as high as 40-50 per cent in some areas.

4.2.1.3 Weed Control Section

The main objectives of this Section are to identify the noxious weeds of cotton, wheat, maize, sorghum and sesame, to plan control measures from an early stage of field preparation to harvest, and to advise the State Farm management.

Weeds are a very serious problem on State Farms; 60 per cent of the annual cost of production goes to herbicides and hand-weeding, while the loss of yield in cereal crops due to the effect of weeds is around 30 per cent. Maize herbicides alone cost SFDM over US$ 480 000 per annum and this quantity is only sufficient to treat half the maize grown areas.

Since manpower is scarce in many areas, in one season 45 000 people were moved to provide labour for hand-weeding of sesame. The cost of this exercise in transport alone is enormous.

4.2.1.4 Pesticide Application Section

This Section gives assistance to others when pesticides have to be used. Chemical control is the main means of plant protection and SFDM spend about 15 million birr (US$ 7 million) each year on pesticides, herbicides, application equipment, protective clothing etc. Field assessments are conducted by scouts or field assessors who are located in different sections; the results are recorded on special printed forms. There are different economic thresholds established for the various crops and the various pests. The reports are sent to the supervisor, who, if the threshold is exceeded, will usually request spraying. Aerial spraying is the most usual method. Aircraft belong to Admas Air Service, a subsidiary of Ethiopian Airways, which is an independent body, but which works closely with SFDM. The Pesticide Application Section decides on the type of aircraft to be used and such technical aspects as the spray equipment, calibration, formulation of pesticide, droplet size, swath width etc.

Aircraft spraying is paid for on the basis of number of hectares covered. The price is increasing steadily. In 1975/76 it was US$ 180/ha based on a

standard application rate of 20 l/ha. By 1980 it had increased to US$ 320/ha. The cost for ULV application is US$ 300/ha for insecticides.

Spraying, especially of cotton, is usually excessive and often carried out when the pest level is well below the threshold. This is due to the drastic punishment inflicted on farm managers who fail to produce the planned yields.

Some control is also conducted by ground methods using a variety of equipment such as knapsack, hand and motorized sprayers, tractor-drawn motor sprayers, ULVAs and a variety of dusters.

The section also advises on safety procedure in handling and storing insecticides and helps to select, purchase and distribute pesticides and equipment to the five ADCs dealing with crop protection. Every October a meeting is held with representatives from each ADC to discuss plans, assess past insecticide consumption and current stocks in the central stores. Requirements are determined and submitted to international tender although the actual purchasing and distribution is done by a separate government agency. The whole procedure is checked by a Technical Committee comprising a team leader and the crop protection manager of each ADC.

4.2.2 *Agricultural Development Corporations*

Within the Agricultural Development Corporations (see 3.2) the plant protection service follows a hierarchy through the Agricultural Development Enterprises (ADEs) (see Fig. 4) to the State Farms.

Each ADC - excluding Animal and Fisheries and Agricultural Equipment - has a graduate Head of Crop Protection and each ADE has a graduate or junior college diplomate Head of Crop Protection who reports to the ADC.

Each State Farm has a plant protection unit consisting of a supervisor and, under him, pest assessment and spray teams. The pest assessment team comprises a pest assessment co-ordinator and, under him, scout team leaders and scouts (with or without bicyles, one per 200 ha). The spray team comprises a spray foreman and, under him, flagmen, loader/mixers and spraymen.

4.2.3 Training, Information and Liaison at SFDM

Training

There is no centralized training for SFDM field staff other than that provided by MoA. This is given in Amharic mostly to lower and middle grades. Training is usually carried out in halls belonging to the various ADEs, 50-100 people per session. Most agronomy training is on a regional or zonal basis, training for the senior technical staff can only be envisaged by further post-graduate studies, principally through scholarships abroad. No definite prospects were mentioned to the Survey team although various professional staff indicated where they would like to go to further their professional studies.

Information

The SFDM uses pamphlets, posters and instruction booklets produced by IAR and MoA; it has produced a large two-volume guide to plant protection in Amharic, of which 200 copies were printed and distributed to SFDM staff.

Liaison

Contact with other organizations is not strong. SFDM does, however, liaise with IAR and with the SPL at Ambo.

4.2.4 Specific Deficiencies at SFDM

(a) Manpower: there is an acute shortage of trained manpower at all, and especially higher, levels.

(b) Laboratory facilities: inadequate and crowded, consisting of one small converted room for each Section comprising four or five people. There is shortage of basic equipment such as microscopes, autoclaves, ovens, refrigerators, lamps, photographic equipment, special glassware, etc. However, since Laboratories are available at MoA and IAR, it would seem that adequate liaison between them and SFDM would solve this problem and avoid duplication of facilities and effort.

(c) Reference material: the collections and herbaria are only just being started. There are problems with identification due to the high fees charged by such institutions as the Commonwealth Institutes of Entomology and Mycology. IAR have an arrangement with CAB financed by FAO, so that if SFDM liaised with IAR the problem could be resolved locally.

(d) The library is very small, although the few reference books available cover most of the subjects. No periodicals other than Tropical Pest Management and various CAB Abstracts are received due to payment difficulties.

(e) There are difficulties in communication with Soviet Expert staff due to the language barrier.

4.3 RELIEF AND REHABILITATION COMMISSION (RRC)

The Plant Protection Section of RRC is part of its Plant Protection and Production Division. It receives no outside help except (rarely) in emergencies such as outbreaks of migrant pests. There are five assistant plant protection officers and three junior college graduates at the Headquarters and one junior college graduate per settlement, acting as monitors. In cotton growing areas scouts are employed, at the rate of one scout to 150-220 ha. The majority are 12th grade diplomates.

Cotton crops are sprayed up to ten times per season by aircraft employed following international tender. Protection of food crops is carried out by settlers under the guidance of extension officers. RRC management provides the guidance and subsidises insecticides and equipment on a repayment basis, by deduction from pay or produce values. There are a variety of hand and knapsack sprayers and dusters available; among them an Italian knapsack sprayer has been chosen as standard. The spares position for these is considered to be satisfactory. There are also 100 ULVAs on order.

RRC does not conduct any research in crop protection, and relies on IAR, MoA, SFDM and commercial companies for advice and information. RRC have no particular staff working on weeds or nematodes.

The annual budget is on average around US$ 1 million for pesticides, but in years of light pest infestations this figure may be reduced to around US$ 820 000.

The RRC store grain for the settlement schemes which is treated by fumigation or dusts to reduce insect damage. Rodent populations are kept down in the stores by the use of baits and cats.

Since early 1981 a Prevention of Food Losses (PFL) project has been proposed to FAO by the Ethiopian Government with RRC acting as counterpart agency for the protection of food and seed grains in settlement projects. The project requirements include training in storage and preservation techniques for RRC storekeepers, insect and rodent control and seed treatments, and, by implication, the need for loss assessment, since it is proposed to evaluate different designs for storage facilities in settlement areas. The Government of Ethiopia, through the RRC, is processing a project proposal that contains a component for training personnel to operate the Food Security Reserve, using an FAO-sponsored training officer in the storage and preservation of food grains.

4.4 MINISTRY OF COFFEE AND TEA DEVELOPMENT (MCTD)

The MCTD does not have a separate plant protection division. Its crop protection activities are conducted at several points through different departmental services. At the Headquarters, the Regular Extension Service has one senior extension officer and five junior extension staff with experience in crop protection who operate in an advisory and organizational capacity. The general plant protection work is conducted by the corps of Extension Agents (EAs) who are college diplomates and Assistant Extension Agents (AEAs), 12th grade school certificate holders. The EAs and AEAs are spread between the various operational bodies, notably the Regular Extension Service, the Washed Coffee Project, the Coffee Improvement Project, and the Cooperatives (a total of 268 EAs and 398 AEAs). The EAs and AEAs are further distributed through the five coffee-growing regions, where they come under the MCTD Regional Management. For instance in the Jimma Region the staff composition is as follows:

Regional level	-	Regional Production Manager (graduate)
Awraja level	-	Supervisors and Cooperative Organizers (diplomates) about 15
Woreda level	-	Extension Agents (EAs): about 35
	-	Assistant Extension Agents (AEAs): about 140

Thus, each AEA covers about three Peasants Associations (PAs) of around 800 ha each, though this varies greatly from area to area.

Transport is available to MCTD staff, in the Jimma region, as follows:

- Regional Headquarters and Awrajas - Three Land Rovers and two Toyotas (plus three vehicles out of action)

- Woredas - one motor vehicle shared between every two or three EAs, one bicycle or mule shared between two or three AEAs

Since the organization of PAs comes under the jurisdiction of the MoA, MCTD works closely with the Regional Agricultural Officers. If there is no EA at Woreda level, the DA may take over his work.

Pest Control Operations

The main operation is control of Coffee Berry Disease (CBD) (see 2.1.7). Apart from spraying, the control measures involve distribution of resistant varieties recently developed by IAR, a measure of considerable success in the control of the disease (see 2.1.7), and weed control (see 2.2.6).

Training

- EAs and AEAs receive annual in-service training with assistance from IAR and MoA.
- FAO provided a training course on spraying for CBD control. Ad hoc training is also given by project staff involved in aid projects.
- The international chemical companies, e.g. Shell and Hoechst have funded visits to Kenya for MCTD staff to observe Kenyan methods of crop protection in coffee.

Chemical Supplies

Pesticides are purchased by tender through a government agency. MCTD spends on average US$ 2 million on pesticides annually, it also receives donations of pesticides as bilateral aid.

Specific Deficiencies

(a) Funds to meet the high cost of chemicals for CBD control.

(b) Lack of trained staff, especially at higher levels.

(c) Lack of Government recognition of the importance of plant protection, in particular the severe threat of CBD to the national economy.

(d) Lack of transport. This results in very poor communications where senior management can only see their staff every two months. The EEC project (see 2.1.7) has provided 16 Land Rovers, but this is not sufficient for the distances to be covered.

4.5 REGIONAL ORGANIZATION INVOLVED IN PLANT PROTECTION

Desert Locust Control Organization for Eastern Africa (DLCO-EA)

Facilities and Staff

The administrative Headquarters of the Organization and the operational base for Ethiopia are located in Addis Ababa close to the Sholla Laboratory of the MoA.

The facilities include offices, stores, workshops, a library and a laboratory equipped with locust breeding rooms, radio communications equipment and gas liquid chromatography and thin layer chromatography equipment for pesticide analysis. There is also a substantial transport pool which includes both light survey vehicles of the Land Rover - Toyota type and medium-sized load carriers used to transport control equipment.

The senior staff includes the Director-General, the Directors of Operations, Administration and Finance, the Chief Scientific Officer, the Officer-in-Charge DLCO-EA Ethiopia Unit, together with supporting staff.

The DLCO-EA radio network links its seven national bases in Ethiopia, Tanzania, Kenya, Uganda, Djibouti, Somalia and the Sudan. It also links the secondary bases and the local mobile units. The various regional and local armyworm monitoring stations which are equipped with radios also use the DLCO-EA network (see 2.2.2).

Operations

The present policy places the responsibility for monitoring national migratory pests such as locusts, grain-eating birds and armyworm on the national crop protection services, with DLCO-EA intervening only when requested, i.e. when the infestations are beyond the capacity of national plant protection services. In such events most of the control measures consist of aerial spraying using DLCO-EA aircraft. In Ethiopia, DLCO-EA undertakes additional aerial spraying strictly on a payment-for-services basis.

At their Headquarters Laboratory, DLCO-EA received all the equipment used in the FAO/SIDA Project on the use of alternative insecticides for locust control when the Project ended in 1978. DLCO-EA are now continuing the work which is mainly concentrated on finding suitable alternative insecticides to BHC and dieldrin. The programme is not very intensive since few pesticides are being received for evaluation, and since 1979 there have been few suitable field populations of locusts for experimental tests. At present dieldrin is the main chemical used in the field against hoppers, and fenitrothion against adult locusts.

DLCO-EA is prepared to use its laboratory facilities to carry out pesticide residue testing for the MoA, but MoA need their own facilities.

MoA provide fuel and subsistence pay for DLCO-EA vehicles and drivers who at present transport and distribute the bulk of MoA imported pesticides owing to the latter's lack of transport (see 4.1.5).

Constraints

(a) MoA are concerned that there are delays between their requests and the receipt of aid from DLCO-EA. In the case of controlling armyworm infestations, the consequences of this delay could be serious. The delays are attributed to DLCO-EA's preoccupation with agricultural aviation and their inability to provide aircraft at short notice.

(b) It appeared to the Survey team that MoA feel DLCO-EA could provide more assistance. The Survey team also gained the impression that DLCO-EA facilities are not fully utilized. However, more active aid to Ethiopia could be against the terms of the DLCO-EA convention and be resented by other member states. DLCO-EA are the main line of defense in regional locust emergencies and must, therefore, keep their resources in a constant state of readiness.

5. RESEARCH IN PLANT PROTECTION

As with plant production (see 3.), agricultural research in Ethiopia is highly fragmented. MoA, SFDM, RRC and MCTD all carry out research, largely of a developmental nature (see 4.). The Addis Ababa University (AAU), at Alemaya University College of Agriculture and Debre Zeit Junior College of Agriculture (JCA), also carries out research, which, again, is mostly developmental (see 6.).

By far the most important body undertaking agricultural research in Ethiopia is the Institute of Agricultural Research (IAR). The IAR was established in 1966 and has a clear mandate to coordinate all agricultural research within the country. This mandate was recently reaffirmed by the Ethiopian Science and Technology Committee which is the body responsible for governing IAR. The only other body undertaking fundamental agricultural research is the Scientific Phytopathology Laboratory (SPL) at Ambo (see 5.2).

5.1 INSTITUTE OF AGRICULTURAL RESEARCH (IAR)

In the 15 years since its establishment the IAR has been supported by a series of UNDP/FAO projects. ETH/74/002 and ETH/74/004 have now been succeeded by ETH/78/004 Phase IV which started in 1979 and is expected to extend until December 1983. The title of the project is "Institute of Agricultural Research", Phase IV, and the present objectives are:

- to establish a viable research organization and activity that can support a strong and progressive Ethiopian agriculture;
- to formulate national agricultural research policies;
- to consolidate research at the national level; and
- to advise the Government, development agencies and the farming community on relevant matters.

During the time that the Survey team was in Ethiopia a full review of ETH/78/004 was conducted on behalf of UNDP, FAO and the Government of Ethiopia. The Mission Report contains full details of all the activities of the IAR, staff lists and list of publications and training; it should be read in conjunction with this report.

5.1.1 General Structure

The IAR comprises a Headquarters unit based in Addis Ababa and seven field stations covering various climatic conditions, soil types and elevations (see Fig. 2). The field stations are as follows:

(a) **Holetta - Guenet** (2 390 m altitude)

Objectives: to serve the central highlands, areas above 1 800 m with mixed farming patterns.

Work coverage: barley, bread wheat, horse beans, field peas, lupin, grasspea, fenugreek, Niger seed, rape seed, pasture and forage crops. Crop protection.

Sub-stations: Sheno Bedi, Wollencome, Adami-Tulu, Ginchi, Indibir.

(b) **Bako** (1 600 m)

Objectives: to develop improved varieties and practices, identify promising new crops and socio-economic conditions for the mid-highland, high rainfall areas of western Ethiopia.

Work coverage: maize, sorghum, soybean and other pulses; vegetable crops, particularly chilli peppers and sweet potatoes. Crop protection.

Sub-stations: Didessa, Nedjo.

(c) **Jimma** (1 700 m)

Objectives: to study means to improve coffee yields through selection breeding and improving cultural practices and to find food crops suited to the region and other cash crops for marginal coffee areas (see 2.1.7).

Work coverage: coffee breeding, agronomy, pathology, entomology and weed control; field and vegetable crops, particularly traditional roots and tubers, herbs and spices.

Sub-stations: Agaro, Anfillo, Metu, Tepi, Wenago, Bedessa, Gera.

(d) **Awassa** (1 700 m)

Objectives to find ways to improve crop production in the southern part of the Ethiopian Rift Valley.

Work coverage: maize, soybean, haricot bean, other pulses, sun-flower; vegetable crops, particularly chilli pepper and tomato.

Sub-stations: Arsi, Negeli.

IAR Awassa was established in 1967/68 to serve the needs of State Farms. It was operated by IRAT until 1977/78 when it came under the control of IAR.

(e) **Mekele** (2 100 m)

Objectives: to find ways to improve yields in the food deficient semi-arid highlands of northern Ethiopia.

Work coverage: wheat, barley, chickpea, lentil, sunflower. Crop protection.

Sub-stations: Kobo.

(f) **Melka Werer** (1 350 m)

Objectives: to determine crops and animals and their management suitable for production using irrigation, and for rainfed production in lowland areas.

Work coverage: irrigated production of maize, sorghum, teff, wheat, groundnuts, sesame, lowland pulse crops, cotton, kenaf, citrus, banana, pineapple, papaya, sweet potatoes, onion. Crop protection.

Sub-stations: this station conducts trials on State Farms in the Upper, Middle and Lower Awash Valley and cooperates with State Farms and Settlement Schemes in other parts of the country.

(g) **Nazareth** (1 560 - 1 680 m)

Objectives: to act as the main centre for lowland pulse and horticultural crop research development. The main centre for agricultural engineering research development.

Work coverage: sorghum lowland pulses and horticultural crops of all kinds. Crop protection to be developed as a main quarantine station for research materials.

Sub-stations: this Station runs trials on other IAR stations, State Farms and cooperates with the extension service of MoA.

Entomology, plant pathology and weed science are represented at each station. Rodent research within the IAR is restricted to a small section in Addis Ababa.

5.1.2 IAR Administration

Major policy decisions are made by a Board of Governors which includes representatives of the various users of agricultural research information including MoA, SFDM, MCTD, etc., in addition to non-technical members. These users appear to have little say in the selection of specific research priorities.

5.1.3 Plant Protection Staff

The total numbers of staff engaged in plant protection activities for all stations, including the IAR Rodent Group based in Addis Ababa, is as follows:

Senior Staff:

1 Ph.D. (a weed scientist in charge of Holetta but working full-time on administration), 4 M.Sc., 16 B.Sc.

Junior Staff:

9 technical assistants, 21 field assistants (12th grade), 8 field and laboratory attendants.

Staff in Training:

2 plant pathologists, 1 entomologist, and 1 weed scientist (undertaking further studies overseas); and
2 entomologists, and 1 plant pathologist, taking the M.Sc. course at Alemaya.

There is a full-time FAO Expert in plant pathology working at Jimma on Coffee Berry Disease (CBD) as part of ETH/78/004. The other FAO staff, approximately eight in number, are working on agronomy, plant breeding, social economics, animal production and administration at Headquarters, and on various IAR research stations. There is an FAO Documentalist at IAR Headquarters.

5.1.4 Organization and Documentation of Research

Original system (1966-1977)

During this period, research was conducted, and reports were produced, on a station by station basis. Theoretically, all these reports should be available, but only a few copies of each were produced so that even the individual stations have incomplete runs.

Intermediate system (1977/78 - 1979/80)

During this period, research and reports were based on various disciplines, i.e. department by department. The Crop Protection Coordinator was responsible for gathering individual sections of reports from the Entomology, Plant Pathology, Weed Science Coordinators etc. This took a considerable amount of time hence reports are at present in manuscript form but will be published in due course. This sytem excluded coffee which was dealt with on a team approach basis.

Present system (1980/81 onwards)

Research and reports are now based on a team (National Crop Improvement Team) approach which is essentially crop production orientated. In 1981 there were 14 teams but it is proposed to extend these to 16 institutes including a non crop-specific Basic Research Unit covering methodology, e.g. surveying techniques, pest and disease collections etc.

Details of the teams are given in Appendix VI. These teams are composed jointly of staff from IAR and AAU. Core team members usually include the following: breeder/agronomist, soil fertility expert, entomologist, plant pathologist, weed science expert. Because of staff shortages, many individuals belong to two, three or more teams. 'Preview and Review' meetings are held once a year to plan the forthcoming programme of research and to discuss, at least in outline, the preliminary results of the previous year's work. It is proposed that, in future, these meetings should be preceded by additional meetings between staff members of particular disciplines simply as a check on the desirability of particular research lines.

A Programmes and Planning Unit is now being set up under the direction of the IAR General Manager. This Unit will benefit from improved documentary analysis and will further the research team approach.

5.1.5 Insect Collections

IAR Holetta supports an extensive, well-housed and well-maintained insect collection built up over many years. It is the definitive collection for economic insects in Ethiopia except for Acrididae where the collection at MoA Sholla Laboratories is comprehensive. In many cases, adults have been reared from larval forms where these are responsible for damage.

Each of the IAR stations has a small working collection of economic insects appropriate to its needs.

Insect specimens collected in the field are referred to IAR Holetta for identification. If necessary, examples are sent to the Commonwealth Institute of Entomology for confirmation. The cost of this is met by FAO.

5.1.6 Research Publications

Apart from the various IAR Progress Reports and international scientific journals, there are two indigenous outlets for scientific publication of research work conducted in Ethiopia. The older of these is the Ethiopian Journal of Science (SINET) which publishes some agricultural material. More recently the Ethiopian Journal of Agricultural Science (EJAS) has been launched with the aid of FAO funding. The latter is scheduled to appear biannually but, unfortunately, has already run into financial difficulties.

A full list of all the publications and documents prepared by IAR since its foundation in 1966 is given in Appendix 5 of the Review Mission Report of ETH/78/004 (M). In addition to Research Station Progress Reports there are IAR Annual Reports; Department/Disciplinary Progress Reports; Technical Publications - by discipline - with 16 crop protection titles; Advisory Bulletins of consolidated information which are intended for the extension services and other Government agricultural development organizations and agencies. These include six Amharic leaflets, six bulletins in Amharic and English and seven publications in English, all on crop protection topics.

In general, only small numbers of these publications are produced, e.g. only 500 - 1000 copies of each of the two-language leaflets, which are intended for senior extension staff and were seen to be appreciated by them by the Survey team.

A new series, based on individual crops, e.g. Handbook of Barley Production, is currently in hand.

IAR publications are drafted by professionals in the various stations then submitted to Headquarters for editing, translation, printing and distribution.

The major entomological guide is the Crop Pest Handbook, third revised edition produced by T.J. Crowe and G.M. Shitaye in 1977. Around 2 000 copies of each edition were produced. This very useful handbook also contains notes on the safe use of pesticides, formulation and key to control measures.

5.1.7 Farmers Outreach Programme

This is a form of extension service operated by IAR in conjunction with MoA dealing directly with selected farmers. It has started at Nazareth but is not fully operational as yet at Awassa.

Visits are arranged through MoA extension staff to explain the cost benefits of growing particular crops suited to field size and site etc. to farmers who do the actual work of planting, harvesting and crop protection with IAR guidance on use of fertilizers and pesticides. IAR Nazareth has a small implement section where basic tools such as hand-operated pumps are developed using locally available materials, these are then passed on to the Outreach Programme for field trials by the farmers.

5.1.8 Specific Deficiencies in IAR

(a) Lack of suitably qualified senior staff. Many research workers realize their own limitations and are actively seeking further training, e.g. M.Sc. in general crop protection or M.Sc. or PhD degrees in specific applied fields. New graduate staff have a very general background, with no specialization in plant protection. There are certainly insufficient staff for the new team approach (see 5.1.4). There are no nematologists or virologists who could contribute a great deal to the crop protection work.

(b) Lack of facilities. The Research Stations at Holetta and Jimma are short of laboratory space. Nazareth has a new building in preparation, but this is not yet equipped for work. Awassa has a new extension provided by GTZ and hopes to move into it soon. There are no screen houses or greenhouses at any of the Research Stations.

(c) Lack of information. Holetta and Nazareth have adequate text books but the other stations all lack up-to-date reference books. There is very little specialized taxonomic literature. With the exception of a few publications such as the Tropical Pest Management and Kenya Coffee either supplied free or in exchange, hardly any journals have been received over the past two or three years. Staff are particularly anxious to receive abstracts, such as the Review of Applied Entomology, Bulletin of Entomological Research, etc.

(d) Lack of communication. Telephone contact is intermittent. Radio contact is restricted by old and incompatible equipment. This is further exacerbated by the very poor roads and lack of available transport.

(e) Lack of contact. There has been virtually no contact with the MoA over the past 10 years, although there is good contact between IAR and MCTD. There is limited liaison with SPL and very little with MSFD.

(f) Lack of taxonomists. When specimens are sent to the Commonwealth Institutes of Entomology or Mycology for identification, the results may take three to five months to reach Ethiopia.

(g) No work on stored products entomology, nor on mycotoxins which are a result of fungal infestations in stored grains and are very common when unlined underground pits are used to store produce.

5.2 SCIENTIFIC PHYTOPATHOLOGY LABORATORY OF THE MINISTRY OF AGRICULTURE OF THE USSR IN SOCIALIST ETHIOPIA (SPL)

This Soviet project started work at Ambo in 1973. The Laboratory was in operation by 1977 and is due to be handed over to the Government of Ethiopia by 1987.

5.2.1 Facilities and Staff

The Laboratory stands in its own grounds and is well-equipped with standard laboratory fittings. It also possesses an electron microscope, reference collections, herbaria and library. On the same site are greenhouses, screen houses, workshops, stores and staff quarters. There are also extensive experimental plots.

There are about 14 Soviet scientists working on plant pathology, virology, entomology, weed control and plant breeding. The Ethiopian counterpart participation, however, is well below this number.

5.2.2 Objectives

The main aims of the work programme include:

- Studies on the incidence and importance of diseases and insects and the role of weeds in principal food crops, i.e. teff, wheat, barley, maize, sorghum, potatoes, enset and hot peppers.
- Production of disease-free and resistant crop varieties.
- Development of rational methods of pest control.

SPL operates in liaison with IAR and SFDM. The research results are primarily intended for the benefit of SFDM, but also have a wider application; thus the programme of work includes teff, which is of little importance to SFDM, but a popular crop with the small farmer.

5.2.3 Research Work

Entomology

Studies on the maize stalk borer, Busseola fusca, have been conducted, in conjunction with IAR stations, on economic importance and control in highland areas, particularly in Awassa and Dese where incidence is high. As a result of extensive field sampling, economic thresholds have been determined. Under some conditions one B. fusca larva per stem will reduce yields by five per cent, but under drought conditions this figure may be much higher. SPL have found that carbofuran seed treatment at planting may reduce infestations, but there is a lack of suitable equipment for seed treatment. New pyrethroids are being tested and deltamethrin seems promising as a control measure.

Varieties of maize and sorghum resistant or tolerant to pest attack are being sought.

Work is also being conducted on the sorghum shoot fly (Atherigona soccata), the red teff worm, potato tuber moth and virus vectors in peppers. It has been shown that grasshoppers may cause 15-17 per cent damage to young maize which is sown early. The resistance of American bollworm, Heliothis armigera, to insecticides is under study.

Plant Pathology

An attempt has been made to define areas of distribution of stem rust and yellow leaf rust of wheat. The aetiology of rusts is studied and resistance in wheat is being investigated using local varieties and material from international nurseries provided by IAR. Two Soviet scientists are conducting the wheat breeding programme.

Work is in progress on teff diseases including damping-off and other fungal infections. Teff varieties are tested in conjunction with IAR stations.

The Soviet virologist is studying virus diseases of hot peppers, potatoes, tomatoes and tobacco. Pathogens are being identified, their distribution and control determined and disease-free tissue produced in vitro for propagation work.

Nematology

No work was in progress at the time of the Survey, but a nematologist was expected to join the SPL in late 1981.

Weed Control

Crop losses due to weed infestations in cereals have been shown to be very high. Twenty-five per cent is not unusual in teff-growing areas, and may be as high as 35 per cent in the Gojam region. Losses for maize are also very high, up to 25-35 per cent for all types of farms in 11 out of the 14 regions investigated. Sorghum losses averaged 35 per cent over three years.

Long-term experiments are continuing on integrated methods of weed control in cereals. These include agronomic and chemical control methods, e.g. deep ploughing, increased seeding rates and herbicides. Deep ploughing decreases weeds by about 20 per cent and increases overall yield, but increased seeding has had relatively little effect. Chemical control on State Farms has reduced losses to about 10 per cent.

Striga (see 2.2.6) is also a major problem but the main work on its control is being conducted at IAR, Holetta.

Rodent Control

No work is conducted at Ambo, but there is a Soviet expert working at the MoA Sholla Laboratory.

5.2.4 Publications

Results of SPL work are summarised in Annual Reports, and some are published in 'Tropical Agriculture and Veterinary Science'.

5.2.5 Training

Training of national specialists is undertaken in conjunction with IAR. There are at present several unfilled vacancies among the counterparts at SPL.

Scholarships are provided for M.Sc. degrees in USSR for those Ethiopians with B.Sc. and for Ph.D. degrees for those with M.Scs. One counterpart virologist has achieved the first and is now in USSR working for the second.

Training is also provided for technical assistants of JCA diplomate standard, those more gifted may also be sent for training in USSR. Some assistance is also provided for others, for example, to attend evening courses at Ambo.

Field trials are conducted for demonstration purposes with the extension officers of Peasant Associations, while laboratory demonstrations are arranged for extension workers and farmers.

5.2.6 Limitations of SPL

Very few results have so far been achieved. This is mainly due to the fact that the Soviet staff only stay in Ethiopia for two years, which means there are severe language problems, necessitating the use of interpreters and it is difficult to find Ethiopian counterparts to ensure continuity of the research programmes.

5.3 PROFESSIONAL SOCIETIES

Within Ethiopia the preferred title for professional societies is 'Committee'. There are several Committees whose purpose is to strengthen the links between professionals working in research, teaching and extension.

Scientists in the various disciplines of crop protection may be working in one of many different organizations, e.g. IAR, MoA, SPL or MCTD; it is important that they meet regularly to coordinate research programmes and avoid duplication of effort.

There was a Crop Protection or Crop Entomology Committee in Ethiopia, but as more professional scientists have started to work in the country this Committee has evolved into a number of separate Committees representing various disciplines. The Phytopathological Committee is particularly successful, the Entomology Committee is well-established and there is an embryonic Weed Science Committee.

These Committees plan to hold seminars and produce newsletters, but at present their development is limited by lack of funds rather than by lack of enthusiasm.

6. EDUCATION AND TRAINING IN AGRICULTURE AND PLANT PROTECTION

6.1 PROFESSIONAL LEVEL: ADDIS ABABA UNIVERSITY

Alemaya University College of Agriculture

A University College was founded in Addis Ababa in 1950, and became a full University in 1961. It was closed in 1974 and reopened in 1976 under the Commission for Higher Education. Agricultural studies are centred on Alemaya University College of Agriculture near Dire Dawa in Harrar Region. Until recently the B.Sc. Agriculture degree course has taken three years but, following extensive criticism within the country concerning quality of graduates, this has now been extended to four years. As a result, no students graduated in 1981.

The entry requirements for the B.Sc. course is the Ethiopian School Leaving Certificate, which is equivalent to the UK General Certificate of Education.

The Survey team did not have sufficient time to visit Alemaya but received the following information from the former Dean of the College who is now working with the MoA.

The B.Sc. course in Plant Science covers the broad principles of plant production but provides very little information on plant protection. Graduates joining MoA, SFDM, CTDM etc. in a plant protection capacity require post graduate training at the most basic level. The number of Plant Science graduates varies from year to year, i.e. 34 in 1976/77, 25 in 1977/78, 59 in 1978/79. This is very few compared to the numbers of diplomates from Junior Colleges of Agriculture (JCAs) (see 6.2).

An M.Sc. course in Crop Protection has recently been started at Alemaya within the School of Graduate Studies. At the present time intake is almost exclusively limited to graduate staff of the University itself. It is understood that most of the lectures are given on a part-time basis by existing staff members of the IAR and MoA. As yet there are no M.Sc. graduates of this course so it is not possible to assess its merits or shortcomings.

As members of the University, staff are expected to carry out research work and some are conducting projects in addition to their teaching commitments at JCAs.

6.2 TECHNICAL LEVEL: JUNIOR COLLEGES OF AGRICULTURE (JCAs)

There are currently four Junior Colleges of Agriculture in Ethiopia producing a total of about 800 diplomates per annum. Two of these, Ambo and Jimma, come under the control of the Commission for Higher Education and only offer diplomas in General Agriculture. Nevertheless, the principles of plant protection are included in the course and diplomates of these colleges employed in a plant protection capacity are generally well thought of. The other two JCAs, Awassa and Debre Zeit, come under the control of Addis

Ababa University and offer diplomas in Plant Science and Technology and Crop Science respectively. Both colleges place heavy emphasis on plant protection and were visited by the Survey team.

Awassa Junior College of Agriculture

The aim of this JCA is to produce middle level technicians capable of working under field conditions. The first year consists of a common Basic Science Department course. The second year entails more specialization, e.g. in 1981:

Topic	Teaching hours
Plant Science and Technology	90
Animal Science and Technology	80
Agricultural Engineering	35
Home Economics	25

Crop protection forms only a very small part of the curriculum in the first year, i.e. four hours on weeds and five hours on insect pests under Introduction to Crop Protection. However, for those specializing in Plant Science and Technology in the second year there are 29 hours spent on an Introduction to Crop Protection and 4 hours on Agricultural Crops: Diseases and Pests of Major Economic Importance. Additional plant protection information is provided under the broad guidelines for crop production, e.g. Principles and Practices of Coffee and Tea, Vegetable Production and Management, Principles of Cereal Crops Production, Principles of Fibre and Plantation Crop Production and Production of Major Tropical and Sub-tropical Fruits. Therefore, a diplomate in Plant Science and Technology would have received a basic training in general agriculture plus two semesters, of 48 hours each, covering fundamentals of crop protection and two semesters, also of 48 hours each, covering pests of major economic importance. The total crop protection component of 144 hours is split into approximately 60 per cent theory and 40 per cent practical work.

Since the college was established it has had five intakes of approximately 300 students per annum. From each intake between 220 and 250 students actually graduate with diplomas. Most of the 720 diplomates to date have found work with SFDM, IAR, MoA or similar institutions.

Awassa JCA is financed by the Government of Ethiopia, but it does receive some assistance from GTZ. At present there are instructors and technicians from West Germany and a small number of expatriate staff from elsewhere, e.g. the Philippines, teaching in the college.

Research work

The lecturer in charge of Plant Protection, Assefa G. Amlak, an entomologist, is working on the maize stalk borer, Busseola fusca, in particular on its range of importance, factors controlling termination of diapause, the choice of chemicals for its control and the most suitable time for chemical application.

Future Plans

In the long term, it is hoped to extend the facilities at Awassa to enable capable students to qualify for full AAU degrees. A possible scheme would involve a two-year diploma course with the option of a two-year supplementary course after two years field work. It was hoped that this course would be organized within the next two or three years. In addition it is hoped that a separate department could be created at Awassa dealing solely with crop protection.

Debre Zeit Junior College of Agriculture

This is a sister college to Awassa JCA but, unlike the latter, does not receive any technical assistance from GTZ. The annual intake is about 200-250 students. The second year course entails more specialization, e.g. in 1981:

Topic	Teaching hours
Crop Science (formerly Crop/ Horticultural Production and Protection Technology)	100
Animal Science	57
Rural Economics and Social Development	79

Only the Crop Science course has a plant protection component.

Research work

The Research Institute attached to Debre Zeit JAC has one student carrying out post-graduate research on a crop protection topic. He is currently writing up an M.Sc. following a survey of the major weeds of teff and is also lecturing part-time at the college. The Lecturer in charge of Plant Protection, Tessema Megenassa, an entomologist, is working on the wheat aphid of Eastern Europe, Rhopalosiphum maidis, which has become an important pest on barley in Ethiopia over the past four years. This aphid does not thrive under conditions of high humidity but becomes prominent at the end of the rains. Since Ethiopian farmers tend to plant late to be certain that the rainy season is really underway, barley is often still in the ground at the vulnerable time. Dr. Tessema has demonstrated that attacks can be avoided by careful manipulation of the planting date and/or the use of resistant varieties. He has also shown that the insecticides aldicarb, dimethoate, phosphamidon and disulfoton are effective at controlling infestations.

Specific Deficiencies at Awassa and Debre Zeit JCAs

(a) Lack of Government recognition of the importance of plant protection.

(b) Lack of manpower. One man has to cover all aspects of crop protection teaching at each college.

(c) Lack of equipment such as visual aids for teaching purposes.

(d) Lack of equipment for research purposes. There are no microscopes of even the most basic design.

(e) Lack of text-books and journals due to budget constraints.

(f) Lack of space (although building work is currently in progress which should ease the situation).

(g) Lack of contact with other research workers. Although he is working on the control of Busseola fusca, Ato Assefa is not in touch with others working on this pest at Ambo or with CIBC.

6.3 VOCATIONAL LEVEL: AGRICULTURAL SCHOOLS

There are agricultural schools at Ambo (120 students) and Jimma (200). The schools are government-funded and preference is given to candidates with Ethiopian School Certificate, including a Grade 10 in Science. The schools teach a General Agriculture Certificate course for two years including theory and practical training. The Survey did not visit any schools since these give instructions in basic agriculture but not in plant protection. However, it should be noted that one of the easiest ways of reaching adults is through their children. The Curriculum Development Unit of the Ministry of Education has set up special 'Pedagogy Centres' concerned specifically with the development of a rural science curriculum. It is possible that some plant protection input could be made in this area.

6.4 INSTITUTE OF CROP PROTECTION (ICP)

Since the establishment of such a body has recently been called for by the Supreme Council, it must be assumed that an Institute of Crop Protection would take over the training of plant protection staff, therefore presumably taking over the present responsibilities of the Junior Colleges of Agriculture in this field. The JCAs would, in turn, restructure accordingly to concentrate on other sections of their work. Staff would come from MoA, SFDM, AAU and the existing JCAs. Some assistance from expatriate teaching staff would be welcome. Students would start from 12th Grade and receive two years training to diploma level. The intake would need to be around 200 per year.

The ICP will clearly need buildings and it is understood that these will be located outside Addis Ababa. Equipment will also be required, e.g. microscopes and visual aids, since these are already in short supply at the existing JCAs.

7. PESTICIDES AND APPLICATION EQUIPMENT

7.1 PESTICIDES, REGULATION AND CONTROL

In 1971 the Government Plant Protection Decree clearly placed the responsibility for pesticide regulation and control with the Ministry of Agriculture (MoA). However, the acknowledged inability of MoA to enforce the necessary regulations has led to independent action by many other Government bodies of equal rank, e.g. the State Farm Development Ministry (SFDM), the Relief and Rehabilitation Commission (RRC), the Ministry of Coffee and Tea Development (MCTD) etc. who are now independently ordering and importing pesticides.

In the past major difficulties have arisen when emergency situations have necessitated the rapid availability of chemicals for control operations. These Government bodies, and others such as DLCO-EA, have generally acted responsibly, but it is now agreed that the situation must be improved. The MoA has now started to register new pesticides but has so far been unwilling to restrict any of those in current use other than the most hazardous, e.g. methyl parathion. The MoA feels a responsibility for the safety of the workers and the protection of the environment which it shares with all other pesticide users.

The only facilities for pesticide analysis, other than those of DLCO-EA, are in the Pesticide Laboratory which is part of the Laboratory Group of the Crop Protection Section of the MoA. This Laboratory (see 4.1.2) is at present working on determining the levels of active ingredients in old and/or unlabelled pesticides, a major task in Ethiopia where pesticide stores are acknowledged to be very unsuitable (see 4.1.2, 4.1.4) and many pesticides stocks degenerate rapidly. The Laboratory also checks the quality of pesticide stocks newly acquired by the MoA as a safeguard against fraud. Although there are laboratory facilities for some residue analysis, this is not being carried out at the present time.

7.2 PESTICIDES, CHOICE AND PROCUREMENT

Virtually all pesticides used in Ethiopia are obtained through Government contracts after international tender. There are some limited facilities for the formulation of dusts, e.g. 10 percent DDT, 2.6 percent BHC etc., and for small scale preparation of rodent baits.

Several ministries import independently, and play an important role in the decisions made on pesticide importation since they spend a considerable proportion of their budgets on pesticides (see 4.2.1, 4.2.2, 4.2.3). There are also pesticides which DLCO-EA import into Ethiopia (see 4.3.1) and some given as bilateral aid to individual ministries. Contracts are established with individual companies, e.g. MCTD have used Shell as their major supplier of fungicides for CBD control for the past three years, but they also import supplies from Hoechst and Ciba-Geigy.

In an attempt to evolve a means of control on the import of pesticides, there is now a proposal that the Ethiopian Import-Export Corporation takes over the national task of importing all pesticides and fertilizers.

7.3 APPLICATION EQUIPMENT

The MoA, SFDM, RRC and MCTD all own application equipment, but there are very severe problems with its storage, maintenance and repair (see 4.1.2). There is a great shortage of spare parts, and this problem is compounded by the lack of standardization and the large variety of existing machinery.

In times of emergency there is heavy reliance on DLCO-EA who have mechanics and maintenance facilities for their own equipment (see 4.3.1).

7.4 PESTICIDES AND EQUIPMENT DISTRIBUTION

The MoA has a Section responsible for the distribution of pesticides and application equipment (see 4.1.2). Other ministries are also responsible for maintaining spray teams and equipment for application to crops and farms which are their responsibility (see 4.2.1, 4.2.2, 4.2.3). Spray equipment, protective clothing and pesticides are also provided to the PAs through the MoA but the full cost of these is deducted through a credit system. Spray equipment provided in this way must be maintained by the PAs themselves or, more frequently, by local blacksmiths.

Spray equipment and pesticide requirements are based on a notional 800 ha area for each PA, modified according to the particular characteristics of the land,the crops grown; the previous history of pest outbreaks and the residue of stocks from the previous year. In 1980, the average sum available for pest control for an 800 ha PA with about 300 ha of productive land was around 8 000 birr (US$ 2 000). Some equipment is under the control of separate projects, e.g. for CBD control (see 2.1.7); DLCO-EA also provides assistance to campaigns for the control of national pests (see 4.3.1).

There is also a private company, Admas Air Service, which undertakes crop spraying on a commercial basis (see 4.2.1).

8. ASSESSMENTS OF THE MISSION

8.1 GENERAL CONSIDERATIONS

The size of Ethiopia and the relative inaccessibility of large sections makes transport and communication difficult. This has been aggravated by wars on two fronts (affecting five or six of the fourteen regions), by drought and by the upheavals of the socialist revolution, land reform and nationalisation. The extent of foreign assistance from some sources has been reduced for political reasons. As a result, foreign exchange is in very limited supply thereby making it difficult for Ethiopia to obtain vehicle spares, chemicals, equipment and publications from Western sources. Building work is also restricted so that facilities are often cramped, occasionally to the extent of actually limiting the acquisition of new equipment. Fuel is available but expensive. There are, however, many other factors involved which are dealt with individually in the following sections.

8.2 FRAGMENTATION OF PLANT PROTECTION RESPONSIBILITIES

The Ministries of Agriculture (MoA), State Farm Development (SFDM), Coffee and Tea Development (MCTD), and Industry (MoI), as well as the Institute of Agricultural Research (IAR), and others are all concerned to a greater or lesser extent with plant protection. This, in itself, need not be a disadvantage provided there is reasonable communication (see 8.3). However there are certain areas, for example in Plant Quarantine (see 8.10), where there is a need for decisions to be made on a totally impartial basis. At the present time there is nothing between these institutions and the Supreme Council. It is possible that some sort of umbrella organization could be set up to ensure a reasonable balance of interests in specific areas such as Quarantine. The overall balance will depend on the individual budgetary provisions and, therefore, on the development policy of the Supreme Council.

8.3 LACK OF COMMUNICATION BETWEEN INSTITUTIONS AND INDIVIDUALS CONCERNED WITH PLANT PROTECTION

The economic situation has often meant that various institutions have had to compete for existing funds, and this has lead to a certain amount of rivalry. This in turn has meant that communication between staff of these institutions has tended to be poor. The Survey team was therefore pleased to see that the various individuals concerned with plant protection did manage to get on well with each other on a person to person basis. However it is clearly essential to coordinate their activities to avoid wasteful duplication and to use the limited resources to their maximum advantage. For example IAR, SFDM and MoA all have staff carrying out weed surveys of Ethiopia independently of one another.

IAR have a Liaison Officer based at their Headquarters. His main difficulty appeared to be finding suitable people in other government bodies with whom to liaise.

8.4 LACK OF SUITABLY QUALIFIED MANPOWER AT ALL LEVELS

One basic problem is that graduates from the Plant Science Department of Addis Ababa University are few in number and virtually devoid of any knowledge on plant protection. The various institutions within whom these might find employment in a plant protection capacity are themselves understaffed and so have little time to provide adequate instruction. Young graduates, consequently, often find themselves in a difficult and responsible position which they feel totally ill-equipped to handle. Under such circumstances it is hard for them to install the necessary confidence into those below them who may have good field experience but lack academic training. The more able graduates who reach senior positions in research or operational units also find themselves ill-equipped to face their still more demanding work and find the lack of equipment, facilities and promotion prospects totally frustrating. The most senior staff, while realising that these difficulties exist, are hampered by lack of funds and, not infrequently, have little experience outside Ethiopia on which to plan improvements. Finally, at the other end of the scale, the Development Agent has to cover a wide range of agricultural practices starting only with 12th grade qualifications.

A second basic problem has been the transfer of more able, and often better trained, individuals from the MoA to key positions in other organizations. In the past this practice has tended to weaken the MoA but it is now hoped that such moves will be unnecessary. Another problem is the failure of many trained personnel to return to Ethiopia at the end of their academic training abroad.

8.5 TRANSPORT

Lack of adequate and/or suitable transport is a major constraint at all levels of plant protection research and control operations. There can be no doubt that, whatever the advantages of the Government Transport Pool are for the country as a whole, it seriously restricts plant protection staff both in routine and emergency work. Delays are of two kinds. Firstly, vehicles sent in for even minor repair may be out of service for long periods as they wait their turn for attention. Secondly, because of the same wait that may be involved in routine servicing, staff often exceed the recommended service mileage and incur even more inconvenient and expensive roadside breakdowns.

No doubt the Transport Pool has its own difficulties as regards foreign exchange for spare parts and suitably qualified mechanics. Because of the pressure on transport, there is competition between ministries and even within the ministries. Outside of Addis Ababa there seems to be more flexibility and Regional Agricultural Offices (RAO) are able to have vehicles privately maintained. Since the concept of the Transport Pool is clearly part of Government's policy, it is unlikely that the problem could be alleviated by providing maintenance facilities at MoA. The only palliative is that vehicles supplied through specific outside aid projects should remain immune and budgetary provision should be made for their regular maintenance and repair.

8.6 AGRO-AVIATION

There are obviously operational difficulties in obtaining the services of both DLCO-EA and Admas Air exactly as and when required. The problems of

the first of these two organizations are discussed under 8.19. The problems of the second are not known in detail but the result is essentially similar, i.e. that pilots, aircraft and cash are in short supply. The cost per hectare of aerial spraying to SFDM and MoA has almost doubled over the past six years, and the area requiring spraying has steadily increased as pest problems have become worse. Also, whereas Admas Air is used to dealing with the large continuous areas forming State Farms, it is less familiar with rugged, scattered areas more typical of MoA situations. Indeed, the MoA feel that fixed wing aircraft are frequently uneconomic, because of the scarcity of suitable landing areas, and are considering the economics of leasing a helicopter for spray application and have requested advice on this subject. They see this as a multipurpose aircraft suitable also for survey work. If a helicopter were available, training would be required for pilots and engineers. Even former military helicopter pilots would need instruction on pesticide application techniques. Pilots, in particular, may be difficult to obtain during the tourist season.

8.7 RADIO AND TELEPHONE COMMUNICATIONS

A good communication system is vital to the success of any plant protection project. During most of the visit, telephone links between IAR Holetta and IAR Addis Ababa Headquarters were down and even telephone contact within Addis Ababa itself, e.g. between IAR Headquarters and MoA Headquarters, was extremely unreliable. On the other hand, links to more distant places such as Jimma and Awassa were rather better and it is understood that improvements in the telephone system using microwaves are in hand. Nevertheless, the Survey team felt that an improved radio network would be the most cost effective way of coordinating plant protection activities at all levels (see 9.).

8.8 LIBRARY RESOURCES

With the exception of IAR Holetta, none of the organizations concerned with plant protection are well equipped with basic text-books. This is particularly true for books on plant diseases and weeds. It is, of course, unlikely that many of the more specialised books, e.g. those concerned with details of taxonomy etc., could ever be acquired as these are often out of print. It is also true that the present cost of even the most basic technical books are beyond the pockets of most individual workers. Even so, the provision of modern general work such as Kranz J., Schmutterer H., and Koch W. (1977): Diseases, Pests and Weeds in Tropical Crops, to every research station, ministry headquarters and Regional Agricultural Office in the country would cost less than US$ 2 000.

As regards the receipt of international scientific journals, the present situation is bleak indeed. With the exception of Tropical Pest Management (formerly PANS), virtually no journal covering plant protection has reached Ethiopia during the past three years. The problem has been that the Government will only pay for goods received, while the international publishing houses will only despatch goods that have been paid for. Tropical Pest Management is the exception because it is distributed free of charge and sent not merely to the various administrative headquarters, but also to the sections actually involved in plant protection activities.

8.9 TRAINING, POST-GRADUATE LEVEL

With the exception of the recently established M.Sc. course at Alemaya College with its limited resources and restricted entry, there are no facilities for post-graduate training in plant protection within Ethiopia. A small number of staff are at present training overseas, mostly in the USSR and the USA. Occasionally opportunities arise for short overseas visits, e.g. Ato Tadesse recently participated in the FAO/UNDP 'Travelling workshop for the preparation of research, development, training and information programmes for the prevention of food losses'. However the main constraints are, firstly, the language difficulty in non-English speaking countries and, secondly, the fact that the Government of Ethiopia is unwilling to contribute any foreign exchange towards transport or cost of living allowance, so that donor countries must make full provision for all expenses.

In the past, the provision of counterpart staff for bilateral projects has presented difficulties. Often suitable staff has been unavailable or administrative delays have resulted in the late appointment of a counterpart. Sometimes the appointment has been so late that the project expert himself (or herself) has already departed.

8.10 PLANT QUARANTINE

Although the legislation and mechanism for an effective plant quarantine system exists, it is widely acknowledged that the system does not work. A fundamental difficulty is the lowly position of the plant quarantine section within the organizational structure of just one of the several ministries or public bodies concerned with the importation and exportation of plants or plant produce. Although the separation of MoA, SFDM, RRC and MCTD may have several organizational and/or marketing advantages, it is disastrous from the point of view of plant quarantine. The Survey team felt that these ministries and the IAR had tried to operate within the existing law but occasionally failed to do so through frustration. The MoA was well aware of its own deficiencies in this respect and all concerned are anxious to remedy the situation (see 9.8).

At the present time there is no fully effective plant quarantine in operation at ports of entry by sea and air. Only visual inspections are carried out and these will not detect most potential problems. However, the lack of inspection houses at the seven Plant Quarantine Stations and the absence of a post-entry Plant Quarantine Station means that the country depends very heavily on the phytosanitary certificates issued by other countries. Since many of these, in turn, have totally inadequate inspection facilities, the risk of introduced diseases, in particular, is very high. A brief look at the cost to Ethiopia of Coffee Berry Disease (CBD) should be enough to convince even the most sceptical as to the grave risks involved.

8.11 PESTICIDE CONTROL

As with Plant Quarantine, the mandate for the control of pesticide usage is clearly with the MoA. Again, it is generally agreed that the present system is not working. Although the Pesticide Laboratory at Sholla is doing its best, it has insufficient equipment and trained staff to monitor quality control and pesticide residues. Indeed, a great deal of the Laboratory's time is spent

analysing pesticide samples of unknown identity or quality as a result of poor labelling or poor storage. Effective implementation of even the existing regulations should eliminate, or at least drastically reduce, this part of their work. The Survey team felt that the MoA should not be afraid to act retrospectively. In a country where virtually all pesticides are acquired through government tender, it should not be difficult to agree on acceptable and non-acceptable products. It is acknowledged that there are times when emergency situations necessitate the speedy flow of relief supplies which may include pesticides. However, experience has shown that such pesticides are not always appropriate to the needs and that they may remain indefinitely as a hazardous, costly and time-consuming burden on the country, occupying valuable storage space and creating considerable problems of stock control and safe disposal. It is suggested that emergency situations of this nature are sufficiently important, and sufficiently infrequent, to be dealt with on a high level, person to person basis within the ministries concerned.

Coupled with this problem is the need to provide suitable pesticide stores and proper stock control. Even the MoA central pesticide store in Addis Ababa is totally inadequate. Outside Addis Ababa, the stores themselves may be more sound structurally but nevertheless remain inadequate on the grounds that shortage of space requires that pesticides and food products are often stored in close proximity.

It should be noted that there is no official body, within Ethiopia, specifically concerned with the hazards of pesticide pollution despite the fact that the country uses large quantities of such chemicals. It is understood that a representative of UNEP has recently visited Addis Ababa and made recommendations on monitoring systems. The Pasteur Institute (Central Medical Laboratories of the Ministry of Public Health) has looked at pesticide levels in blood etc., but the staff are hampered by lack of suitable known standards.

8.12 OPERATIONAL GROUP FOR MIGRATORY PESTS (MoA)

The Survey team felt that problems of manpower, communication and transport made it most unlikely that the operations group could carry out its work effectively. This applies in particular to Armyworm control where several field workers told of instances where outbreaks have been reported but no follow-up was forthcoming.

8.13 WEED RESEARCH AND CONTROL

This is fragmented between IAR, MoA, SFDM, MCTD and others. The Survey team felt that there was good cooperation between IAR and MCTD, reasonable cooperation between IAR and SFDM and very poor cooperation between MoA and anybody else. It was particularly surprising to find that IAR staff worked closely with the International Livestock Centre for Africa (ILCA) but not with the adjacent MoA Sholla laboratories. It is generally acknowledged that weed science is a new and previously neglected field in Ethiopia. It is also clear that it is already very important and is becoming increasingly so at an alarming rate as farming systems move into larger and larger units. The weed science area as a whole is understaffed and underequipped if it is to fulfill its responsibilities. Insufficient consideration is given to potential weed problems in national and international projects. It is therefore essential that existing weed science work is coordinated and expanded.

8.14 QUELEA CONTROL

The Survey team was impressed both by the enthusiasm and ability of the staff and the degree of cooperation between the National and Regional Quelea projects and the Ministries of Agriculture and State Farm Development. The objectives of the present Quelea programme are likely to be achieved within the time available and it would appear sensible to support the transformation of the existing Quelea Control Section into a Vertebrate Pest Control Section. The advantages of this development would be the concentration of the existing but fragmented rodent research and control operations into one effective unit, a greater infusion of enthusiasm into this rather neglected field and a small reduction in the scope of activities of the IAR and other ministries. Since Quelea are essentially narrowly confined to lowland areas and rodents are widespread, particularly in highland areas, it seems unlikely that there will be many purely logistical advantages in the control of these pests.

8.15 RODENT RESEARCH AND CONTROL

This is fragmented between IAR, MoA and SFDM. Despite the enthusiasm of some staff and a limited amount of outside assistance, the Survey team felt that no group was large enough or had sufficient resources to be individually viable. It is therefore suggested that activities are concentrated around the proposed Vertebrate Pest Control Section within the MoA.

8.16 PEST IDENTIFICATION SERVICES

IAR maintains an extensive and well curated collection of insect specimens. MoA also has a useful working collection of insects at Sholla laboratories - in fact, the most comprehensive as regards Ethiopian orthoptera - and SFDM has the beginnings of a small collection at its Addis Ababa Headquarters. It should be possible for one competent entomological taxonomist, preferably based at Holetta, to expand and systematically reorganise the existing collection and assist other bodies in routine identifications. In the unusual event of an unknown pest species appearing, identification can be confirmed - as at present - through the Commonwealth Institute of Entomology (CIE).

In general terms, what has been said for insect pests also applies to plant diseases and weed specimens except that unknown material is sent to the Commonwealth Mycological Institute (CMI) and to the Royal Botanic Gardens, Kew, respectively. The IAR collections are probably the best in each case though both MoA Sholla laboratories and SFDM HQ have good herbarium coverage of weeds. There are also very good general herbaria at Alemaya and at AAU in Addis Ababa.

Finally, both IAR and MoA Sholla laboratories have useful rodent skin collections. No organization has any prepared nematode material.

8.17 ADVISORY PUBLICATIONS

MoA, MCTD, IAR, SFDM and RRC all produce their own advisory publications aimed at workers in the field. At first sight it appeared that there was unnecessary duplication. On closer examination, however, the

Survey team felt that all these publications were of good standard and either aimed at different levels, e.g. Regional Plant Protection Officers or DAs, or reflected the different needs of the particular ministries, e.g. predominantly small farmers or predominantly State Farms. At the regional level, all these publications were in use and were obviously well thought of by those working in plant protection. It is probably true that they could be improved by closer communication between all of the producers of such information and the potential users. Often the numbers of copies available were too few when more could have been produced at very little extra cost.

The Survey team was not surprised to find the GTZ publication 'Crop Pests in Tanzania and their Control' by E. Bohlem (1978) in widespread use. The appeal of its simple photographic representation coupled with up-to-date technical information is obvious. It was felt that a similar publication illustrating insects, plant diseases and weeds of Ethiopia in colour would be well worthwhile despite the initial high printing costs.

It was understood that the concept of economic thresholds is applied in very few instances. A few thresholds have been worked out, e.g. those for cotton pests - mainly lepidoptera - which are used by the SFDM.

8.18 RESEARCH, DOCUMENTATION AND PUBLICATION

In theory, all research carried out within the IAR and the ministries should be covered in the respective annual reports. In practice, due to lack of time and lack of money, this is not so. Although the IAR has reports for the period 1977/78 - 1979/80 in manuscript form, the difficulties in collating all the information are considerable. A notable exception to this general rule is the work of the Quelea Control Section which is well documented through the Minutes of the Annual Technical Meetings of FAO/UNDP Regional Quelea Project.

Similarly, although it is possible to publish major research findings in Ethiopian or international scientific journals, only rarely does this occur in practice. The main reasons appear to be shortage of time on the part of the workers themselves and the fact that much of the work is of a developmental nature and is, somehow, felt less important by those directly concerned. Finally, in the case of the newly established Ethiopian Journal of Agricultural Science (EJAS), the reason is simply lack of funding.

The Survey team felt that all research being carried out within Ethiopia is worthy of proper documentation. Research not repeated is equivalent to work not carried out and can be ill afforded in any country, certainly not in a developing country. Moreover it is essential that documentation takes place within a reasonable time of the work having been carried out - if it is not, the procedure becomes a bore. Not only does documentation assist others working in the field, but it also helps clarify the mind of the research worker himself and, not infrequently, prevents precipitate decisions. Annual reports can be exchanged with research organizations in other countries and so generate market intelligence and facilitate contact. Finally, documentation of work successfully carried out is a great boost for morale. In short, it is well worthwhile at all levels.

8.19 DESERT LOCUST CONTROL ORGANIZATION FOR EASTERN AFRICA (DLCO-EA)

This assessment is concerned only with the ability of DLCO-EA to carry out its commitments to the Government of Ethiopia as a member country of a regional organization.

One of the main responsibilities of DLCO-EA is to assist member countries in the control of migratory pests when these cannot be contained by national control teams, i.e. when these national teams are 'unable to cope'. The problem with this definition is that it fails to take into account what is, or is not, reasonable provision by that member country to look after its own affairs. It is possible to conceive of two countries, one of which spent its entire plant protection budget on control measures against migratory pests and another which spent nothing at all. The actual point at which either country was 'unable to cope' would still be a matter of conjecture and a bone of contention between the two countries. It is therefore unrealistic to expect DLCO-EA to be at full strength and on full alert in each member country, all at the same time. Certain delays are inevitable, therefore, and the Survey team was assured that DLCO-EA was aware of these problems and was doing its best to overcome them. The corollary of this, of course, is that DLCO-EA may well be forced to cancel or postpone long standing engagements for routine activities (e.g. banana or tsetse spraying, Quelea survey work, etc.) at short notice, in order to fulfill emergency obligations. The deployment of aircraft at any one time much depends on the work in hand, the probabilities of emergency operations being required in one place or another and the availability of fuel and maintenance facilities. In addition, there is the very human tendency for individuals to prefer a favourable environment to a hostile one. It would seem desirable, therefore, to strengthen national plant protection capabilities whilst maintaining that of DLCO-EA. This will mean fewer unscheduled emergency operations with less interruption of scheduled routine operations while, at the same time, maintaining the capacity to concentrate its efforts should the need arise.

Most of the other activities of DLCO-EA, such as field trials on new pesticides, development of survey, forecasting and control strategy etc., are of all-round benefit. There are a few areas, however, where DLCO-EA is in a position to provide valuable local assistance. In Ethiopia, for example, transport is available which could be used to facilitate the distribution of pesticide supplies. Equally, the laboratories of the DLCO-EA Headquarters in Addis Ababa, fully equipped with gas liquid chromatography apparatus and highly competent scientific staff, are located adjacent to the Sholla Laboratories of the MoA with no facilities at all for residue analysis. The Survey team felt that DLCO-EA was doing the best it could, within its terms of reference, to provide assistance. However, an increased flexibility of these terms, enabling greater participation in national programmes, would be to the advantage of all member countries.

9. RECOMMENDATIONS

9.1 COORDINATION OF PLANT PROTECTION ACTIVITIES BETWEEN GOVERNMENT BODIES

It is recommended that urgent attention be given to the problem of coordinating the work of the various institutions concerned with plant protection in Ethiopia. While it is recognized that MoA, SFDM, MCTD and IAR each have important and individual responsibilities, it is clearly in the interests of all concerned to pool resources and avoid unnecessary duplication wherever possible. The Survey team felt this was a sufficiently important matter to justify the establishment of a high level National Plant Protection Coordinating Committee, directly responsible to the Supreme Council. Under this Committee, a special Liaison Unit could be set up. This Unit, based at Addis Ababa, could share facilities with the suggested Documentation Centre (see 8.4). It should include several liaison Officers who would bring to the attention of the Committee ways in which genuine cooperation and coordination could be achieved, and would liaise with the various institutions involved.

9.2 TRAINING

9.2.1 Post-Graduate Training

There is a need to provide post-graduate training to enable existing staff to be more effective. As a priority, attention should be given to training specialists in the following disciplines: entomology, plant pathology (including virology and nematology), weed science, vertebrate pests, biological control, post-harvest pests, plant quarantine, pesticide chemistry and regulation. In addition, there is a need for short 2-3 month specialized courses. It should be noted that the Government of Ethiopia has made it clear that it has no intention of releasing any foreign exchange for this purpose, so prospective donors would be required to make full provisions for all expenses including a cost of living allowance.

9.2.2 Senior Staff Study Tours

Very few of the existing plant protection staff have any experience outside Ethiopia. It is recommended that short study tours to nearby countries are funded, but that care is taken to ensure that the candidates selected are the ones most likely to benefit. The Sudan or Egypt are both countries which could be visited to good advantage. Again, foreign exchange would need to be provided.

9.2.3 Graduate Training

There is a need to rapidly increase the numbers of graduates with plant protection knowledge and experience. The best way of doing so is to train approximately 50 diplomates to B.Sc. standard for each of 2 years. Where and how this would take place is not clear as details of the proposed Institute of Crop Protection (ICP) are not yet available. However, one major requirement

will be funding for students to enable them to support their families during the period of their training.

The long term objective should be to have an entomologist, plant pathologist and weed science graduate in each zone and then each region.

9.2.4 Development Agent (DA) Training

The numbers of DAs and the distances between the regions are such that only in-service training is practicable. Direct assistance can be provided only through a 'train the trainer' type programme. Suitable courses are provided by the Centre for Overseas Pest Research (COPR),UK, and certain pesticide manufacturers, e.g. Shell (East Africa) at their new Training Centre in Zambia.

It is possible that the present system of rather generalized DAs will be more extensively replaced by specialist Crop Protection Agents (CPAs). It is possible that this smaller number of people could be handled by the proposed ICP. The number of DAs and/or CPAs requiring in-service training is about 200-300 per year. Funding would be required for materials and living allowances for 2-4 weeks annually.

9.3 CORRECTION OF MATERIAL SHORTAGES

It is recommended that the supply procedure for laboratory chemicals and equipment is re-examined. The present system of purchasing through the Central Laboratories does not seem to be working well.

At the regional level, books and microscopes are urgently required. Visual aids for teaching purposes are also required wherever teaching and training programmes are conducted.

9.4 TRANSPORT

It is recommended either that some formal arrangement is agreed whereby DLCO-EA tracks can be used to distribute pesticides, or that suitable trucks are acquired by the MoA.

It is also recommended that steps are taken to improve the availability of 4-wheel drive vehicles for survey and control work over the 6 million hectares of land. How this can be done is not clear. Vehicles previously supplied to the MoA have tended to be absorbed into the Government Vehicle Pool and it is unlikely that any donor would be prepared to provide replacements without safeguards that this would not happen again. It is realistic to assume that vehicles will only be supplied to service specific projects. Provision should be made for such vehicles to be estimated that the MoA require around 28 4-wheel drive vehicles for routine survey and control work in addition to the 8 mobiles already in use. It is recommended that these mobiles be deployed on a zonal basis to enable them to be mobilized more readily in emergency situations.

It is hoped that the upgrading of the Crop Protection Division to the level of a Department will give it more control over its vehicles.

9.5 LIBRARY FACILITIES

The provision of good, modern, standard text books on plant protection (entomology, plant pathology and weed science) for all ARI stations, Ministry HQ's and MoA regional offices is an urgent priority. In addition, basic international scientific journals appropriate to each field must be made available somewhere in Ethiopia. These could be purchased outright by donor funding or, if this was not forthcoming, could be facilitated by using some intermediate body, such as FAO or DLCO-EA, to provide temporary credit facilities for subsequent reimbursement by the Government of Ethiopia. It is suggested that these are located somewhere easily accessible within Addis Ababa. To ensure that knowledge of the contents of these journals is circulated speedily, it is recommended that a Documentation Centre is set up to provide details of current contents to the specialists in each field. Photocopies of important papers should be available, on request, from the Documentation Centre which should have two good quality, low maintenance photocopy machines as part of its equipment. Users of the scheme would need to have some budgetary limit to curb reckless use. The circulation of abstracts would obviously reduce the risk of photocopying irrelevant material. A similar system to the one suggested is already in operation at the University of Dar-es-Salaam, Morogoro, Tanzania.

9.6 RADIO COMMUNICATIONS

It is urgently recommended that steps already in hand to improve the radio communication network are completed as soon as possible. This is seen as one of the easiest and most cost effective methods of improving the standard of plant protection within Ethiopia. It is understood that the FAO have made a study of the communication requirements for migratory pests in the region. The MoA itself would like to see one fixed radio at each regional HQ plus an additional 10 mobiles evenly distributed throughout the country. Some provision should also be made for the training of radio operators and technicians.

9.7 POST-HARVEST PEST CONTROL

It is urgently recommended that the most suitable method of post-harvest storage is re-evaluated for the various regions. In particular, it is necessary to determine the technical and social reasons why the FFHC design has not been more widely accepted. It is also essential to try and obtain more accurate assessments of post-harvest losses. It is likely that present estimates are too high in some areas and too low in others - both resulting in unnecessary expenditure of resources. However, since crop yields within Ethiopia as a whole tend to be low, the relative importance of post-harvest losses is likely to be greater than usual.

9.8 PLANT QUARANTINE

There is an urgent need to improve the plant quarantine service, particularly in view of the members and quantity of plants and seed materials which are being imported and the high risk of pest diseases from neighbouring countries. A consultancy visit will be necessary to determine the exact needs and to develop proposals for improvements.

9.9 PESTICIDES

The following points related to pesticides should be given careful consideration:

(a) There is a need to reappraise the existing legislation on pesticides, and to formulate realistic regulations for the importation, registration, and use of pesticides. Appropriate personnel will require training for the implementation of these regulations, and should be provided with the necessary equipment and facilities.

(b) There is a need for a coordination between the various ministries and agencies importing and using pesticides to evolve a common policy on the most appropriate pesticides to be imported. Consideration should also be given to the safe use and ease of application of various formulation under local conditions.

(c) As an urgent priority, adequate pesticides stores should be provided both in Addis Ababa and in the regions. Where necessary, new stores should be constructed, solely for pesticides. Existing stores should be repaired. No consumable produce should ever be stored in close proximity to pesticides. Personnel should be given training in the specific requirements of pesticide store management.

(d) Decisions should be taken on the fate of the old stocks of pesticides at present in store. In many instances it may be advisable _ on the grounds of safety, efficacy, and economy _ to dispose of these stocks. Advice should be sought on their safe disposal.

To deal with the above, it is advisable that guidance be sought from qualified specialists.

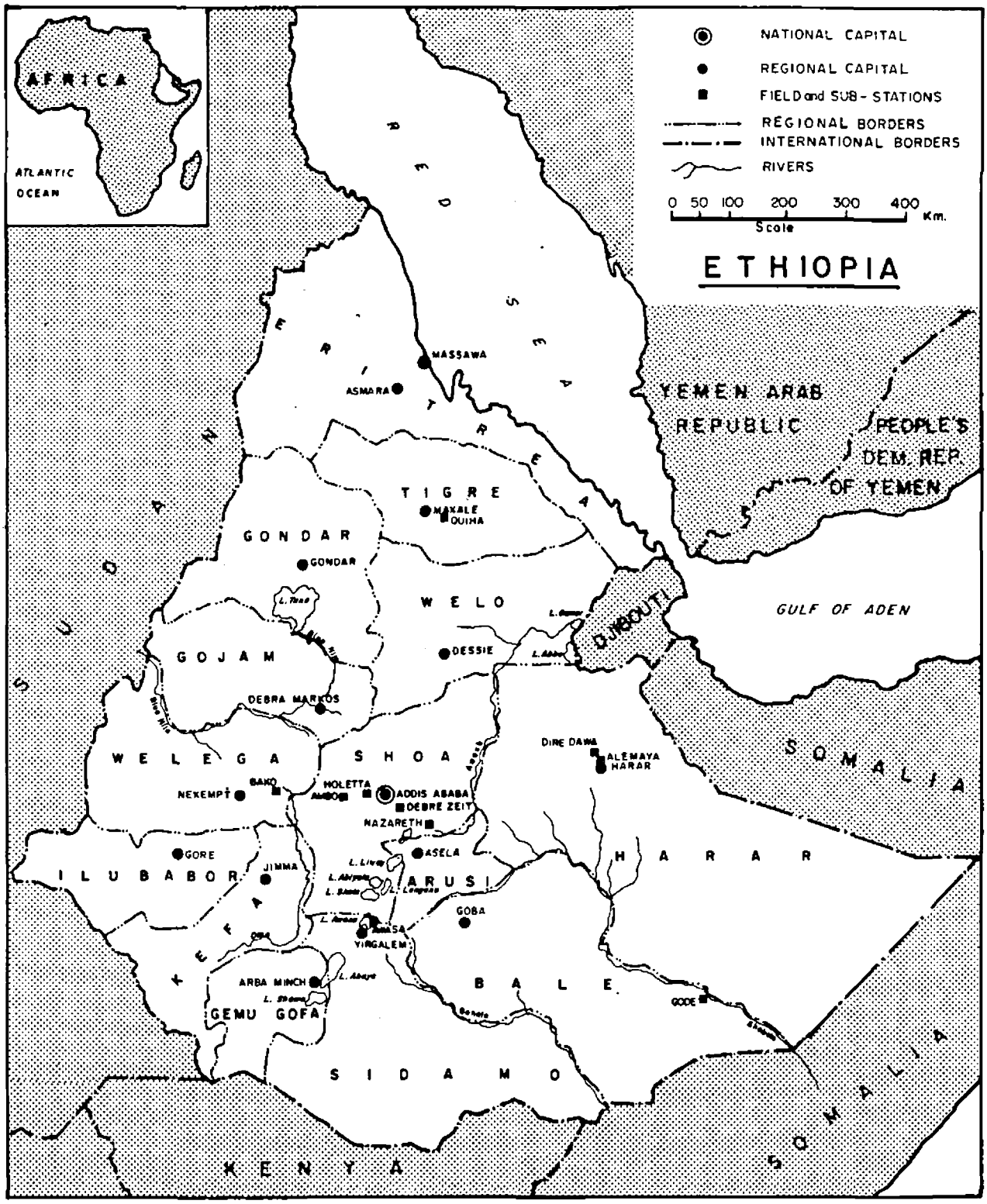
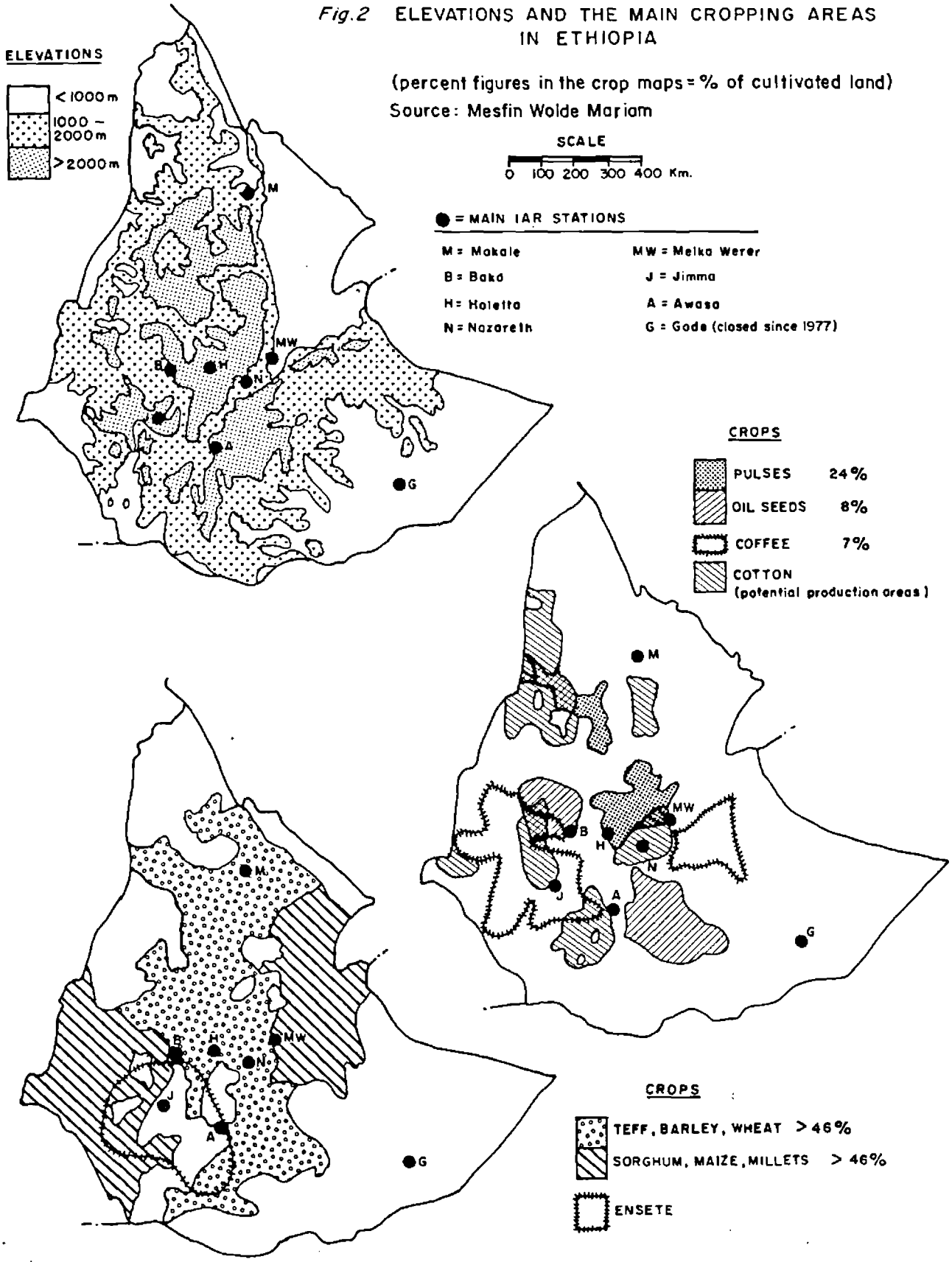


Fig. 1 ETHIOPIA, PROVINCES and MAIN RIVERS

Fig.2 ELEVATIONS AND THE MAIN CROPPING AREAS IN ETHIOPIA

(percent figures in the crop maps = % of cultivated land)

Source: Mesfin Wolde Mariam



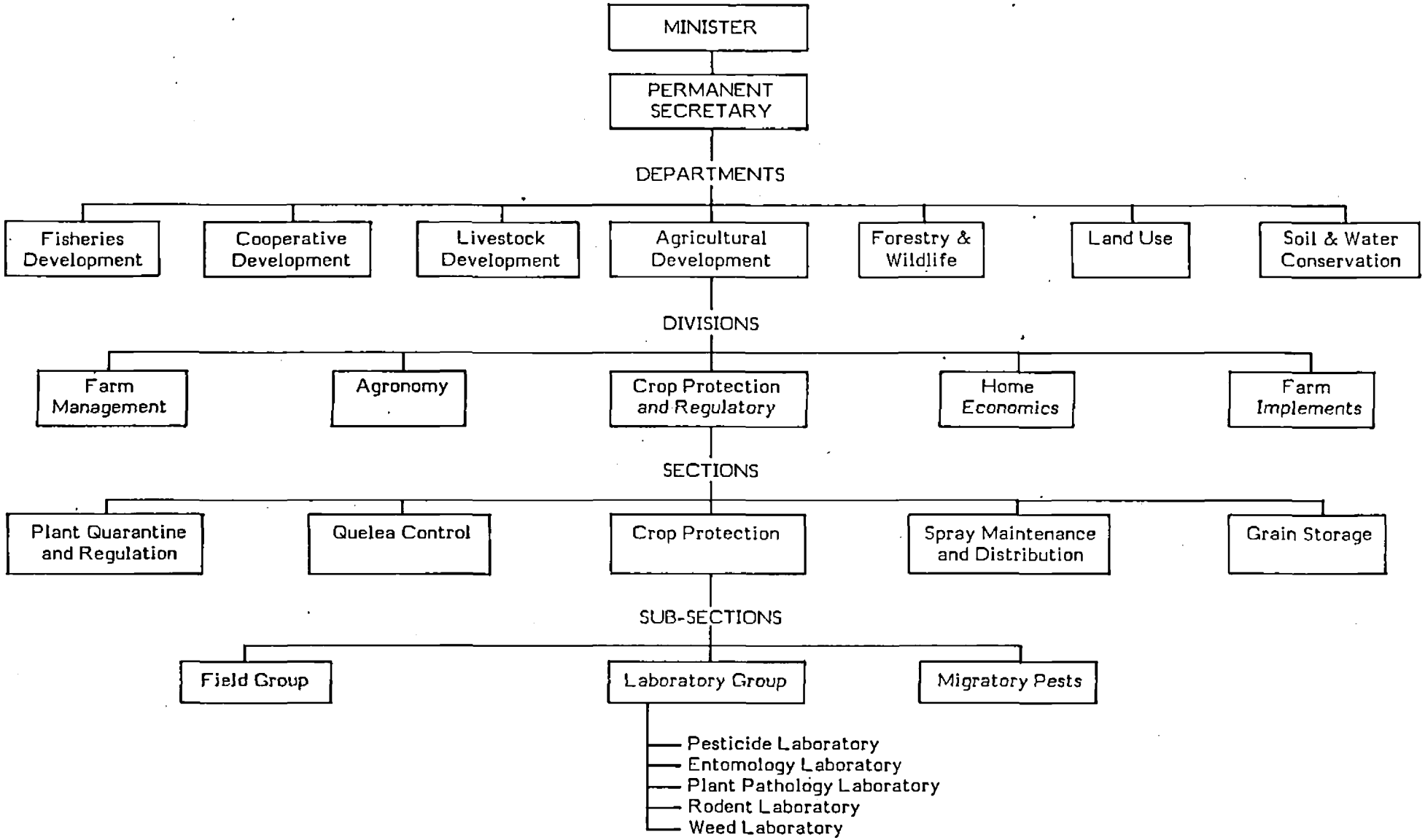
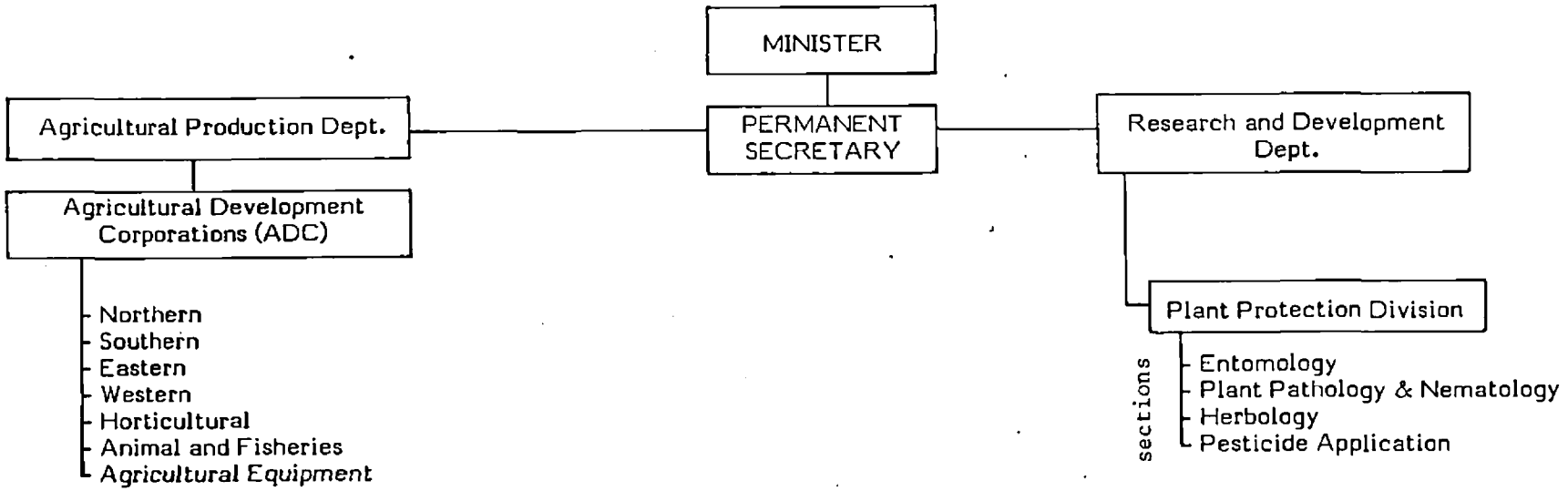


FIG. 3: ORGANIZATIONAL CHART, MINISTRY OF AGRICULTURE



(ADCs are divided into ADEs: Agricultural Development Enterprises. Each ADE comprises a number of State Farms. Each ADC (except last two) has a plant protection service)

(applied research and training, and advisory services to ADCs)

Fig. 4: Organizational chart, State Farm Development Ministry

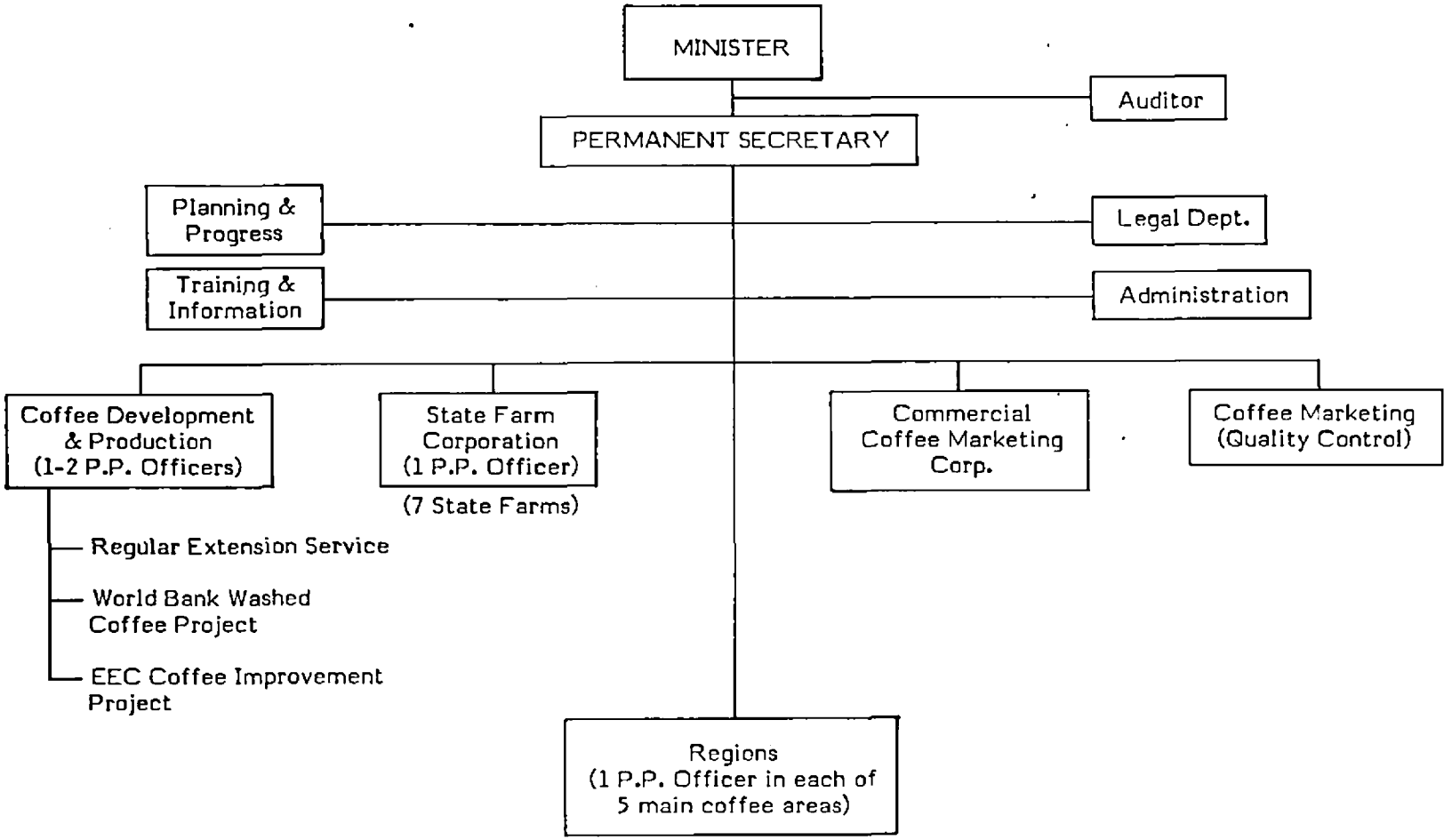


Fig. 5: Organizational chart, Ministry of Coffee and Tea Development

TABLE 1 - LAND USE, POPULATION AND LABOUR FORCE IN ETHIOPIA

	1978	1979	1980
LAND (000 ha)			
Total	110 100		
Arable	13 000		
Irrigated	55		
Forest and Woodland	8 860		
POPULATION (000)			
Total	30 982	31 773	32 601
Agricultural	24 852	25 319	25 800
LABOUR FORCE (000)			
Total	12 898	13 153	13 435
Agricultural	10 346	10 482	10 632

Source: FAO Statistics Department.

	Area harvested (000 ha)	Production (000 t)
CEREALS		
Barley	962.1	772.0
Maize	1 105.8	1 143.6
Millet	266.9	193.2
Oats	20.0	614.0
Sorghum	763.2	689.4
Wheat	515.9	468.5
SUGAR AND STARCH CROPS		
Potatoes	38.5	238.0
Sugarcane	8.2	1 320.0
OIL CROPS		
Castor	12.0	12.0
Groundnuts	47.0	28.0
Linseed	35.7	13.5
Rape	53.0	21.5
Sesame	63.0	36.0
Safflower	65.0	31.0
Melonseed	-	78.0
FIBRE CROPS		
Seed Cotton	28.0	60.0
Sisal	1.0	0.4

	Area harvested (000 ha)	Production (000 t)
FRUITS		
Citrus	-	22.1
Banana	2.9	72.5
Other Fresh Fruits	6.7	105.0
VEGETABLES		
Beans (dry)	14.9	13.4
Broad beans	324.9	276.8
Chick peas	142.6	78.7
Lentils	58.3	27.4
Peas	131.4	129.4
Yams	63.5	276.0
Total Roots and Tubers	320.0	900.0
Cabbages	2.7	42.0
Onions	3.5	36.0
Tomatoes	3.6	46.0
Vegetables (fresh)	135.0	360.0
Feed Vetches	63.3	30.5
Coffee	690.0	187.2
Tobacco	4.5	2.8

TABLE 2. CROP PRODUCTION IN ETHIOPIA, 1980

Source FAO Statistics Department.

Table 3 ETHIOPIA: CROP AREAS 1978/79 (thousand ha)

	Arusi	Bale	Eritrea	Gemu Gofa	Gojam	Gondar	Harar	Iluba-bor	Kefa	Shoa	Sidamo	Tigre	Welega	Welo	Total
Teff	29.0	8.2	28.9	14.6	243.3	205.9	2.6	47.4	116.9	345.7	13.3	67.1	177.6	64.7	1365.2
Barley	164.2	78.0	25.8	82.4	86.2	120.9	1.6	3.5	23.2	199.9	54.5	25.6	14.4	3.7	833.9
Wheat	163.3	34.0	16.1	1.5	27.8	26.3	5.8	1.8	7.6	160.3	0.5	36.0	2.3	19.9	503.2
Maize	43.9	1.2	18.1	29.3	48.0	27.6	39.6	63.5	171.3	195.6	94.5	5.8	143.5	6.8	888.7
Sorghum	24.9	1.1	82.9	6.5	9.0	57.1	162.1	17.5	31.4	137.2	2.4	44.5	79.7	63.0	719.3
Millet	-	0.8	34.8	2.4	41.9	53.1	0.8	6.2	7.5	3.2	-	42.7	42.9	0.3	236.6
Horse beans	41.0	2.5	3.1	1.5	29.2	57.2	2.4	1.9	7.8	106.1	3.4	9.2	5.5	24.9	295.7
Chick peas	1.1	0.1	6.8	2.5	6.0	52.8	0.1	2.0	0.3	45.7	3.5	15.4	0.5	3.7	140.5
Haricot beans	1.3	-	-	0.9	-	0.5	0.3	0.4	-	11.3	2.3	0.3	2.3	0.1	19.7
Field peas	16.9	13.3	5.0	2.4	15.5	16.4	0.2	4.8	9.2	29.5	1.4	2.7	3.3	5.4	126.0
Lentils	5.4	0.6	2.6	0.1	1.0	10.1	0.3	-	-	29.7	0.1	2.2	2.3	4.0	58.4
Noug	0.3	-	-	-	38.4	39.9	-	1.3	1.2	3.6	-	5.3	23.6	0.3	113.9
Flax	3.4	2.8	9.7	-	10.1	2.1	-	0.1	0.1	5.9	-	2.5	0.3	0.9	37.9
Vetch	1.0	-	8.2	-	5.5	18.3	-	-	-	13.0	-	7.6	-	3.9	57.5
Total															5396.5

Source: Preliminary forecast of area, production & yield of major crops, Ministry of Agriculture, Addis Ababa, July 1979.

Table 4 ETHIOPIA: CROP YIELDS 1978/79 (quintals/ha)

	Arusi	Bale	Eritrea	Gemu Gofa	Gojam	Gondar	Harar	Iluba-bor	Kefa	Shoa	Sidamo	Tigre	Welega	Welo	Mean
Teff	11.4	6.5	7.4	4.3	7.4	10.0	7.0	6.9	7.8	7.8	9.5	7.5	4.7	10.4	7.8
Barley	10.9	13.5	5.5	2.3	4.3	7.5	5.3	3.7	7.9	5.6	3.3	7.5	5.1	5.9	7.4
Wheat	12.5	12.0	4.7	2.6	7.2	4.2	6.0	2.1	11.3	5.1	13.0	5.6	5.1	9.3	8.3
Maize	14.8	39.3	6.9	7.1	6.8	6.7	7.7	8.5	8.5	15.4	9.5	16.1	5.1	10.0	9.7
Sorghum	15.1	8.6	8.8	5.6	6.5	10.5	7.6	9.6	6.5	11.4	7.6	10.7	6.1	11.2	9.3
Millet	-	6.3	6.7	5.5	10.5	11.2	10.1	10.1	4.6	5.2	-	5.6	5.3	13.3	7.9
Horse beans	10.6	12.6	5.5	2.5	8.1	5.4	5.3	1.0	6.6	10.3	5.4	10.8	4.3	11.6	8.9
Chick peas	5.3	8.0	3.9	2.2	3.0	7.2	14.0	5.0	-	4.5	7.2	4.0	1.8	1.8	5.4
Haricot	4.1	-	-	3.7	-	2.6	18.7	6.5	-	6.3	11.1	4.0	5.5	-	6.5
Field peas	4.2	7.5	7.2	1.8	4.5	13.1	15.5	1.5	11.0	5.3	10.7	8.6	4.6	5.2	6.9
Lentils	3.1	16.5	9.4	4.0	7.1	4.9	13.3	-	-	3.2	-	8.0	5.4	7.5	4.6
Noug	3.0	-	-	-	2.4	2.9	-	3.5	5.1	3.2	-	1.8	3.9	1.7	2.9
Flax	8.0	5.4	3.8	-	2.5	3.4	-	-	-	2.1	-	2.9	3.7	3.9	3.6
Vetch	4.0	-	5.3	-	5.1	6.1	-	-	-	4.6	-	4.9	-	3.9	5.2

Source: Preliminary forecast of area, production & yield of major crops, Ministry of Agriculture, Addis Ababa, July 1979.

APPENDIX I

ITINERARY WITH NOTES ON VISITS AND DISCUSSIONS

Tuesday, 7 April 1981

Addis Ababa. Meeting with G.S. Campbell, Principal Research Adviser ETH/78/004 (M) Institute of Agricultural Research, Phase IV (Addis Ababa), and L.S. Thrower, Consultant, FAO Review Mission, ETH/78/004.(G.B. Popov only)

Wednesday, 8 April

Addis Ababa. Meeting with Hadera Gebremedhin, Head, Crop Protection and Regulatory Division, Agricultural Development Department, Ministry of Agriculture, and M.M. Jaeger, Expert Ornithologist/Ecologist and Project Manager, ETH/77/022, Control of Grain-Eating Birds. Discussion on proposed programme of Survey.

Thursday, 9 April

Addis Ababa. Meeting with Demissie Gebre-Michael, Head, Agricultural Development Department, MoA, Hadera Gebremedhin and Abdurahman Abdulah, Entomologist in charge of Sholla Laboratories, MoA. Discussions on the organization and functions of the Crop Protection Division of MoA and the problems of crop protection in Ethiopia.

Friday, 10 April

(a) Addis Ababa. Visit to Sholla Laboratories, MoA.Discussions with staff working on entomology, plant pathology, pesticide chemistry, rodent control, weed science and armyworm monitoring. Examination of the weed herbarium, insect reference collections and library.

(b) Visit to the UNDP/FAO Project, ETH/77/022, Control of Grain-Eating Birds, Headquarters in Addis Ababa. Discussions with M.M. Jaeger, Expert Ornithologist, Project Manager, W.A. Erickson, Survey Ornithologist and Hadera Gebremedhin on the achievements of the Project and the proposals for future work.

(c) Visit to the MoA Crop Protection Division Central Pesticide Store and Spray Maintenance and Distribution Section, Sholla. Discussions on stock control and building requirements.

Saturday, 11 April

(a) Addis Ababa. Visit to Relief and Rehabilitation Commission (RRC) Headquarters. Discussions with Bayou, Habte, Giorgis, Head, Plant Protection Division, on plant protection within the 32 000 ha of settlements and associated crop areas which are the RRC's responsibility.

Monday, 13 April

(a) Addis Ababa. Visit to Coffee and Tea Development Ministry (CTDM) Headquarters. Discussions with Awatahagne Alemayoh, Chief, Extension and Development CTDM and Yilmama Yemane Berhane, Head of Cooperatives on plant protection operations independent of MoA and reseach in conjunction with IAR.

(b) Visit to Plant Quarantine Headquarters, MoA. Discussions with Tesfaye Gabrehiwot, Officer-in-Charge and Hadera Gebremedhin. This Division of the MoA has sole jurisdiction over the importation and exportation of plants, plant products, and pesticides to and from Ethiopia.

Tuesday, 14 April

(a) Addis Ababa.Visit to State Farms Development Ministry (SFDM). Discussions with Bayou Belayneh, Chief, Crop Protection Department, Dereje Ashagati, Plant Pathologist, Lagesse Zewdie, Entomologist, Shewarega Berhanu, Weed Scientist, and Fulassa Sorri, Pesticide Application Specialist on the crop protection activities of SFDM and the associated problems. Tour of laboratory facilities. As with RRC and CTDM, the activities are largely independent of MoA and other Ministries. Research is of a developmental nature and is assisted by Soviet counterpart experts with some input from IAR. The work of the Scientific Phytopathology Laboratory (SPL) at Ambo is also principally for the benefit of SFDM.

Wednesday, 15 April

(a) Addis Ababa. Visit to DLCO-EA Headquarters. Discussions with: D.M.Wako, Director General; K.M. Ahmed, Director, Operations; I.A. Musa, Director Administration and Finance; M.O.M. Nurein, Chief, Scientific and Research Department; K.J. Musa, Research Officer and Ahmed Ibrahim, Research Assistant. Tour of laboratory, library and other facilities.

Thursday, 16 April

(a) Addis Ababa. Visit to Institute of Agricultural Research (IAR) Headquarters. Discussions with Tage Worku, General Manager and Tadesse Gebremedhin, Research Entomologist/Crop Protection Department Coordinator. The function of the Headquarters Section is to provide administrative support, coordinate research and disseminate information. Research itself is carried out at the various IAR stations, i.e. Holetta-Guenet, Nazareth, Bako, Jimma, Awassa, Melka Werer and Mekele.

(b) Visit to Ciba Geigy Technical Advisory Office. Discussions with Shitaye Wolde Hitsan (Manager), formerly of IAR and associate of Dr. T.J. Crowe, FAO Entomologist.

Friday, 17 April

Ambo. Visit to Scientific Phytopathology Laboratory (SPL)of the Ministry of Agriculture of the USSR in Ethiopia. Discussions with B.P. Strekozov, Weed Control Specialist and Deputy Director and Mr. Kitov, Entomologist, on the general activities of SPL. Tour of laboratories and greenhouses and further

discussions with individual experts on plant pathology, virology, bacteriology, entomology, weed science and agronomy. The principal objectives of SPL are: the study of pests on main food crops, particularly teff, wheat, barley, maize, peppers and potato; the development of resistant strains; and improved crop protection methods. There is some cooperation between SPL and IAR but little contact with MoA. The Ambo laboratories are well equipped and operate a high resolution electron microscope. Most, though not all, of the research is directed towards State Farms. The Station is due to be handed over to the Ethiopian Government by 1987 but at present the recruitment of Ethiopian counterpart staff is behind schedule.

Saturday, 18 April

Holetta. Visit to IAR Station, accompanied by Akalu Sahlu, Plant Pathologist, MoA, discussions with Tadesse Gebremedhin, Research Entomologist/Crop Protection Coordinator. Tour of laboratory, library, herbarium, insect collections and other facilities. Further discussions with research staff concerned with plant pathology, entomology and weed science.

Monday, 20 April

Travelled from Addis Ababa to Awassa (275 km south) by road, accompanied by Akalu Sahlu.

Tuesday, 21 April

(a) Awassa. Visit to MoA Sidamo Regional Agricultural Office. Discussions with Ato Tadessa, Regional Agricultural Officer, on the general structure of the MoA at regional level.

(b) Visit to MoA Regional Crop Protection Office. Discussions with Assaye Lemma and Markos Derebie, Regional Plant Protection Officers on operational problems.

(c) Vist to IAR Station, Awassa. Discussions with Abdurahman Ali, Officer-in-Charge and Agronomist/Breeder, and Teclemariam Woldekidan, Entomologist/Pathologist. This Station was originally established in 1976 as part of the Agro-Industry Programme and was run by the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières (IRAT). In 1977 the Station came under the control of IAR.

(d) Visit to Awassa Junior College of Agriculture. Discussions with Geremew Haile, Dean/Assistant Professor and Assefa G. Amlak, Lecturer in Plant Protection/Entomologist on the teaching of plant protection techniques. This JCA comes under the control of Addis Ababa University, AAU.

(e) Travel to Nazareth.

Wednesday, 22 April

(a) Visit to IAR Station, Nazareth. Discussions with Hattu Assefa, Pulse Crop Pathologist and Pathology Coordinator, Tsedeke Abate, Horticultural and Pulses Entomologist, and Woizerit Alnaz Pilmu, Plant Pathologist.

(b) Visit to Debre Zeit Junior College of Agriculture. Discussions with Tessema Megenassa, Lecturer-in-Charge of Plant Protection/Entomologist on the teaching of plant protection techniques. This JCA comes under the control of Addis Abaa University, AAU.

(c) Return to Addis Ababa.

Thursday, 23 April

(a) Addis Ababa. Visit to the Central Statistics Office, to collect information on cropping areas and yields.

(b) Visit to IAR, Sholla, for discussions with Ms. S.B. Edwards, FAO Documentalist attached to UNDP/FAO Project ETH/78/004 (M), Institute of Agricultural Research Phase IV, (Addis Ababa), on the organization of research and the presentation of research results for extension staff.

Friday, 24 April

Travel to Jimma, 343 km south-west of Addis Ababa.

Saturday, 25 April

(a) Visit to IAR Station, Jimma. Discussions with Gebremasiam Shekour, Officer-in-Charge and General Field Crops Agronomist, on plant protection activities. This Station is primarily concerned with coffee and especially with the selection of resistant strains against Cofee Berry Disease (CBD). Work is also carried out on coffee diversification, field and horticultural crops.

(b) Visit to CTDM Regihal Office, Kefa at Jimma. Discussions with Tedla Alemayehu, Regional Agricultural Officer and Woizerit Hymano Abebe, Plant Protection Officer, on field equipment.

Sunday, 26 April

Travel from Jimma to Ghian.

Monday, 27 April

(a) Travel from Ghian to Addis Ababa.

(b) Further discussions with Hadere Gebremedhin and M. M. Jaeger at MoA Headquarters.

(c) Discussions with Tibebu Tessema, MoA Grain Storage Specialist, on the technical and sociological problems of providing effective protection for stored products at the farm level.

Tuesday, 28 April

Addis Ababa. Final visit to DLCO-EA Headquarters and MoA Sholla Laboratories.

Wednesday, 29 April

Addus Ababa. Final discussions with Demissie Gebre-Michael and Hadera Gebremedhin on development proposals at MoA Headquarters. .

Thursday, 30 April

(a) Final meeting with Demissie Gebre-Michael and Hadera Gebremedhin to discuss summary of findings and recommendations of the Survey.

(b) Dinner at the Ghian Hotel given by the MoA in honour of the FAO Plant Protection Survey. Guests included Demisie Gebre-Michael, Hadera Gebremedhin, Abdurahman Abdulahi and Akalu Sahlu, MoA, Awatahagne Alemayoh, (CTDM) Bayou Belayneh, SFDM, Bayou Habte Giorgis, RRC and M.M. Jaeger, ETH/77/022.

Friday, 1 May

Report writing, Addis Ababa.

Saturday, 2 May

Return to FAO Headquarters, Rome.

APPENDIX II

DOCUMENTS USED IN THE PREPARATION OF THIS REPORT

Acland, J.D. East African Crops. Longmans, London. 252 p.
1971

Crowe, T.J. and Shitaye, G.M. Crop Pest Handbook Third (Revised) Edition.
1977 Institute of Agricultural Research. Addis Ababa. 55p.

Crowe, T.J. and Tadesse, G.M. and Tsedeke, A. An Annotated List of Insect
1977 Pests of Field Crops In Ethiopia. Institute of Agricultural Research. Addis Ababa. 71p.

FAO Coffee Mission to Ethiopia 1964-65. Observations on Coffee Pests in
1968 Ethiopia by D.J. Greathead. Rome. 82p. PCL/IC/3 Consultant Report.

FAO Prospects for Horticultural Development and Research with Particular
1970 Reference to Vegetable Crops by H. D. Tindall. Rome. 35p. AGP:SF/ETH/7 Consultant Report.

FAO The Possibilities of Improving and Developing Fruit Crops with Particular
1970 Reference to Citrus. Rome. 65p. AGP:SF/ETH/7

FAO Institute of Agricultural Research Ethiopia. Rome. 80p.
1971 AGP:SF/ETH/7. Interim Report.

FAO Institute of Agricultural Research, ETH/71/553. Virus Diseases of Pulses
1974 and Other Crops by L. Boss. Rome. 20p. Consultant Report. WS/F 6654.

FAO Institute of Agricultural Research, ETH/71/553. Terminal Report
1974 by R.A. Robinson, FAO Coffee Pathologist. Rome. 17p. WS/F 5503.

FAO Institute of Agricultural Research, ETH/71/553. Coffee Berry Disease
1974 Problem at Jimma Research Station by C. Person. Rome. 7p. Consultant Report. WS/F 3468.

FAO Institute of Agricultural Research, ETH/74/002. Terminal Report, Part I
1976 Weed Control in Ethiopia Part II Horticulture and Miscellaneous Crops in Middle Awash Valley by J.E. Moore. Rome. 32p.

FAO Institute of Agricultural Research, ETH/74/002. Report on Highlands
1978 Agronomy Programme by F.F. Pinto. Rome.

FAO *Control of Armyworm, Spodoptera exempta in Eastern Africa and*
1979 Southern Arabia. Report on a Mission to Formulate an Interregional Project by R.C. Rainey. Rome. 23p. Consultant Report. W/L9114.

FAO Production Yearbook 1979, vol. 33. Rome. 309p.
1980

FAO 1980 Travelling Workshop for Preparation of Research Development, Training and Information Programmes for Prevention of Food Losses. Africa Region, Project Findings and Recommendations. Technical Report. RAF/79/018. Rome. 45p.

FAO 1980 Institute of Agricultural Research, ETH/78/004. Assignment Report by R.G. White, FAO Coffee Agronomist. Rome. 25p.

FAO 1980 Institute of Agricultural Research, ETH/78/004. Assignment Report by T.J. Crowe, FAO Entomologist. Addis Ababa. 15p.

FAO 1981 Institute of Agricultural Research, ETH/78/004. Report of Joint UNDP/FAO/Government of Ethiopia Evaluation Mission. Rome. 74p.

FAO 1981 Institute of Agricultural Research, ETH/78/004. Plant Pathology in Ethiopia. Problems, Accomplishments and Recommendations. Technical Report by E.C.H. Niemann, FAO Senior Pathologist. Rome. 60p.

APPENDIX III

PESTS OF CROPS IN ETHIOPIA

This list is compiled from many sources. The identifications would be expected to be reliable, but the list should not be taken as definitive or complete. No information was available on the relative importance of some species, which may be serious but local.

CEREALS

TEFF

1/		
**	Welo bush cricket	Decticoides brevipennis
*	African Armyworm	Spodoptera exempta
*	Barley fly	Delia arambourgi
**	Red teff worm	Metaxya ignicollis
	Teff epilachna	Epilachna similis
	Black teff beetle	Erlangerius niger
	Lesser armyworm	Spodoptera exigua
***	Smudge	Helminthosporium miyakei
	Rust	Uromyces eragrostidis
	Bunt	Tilletia baldratii
	Leaf spots	Drechslera spp.

BARLEY

*	African Armyworm	Spodoptera exempta
**	Barley fly	Delia arambourgi
**	Maize aphid	Rhopalosiphum maidis
	Plusia worms	Chrysodeixis acuta
**	Net blotch	Pyrenophora teres f. sp. hordei
*	Eyespot, scald	Rynchosporium secalis
*	Leaf rust	Puccinia hordei
	Powdery mildew	Erysiphe graminis
	Covered smut	Ustilago hordei
	Loose smut	Ustilago nuda
	Wild oats	Avena fatua
*	Ergot	Claviceps purpurea

1/ * indicates increasing degree of severity
**
***

MAIZE

*	African Armyworm	Spodoptera exempta
*	Maize stalk borer	Busseola fusca
**	Spotted stalk borer	Chilo partellus
*	Maize aphid	Rhopalosiphum maidis
**	Grasshopper	Aiolopus simulatrix
	Lesser armyworm	Spodoptera exigua
	Leaf blight	Helminthosporium turcicum
	Rust	Puccinia sorghi
	Head smut	Sphacelotheca reiliana
	Heart rot	Gibberella spp.

MILLETS

	Bush locusts	Phymateus spp.
	African Armyworm	Spodoptera exempta

SORGHUM

*	African Armyworm	Spodoptera exempta
**	American bollworm	Heliothis armigera
*	Spotted stalk borer	Chilo partellus
	Cluster bug	Agnoscelis pubescens
	Plusia worms	Chrysodeixis acuta
	Sorghum midge	Contarina sorghicola
	Sorghum chafer	Pachnoda interrupta
***	Covered kernel smut	Sphacelotheca sorghi
***	Loose kernel smut	Sphacelotheca cruenta
	Head smut	Sphacelotheca reiliana
	Rust	Puccinia purpurea
	Downy mildew	Sclerospora sorghi
	Bacterial streak	Xanthomonas holicicola
	Bacterial blight/stripe	Xanthomonas andropogani
***	Grain-eating birds	Quelea quelea intermedia Quelea quelea aethiopica
***	Parasitic weeds	Striga spp.

WHEAT

**	African Armyworm	Spodoptera exempta
***	Maize aphid	Rhopalosiphum maidis

**	Leaf rust	Puccinia recondita
***	*Stem rust*	*Puccinia graminis* f. sp. *tritici*
*	Stripe rust	Puccinia striiformis
*	Stinking smut, bunt	Tilletia foetida
*	Leaf blotch	Septoria tritici
**	Bacterial blight	Xanthomonas translucens
	Glume blotch	Septoria nodorum
	Powdery mildew	Erysiphe graminis
	Eyespot	Rhynchosporium secalis
	Wild oats	Avena fatua
	Ergot	Claviceps purpurea

SUGAR AND STARCH CROPS

SUGAR-CANE

**	*Smut*	Ustilago scitaminea
	Leaf spot	Cercospora longipes

POTATOES

	Potato tuber moth	Phthorimaea operculella
	Potato epilachna	Epilachna hirta
***	Bacterial wilt	Pseudomonas solanacearum
	Bacterial soft rot	Erwinia carotovora
	Late blight	Phytophthora infestans
	Early blight	Altenaria solani
	Powdery mildew	Erysiphe cichoracearum

OIL CROPS

NOUG

**	Plusia worms	Diachrysia orichalcea
*	Noug fly	Dioxyna sororcula

SESAME

**	Sesame seedbug	Elasmolomus sordidus
	Sesame webworm	Antigastra catalaunalis
***	Bacterial blight	Pseudomonas solanacearum

GROUNDNUTS

*	Groundnut aphid	Aphis craccivora
	Lesser armyworm	Spodoptera exigua
**	Leaf spots	Mycosphaerella spp.
**	Rust	Puccinia arachidis

LINSEED

*	Plusia worms	Chrysodeixis acuta
	Linseed flea beetle	Altica pyritosa
	Wilt	Fusarium oxysporum f. sp. lini
	Root rot	Pythium spp. and others

SAFFLOWER

	Safflower aphid	Dactynotus compositae
	Safflower budworm	Heliothis peltigera

SUNFLOWER

	Rust	Puccinia helianthi
	Leaf spot	Septoria helianthi
	Stem/root rot	Sclerotinia sclerotiorum

FIBRE CROPS

COTTON

**	American bollworm	Heliothis armigera
**	Cotton leafworm	Spodoptera littoralis
*	Cotton aphid	Aphis gossipii
*	Tobacco whitefly	Bemisia tabaci
**	Cotton jassid	Empoasca lybica
*	Pink bollworm	Pectinophora gossypiella
*	Red cotton mite	Tetranychus spp.
**	Cricket	Gryllus bimaculatus
	Cotton stainer	Dysdercus spp.
	Cotton thrips	Caliothrips spp.
	Sudan bollworm	Diaparopsis watersi
	Spiny bollworm	Earias spp.
	Lesser armyworm	Spodoptera exigua
	Cotton flea beetle	Podagrica spp.
	Wilt	Verticillium sp
	Bacterial blight	Xanthomonas malvacearum

FRUIT

CITRUS

***	False codling moth	Cryptophlebia leucotreta
*	Orange dog	Papilo demodocus
*	Red scale	Aonidiella aurantii
*	Black scale	Parlatoria zizyphus
**	Citrus aphid	Toxoptera citricidus
**	Citrus psyllid	Troiza erytrae
	Cottony cushion scale	Icerya purchasi
	Soft brown scale	Coccus hesperidum
	Orange scale	Chrysomphalus dictyospermi
*	Purple scale	Chrysomphalus aonidum
	Mediterranean fruit fly	Ceratitis capitata
***	Foot rot, gummosis	Phytophthora citrophthora
***	Greening	(mycoplasma)
***	Tristeza	(virus)

ENSET

**	Enset wilt	Xanthomonas musacearum
*	Mole rats	

GRAPES

Downy mildew	Plasmophora viticola
Powdery mildew	Uncinula necator

VEGETABLES

PULSES

***	American bollworm	Heliothis armigera
**	Bean aphid	Aphis fabae
*	Groundnut aphid	Aphis craccivora
**	Bean fly	Ophiomyia phaseoli
**	Bruchid beetles	Bruchus spp.
	Pea aphid	Acyrthosiphon pisum
	Pollen beetles	Coryna spp., Mylabris spp.
	Striped blister beetle	Epicauta albovittata
**	Anthracnose	Colletotrichum lindemuthianum
*	Chocolate spot	Botrytis fabea
*	Rust	Uromyces fabae
***	Ascochyta blight	Ascochyta rabeii

Chickpea wilt	Fusarium oxysporum f. sp. ciceris
Soybean downy mildew	Peronospora manshurica
Blight	Xanthomonas phaseoli
Halo blight	Pseudomonas phaseolicola
Root rot	Sclerotium rolfsii

BEETS

Leaf spot	Cercospora beticola
Rust	Puccinia sp.

CARROTS

Leaf blight	Alternaria dauci
Powdery mildew	Leveillula spp.

SWEET POTATO

Sweet potato tortoise beetle	Aspidomorpha tecta
Sweet potato weevil	Cylas compressus
Early blight	Alternaria sp.

CABBAGE

*	Cabbage aphid	Brevicoryne brassicae
	Diamond back moth	Plutella xylostella
	Cabbage white	Pieris brassicoides
	Cabbage sawfly	Athalia spp.
	Cabbage flea beetle	Phyllotrea spp.
	Cabbage weevil	Lixus latro
	Lesser armyworm	Spodoptera exigua
	Black rot	Xanthomonas campestris
	White rust	Albugo candida
	Soft rot	Rhizopus nigricans

LETTUCE

*	Leaf spot	Septoria latucae
	Damping off	Pythium sp.
	Virus diseases	

ONIONS

***	Onion thrips	Thrips tabaci
**	Purple blotch	Alternaria porri
*	Downy mildew	Peronospora destructor
**	Garlic rust	Puccinia sp.

CUCURBITS

*	Melon bug	Aspongopus viduatus
***	Melon fly	Dacus spp.
	Powdery mildew	Erysiphe cichoracearum

EGGPLANT

**	Tobacco whitefly	Bemisia tabaci
	Eggplant lace bug	Urentius hystricellus
	Eggplant epilachna	Epilachna fulvosignata
*	Striped blister beetle	Epicauta albovittata

PEPPERS

*	American bollworm	Heliothis armigera
*	Tobacco whitefly	Bemisia tabaci
*	Gojam red ant	Dorylus sp.
*	Cutworms	Agrotis segetum
*	Termites	Macrotermes sp.
**	Wilt	Phytophthora sp.
***	Bacterial rot	Xanthomonas vesicatoria
***	Soil rot	Thanetephorus cucumeris
**	Wilts	Verticillium sp.
		Fusarium sp.
**	Powdery mildew	Leveillula taurica
**	Bleaching disease	(fungus)

TOMATO

***	American bollworm	Heliothis armigera
**	Tobacco whitefly	Bemisia tabaci
*	Gojam red ant	Dorylus sp.
*	Termites	Macrotermes spp.
	Cutworms	Agrotis segetum
**	Late blight	Phytophthora infestans
**	Leaf spot	Septoria lycopersici
	Early blight	Alternaria solani
	Parasite weeds	Orobanche spp.

COFFEE

**	Antestia bug	Antestopsis intricata
	Coffee leafminer	Leucoptera caffeina
	Coffee leaf skeletonizer	Epiplema dohertyi
	Coffee berry borer	Hypothenemus hampei
	Scale	Coccus hesperidum
***	Coffee berry disease (CBD)	Colletotrichum coffearum
*	Vascular wilt	Gibberella xylaroides
*	Brown eye spot	Cercospora coffeicola
*	Leaf blight	Ascochyta tarda
**	Leaf rust	Hemilea vastatrix
***	Couch grass	Digitaria scalarum

TOBACCO

**	Tobacco whitefly	Bemisia tabaci
*	Peach aphid	Myzus persicae
	Potato tuber moth	Phthorimea operculella
**	American bollworm	Heliothis armigera
	Cotton leafworm	Spodoptera littoralis
*	Tobacco mosaic virus	TMV
*	Powdery mildew	Erysiphe cichoracaerum

APPENDIX IV

CROP PROTECTION STAFF AT MoA HEADQUARTERS (1980 - 81)

1. Entomology

Hadera Gebremedhin	M.Sc. Entomology
Abdurahman Abdulahi	M.Sc. Entomology
Abraha Hagos	B.Sc. Agriculture
Mekdes Getaneh	B.Sc. Plant Science
Gedle Gebreal Bekele	Technician
Getaneh w/Ab	Technician

2. Grain Storage

Tibebu Tessema	M.Sc. Agriculture

3. Plant Pathology

Akalu Sahlu	B.Sc. Plant Science
Hailemelakot G/Medhin	B.Sc. Plant Science

4. Pesticide Chemistry

Nigist Asfaw	B.Sc. Chemistry
Ashagre Goudu	Diploma, Polytechnic
Degefa Wolde	Diploma, JCA

5. Rodent Control

Mengistu Kebede	B. Sc. Biology
Merede Kumsa	B. Sc. Biology
Million Teshome	Diploma, JCA

6. Weed Control

Fantaye Yehowala	B. Sc. Plant Science
Kebede Abayneh	B. Sc. Plant Science
Mesfin Berhane	Diploma, JCA
Nega Woldu	Diploma, JCA
Firew Arefayne	Diploma, JCA

7. Quelea Project

Damena Assefa	B. Sc. Biology
Woldu T/Giorgis	Diploma, JCA
Hussin Ali	Technician
Belai Hailu	Technician
Haile Giorgis Alemu	Technician
Mamo Degega	Technician

8. Spray Maintenance

Ayele Mamo	Diploma, JCA
Yacob Fundusa	Diploma, Polytechnic
Tolossa Ayana	Diploma, Technical School
Ayalew Ayehu	Spray repair man
Zenebe Belaineh	Spray repair man
Jemal Abdulmanan	Spray repair man
Arefaine Asresahegne	Spray repair man

9. Plant Quarantine

Tesfaie Gebrehiwot	Diploma, JCA
Teshale Degefu	B. Sc. Plant Science
Tsegaye Egigu	Inspector

10. Mobile Team

Admasu Abebe	Assistant Crop Protection Technician
Mitiku Imagru	Assistant Crop Protection Technician
Temesgen Bogale	Assistant Crop Protection Technician
Ferede Bogale	Assistant Crop Protection Technician
Abdi Osman	Assistant Crop Protection Technician

Source: Ministry of Agriculture, Addis Ababa

APPENDIX V

MoA CROP PROTECTION MAN-POWER SITUATION, 1980-81

Staff Category	HQ	Regions	Awrajas	Woredas	PAs
M. Sc. Entomology	2	-	-	-	-
M. Sc. Agriculture	1	-	-	-	-
B. Sc. Agriculture	7	16	-	-	-
B. Sc. Biology	3	-	-	-	-
B.Sc. Chemistry	1	-	-	-	-
Diploma, JCA	11	10	110	-	-
Technician	2	-	-	-	-
Mobile Team (2)	14	-	-	-	-
Radio operator	1	-	-	-	-
Light trap operator	-	13	-	-	-
Development Agent	-	-	-	586	-
Inspector	-	-	7	-	-
Agricultural Inspector	-	-	3	-	-
PA Squad Leader	-	-	-	-	23,031
PA Squad member	-	-	-	-	92,124
Total	42	39	120	586	115,155

Source: Ministry of Agriculture, Addis Ababa

APPENDIX VI

NATIONAL CROP IMPROVEMENT TEAM APPROACH

Team	Crops covered	
	Major	Minor
Small grain cereals	barley, wheat (bread + durum), teff.	
Large grain cereals	sorghum, maize.	
Highland pulses	chick pea, lentil horse bean, field pea.	lupin, grass pea, fenugreek.
Lowland pulses	haricot bean, cowpea, mung bean.	pigeon pea, lima bean, tepary bean, moth bean, winged bean
Highland oil crops	noug, rape seed, linseed, sunflower.	safflower, castor.
Lowland oil crops	sesame, groundnut.	
Fibre crops	cotton, kenaf.	
Fruits and nuts	citrus, grapes.	Apple, plum, peach, also introduced fruits under observation, e.g. mango, avocado.
Roots and tubers	Irish potato, sweet potato	taro, achote, yams.
Enset	enset	
Vegetables	chili pepper, tomato, onion, shallot, garlic	green bean, beetroot, celery, Ethiopian cabbage, head cabbage, other leafy vegetables (particularly concerned with seed production since most seeds are imported).
Herbs and spices (especially for diversification in coffee area)	ginger, turmeric, false (or African) cardamom, true cardamom, black pepper, long pepper,	many others under trials
Coffee and tea	coffee.	tea (no research).