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

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INDICATIVE PROGRAMME FOR THE DEVELOPMENT OF THE PESTICIDES INDUSTRIAL SYSTEM IN GHANA

Prepared by
Cyrus A. Macfoy
CONSULTANT

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TABLE OF CONTENTS

1. ACKNOWLEDGEMENTS

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Thanks are also extended to other UNIDO officials in Vienna, to the informants in the various Government Ministries, Institutions, other UN agencies, the World Bank and private companies in Ghana, for their time and assistance.

2 SUMMARY

This study assesses the present pesticides industrial system in Ghana and designs strategies for its further development. In doing so, both qualitative and quantitative parameters of the major components of the system have been identified together with the linkages between them. Constraints and bottlenecks hindering the further development of the system are also highlighted. Moreover, strategies for the further development of the system by overcoming the bottlenecks and constraints, including technical assistance and investments projects together with pertinent policy measures are included. These were achieved by taking into consideration the present Government development objectives related to the pesticides industrial system together with pertinent projects already planned or being implemented by the Government.

The methodology used was based on that of the UNIDO for assessng and programming integrated production and consumption systems (MEPS).

3 INTRODUCTION

3.1 Background

The Programme Development Support Unit (PDSU) has been established at UNIDO to promote the application of the programme approache to project identification and formulationn. In 1989 the Unit's efforts are being directed mainly to the preparation of the 1990/91 Industrial Development Decade for Africa (IDDA) programme, which will concentrate on the development and rehabilitation of agro-related industries in Africa.

The Programme approach is applied at three levels. The first level, which provides the basis for the following work, is the classification of countries according to patterns of development of specific industrial systems. In order to prepare the 1990/91 IDDA programme, PDSU is classifying 50 African countries according to development patterns in the agro-food related sectors (agro-food industries, fertilizers, pesticides and agricultural machinery). The objective of the classification work is the identification of countries with similar development patterns in specific agro=related industrial sectors in order to facilitate the cost effective design of integrated development programmes of technical assistance, investments and policies. The variables identifies by the PDSU (9 in all) were analysed to them using various statistical analysis techniques such as multivariate analysis, principal component analysis and clustering techniques. The PDSU has now grouped African countries into 9 clusters depicting the level of development of their Pesticides Industrial Systems. On the basis of these, Ghana has been classified in cluster 5.

Building and expanding upon the results of the classification of African countries, UNIDO is now undertaking the second stage of the programme approach work, the preparation of indicative programmes for groups of countries to promote the development of specific agro-related industrial systems.

3.2 Objectives of the Consultancy Services

To assist PDSU in the preparation of indicative programmes for a group of African countries. Each indicative programme will include a package of technical assistance and investment projects and policy advice that can serve as a basis for designing integrated development programmes for specific country or sub-sector and can also be useful in the analysis and programming of technical assistance for countries with similar agro industrial development patterns.

3.3 Scope of the Work

This assignment will cover two African countries namely, Ethiopia and Ghana. It is important that the expert has experi

ence directly relating to the development of the pesticides industrial system in African(Figure 1).

The assignment will last approximately two months, including one week at UNIDO Headquarters, a total of five weeks in two African countries, and the remaining time at home. The expert will prepare and submit two complete typed reports, preferably prepared on a wordprocessor and submitted on diskette.

3.4 Activities

The work assignment will include:

A. At Home:

1. Review of documents provided by PDSU describing the programme approach and the results obtained to date in the classification of African countries according to the patterns of development of their pesticides industrial systems.

2. Collection of information on the two countries selected for study and their pesticides industrial systems.

B. At UNIDO Headquarters:

1. Together with the other experts preparing indicative programmes, the expert will take part in a meeting that will provide him/her with an introduction to the programme approach, a review of the work of PDSU and IDDA completed so far on the analysis and programming of agro-related industrial systems, and explanation of the methodology to be used in carrying out the country studies and a detailed description of the report he is expected to prepare. He will be provided with a kit of materials to help collect information.

2. Using the information material available at UNIDO and other sources, the expert will prepare desk studies of the two countries he is going to report on and their pesticides industrial systems. In each study he will include a preliminary description of the pesticides industrial system in the country, a base diagram showing all main components of the system and their linkages, and a preliminary disaggregation of components and assessment of the system. These desk studies will be reviewed by PDSU and discussed before the expert leaves for the field, thus enabling him to make more efficient use of his time in the countries and helping to ensure that all expert follow a common approach in preparing the indicative programmes.

C. In the Field:

1. The expert will visit two countries for a period of approximately two weeks each. On the basis of the work

done at UNIDO Headquarters and the attached outline, he will study the pesticides industrial system in each of the countries he visits. The purpose of the study is, first, to identify qualitative and quantitative parameters for all major components of the system and the linkages between them resources,, trade flows, capacities and capacity utilization, the main actors in the system and all constraints and bottlenecks hindering the further developments of the system secondly, to design a strategy for developing the system by overcoming all the bottlenecks constraints; and thirdly, to identify the actions necessary to implement the strategy, including technical assistance, investments and policy measures.

2. The expert will discuss the development of the pesticides industrial system with the relevant authorities in Government, specialized institutes and industry in order to identify the Government's development objectives with relation to the system.

3. At Home:

1. The expert will prepare an indicative programme for each of the two countries. Each indicative programme will include a description of the pesticides industrial system, all its main components and the linkages between them, the evolution and development potential of the system, the main bottlenecks and constraints hindering the further development of the system, as well as the resources and enhancements that can promote its development. It will include an identification of various options to overcome the bottlenecks and constraints and the selection of the best options to achieve the Government's objectives in relation to the development of the system. A group of complimentary options will constitute a development strategy. Each strategy will be assessed against the Government objectives and one will be selected as the most appropriate. Finally, the indicative programme will include a package of technical assistance and investment projects as well as policy advice to implement the strategy selected.

2. After the indicative programmes have been submitted to and reviewed by UNIDO, the expert will make whatever revisions considered necessary before they are accepted by UNIDO as completed.

A flow diagram for pesticides production and consumption system in Africa is shown in Figure 1.

PESTICIDES PRODUCTION AND CONSUMPTION SYSTEM IN AFRICA - BASE DIAGRAM

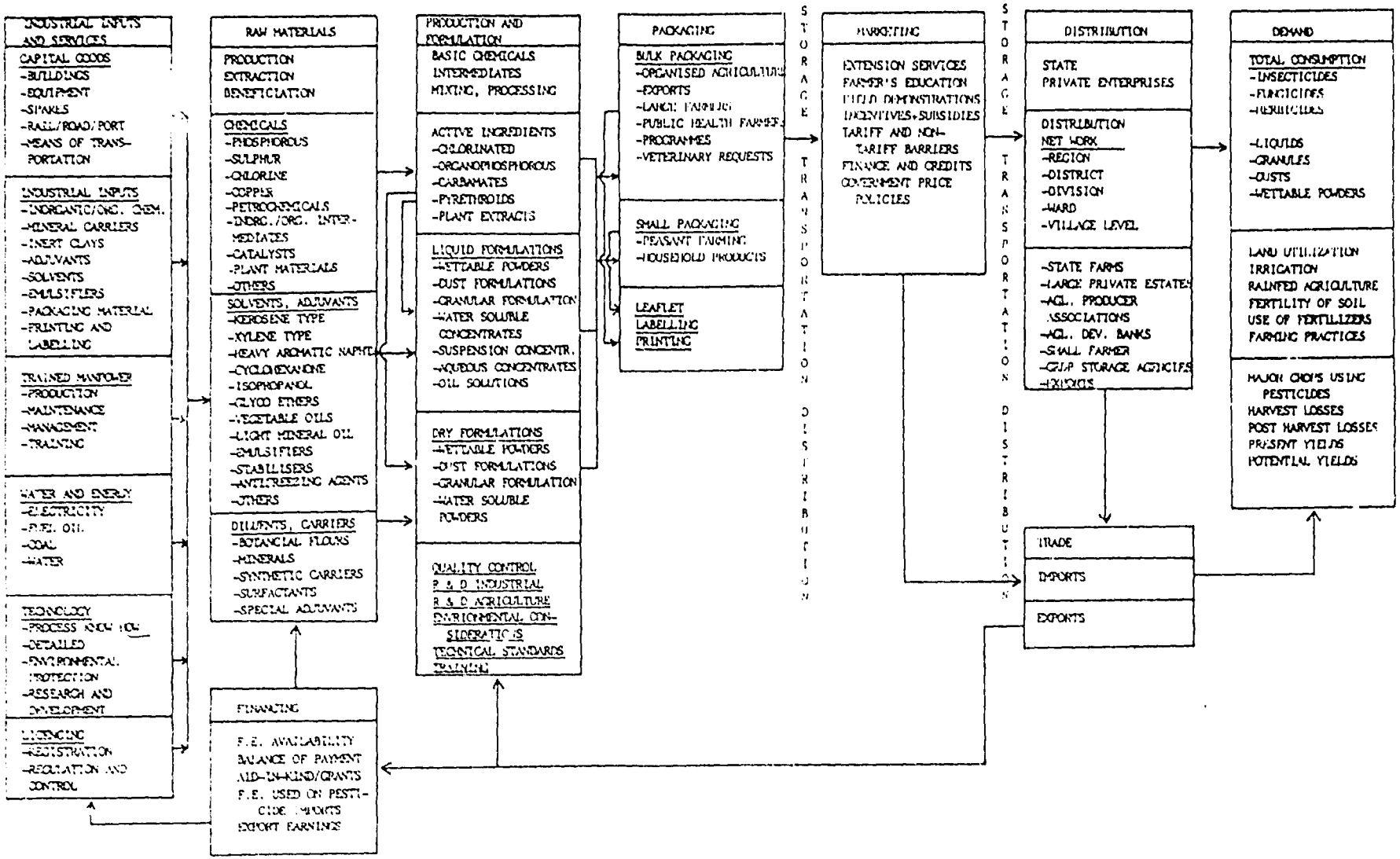

Figure 1

4. PROGRAMME CONTEXT

4.1 Description and Quantification of the Systems Main Components and Linkages.

The Country

The Republic of Ghana (Figure 2) is located in West Africa and is bounded on the North by Burkina Faso, on the West by Ivory Coast, on the East by Togo and on the South by the Atlantic Ocean. The total land area is 23,854,000 ha whilst the land area is 23,020,000 ha. The Volta River basin includes 8,480 sq. kilometre artificial lake (the largest man-made lake in the world) formed behind the Akosombo hydroelectric dam. In the North the vegetation is predominantly savanna or scrub, while in the South there is an extensive rich rain forest belt. The climate is tropical and the population in 1987 was 13,242,000 which has been estimated to be a little over 14.5 million by 1990 and 19.2 million by the year 2000. About 52% of the population live in rural areas and derive their income from agriculture and related activities. Agriculture employs 52% of Ghana's total labour force.

In 1986, the GNP per caput was $390. In 1981, the economy was in a very bad shape, so the Government undertook a major re-orientation of the economy by initiating a package of comprehensive economic and social development programmes in the Economic Recovery Programme (ERP1) of 1983, in order to reverse the trend. These programmes successfully arrested and reversed the negative trends although some weaknesses still remained. Thus in 1986, ERP2 was launched to reinforce the achievements of ERP1. All these programmes were supported by local resources and by external agencies such as IDA, IMF, ADB etc.

The economy of Ghana is largely dependent on agriculture, thus this has always been a priority area in the country. Agriculture and forestry accounted for about 55% of the country's GDP. Cocoa has been responsible for 18% of the agricultural GDP, other crops 62%, livestock 7%, fishing 3% and forestry about 10%. Of the country's total merchandise exports, agricultural exports account for 77% with cocoa alone accounting 73% and forestry about 4%. Agriculture and forestry alone employ about 55% of the total work force.

In 1986, the total arable and permanent crop land was 7,800,000 ha which consisted of an arable land of 1,100,000 ha, the permanent crop land (1,290,000 ha) the permanent pasture (3,410,000 ha) the forest and woodlands (9,300,000) and others were (8,750,000 ha). The total suitable land in Ghana is 11,000,000 ha. The major crops are cereals (maize, rice, millet, sorghum), root crops (cassava, yams, cocoyam), pulses and vegetables. Vegetables include pepper, tomatoes, eggplant, okra and beans. Cocoa is the main export crop and others include oil palm, cotton, coconut, tobacco, groundnut and rubber. About 50% of the country's total cultivated land area is under cocoa, followed by cereal (27%) and roots and tubers (20%). Tables 1,2

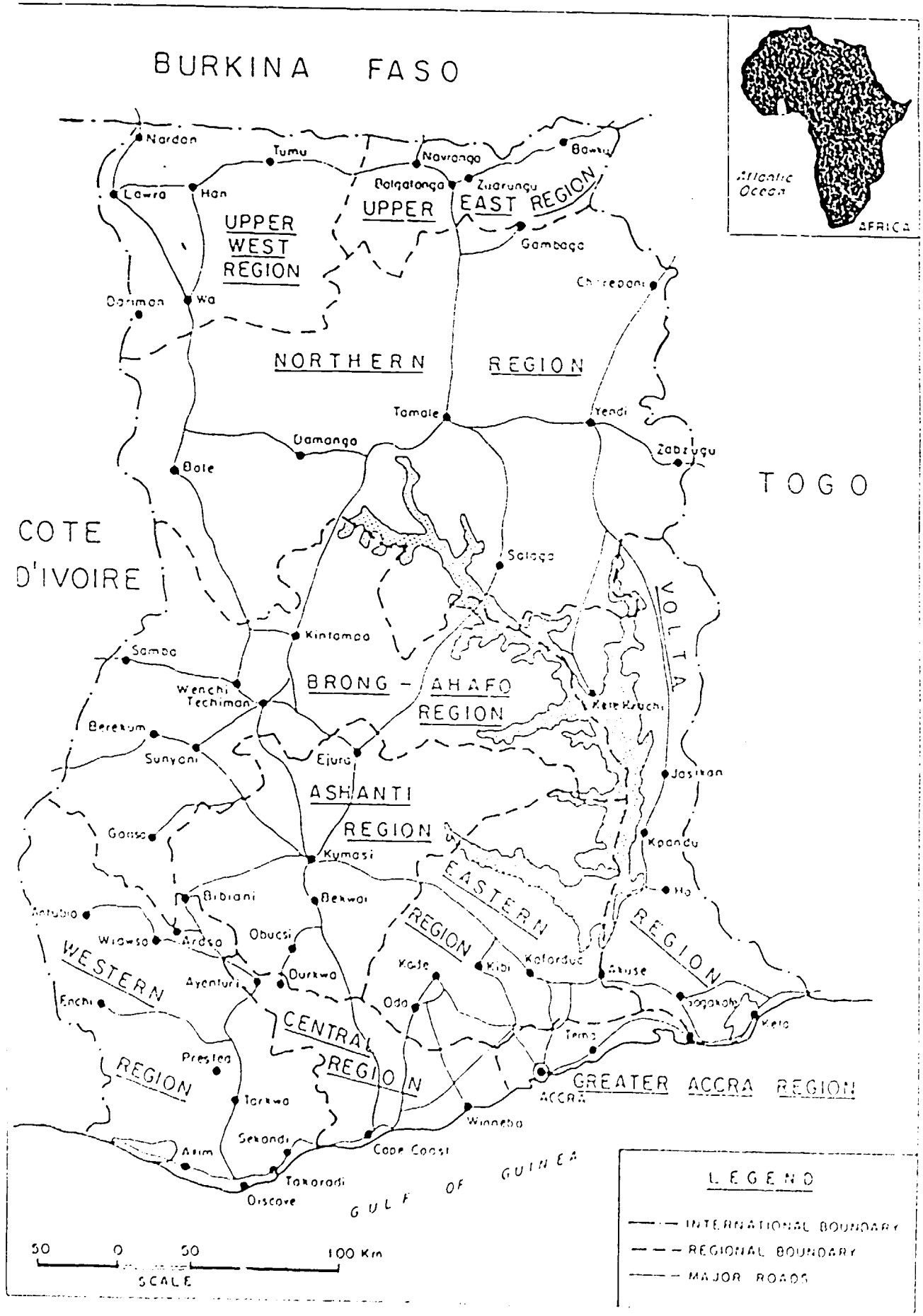

FIGURE 2 ADMINISTRATIVE

TABLE 1. CROP PRODUCTION IN GHANA, 1987

CROP	AREA HARVESTED (ha)	PRODUCTION (mt)
CEREALS		
Rice, Paddy	82 000	88 000
Maize	489 000	553 000
Millet	165 000	121 000
Sorghum	190 000	151 000
ROOTS AND TUBERS		
Cassava	500 000	2 943 000
Taro (Cocoyam)	123 000	650 000
Yams	179 000	1 000 000
SUGAR CROPS		
Sugarcane	4 000	110 000
OIL CROPS		
Oilpalm Fruit	163 000	1 036 000
Sheanut (Karite Nuts)	-	60 000
Groundnuts, Shelled	120 000	128 000
Coconuts	13 000	110 000
Cotton Seed	2 000	3 000
FIBRE CROPS		
Cotton Lint	-	1 000
VEGETABLES		
Tomatoes	80 000	400 000
Eggplants	9 000	24 000
Chillies and Peppers, Green	25 000	75 000
Onions, Dry	1 900	28 000
Fresh Vegetables	52 000	190 000
Pulses	125 000	11 000
Pimento	17 000	22 000
FRUITS AND NUTS		
Bananas	19 000	22 000
Plantains	116 000	700 000
Oranges	4 500	35 000
Lemons and Limes	5 000	30 000
Mangoes	500	4 000
Avocados	1 300	5 500
Pineapples	2 000	5 000
Fresh Fruit	32 000	36 000
Kola Nuts	-	12 000

TABLE 1. CROP PRODUCTION IN GHANA, 1987 (Contd.)

CROP	AREA HARVESTED (ha)	PRODUCTION (mt)
INDUSTRIAL CROPS		
Coffee, Green	10 000	2 000
Cocoa, Beans	1 200 000	210 000
Tobacco Leaves	4 000	2 000
Natural Rubber	10 000	6 000

Sources: FAO Statistics Department

Table 2 - Area under important crops

(Thousand hectares)

	1982	1983	1984	1985	1986	1987	1988
CEREALS	825.0	835.0	1,276.0	1,034.0	880.0	926.0	1,051.1
Maize	373.0	400.0	724.0	579.0	472.0	489.0	551.0
Rice	61.0	40.0	69.0	68.0	76.0	82.0	92.1
Millet	175.0	175.0	231.0	185.0	156.0	355.0	408.0
Guinea Corn	216.0	220.0	252.0	202.0	176.0		
STARCHY STAPLES	735.0	738.0	1,765.0	1,411.0	959.0	593.0	449.0
Cassava	339.0	339.0	813.0	650.0	387.0	422.0	449.0
Cocoyam	145.0	113.0	396.0	317.0	207.0		
Yam	110.0	143.0	223.0	178.0	174.0	171.0	
Plantain	141.0	143.0	333.0	266.0	191.0		
PULSES AND NUTS	464.1	410.3	443.0	353.0	369.0		
Groundnuts	115.1	95.3	149.0	119.0	163.0		
Coconuts	45.2	45.5	33.0	26.0			
Oil palm	143.3	113.3	123.0	98.0			
Beans and peas	160.5	126.2	138.0	110.0	206.0		
VEGETABLES	52.8	46.5	155.0	124.0	161.0		
Tomatoes	9.7	1.2	96.0	77.0	80.0		
Pepper	23.4	23.2	25.0	20.0	47.0		
Okro	10.9	14.8	26.0	21.0	31.0		
Garden eggs	8.8	7.3	8.0	6.0	3.0		
OTHERS	29.7	23.3					
Sugar cane	3.3	4.0					
Oranges	21.2	16.2					
Pineapples	2.5	1.9					
Banana	2.7	1.7					

Source: Policy Planning Monitoring and Evaluation; Ministry of Agricultur

(Thousand tonnes)

1. CEREALS	544.0	308.0	1,066.0	909.0	867.0	905.0	995.0
Maize	346.0	172.0	696.0	584.0	559.0	553.0	600.0
Rice	36.0	40.0	65.0	68.0	70.0	81.0	95.0
Millet	76.0	40.0	133.0	112.0	110.0	271.0	300.0
Guinea Corn	86.0	56.0	172.0	145.0	128.0		
2. STARCHY STAPLES	4,431	3,656	11,173	9,378	6,016	5,949	6,815
Cassava	2,470.0	1,728.0	6,186.0	5,193.0	2,876.0	2,943.0	3,300.0
Cocoyam	628.0	720.0	1,866.0	1,569.0	1,005.0	1,000.0	1,115.0
Yam	588.0	866.0	1,178.0	987.0	1,048.0	1,001.0	1,200.0
Plantain	745.0	342.0	1,943.0	1,629.0	1,087.0	1,005.0	1,200.0
3. PULSES AND NUTS	1,352	1,331	1,214	1,013	210		
Groundnuts	111.1	91.1	167.0	140.0	190.0		
Coconuts	337.0	338.8	265.0	219.0			
Oil palm	889.4	889.4	768.0	643.0			
Beans and peas	14.1	11.7	14.0	11.0	20.0		
4. VEGETABLES	186	202	674	566	670		
Tomatoes	52.3	57.2	456.0	384.0	380.0		
Pepper	62.6	62.6	74.0	62.0	137.0		
Okro	46.4	62.0	121.0	102.0	146.0		
Garden eggs	24.2	20.2	23.0	18.0	7.0		
5. COCOA	202.5+	168.1+	166.7+	194.4+	226.4+	233.6+	288+
6. OTHERS	178	224					
Sugar cane	58.5	85.9					
Oranges	107.9	129.3					
Pineapples	6.9	5.5					
Banana	4.7	3.0					

& 3 gives the areas and yields of various crops.

In Ghana the bulk of the farmers are small holders accounting for about 80% of agricultural production. The average holding is less than 1.5 hectares, and shifting cultivation is widely practised. Subsistence farming is quite common in the rural areas and productivity is low mainly because of limited use of available technical packages, untimely delivery of inputs, poor credit availability and weak infrastructure. Recently however several large scale commercial farms have been developed.

Administratively, the Ministry of Agriculture is responsible for all agricultural production with the exception of cocoa, coffee and sheanuts which are under the responsibility of the Ghana Cocoa Board (COCOBOD). Other governmental organisations include the Grains and Legumes Development Board (GLDB), the Bast Fibres Development Board (BFDB), the State Farms Corporations (SFC), the Ghana Food Distribution Corporation (GFDC), the Ghana Food Production Corporation (GFPC), the Ghana Oil Palm Development, the National Oil Palm Corporation, the Twifu Oil Palm Plantation (TOPP) and the Irrigation Development Authority. Agricultural companies are the Ghana Seed Company, the Cotton Production Company and the Ghana tobacco company. There is also the Cocoa Services Division (CSD) and the Private Farming Organisations.

There are various Integrated Rural Agricultural Development Projects in the country with loans from the World Bank and the Netherlands. Their functions include plant protection, seed multiplication, extension, home economics and adaptive research. The three projects are the Upper Region Agricultural Development Project (URADEP), the Volta Region Agricultural Development Project (VORADEP) and the Northern Region Rural Integrated Project (NORRIP). There is also the Ghana-German Agricultural Development Project (GGADP) and the Ghana-CIDA Grains Development Project which is on its third 5-year phase to end in 1994. This project also contains pest management components. In addition, there is the Global -2000 project initiated by former US President Carter which gives loans and inputs to farmers, who pays back after harvesting their crops. Infact, the government is planning a similar form of assistance in other areas of the country.

The general decline in the economy of the country has already been discussed. There was also a significant decline in agricultural production. For example, cocoa production fell from about 400,000 tons in the early 1970's to about 168,000 in 1983. Cotton, tobacco and rubber fell from about 11,000 tons, 2,700 tons and 3,300 tons respectively in the mid seventies to about 500 metric tonnes each in 1983.

In support of the ERP, the Government prepared firstly a short term plan (1984-1986) for agriculture in the context of a 5 year medium term plan (1984-88) and a 10-year plan project to 1993. The objectives of the plan include amongst others self-

sufficiency in the production of cereals, starchy staples, animal protein and industrial raw materials such as cotton, oil palm, tobacco and groundnuts; increased agricultural exports; provision of improved storage and processing and distribution systems to minimise post-harvest losses.

A more recent agricultural policy for the period 1989-1993 in support of the second phase of the ERP has been announced by the Government emphasising again the Government's determination to improve the low level of productivity of land and labour reflected in the small yields of cultivated and the low output per head of labour. Although productio . has gradually increased since, there is still a tremendous potential for further increase in productivity. In 1984, production grew by 10% and accounted for about 51% of the GDP and by 4% and 2.5% in 1985 and 1986 respectively.

Other related development activities include the manufacturing industries especially chemicals and agro-chemicals. Growth in manufacturing in general has averaged 14% a year since 1983 such that a capacity utilisation of 10-15% in 1981 by most industries is now increasing, largely due to increased availability of imported raw materials and spare. However, there still remains quite a lot of improvement to be made in this subsector especially since under E.R.P.11, the main thrust of industrial policy is the strengthening of industrial growth by maximising utilisation of existing plant capacity through the ready availability of raw materials and spare parts. At the same time dependence on imported raw materials is being reduced through the encouragement of local production. support is also pledged for the establishment of small-scale industries.

With regard to the health subsector, an important thrust of the Government is to establish a viable Primary Health Care System with a carefully designed referral system aimed at efficient medical delivery. While improvement in the development of livestock resources will be facilitated by e.g. making available to cattle farmers improved breeding stocks and by controlling animal diseases.

In 1985, an Investment Code was produced by the Government of the PRovisional National Defence Council of Ghana who ha. embarked on an Economic Recovery PRogramme and redress. po.t decline in the economy of Ghana.

An Investment Centre was established as an agency of the Government for the encouragement, promotion and coordination of investments in the Ghanian economy to enable increased production and productivity for national development and to enable the exploitation of the immense natural resources of Ghana in a manner conducive to the mutual benefit of investors and the nation to promote effective employment and the development of skills and technology requisite for the progress of Ghana.

Priority areas include agriculture, manufacturing indus-

tries that predominantly use local materials, applicable incentives and benefits.

4.1.2 CROP PROTECTION IN GHANA

A wide range of pests and diseases are prevalent in Ghana and pose severe constraints to the production of the wide variety of crops grown in Ghana. Pre and post harvest losses are estimated at 30%. Post harvest losses alone are presently estimated at an average of 10% but the MOA's aim is to reduce it to about 5%. In marketed maize, post harvest losses can be as high as 30%, while in grains stored traditionally it is about 10%.

The MOA in its medium term agricultural development plan of 1990 has emphasised increased productivity through crop protection and post harvest activities amongst other measures.

Pesticides are available for many of the common pests and diseases but they are usually expensive and thus add to the costs of production of the crops. Thus it is recommended that an integrated pest management strategy be instituted focusing on the development of pest and disease tolerant varieties, biological control and sanitation and other control measures including pesticides.

Research has shown that the yields normally obtained for various crops are well below the achievable yield (Table 4). The reasons for this are lack of effective extension and other logistic support such as pesticides amongst others. For cocoa average estimates for present production yields are about 350kg/ha while the maximum possible is about 1,200kg/ha.

Organisationally, the Plant Protection and Regulatory Services Division (PPRSD) a unit within the Ministry of Agriculture under the Crop services Department is responsible for all plant protection matters except for cocoa, coffee and shearnuts. The Cocoa Service Division (CSD) of the Ghana Cocoa Board is responsible for preharvest plant protection matters whilst the Infestation Control Department of the Cocoa Board is charged with the responsibility of prevention of post-harvest losses in cocoa, coffee and shearnuts.

The Headquarters of the PPRSD in Pokoase is very poorly equipped with limited equipment, staff and vehicles. There is no library or reference collections for pest identification. The ten regional offices have little or no equipment and supplies.

In all, there are five units within the PPRSD namely (a) Post-entry Quarantine; (b) Pre-entry Phytosanitary Inspection; (c) Plant Pest and Disease Survey and Control; (d) Seed Inspection and Certification; and (e) Special Services.

The Seed Inspection and Certification Unit is non-function-

TABLE 4

AREA, PRODUCTION AND YIELD RANGES FOR SELECTED COMMODITIES (1970 - 1986)

COMMODITY	AREA '000 HA	PRODUCTION '000 M/T	YIELD RANGE TONS/HA	ACHIEVABLE* YIELD/T/HA
Maize	257.5 - 486	140.8 - 574	0.5 - 1.2	5.0
Rice	36.6 - 90	26.9 - 80	0.7 - 1.0	3.0
Millet	175.6 - 249.7	98.6 - 154.4	0.5 - 0.7	2.0
Guinea Corn	184.3 - 250	105.8 - 190	0.5 - 0.8	2.5
Cassava	242 - 436	1375.2 - 4083	4.2 - 9.5	28.0
Cocoyam	134.8 - 282.7	613.2 - 1510	3.7 - 5.4	8.0
Yam	75.4 - 177.4	354.3 - 909.4	4.0 - 5.8	10.0

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*Indicates yields that have been achieved in Ghana in isolated cases due to the lack of effective extension and other logistic support.

* Source: Policy Planning Monitoring and Evaluation Ministry of Agriculture

al whilst the facilities in the others are poor. The largest unit i.e. the Plant Pest and Disease Survey and Control Unit is responsible for the detection, monitoring and control of plant pest and diseases. This unit has no reliable reference collections and materials to aid pest identification. Pesticides for emergencies are very low in supply and pesticide application equipment few, old and inefficient. Protective clothing and othe basic pest survey equipment such as hand lenses, insect collecting equipment, specimen bottles are grossly inadequate or not available. Vehicles i.e. motorcycles, bicycles and vans are a major problem. Camping equipment is lacking and there is no forecasting of pest outbreaks. There is also a shortage of trained manpower.

The Special Services Unit is responsible for emergency pest outbreaks. Presently, together with the PPRSD it is cooperating with the Africa-wide Biological Control Programme of IITA in the control of cassava mealy-bug and the green spider mite.

Post-harvest is handled by the Post-harvest Development Unit (PHDU) within the Crop Services Department of the Ministry of Agriculture with FAO/UNDP assistance.

Individual farmers and the large-scale commercial farms protect their crops against pests. Advice on improved plant protection methods are provided by staff of the PPRSD, Extension Services and other bodies.

Major Crops Using Pesticides in Ghana

Cocoa (Theobroma cacao) is Ghana's most important economic crop called the "lifeblood" of the economy. Together with coffee and sheanut, cocoa is under the Ghana Cocobod. The three main problems of the cocoa are the swollen shoot virus disease, capsids (Mirids) and the black pod disease caused by the fungus Phytophthora palmivora. The virus causing the swollen shoot virus diseases is transmitted by mealybugs and can be controlled by a combination of sanitation methods, resistant varieties, cultural practise, use of systemic or contact insecticides and biological control. Various insecticides and fungicides are used against the cocoa mirads and the black pod disease respectively (Table 5) and against sheanut and coffee pests.

Table 5

	Pesticide	Pests
1.	Gammalin	Capsid bugs (1500 litres/annum)
2.	Unden	" " (" ")
3.	Synthetic Pyrethroids	" " (are required)
4.	Vapona (Carbamate)	" "
5.	Fenitrothion	" "

6.	Sumithion	" "
7.	Actellic EC	Post harvest
8.	Pentachlorophenol	Capsid bugs
9.	Phosphene	" "
10.	Methyl bromide	" "

Preharvest fungicides (For rusts and the coffee berry disease)

1. Kocide 101 (Cupric hydroxide)
2. Caocobre (Cuprous oxide)
3. Champion (Cupric hydroxide) being tested
4. Nordox plus (Cuprous oxide)
5. Radonil (Metal axyl)

Herbicides

1. Gammoxone
2. Baster Used in plantations only
3. Roundup

Rodenticide

1. Sodium monofluoroacetate Rodents

All these pesticides have been tested and found to be safe. Cocobod actually buys pesticides directly and distributes to farmers for use against preharvest pests, whilst for post-harvest pests cocobod handles it directly.

Pesticide orders vary from year to year but in recent times approximately $7 million are spent annually. Liquidity is sometimes a problem i.e. foreign exchange, although Cedis are also sometimes scarce. There is apparently no working capital, thus, once the produce are sold and overheads taken, the remainder goes to the Ghana government. Loans with interest are sometimes obtained from the Bank of Ghana.

Other crops using pesticides include maize, sorghum, millet, rice, cotton, cowpea, citrus, mango, pineapples and vegetables.

Maize/sorghum/Millet

	Pest	Pesticide
1.	Borers	Sumithion,Ripcord,Thiodan (I
2.	Weeds	Atrazine based
3.	Striga	(Cultural practise)
4.	Storage pests	Actellic and Phostoxin

Rice	
Rice Blast Borers Weeds	Dithane Furadan Stan F 34T and Aborisan
Cotton	
Various Insect Pests	Chlorpyriphos,Karate Thiones, Fernon
Cowpea	
Various insect pests	Dimethioate,Cymbush, Ripcord Thiodan 35 EC
Citrus/Mango	Biocontrol
Pineapple	Basodin (Diazinon) for mealy bug
Vegetables	Insecticides include Sumithion Cymbush,diamethoate,Karate, actellic,furadan,dithane. Fungicides include pentacor, kocide,cobox,dithane

4.1.3 Pesticides Procurement, Formulation, Marketing and Distribution

Most pesticides utilised are imported by chemical companies. In addition various agricultural organisations, NGO's and other organisations import pesticides for use within the country. The Ministry of Agriculture buys quite a lot of pesticides from these companies for emergencies such as outbreaks of armyworm, variegated grasshoppers etc. Until recently there was virtually no control on the importation, distribution, marketing and use of pesticides in the country. Thus anyone could import any chemicals into the country. However, the Environmental Protection Council (EPC) has recently set up the Toxic Chemicals Committee to advise on measures to ensure safe and efficient use of pesticides in Ghana and from whom clearance must be obtained by importers of pesticides before processing the import documents.

The major agrochemical companies include Tema Chemicals (a subsidiary of ICI) Agrakwa formulation plant, Ionicon Wax Ltd, Shell (Ghana) Ltd., Bizengoff (Ghana) Ltd., Reiss & Co.(Ghana)Ltd., BASF and Danarco Ltd. Apart from importing, the following four companies also formulate selected pesticides

locally using mainly imported raw materials.

Company	Product Formulated	Use
1. Abuakwa Plant, Kumasi	Unden-200	Cocoa only
2. Tema Chemicals Ltd, Accra	Gammalin-20 EC	Cocoa only
3. Johnson Wax Ltd, Accra	Raid(aerosol) and spray liquid	Mosquitoes and other crawling insects
4. Shell (Ghana), Accra	Shelltox (aerosol) and spray liquid	Mosquitoes and other crawling insects

There is no pesticide manufacturing plant in Ghana presently, thus all pesticides in the country are either imported or formulated as mentioned above.

The bulk of pesticides used in Ghana are insecticides followed by herbicides and fungicides. In agriculture, insecticides are used mainly against cocoa capsids, grasshoppers, armyworks, borers and other insect pests of crops. Insecticides are also used in the public health programmes for the control of mosquitoes, blackflies, other disease vectors and in the veterinary sector.

In veterinary, various acaricides are used against ectoparasites. The pesticides include, Gammatox (liq.), a lindane based acaricide, (benzene hexachloride); Delnab DFF (liq.), an organophosphorus compound, the synthetic pyrethroid coopex WP, and Diametrin (liq.) also a synthetic pyrethroid, presently being used at a rate of 50 gal/year on an EEC project.

The veterinary department either [illegible] directly with foreign exchange from the Bank of Ghana through tender; or purchases pesticides locally in the open market or obtains some through technical assistance programmes. Formerly there was not enough in the system due to liquidity problems but no shortages are expected anymore.

As with other establishments, pesticides arrive at the Tema Port and are then distributed to various outlets throughout the country in the ten regions, then to the districts and sometimes even at village level.

Various problem areas have developed over the years including parasite resistance to gammatox for which some assistance may be needed. Presently the veterinary department is liaising with Coopers (UK) to investigate this problem. Extension may also

need to be improved by training more personnel to teach farmers, since some accidents in the form of poisoning have occured in the past. Some have even used these pesticides to catch fish or to treat headlice. Organophosphorous used for this latter purpose has resulted in the death of an individual.

Sometimes the veterinary department organises a weekend clinic for dipping in Accra, where dogs, cattle, poultry etc. are treated.

Gammatox comes in 5 gallon containers but it is usually dispensed into smaller aliquots (1 litre) into customers bottles containers. Delnab however comes in 1 litre containers. There are no subsidies whatsoever on these pesticides but the profit margins are usually smaller than those of chemical companies. The quantities of pesticides imported by the Veterinary Department and by the company J.L. Morrison Son & Jones are as follows:-

Veterinary

1984	1040 litres	Delnab
1988	492 litres	"
1989	539 litres	"

J.L. Morrison Son & Jones

1988	495 litres	Gammatox
1990	5000 litres	"
1990	4000 litres	Delnab

There is however a current trend to go in for the pyrethroids. Infact Coopers will be terminating production of Delnab soon and going for other products.

As far as training goes, the Veterinary School trains Technical Officers as Field Officers. There are 4 or 5 Field Officers per district and one Senior Officer at each district.

Public Health

Pesticides are also used in public health programmes such as control of mosquitoes, blackflies and other disease vectors. Table 6 gives a list of some pesticides in public health control programmes in Ghana. In 1986, the Ministry of Health ordered directly from Cooper Mcdougall & Robertson Ltd., U.K., 4600 litres of Agua reslin (230x20 litres) at a rate of £420 totalling £96,600 and Coopex 25 WP (80x25g) at a rate of £2.67 totalling £21,368. Several small scale cottage pesticides formulation plants exist, mostly unregistered, producing pesticides for household pests.

Tables 7 and 8 list the range of pesticides imported by two chemical companies in 1989. For importation, companies bid for

TABLE 6 MAJOR PESTICIDES IN PUBLIC HEALTH CONTROL PROGRAMMES IN GHANA

VECTOR		RECOMMENDED PESTICIDES	RECOMMENDED DOSAGE RATES	MODE/FREQUENCY OF APPLICATION	RECOMMENDED PROTECTED SPECIES
1. Simulium Fly	(1)	ABATE	0.3 Lit/M3/S at 0-9 MS/S	Aerial application	Human and animals
			0.2 Lit/M3/S at 10-49 MS/S	Aerial application	Human and animals
			0.1 Lit/M3/S above 50 MS/s	Aerial application	Human and animals
2. Simulium Fly	(1)	BACILLUS THURINGIENSIS (B.T.)	0 72 Lit/M3/S	Aerial application	Human and animals
3. Simulium Fly	(1)	CHLORPHOXIME	0.15 Lit/M3/S	Aerial Application	Human and animals
4. Simulium Fly		PERMETHRINE 20%	0.45 Lit/M3/S	Aerial aplication	Human and animals
5. Simulium Fly		CARBOSULFAN 25%	0.12 Lit/M3/S	Aerial application	Human and animals
6. Mosquitoes	(2)	DDT (DUSTS)	10.0g/hectare	Improvised applications twice per year	Human and animals
7. Mosquitoes		AQUARESLIN	0.05 Lit/hectare	Mist blower/ULV. Twice per year	Human and animals
Mosquitoes		COOPEX	1.0 Lot/hectare	Knapsac Spraying machine or other equipment. Twice per year	Human and animals
9. Mosquitoes/Snakes		FENITHROTHION	2.0g/m2	Improvised applicators or Knapsack machine. Four times in a year	
10. Rodents		COMPOUND 1080	-	As bait on food or suitable material	
11. Ectoparasites		Gamma-BHC 15% (Bremer Dip)	-	Dip (+)	Livestock, Poultry
12. Ectoparasites		Dioxathion 110% (Delnav DFF)	-	Dip and washing solution (+++)	Livestock, Poultry

TABLE 6 (CONTD)

VECTOR	RECOMMENDED PESTICIDES	RECOMMENDED DOSAGE RATES	MODE/FREQUENCY OF APPLICATION	RECOMMENDED PROTECTED SPECIES
13. Ectoparasites	Napthyl-N-Methyl-carbanate (Kartzimet)	-	-	Poultry
14. Ectoparasites	N-Methyl-& Napthyl Aminoformate(OFTGAL 50)	-	-	Poultry
15. Ectoparasites	Parasitex	-	+	Pets
16. Ectoparasites	Bromocyclen (Alugan)	-	+	Pets
17. Ectoparasites	Asuntol	-	++	Livestock, Poultry and Pets
18. Ectoparasites	Malathion	-	++	Livestock, Poultry and Pets
19. Ectoparasites	Gamma-BHC 20% (Gammatox)	-	++++	Livestock, Poultry and Pets

(1) Abate has been replaced by (BT) in Dry Season and Chlorophoxime in Wet Season since 1986

(2) The use of DDT is discontinued since 1979

(+) Indicates the frequency of use of listed chemical

TABLE 7 TEMA CHEMICALS 1989

PRODUCT	PACK	
INSECTICIDES		
ACTELLIC 25 EC	1-LITRE	
ACTELLIC 25 EC	250-ML	
ACTELLIC 2% DUST	500-G	
CYMBUSH-DIMETHOATE	1-LITRE	
DRAGON RFU	1-LITRE	
DURSBAN 4E	1-LITRE	150,000 Litres
KARATE 2.5 EC	1-LITRE	
KARATE 2.5 EC	250-ML	
HERBICIDES		
ATRAZINE 50 WP	5-LITRE	
DIURON	1-KG	
FUSILADE	1-LITRE	
GARLON 2E	1-LITRE	
GLYPHOSATE	1-LITRE	
GRAMOXONE	1-LITRE	
GRAMOXONE	5-LITRE	100,000 Litres
HYVAR X	1-KG	
PARACOL	5-LITRE	
STAM F 34	5-LITRE	
FUNGICIDE		
CHAMPION WETTABLE POWDER	2-LB	30 Tons
RODENTICIDE		
KLERAT WAX BLOCK	400-G	5 Tons
NEMATICIDE		
FURADAN 3G	1-KG	30 Tons
SPRAYERS AND ACCESSORIES		
CP 15 KNAPSACK SPRAYER	UNIT	
SPRAY SHIELD 30CM	UNIT	
SPRAY SHIELD 38CM	UNIT	
NOZZLE 300M	UNIT	
TRIGGER SPRAYER	UNIT	
BUG GUN	UNIT	
SEED TREATMENT CHEMICAL		
FERNASAN D	9-G	5 Tons

TABLE 8

SHELL GHANA SERVICES LIMITED
PRICE LIST OF AGROCHEMICALS AND AGRIC SPRAYERS (1989)

PRODUCT	PACK	RETAIL PRICE (¢)
	AGRICULTURAL INSECTICIDES	
1. Ripcord 100/1 EC	a. 12 tins x 1 lit	84,840.00 (7070.00/lit)
	b. 6 tins x 1 lit	42,420.00
2. Phostoxin Round Tablets	a. 1 ctn x 70 flasks 100 tabs	-
	b. 10 flasks x 100 tabs	-
	HERBICIDES	
1. Atrazine 500	10 x 1 lit	18,400.00 (1840.00/lit)
2. Daconate 6 E	2 x 2.5 AG	37,720.00 (18,860.00/2.5 AG)
3. Diuron 80%WP	1 x 25kg bag	69,570.00
4. " "	10 x 1 Kg Pkt	38,850.00 (3885.00/Kg)
5. Stam T-8	4 x 5 lit	88,220.00 (22,055.00/5lit)
6.		(17,600.00/5lit)
7. Stamp 330 E	4 x 5 lit	68,200.00 (17,050.00/5lit)
8. Bellater	4 x 5 lit	46,000.00 (11,500.00/5lit)
	FUNGICIDE	
Dithane M-45	40 x 0.5Kg Pkt	-
" "	20 x 1 Kg Pkt	46,200.00 (2310.00/Kg)
" "	1 x 5Kg bag	10,450.00/bag
" "	1 x 25 Kg bag	44,000.00/bag
Allman APT 20 Knapsack Sprayers	1 unit and accessories	21,970.00
Allman 'Farmer 500' Tractor mounted Boom Sprayer	1 unit and accessories	353,750.00

the foreign exchange from the Government to purchase the pesticides. In addition, all companies, agricultural agencies, Agricultural Projects and individuals who would like to import pesticides apply to the sub-committee on pesticides of the National Toxic Chemical Committee under the Environmental Protection Council for clearance. This must however be obtained before processing the import documents. Pesticides usually arrive in Ghana by ship at the Tema port and are transported by road to the various regions.

Pesticide Formulation

There are four pesticides formulation plants in Ghana owned by the following companies.

1. The Abuakwa Formulation Plant

This plant is located at Kumasi about km from Accra, with a small administrative office in Accra, and has been in operation for the past 12 years. The company is owned by two share holders i.e. Bayer (West Germany) holding 51% and the Ghana Cocobod, 49%. They formulate an insecticide called Unden- 200 EC which has a carbamate- based active ingredient and used against the cocoa capsid bugs (miriads). Control of both bugs is reported to be about 90.9%. The installed capacity of this plant is 7.2 million litres/annum in three working shifts with 30 staff. However, the reliable capacity is 6 million litres/annum. Unden 200 EC is composed of the following:

Unden Tech	-	Bayer
Emulsifier	-	"
DMF	-	"
Packaging	-	"

In 1986, 30,000 litres were produced using $50,000 of raw materials and $20,000 of packaging materials.

Operating at only 1 shift i.e. 30%, the plant produces 2.5 million litres/annum (more than the requirements), with 40 staff members. But presently less than 1 million litres are produced. Efficiency is reported to be 90%. The plant operates its own quality control laboratory etc. on site.

Estimates show that to produce 1 million litres of Unden, 2 million dollars of foreign exchange are needed. All Unden produced are supplied to the Cocobod and constitute 50% of the board's requirements.

Use of locally available raw materials have been investigated but the solvent used is purported to be absent in Ghana. However, local wooden crates are used for packaging, while the 1 litre tin containers are obtained from Germany. Printing is done both in Ghana and Germany. Prices are competitive with those of other companies as the Cocobod subsidises the pesticide sold to farmers. Also, the company is launching a campaign to educate

farmers on pesticide use and other issues.

2. Tema Chemicals Ltd. (Tema)

This is a subsidiary of ICI which started in 1959. The marketing arm is Chemico, also in Tema. ICI holds 51% and the Ghana Cocobod 49% shares. Tema Chemicals formulates Gammalin - 20, a lindane-based insecticide specifically for capsid bugs of Cocoa under the trade name PP KUMAKATE i.e. Gammalin-20(IL) EC. Gammalin is 200 g r- BHC/litre of mixed solvents already containing emulsifiers, stabilizers etc. (i.e. 20%). The installed capacity of the plant is 2 million litres/annum, but present output is far less i.e. 400,000 litres/annum. The plant employs about 34 staff members. Both active ingredients, and mixed solvents are imported, but blending, formulation, standardisation and packaging in 1 litre imported bottles takes place at the Tema Plant and all Gammalin produced is supplied to the Ghana Cocobod, who distributes them to the farmers for use on cocoa only. This constitute the remaining 50% of the cocobod's requirements.

Tema Chemicals also supplements Gammalin with other insecticides, fungicides and herbicides for general agricultural use which constitute 30% of its activities. In addition pesticides for domestic uses (pyrethroids) e.g. against mosquitoes are also imported.

Although the capacity to formulate this latter exist, it has not been very successful since, although liquid pesticides can be produced, the spray cans were not very readily available.

There is no R and D presently, however powder formulation has already been investigated using locally available materials such as coconut husk (used in East Africa) presently used as fuel in Ghana especially when one considers that pesticides such as actellic contains only 2% active ingredients. Other possible locally available raw materials being investigated are elephant grass as possible fillers and sawdust for which more research will be needed since its density is too high. Limestone and Kaolin will have to be mined since present small scale mining would be inadequate. In addition these two possible carriers will have to be investigated for compatibility with the active ingredients. Corn husks which are presently being used to sell Kenke can also be investigated. Locally available solvents from the refinery in Tema are also being investigated as possible solvents for lindane. Present packaging is in 1 litre bottles, which are imported, but although local sources are being investigated, the required mould is absent. But, if demand for these 1 litre bottles increases to about 2 million bottles/annum, Tema Chemicals would be prepared to bring in the mould which would satisfy both Abuakwa Formulation Plant (400,000 litres/annum) and Tema Chemicals (400,000 litres/annum).

As far as packaging goes, cartoons are usually locally available from GIHOC, although some are also imported. Printed labels are imported from the U.K., but this can be produced

locally if self-adhesive labels can be made.

Water and electricity presently pose no problem at all. A stand-by generator is currently available. Likewise, trained manpower is available in the company and within the country.

Foreign Exchange was once a problem, but this is no longer the case. Infact if any, Cedis availability appear to be the present problem, so much so that sometimes the Cocobod imports the raw materials directly and Tema Chemicals formulates, since demand is always there for cocoa pesticides. Pesticides for other crops, however, like cotton are required in too small a quantity to justify local production (requirements of 2.5% pyrethroids for cotton is about 100,000 litres/annum).

Cocobod does all the distribution of PP Kumakate through its distribution network i.e. from Tema to the regional depots then to district offices and to the rural areas. There are, however, major marketing and distribution bottlenecks due to inefficiency precipitated by serious attitudinal problems though cocobod subsidises the product. Thus major policy decisions would have to be made to improve the marketing/distribution of the pesticide such as privatisation of marketing and distributing of the product. Extension services seem fairly reasonable as are the supporting education packages. Lorries carry the advert "Gammalin -20 is best for Cocoa". Tema Chemicals have their own small quality control laboratory and their concern for the environment is constantly being reviewed. For example, even though lindane is in restricted use in the world and has been banned in some countries, Tema Chemicals defends itself by emphasising spraying of canopy only and residues on beans usually about 1 ppm which is less than the acceptable 5 ppm. Critics claim that lindane affects the other crops e.g. beans, usually intercropped with the cocoa. This is however being investigated, while R and D into new pesticides e.g. pirimiphos methyl and pyrethroids are also being conducted. Thus the Cocoa Research Institute of Ghana is actively screening new compounds as future candidates to replace lindane.

Presently, there are constant enquiries from neighbouring countries for the product which can be stored for a minimum of 2 years hence export potential.

3. Johnson Wax Ltd.

This is a private company with American and Ghanaian shareholders. They formulate the household insecticide called, Raid, in liquid and aerosol forms for the control of mosquitoes and other household insect pests. R and D is conducted in the USA, but quality control is carried out in Ghana. There are nine production lines requiring ¢500,000/annum for raw materials etc. i.e. cans, valves, caps, etc. all of which are imported. However some use is made of locally available raw materials such as gas and solvents (alcohol) cotton seed oil, coconut oil, processed

fillers, shear butter, cocoa butter and crude glycerine (obtained from Lever Bro. Ltd.) are also used by this company.

Johnson Wax uses both local and external experts and it is claimed that their products vary from 53% - 99% locally available materials.

4. Shell Ghana Services Ltd.

This company has offices in Accra and a formulation plant in Tema. Shell has majority shares while the Ghana government is the other share holder in the company. In the past, Shell Ghana Services Ltd. (Tema) formulated aldrin, dieldrin, ripcod and shelltox but presently only the latter is produced i.e. shelltox liquid which is used for spraying mosquitoes and other insects, using kerosene as solvent. Shelltox liquid is packaged in 1 litre tins and presently retails at 1035 cedis per tin. There are two aerosol formulation plants at Tema, one producing 7 (300ml) cans/minute and the other producing 4 cans/minute. Each can sells at 450 cedis.

Foreign exchange was once a problem i.e. investors could not remit cedis, hence lots of cedis accumulated by Shell Ghana Services Ltd. Presently, although foreign exchange does not appear to be a major problem, Shell will be pulling out of Agrochemicals and concentrate on just domestics (aerosol & liquid shelltox), and industrial chemicals, since the main worthwhile sector in Ghana is cocoa and both ICI and Bayer are formulating the pesticides for this crop. Other crops like cotton and cereals e.g. will not be profitable on their own for shell, since several other companies are present in the country hence great competition exist. In addition, local industries are not protected by preventing imports of similar products e.g. although there are three mosquito coil industries in Ghana, three other brands are imported. Hence policy measures need reassessments since changes in personnel had in the past resulted in policy changes. Policies, in general are never enforced in Ghana.

Shell has in the past instituted educational programmes relating to handling and use of pesticides in the form of farmers forum. Leaflets are printed in English only, and some attempts are made at using some locally available raw material. For example, liquefied petroleum gas from the Ghana Oil Refinery had been distenched using silica gel columns, for use in aerosols. Kerosene had been distenched with activated charcoal or activated bauxite and used for making liquid shelltox.

Containers are however imported i.e. liquids are packaged in tins, and aerosols in cans, but plastic bottles i.e. PVC are being investigated. Cartoons are also presently imported though local sources are now being investigated, but printing and labelling of boxes are done locally. There are trained personnel and a small quality control laboratory. Environmental considerations are adhered to by periodic audit (once every 3 years) by experts

from the Head Office in the Hague to ascertain that standards are maintained. Shell distributes its formulated products through filling stations and through its depots in Tema, Kumasi and Takoradi. In addition, there are retail outlets all over the country and mobile distributors are used on market days, in addition to merchandising outlets e.g. GBO and UAC outlets all over the country. Export to other countries like Togo (1200 litres Shelltox exported in 1989) and to other countries like Liberia are being investigated.

Licensing and registration so far just conforms with the trade mark of the parent company and Research and Development is undertaken by liaising with the Crops Research Institute in Ghana. Other research activities concentrate on product presentation to buyers and distenction of solvents being undertaken by the Ghana Standards Board and the University, using locally available activated charcoal. For these research, UNIDO could assist in funding two three-months attachment for further training of two personnel in a suitable institution in the West.

Problems encountered by Shell Ghana Services Ltd were, firstly, regarding import licence of raw materials, were a letter of credit obtained from the bank for the active ingredient in one year, but not for the solvent or emulsifier. Thus, because of this lack of coordination due to the lack of understanding that active ingredients, solvent, and emulsifier are all needed simultaneously for pesticide formulation, it is sometimes better to import the finished products. Furthermore, the quantum of foreign exchange obtained from the bank is sometimes inadequate to import economically viable quantities of raw materials for formulation. Also, investors were unable to remit cedis accrued thus lots of cedis accumulated.

5. TEMCO Ltd.

There are also small private, cottage formulation plants (about nine) although only one i.e. Temco Ltd. in Accra-North about 6 miles from the centre of Accra is licensed. The others are operating illegally in the country. One even attempts to copy the same colour of label from Temco. In addition there are other registered pest control agencies in the country.

Temco is a small company with only thirteen staff members. It formulates a dust insecticide called Acamark 10 for use against crawling insects from the following composition: Pyrethroid, kaolin and perfume. The product Acamark 10 is active against cockroaches, bedbugs, ants, lice, ticks and others and is not harmful to man.

The pyrethroid is now obtained from Ivory Coast (originally obtained from Japan thus a foreign exchange component). Alternatively, ripcord (as good as the pyrethroid) obtained from Shell Ghana Ltd is also used. Pyrethroid from Ivory Coast also has no foreign exchange component since Managing Director has an ar-

rangement whereby pyrethroid and perfume are bought in Ivory Coast and remittance made in Ghana in cedis.

Kaolin is locally obtained in Ghana from the Cape Coast about 2 h from Accra. Mining of kaolin is undertaken by simple, crude, traditional methods and sold at 1,300 cedis/50kg bag CIF Accra. The perfume is obtained from the Ivory Coast but at no foreign exchange cost as mentioned earlier. Locally available essential oils from Citronella has been investigated but the odour was rather too strong.

Formulation by Temco is conducted by handmixing with gloves and masks in a container, of the ingredients (active ingredient i.e. pyrethroid; kaolin; perfume and water) in the required proportions.

Packaging is done in 200g plastic packets (polythene) placed inside labelled paper packets and stapled. The cost of the plastic bags are one cedi each and for the labels and paper packets 3 cedis each. Both plastic and paper bags are locally available. Production is twice weekly, using 28 bags kaolin/week and producing a total of 10,000 packets per week. Marketing is done by the Head Office and shop, the main marketing centre about 3 miles from the centre of Accra. The price for the 200g packet is 66 cedis - 6 cedis of which goes to customs as tax. Product is distributed to all ten regions of the country and in each region there are 6 agents who carry out house to house sale of the product. These agents buy wholesale at 66 cedis and sell at 120 cedis in Kumasi and 100 cedis in Accra. Price control is enforced by the Managing Director.

Quality control is maintained by the Ghana Bureau of standards who tested the product and should do so once every 6 months. For this, 5,000 cedis per product per test is charged. Temco is also registered with the Ghana Environmental Protection Council.

Apart from domestic use, this powdered product has been used in tomato fields and after dissolving in water sprayed on onions with apparent success.

Other products formulated by Temco were liquid Acamask 10 (deodorant, disinfectant) in 1 litre cans. This was formulated for use in hospitals, municipal services, offices, schools, factories, farm canteen, laundries, sports, camping, holiday centres, supermarkets and for general environmental hygiene. In the past it required Aluminium containers, but containers have always been a severe problem for liquid insecticides which were made from pyrethroids, water and perfume. So far no suitable locally available container has been found. The Aluminium company in Tema cannot make these containers and the compound dissolves plastic containers. Because of these problems, liquid Acamask has been discontinued.

Also, the rodenticide 1080 was mixed and distributed by Temco, but this is now produced on contract only.

Like most small private manufacturing companies, Temco Ltd. is beset with many inadequacies which could be improved especially since Temco is seriously contemplating expansion to the use of about 50 bags kaolin/week. Firstly, the mixing method needs improvement as the present method may not be very homogeneous and hygienic enough. Boots, gloves, hats and masks are to be used by all workers at all times. Training is absolutely a necessity for all workers especially senior workers who can then train the junior workers on site on all aspects including environmental considerations.

Presently, most workers are only secondary school level personnel and the General Manager had worked in Pest Control in Ivory Coast for 2 1/2 years. Furthermore transportation for distribution of finished product had always hampered further expansion, thus acquisition of a van will greatly alleviate this problem so that every village can be reached. Thus a loan from the bank to purchase this vehicle will greatly facilitate this expansion process envisaged to use about 50 bags kaolin/week by the end of the year, plus an expansion of the factory building as well.

It is therefore clear that in Ghana, distribution of pesticides is carried out by the importing companies through their agents in the various regions, who in turn undertake the marketing of the products to all users throughout the country. In addition, private agents of the major importing firms in the various regions also distribute and market their pesticides. The major distributing and marketing companies include: Chemico Ltd., Danafco, Abuakwa Formulation Plant, Johnson Wax & Co. Ltd., BP Ghana Ltd., Cotton Company, Plant Protection and Regulatory Services, Global 2000, Irrigation Development Authority, Cocoa Marketing Board, UAC, G P Gillivant and Grains Board.

The Cocobod distributes its own pesticides by firstly dividing the country into 1,200 units, each made up of 3,000 acres. Each of these units has three extension staff responsible for advising farmers on the type and quantity of pesticides to be used. Normally cocoa and coffee plantations are 500-1000 ha whilst sheanut grows wild. The pesticides are sent to the various districts (about 30 throughout the country) were they are stocked and the farmers purchase the chemicals at the district level.

Fungicides are obtained in small packets of 100g each and insecticides in 1 litre containers. For post harvest pest., insecticides are obtained in larger quantities since this is handled by the cocobod itself.

The Plant Protection and Regulatory Service has offices in all regions and in the 110 districts of Ghana. It markets about 30% of the total pesticides imported.

4.1.4 Retail Prices and Trends of Pesticides Use

Table 9 gives the retail prices of some of the major pesticides used in Ghana. As can be seen, even though prices have increased over the years, consumption has also increased considerably, apparently due to the many pest problems of the Ghanaian farmer. Prices are dependent largely on market forces rather than government controlled. However for pesticides used in cocoa production the government used to provide some form of subsidies (Table 10) hence the selling price of these were controlled. Now all subsidies on pesticides have been removed by the Government but incentives are given to best farmers during National and Regional Farmers Day Celebrations. The incentives take the form of vehicles, and farm inputs including pesticides, spraying machines, cutlasses etc.

4.1.5 Storage of Pesticides and Safety Precautions

The major pesticides importing companies have storage warehouses but some are not well suited or safe for the workers. Thus most companies in the country do not have good storage facilities. In some cases, pesticides sellers and farmers sleep in the same room containing pesticides but the Plant Protection and Regulatory Services are engaged in educating the public on pesticides hazards. Misuse of the rodenticide aluminium phosphate had caused some accidental deaths possibly due to phosphene contamination.

The Toxic Chemical Committee has delegated to the PPRS to educate farmers and others on the sage and efficient use of pesticides. Thus farmers in the various regions are taught on a regular basis the use of pesticides and safety precautions. But, the much needed protective clothing is rather too expensive for an average farmer, hence locally identifiable materials are recommended for the protection of the skin, hands, legs, mouth, nose and eyes. Only Chemico Ltd. in Tema sells the complete set of protective clothing but other private enterprises sell separate items such as gloves, boots, goggles etc.

4.1.6 Licensing

Until recently there was no organisation charged with the responsibility for regulating the importation, manufacture, distribution, sale and use of toxic chemicals including pesticides in Ghana. So the distribution and use of pesticides in the country was very difficult to control once in the country.

Thus in 1974 when the Environmental Protection Council (EPC) was established by the government, and in accordance with its regulatory and coordinating roles, the EPC appointed a Committee on Toxic Chemicals in order to advise on appropriate measures necessary to curb the possible hazards posed to the environment and to human health, from the indiscriminate use and inappropriate handling of toxic chemicals. In 1975 a broad-based expert committee on toxic chemicals was formed which comprise all

TABLE 9 : RETAIL PRICES OF MAJOR PESTICIDES IN GHANA (1984 - 1989)

PRODUCT	1984	1985	1986	1987	1988	1989
INSECTICIDES	¢/Lt.	¢/Lt.	¢/Lt.	¢/Lt.	¢/Lt.	¢/Lt.
Gamalin 20 EC	100.00	100.00	130.00	600.00	600.00	-
Unden	600.00	133.50	130.00	600.00	600.00	-
Elocron	30.00	30.00	-	-	-	-
Actellic EC 25	113.02	396.00	490.00	490.00	2,650.00	3,180.00
Cymbush	81.57	461.10	925.00	1,150.00	3,058.60	5,500.00
Furadan/kg	95.00	112.02	200.00	480.00	480.00	-
Diazinon 60 EC	-	-	-	8,000.00	10,000.00	-
Sumithion 50 EC	91.10	1,695.00	1,695.00	2,824.07	2,824.07	-
Roxion 40 EC	-	-	-	1,700.00	1,975.00	-
Perfekthion 20 EC	320.00	450.00	450.00	600.00	-	3,700.00
Phostoxin/	171.50	171.50	300.00	300.00	600.00	3,700.00
Methyl Bromide	-	-	150.00	-	-	-
Ripcord 10 EC	-	355.80	355.80	-	7,700.00	-
Cymbush-Dimethoate	-	-	-	1,960.00	4,650.00	
FUNGICIDES:	¢/kg	¢/kg	¢/kg	¢/kg	¢/kg	¢/kg
Diathane M 45	21.60/kg					
Kocide	230.34	-	718.82	1,499.33	1,949.15	
Cobox	-	-	-	-	700 kg	1,950 kg
Champion	-	-	-	1,750.00	2,607.00	-
Cuprous Oxide	174.72	-	648.00	1,132.86	1,849.44	-
HERBICIDES:	¢/Lit	¢/Lit	¢/Lit	¢/Lit	¢/Lit	¢/Lit
Grammoxone	95.13	153.43	255.67	653.55	998.90	1,120.75
Garlon 2E	38.45	-	-	1,909.05	2,083.72	-
Atrazine 50%	-	274.09	-	-	777.44	-
Gramuron	117.39	-	-	-	1,162.84	-
Fusilade	683.61	-	-	-		3,265.18
Paracol	-	-	-	914.43	1,338.22	1,650.24
RODENTICIDES:	¢/kg			¢/kg	¢/kg	
Klerat	150.28	-	-	669.69	1,017.96	-

TABLE 10 GOVERNMENT SUBSIDY ON INSECTICIDE

YEAR	SUBSIDY %	INSECTICIDE
1983	40	Unden '200' Gammalin 20
1984	40	Gammalin 20
1985	40	Gammalin 20 Unden '200'
1986	40	Unden '200' Gammalin 20
1987	50	Unden '200' Gammalin 20
1988	40	Unden '200' Gammalin 20
1989	-	-

Sources: Cocoa Services Division of Ghana Cocoa Board 1989

the relevant institutions, departments and organisations involved in pesticide use and control. First, they compiled a list of all pesticides used in the country and later set up a six member sub-committee on Toxic Chemicals whose responsibility is to advise on appropriate legislation and registration of pesticides in Ghana. The terms of reference of the sub-committee is as follows:

1. To advise on appropriate legislation to regulate the importation, manufacture, sale, distribution and use of toxic chemicals, other than pharmaceutical and drugs, manufactures, formulated or imported into Ghana.

2. To advise the Environment Protection Council on matters relating to the handling of potentially toxic chemicals other than pharmaceuticals and drugs.

3. To review the mode of operation of pest control companies and advise Council on measures necessary to ensure proper conduct of such operations.

4. To advise the Council on the registration and licensing of all agro-chemicals, distributors, importers, manufacturers, sellers and operators of agrochemicals in the country.

5. To evaluate the need for pesticides in particular areas and control their use.

6. To develop and/or advise on preventive measures, appropriate diagnostic tests and treatment facilities for pesticide poisoning.

7. To provide and/or organise training in diagnosis, treatment and prevention of pesticide poisoning to health workers.

8. To advise Council (EPC) on related matters that may from time-to-time be reported by Council to it.

In the draft legislation, provision has been made for licensing Pesticide Distributors, Pest Control Operations, Formulators, Manufacturers, Wholesalers etc.

Furthermore, the FAO International Code of Conduct on the distribution and use of pesticides was also adopted by Ghana, and has been studied by the sub-committee, after which, the pesticide legislation for Ghana was drafted. The sub-committee provided a registration and quality control package which consist of registration, worker health and safety, Quality control and Enforcement.

Also, while awaiting the enactment of the pesticide legislation, the EPC in collaboration with the Ministry of Agriculture now examines all applications for importation of agrochemicals into Ghana to ensure that only "safe" and effective pesticides

are imported into the country. This system is far better than the previous in which the Ministry of Trade issues import licence to pesticides importers with or without the advice of the Ministry of Agriculture. This new system has the advantage of putting expert knowledge of the broad-based expert committee of the Environmental Protection Council at the disposal of the Ministry of Agriculture for better and appropriate decision.

4.1.7 Legislation

There is presently no pesticides legislation in Ghana, so the EPC has invoked their regulatory powers to make it mandatory that all importers and formulators of pesticides should register with the EPC. Thus the EPC would be in a better position to monitor the distribution, sale and use of agropesticides in the country while awaiting the enactment of the draft legislation on pesticides.

Furtner, the present control scheme also regulated the importation of pesticides into Ghana. The Customs, Excise and Prevention Services has officials at all the major ports of entry so that no imported chemicals are allowed to enter the country until it is cleared by the EPC. A newly computerised system indicating pesticides imports, CIF (Cedis) and CIF (Dollars) is now in operation by the Customs Department.

4.1.8 Quality Control

The United Nations FAO has established a Quality Control Laboratory at the Ghana Atomic Energy Commission in Kwabena since January 1990 for testing all pesticides. This laboratory is to be upgraded by the IAEA for the application of tracer techniques to study the fate and movement of pesticides in the environment (pesticides residue analysis).

4.1.9 Raw Materials

Introduction

For pesticide formulation, it is extremely important that cheap and readily available raw materials of consistent quality are used at all times. Locally available formulation inerts, etc., which meet the specification, should be used wherever possible as these would reduce freight costs, foreign exchange, shipping times, etc. Raw materials considered include active ingredients, solvents, carriers and packaging materials. Some are available in Ghana carriers and diluents, solvents and packaging materials which if they meet the required specifications could be used in a local formulation plant.

Active Ingredients

These are the chemicals in the formulation which actually possess the biological activity. All the other ingredients in the formulation are only used to facilitate the application of

the active ingredients to the target organism. The physical properties of the active ingredients imposes a limit to the choice of formulation ingredients used for any given type of formulation. For example, the physical state (liquid or fine crystals, powdered flakes, solid cakes or small lumps) melting and boiling points, specific gravity (density), viscosity, solubility, stability, odour and colour.

Presently, no manufacturing of active ingredients is undertaken in Ghana. This is not surprising since such activity involves highly sophisticated and expensive chemical technologies which cannot be afforded at this time. Furthermore, since only small tonnages are required, local production may not be justified, hence, it is not advisable at this time.

Chemical companies already present in Ghana can, however, supply active ingredients as required (chlorinated, organophosphorus, carbamates, pyrethroids or plant extracts). They can also provide the necessary back-up assistance relating to formulation development work based on utilization of local raw materials (carriers, solvents, etc.), analytical methods, safety requirements and application methods.

In terms of bulk, smaller quantities of active ingredients will be imported compared to finished formulated products, thus many inherent problems will be reduced such as transportation, foreign exchange, handling, etc.

Solvents

The Oil Refinery in Ghana is owned by the Ghana-Italian Petroleum Company (GHAIP) and it is located in Tema. Crude oil is obtained from Nigeria and the refinery process produces the following solvents:-

Naphthas (light and heavy) - Gasoleine, used to run cars; some are imported.

Kerosene - Enough for the country, but sometimes some are imported.

Gasoil - Enough for the country and can probably supply some to formulation plant if quantities and specifications are known.

Liquefied Petroleum Gas - Produced for local market and exports some; so can supply some provided quality is first investigated.

Aviation Kerosene - Supplied to the Aviation Department.

Residual Fuel Oil - Used as combustion fuel in boilers; some exported.

No xylenes or toluenes are produced. It is however quite possible to obtain solvents from the GHAIP but this will depend on the quality of crude oil imported (foreign exchange

component). It would also be up to the Pesticide Company/Industry to look at the specifications of the solvents and adapt it to their needs. Thus it will obviously depend on the priorities of the company.

Kerosene had already been used by some pesticide industries in Ghana and a project to produce chlorinated solvents by chlorinating local Naphtas has been discussed with Tema Chemicals.

Ethanol - This is produced by several industries in Ghana. For example, the Ghana Sugar Estate Ltd. in Asutsuare with head office in Accra. They have an integrated system comprising a sugarcane plantation, a sugar plant and an alcohol plant. However, both the sugar plantation and the sugar plant need rehabilitation and presently the industry imports molasses and obtains some from local farms. The GORKU Ltd. at Akuse about 80Km from Accra also manufactures alcohol. It has its own plantation but no sugar plant. The Animens in Takoradi owns a sugarcane plantation and produces alcohol but does not produce sugar presently. Alcohol price in 1989 was 550 Cedis/litre (factory price), with an installed capacity of 16 k Litres/day, but the present capacity is less.

Oil Seeds

Formerly two main companies were responsible for this, but presently all cotton oil is exported; there is no corn oil; and groundnut oil is produced by Sora Oils Ltd. Other oil producing companies include about fifteen palmoil milling companies, three coconut oil companies, and seven palm kernel oil companies. Citronella oil from the leaves is produced by Lever Brothers, and Lime Oil is produced for use in food industries.

Carriers and Diluents

In Ghana, some amount of minerals that can be used as carriers and diluents for making dry formulations exist in the country. Kaolin is already being mined in Tema for example, on a small, low technological level. A small privately owned formulation plant uses kaolin from Tema for dust formulations. Kaolin is also used in the Ceramics Industry, while limestone is to be used in the cement industry. The market price in 1988 was 6000 cedis/25kg bag and for limestone 1500 cedis/50kg bag.

The following are the minerals present in Ghana which can be used in pesticides formulations:

Kaolin - This is located in the saltpans in the central region of Ghana and is presently being exploited by the Saltpond Ceramics Limited. Kaolin deposits with enough information concerning its future exploitation on a large scale, are those deposits 10 km north-east of Kibi on the Atewa Range in the Eastern Region whose estimated reserve is 4,750,000 metric tones and average chemical composition thus: (Kaolinitic - 60%, $Si\ O_2$ - 30%, Mica - 5%, K_2O 0-0.77%, Na 0-0.01%).

Present traditional low level exploitation in the Tema area involves digging, washing, refining and drying.

Limestone and Dolomite - These minerals are located in Buipe in the Northern Region and limestone is presently being exploited by the Buipe Lime Factory. There is enough information available concerning their future exploitation on a large scale. Limestone together with dolomite is located in Bongo-Da in the Northern Region and has an estimated ore reserve of 15 million tones of calcium carbonate ($CaCO$) and 20-30 million of dolomitic limestone i.e. $CaMg(CO_3)_2$. The average chemical composition of both the calcium carbonate and the dolomitic limestone are known as follows:-

Calcium Carbonate

Ca - 40.0 - 49.3%
MgO - 1.2 - 4.2%
Al_2O_3 - 1.7 - 3.9%
Fe_2O_3 - 1.1%

Dolomitic Limestone

CaO - 23 - 51%
MgO - 12 - 19%
Al_2O_3 - 1.4 - 2%
Fe_2O_3 - 0.6 - 1.2%
SiO_2 - 3-12%

There is also enough information for limestone exploitation on a small scale i.e. limestone located in the valley of the River Fo between the hamlets of Kwesi Mrekukura and Foso in Field Sheet 139, Afram N.W. The outcrops of this deposit is situated within the fork made by the Fo River and its tributary, the Ankaniem. A preliminary estimated ore reserve indicates that the deposit may yield about 1.5 million tones of limestone if exploited to a depth of 15 metres. The average chemical composition of this limestone is SiO_2 - 16.9%, CaO - 57.36%, MgO - 5.3%, Al 0-2.59%. Another limestone deposit (~6-10 million tones) is located 6.5km east of Oterkpolu village to the north of Oterkpolu-Odumasi motor road in the Eastern Region, while a third deposit at Daboya in the Northern REgion is estimated at 100,000 tones $CaCO$ and 500,000 tones $CaMg(CO_3)_2$. Another 401 million tones of limestone is located at the southwestern coast of Ghana at Nauli, about 112km west of Takoradi in the Nzima Traditional area in the Western Region. In all of these the average chemical composition is also known.

Gypsum and Talc may also be present in Ghana in unknown quantities.

Phosphorus, Sulphur and Copper are absent but Chlorine has been produced on a small scale by electrolysis of sodium chloride.

Packaging - Plastic packets of various sizes can be produced by several factories most of which are located in Accra. They include Poly Products Ltd., Metaloplastica, Top Industrial Packaging and Agricultural Products, Ltd., Tapolin and Polypropylene, Polysacs Ltd., Ashanti Packaging, Polymers Ltd., Super Industries, Pharmaplast Ltd. and Green Plastica. The total

country wide production is about 6,000 tons/annum. Prices range from 450-600 Cedis per Kg. Recently quite a lot of rehabilitation has taken place in these factories.

Metaloplastica in Accra can also produce drums of different sizes, using different molds. Metal Containers Ghana Ltd. makes steel containers for cosmetics by importing the metal. Although Aluminium is available, drums have not been made from it as yet.

Cartoons of various sizes can be made by GIHOC paper conversion in Takoradi (300 km from Accra). In addition a new factory for making cartoons to be located in Accra is being set up.

Paper is made by Super Paper Products Ltd. in Accra and Tema. The installed capacity is 12 tons/day but it is presently operating at only 20%. Prices are currently 14,000 cedis/Rim of paper. There is however a 4000 ha/Bank/Government Plantation Project to be started in 1992.

4.2 Importance of the System in the Country's Economy

The pesticides industrial system in the country contributes quite significantly to the overall national economic and nutritional goals of Ghana. Pests and diseases of important crops are serious contributions to the low crop yields in the country and they contribute some 30% in crop losses. Thus even though the prices of pesticides have significantly increased over the years, consumption has also increased considerably, apparently due to the myriad pre and post harvest problems of both cash and food crops which are prevalent in the country. Use of these pesticides thus contributes to achieving food self-sufficiency and increased exports of cash crops, hence raising the living standards of the people. Moreover, pesticides make significant contributions in the public health and veterinary sectors in Ghana thus reducing health problems of man and animals raising the living standards as well, in keeping with the government's pledge.

From an industrial viewpoint pesticides industry will contribute to industrial growth by maximising utilization of existing plant capacity through the use, as best as possible, of locally available raw materials and by providing some employment as well.

4.3 Government Development Objectives related to the System

There are various constraints in the Agricultural sector towards realising the potential for increased productivity. These include constraints due to institutional factors (research, extension, input supplies, prices and marketing, credit and poor infrastructure) and technical constraints (soil fertility, soil physical properties, soil erosion, moisture availability, labour

availability, land preparation, crop protection, post harvest losses, and future technology). To alleviate these constraints and promote growth, several strategies have been proposed by the Government including improved varieties and seed production, soil fertility, maintenance, cropping systems, cultivation practices, mechanisation, soil and moisture conservation, crop protection, post harvest activities and sustainable land use. In addition, improved extension and pricing policies that ensure a fair return to the producer and an appropriate macro-economic framework are also important and have been proposed by the government.

For crop protection specifically, the government has stressed that chemical pests control must be cost-effective. In addition other strategies are proposed such as development of pest and disease resistant/tolerant varieties; emphasis on biological control (already being used against cassava and mango mealy bugs), and a pest and disease forecasting system or early warning system. For post-harvest, emphasis should be made on reducing losses at the farm level through improved extension advice. The FAO is actively involved in this activity. Furthermore, addition emphasis is also placed on reducing losses of marketed produce which is dependent on improved market storage and handling.

Development objectives relating to the industrial sector include the setting up of a National Board for small scale industries (NBSSI) which provides both financial and technical assistance to Ghanaians desirous of setting up small scale industries. In addition emphasis is placed on making efficient use of resources for economic growth, building up a body of knowledge, skills and techniques, making use more self-sufficiently and to push forward towards economic independence.

Regarding industry, the general industrial climate immediately before the ERP was launched, was characterised by low capacity utilization as a result of inadequate imported raw material supplies to feed industries, over-dependence on foreign exchange for industrial raw materials and spares, lack of local raw-material-based industries, weak linkages between R & D institutions and industry which should use the research findings, production of poor quality goods as a result of lack of competition, and lack of horizontal and vertical integration within the industrial sector itself for comprehensive industrial development.

Capacity utilization averaged 10-15%. The market was characterised by shortages of all essential goods. Prices were prohibitive and attempts to control them led to artificial shortages. The ERP was therefore intended inter alia, to address imbalances and distortions in the industrial sector. Two major policy measures to salvage the industrial sector are restructuring of the sector and programmed rehabilitation of selected key industries. A number of fundamental operational policies have been adopted and are being actively pursued.

These include:-

- the development of local raw materials to feed industries, thereby reducing the importation of raw materials for industries, easing the demand on the country's foreign resources and optimising utilisation of installed capacity.

- placing emphasis on the establishment of agro-based industries to process agricultural raw materials, minimise post-harvest losses which tend to discourage farmers to produce more, and as a corollary improve the farmers' earning capacity.

- promoting the establishment of key industries which facilitate the country's self-reliance, and pursuing the establishment of appropriate linkages within the industrial sector.

- the spreading of industries throughout the country, depending largely on local resources, the promotion of small-scale industries, the upgrading of traditional technologies and the application of appropriate technologies.

- encouraging potential industries to go into export or sell their idle capacities under tolling arrangements.

- reviewing the operations of industries in the public sector and phasing out the non-viable ones.

- ensuring that the environment is protected against pollution by industries.

The first phase of the ERP resulted in a growth of 13%. The objectives and strategy of the ERP seek to remove production bottlenecks in the most efficient industries and achieve significant cost reductions in others that are potentially viable through selective rehabilitation.

- develop economically viable linkages among local industries and between key sectors (e.g. agriculture, construction, transport, health and education and

- raise export earning of non-traditional manufactured goods.

In the short-term, additional resources will be made to the more efficient priority industries with the capacity to make immediate supply response. The medium-term objective is to rehabilitate the potentially viable and efficient industries, and to develop the local raw material base for industries, taking into consideration, the country's comparative advantage in order to reduce their dependence on foreign exchange. In the long-term, the objective is to achieve an industrial structure more closely linked with domestic inputs and needs, which can provide a higher share of its own foreign exchange requirements through increased export, and which can sustain a rate of growth of

output and employment.

To accomplish the short and medium term objectives of the industrial sector restructuring, the MIST has with the help of the World Bank formulated an industrial adjustment programme.

For the industrial sector to generate at least its own foreign exchange requirements, export promotion has been given a new emphasis and

Priority areas include:-

Aluminium based industries, e,g cans
Packaging materials and
Encouraging public/private industries

4.4 On-going Development Activities related to the System

Various development activities related to the pesticides industrial system in Ghana are underway in the country. These include the following:-

A. Agriculture and Rural Development

(1) Third World Bank Credit to Cocobod for purchase of pesticides. Interest rate 3/4 of 1%, $15 million for 1990-1994.

(2) All World Bank Agricultural Projects have a pest management component.

(3) Medium Term Agricultural Development Plan - submitted by the MOA to Government in March 1990, for approval before implementation.

(4) FAO (TCP/GHA/8855) - Assistance to establish a National Pesticide Registration and Control Scheme. - Quality Control laboratory set up at Kwabena.

(5) Global 2000 in Western Region. Project makes effective use of extension staff, improved seeds, fertilizer and credit. Government is planning similar projects in other regions as well.

(6) Grants in aid from Holland, Japan and the FAO.

(7) UNDP/FAO project GHA/86/007 on strengthening of the Postharvest Development Unit (Ending, 1990). Aid-in-kind for post harvest project financed by UNDP through FAO $35,000 for 5 tons Actellic Super. Project ends in 4/90 i.e. 1985 - 1990. After which other possible donors include ODA, EEC, UNIDO (£2m envisaged).

(8) UNDP/FAO Improvement of Agricultural Statistics Project GHA/84/003.

(9) Rural Banks, a means of obtaining credit by small scale farmers.

B. Industry

(1) National Board for small scale industries (NBSSI) provides funds for both financial and technical assistance to Ghanaians desirous of setting up small-scale industries.

C. Policy

(1) Draft Pesticides Legislation and Registration now with the FAO in Rome for study before enactment.

(2) FAO International Code of Conduct on the distribution and use of pesticides already adopted by Ghana.

4.5 Institutional Framework for the Development of the System

The Ministry of Industry is the main government agency in the development of the pesticides industrial system in the country. To achieve the government's objectives for industrialisation a partnership between the public and private sectors, domestic and foreign investors, workers and entrepreneurs in a way that each party contributes in the manner in which it can be most productive has been recommended.

Thus the Ministries of Industry, Agriculture (particularly the Plant Protection and Regulatory Services Division) Health, the Ghana Cocobod, Mines, Geological Surveys, Development Banks, AID agencies et al all have significant roles to play in the overall development of the system. In addition, private chemical companies (local and foreign), together with other organisations such as the FAO, EEC, World Bank, UNIDO and various NGO's will play active roles in the system. Assistance to Ghana have included technical assistance and investment projects.

5. Programme Justification

5.1 Problems to be addressed

Although pest management in Ghana is comparatively more developed than in many other African countries and various attempts are being made to improve the pesticides industrial system, there still remain several constraints to be addressed including the lack of coordination of the various activities within the country.

To reduce these inadequacies and to increase the level of attainment of the Government's objectives thereby reaching a higher standard, additional inputs are required to address these constraints. These constraints and bottlenecks include the following:

1. Lack of coordination of all pesticides activities.
2. Extension services are weak.
3. Distribution networks and transportation are poor.
4. Training in selected areas is lacking.
5. Use of locally available raw materials for pesticides formulation underexploited.
6. Marketing - credit, pricing etc. need improvement.
7. Inadequate dust formulation.

On the contrary, various enhancement variables i.e. factors which potentially could enhance the development of Ghana's pesticides industrial system are as follows:-

1. Pesticides formulation plants are present in the country
2. Some raw materials suitable as dust carriers are present
3. Some solvents suitable for liquid formulation are produced
4. Great demand for pesticides utilisation in the country
5. Some packaging materials exist in the country
6. Government has accorded a high priority to increased agricultural development and greater productivity

Table 11 lists the various constraints, options for solution, together with on-going and planned projects.

Table 11

COMPONENT	DESCRIPTION	CONSTRAINTS	OPTIONS FOR SOLUTIONS	ON-GOING ACTIVITIES	PROJECT IN THE PROPOSED PROGRAMME
Raw Materials	Active Ingredients - Chemical Synthesis	Unavialable	Local production not justified at this time.	-	-
	Carriers - kaolin	Underexploited "	Large Scale mining required	Small scale low Technological Mining	Large scale mining project required Tests for suitability to be conducted
	- limestone - dolomite - gypsum - talc	" " Unexploited			
	Packaging - plastic - metal -cartoons - paper bags	 " " available "			
	Solvents - mineral oil - distillation products * Kerosene * Naphthas * Gas oil * LPG * Ethanol * oilseeds	Underexploited " " " " " " "	Tests for suitability " " " " " "		Tests for suitability to be conducted and policy on supply of solvents for use in pesticide formulation.
Distribution	Road Networks & Transport	Poor - Roads bad and vehicles inadequate and unappropriate	Road to be improved; 2-3 tonnes vehicle with 4 wheel drive needed.		Improvement of roads and Transportation.
Extension	Extension Services	Weak	Training of more agricultural extension staff; and farmers.	In-Service training Courses	Training of more pest management specialists

COMPONENT	DESCRIPTION	CONSTRAINTS	OPTIONS FOR SOLUTIONS	ON-GOING ACTIVITIES	PROJECT IN THE PROPOSED PROGRAMME
	Pest management	Weak	Training of more agricultural Specialist in pest management including IPM pre-harvest and post-harvest pest management in Research.	In-service training Courses	Training of more Pest Management Specialists
	Quality control	Laboratory equipments inadequate		FAO/TCP of $190,000 for equipmqnt.	
Policy Issues	Marketing - credit - pricing etc. - distribution	Poor	To be improved.	Loan from World Bank to Cocobod.	Policy to be improved.
	Pesticides Legislation.			Draft legislation for Ghana with FAO.	
	Policy on Pest Management coordination.	Non existent			Policy to be instituted.

5.2 Analysis of Alternative Development Strategies

Three strategies for the additional development of the Pesticides Development System have been identified namely:-

1. General Improvement of the present system

2. General Improvement of the present system plus a rehabilitation and extention of Temco dust formulation plant

3. General Improvement of the present system plus establishment of a dust formulation by ICI, Abuakwa formulation plant or Johnson Wax Ltd.

All three aim at the overall improvement of the pesticides industrial system. Strategy one will result in a general improvement including some improvement of Temco. Strategy two, will result in a more extensive improvement and expansion of Temco. Strategy three, on the other hand will result in the establishment of a dust formulation plant in an already established company presently formulating liquid pesticides such as ICI, the Abuakwa formulation plant or Johnson Wax Ltd.

All three strategies will certainly result in a higher degree of attainment of the Government's objectives. However, strategy two and three will result in greater achievement of the Government's objectives than strategy one. But the decision which strategy to adopt e.g. between 2 and 3 lies with the government. Regardless of which strategy is chosen, several constraints and bottlenecks remain the same.

5.3 Strategies for further Development of the Pesticides Industrial System in Ghana

It is clear that the Government of Ghana has made some progress in its attempt to develop the Pesticides Industrial System in the country in collaboration with both bilateral and multilateral donors. However, to fully develop this system and to realise the full benefits of the projects already decided upon, a support programme is presented with additional activities, which, together with the projects already decided on in a linked and well coordinated manner will attain the Governments objectives.

The support programme is presented as follows in summary form:-

Raw Materials

Development of raw materials base including packaging for both liquid and dust formulation plants.

Coordination of all pesticides and pest management activities.

Training of pertinent personnel in relevant areas e.g. extension, pest management including IPM, environmental impact assessment, etc.

Transportation

Road Networks and transportation to be improved.

Policy Issues

- Policy on Pesticides Legislation to be enacted.
- Policy on credit and pricing necessary.
- Policy on coordination of all pest management activities needed.

Formulation

Dust formulation in country needs to be reviewed and improved.

Other inputs include industrial inputs and services such as capital goods (Buildings, Equipment and Machinery), water and energy.

These support programmes together with the on-going activities will inevitably improve the Pesticides Industrial System in Ghana. The support programme are hereby presented in the form of technical assistance projects, investment projects and policy issues (Table 12).

Buildings will be provided by the local counterpart or as part of the technical assistance. Equipment and machinery will be supplied by the foreign investor as a part of technical assistance project. Water and electricity are readily available in Ghana. In 1988 4,306,000 Kilowatt hour of electricity was generated. Hydroelectric power is the main source of energy. Others include petroleum, wood and charcoal. Oil exploration has been conducted by the Ghana National Petroleum Corporation.

Table 12

Component	Technical Assistance	Investments
1	Feasibility Study on improvement of private dust formulation plant.	Establishment and/or improvement of Dust Formulation Plant. (Cost not estimated)
1	Feasibility Study	Strengthening the Ministry of Mines & Geological Department to test locally available raw materials. (Cost not estimated)
1	Strengthening the capacity of packaging establishments and refinery to produce standardised products.	
3	Training and Research in Pest Management including IPM and extension; environmental impact assesment.	
1	Feasibility study for the large scale mining of potential carriers.	Large scale mining of kaolin & other possible carriers. (Cost not estimated)
3	Strengthening the post-harvest Development Unit.	
3	Strengthening the Plant Protection and Regulatory Services Division	
3	Feasibility study on Improvement of pest management by the cocoa.	

Policies

Policy on supply of solvent by refinery for use in pesticides formulation.

- Marketing policy to be improved e.g. privatisation of pesticide marketing and distribution by the cocobod.

- Policy of credit and pricing.

- Policy on coordination of all pestmanagement activities.

5.4 Expected end-of-programme Situation

At the end of the programme the overall pesticides industrial system in Ghana would have greatly improved. All the components of the pesticides scenerio would have been strengthened and well coordinated.

In addition to the liquid formulation plants, a much improved dust formulation plant would have been installed, both based as much as possible on local raw materials. They would be providing the right type of pesticides at the right time in the most appropriate package form suitable to the needs of the consumers. This will obviously improve agriculture, public and livestock health in Ghana, hence contributing to raising the living standards of the people. Valuable foreign exchange will also be saved by the reduction of pesticides imports.

Other improvements include proper planning for pesticides and distribution in a coordinated manner; improved pest management activities, including Integrated Pest Management; monitoring; extension and other farm services for plant protection thereby reducing irrational use of pesticides; improvement of pesticides disposal methods.

In addition to the above, pertinent policies relating to the system would have been implemented not to forget employment opportunities that will be generated together with the development of new skills and technology and the further expansion and diversification of the industrial sector.

A time schedule is shown in figure 3.

Figure 3

TIME SCHEDULE

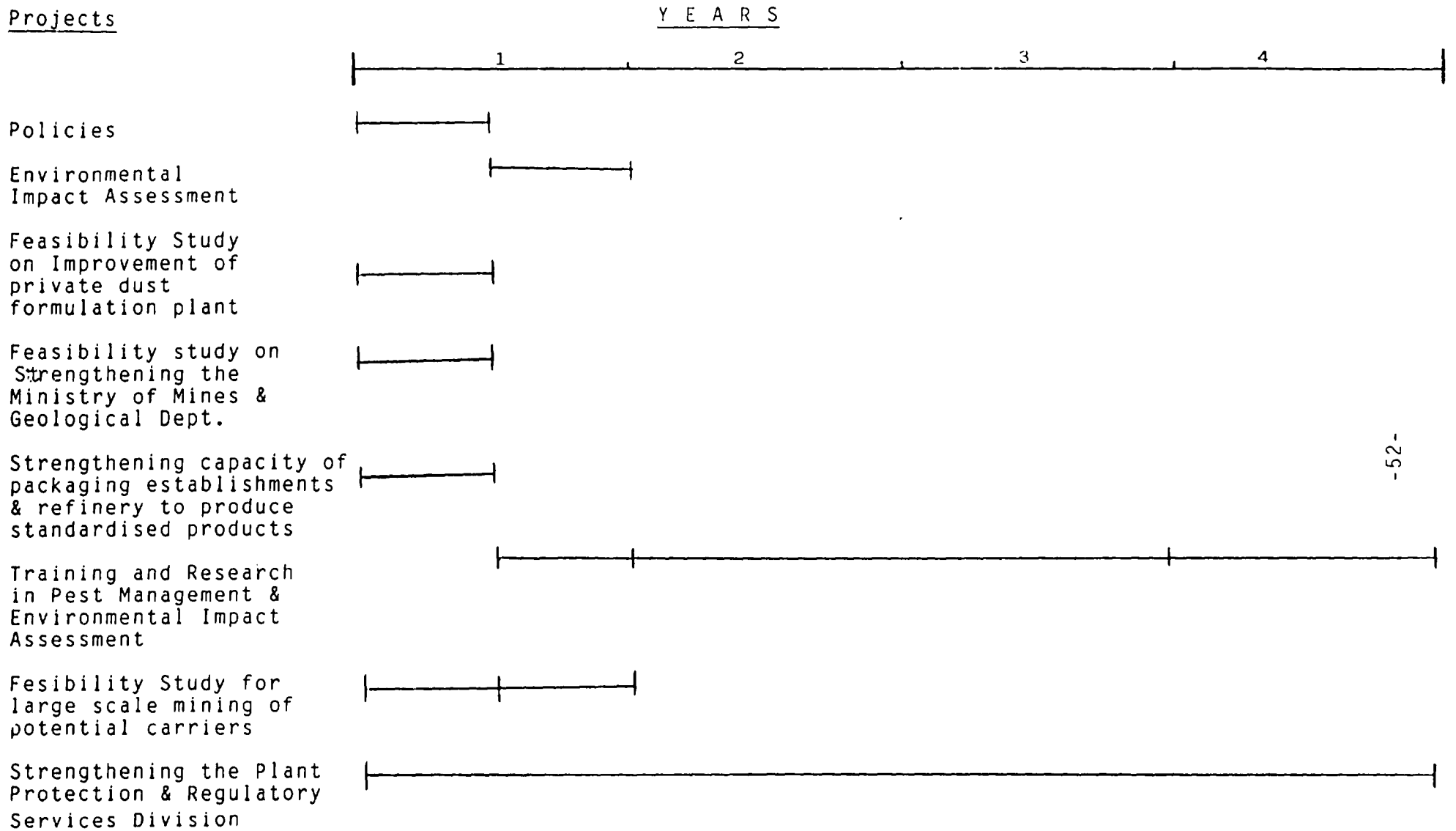

Figure 3 Contd.

TIME SCHEDULE

Projects	YEARS 1	2	3	4
Feasibilty Study on Improvement of Pest Management by the Cocoa Board.	———			

6. ANNEX

6.1 List of Personnel Interviewed

1. Mr J Adasi
   Ministry of Industry
   Accra

2. Mr S E Addo
   Ministry of Industry
   Accra

3. Mr A A Adjavon
   Tema Chemicals
   Tema

4. Dr A Akwei
   Veterinary Department
   M.O.A.

5. Mr Anamoah
   Plant Protection
   M.O. Agriculture

6. Mr L Anuseh
   Shell Ghana Services Ltd.
   Accra

7. Mr J K Appiah
   Ministry of Industry
   Accra

8. Dr Asare-Nyarko
   Ghana Cocoa Board Ltd.
   Accra

9. Mr C A Cudjoe
   Customs Excise & Preventive Service
   Accra

10. Dr S K Dapaah
    Policy, Planning, Monitoring & Evaluation
    M.O.A.
    Accra

11. Mr G A Dixon
    Dept. of Plant Protection
    M.O.A.

12. Mr J Freeman
    Shell Ghana Services Ltd.
    Ghana

13. Mr T Hailemariam
World Bank
Accra

14. Mr G O Kesse
Geological Surveys Dept.
Accra

15. Mr G M S Klufio
Environmental Protection Council
Accra

16. Dr S M'Boob
F.A.O.
Accra

17. Mr N Neequaye
Dept. Agric. Statistics
M.O.A.
Accra

18. Mr K Nicol
Post Harvest Development Unit
M.O. Agriculture

19. Mr I Nikabs
Ministry of Industry
Accra

20. Mr H J Oehmke
Abuakwe Formulation Plant
Accra

21. Mr A Prah
Ministry of Health
Accra

22. Mr R Tandor
Ministry of Industry
Accra

23. Dr J K Taylor
Animal Health & Production Dept.
M.O.A.
Accra

24. Mr G K Temda
Temco Ltd.
Box 8004
Accra-North

25. Mrs W G Woanyah
M.O.I.
Accra

TECHNICAL ASSISTANCE AND INVESTMENT PROJECTS

To implement the strategy already outlined, a package of technical assistance/investment project concepts are attached, together with policy measures, which when fully implemented will greatly improve the pesticides industrial system in Ghana.

TITLE: Feasibility Study on Strengthening the Ministry of Mines, the Geological Department, the Oil Refinery & Packaging Establishments for testing locally available raw materials.

DURATION: 3 Months

BACKGROUND AND JUSTIFICATION:

The Ministry of Mines and/or the Geological Department could be active in testing possible carriers such as kaolin and dolomite for suitability and compatibility with the active ingredients in dust formulation.

On the other hand, the Oil Refinery could also be active in testing refined products as possible solvents for liquid formulation, to ensure that they meet with the required specifications. Kerosene has already been used by some pesticide industries in Ghana.

Also, packaging establishments (10 in Ghana) could be involved in the testing of packaging materials such as plastic packets, plastic drums, metal containers, cartoons and paper packets.

DEVELOPMENT OBJECTIVES: To improve agricultural productivity, health and veterinary sectors through increased inputs using as best as possible locally available raw materials.

IMMEDIATE OBJECTIVES: To provide a detailed state of the various establishments to conduct tests on locally available raw materials and to provide the requirements needed to upgrade the capabilities of these establishments to conduct such tests.

OUTPUTS: A comprehensive report on the state of the various establishments to conduct tests of raw materials and the requirements to upgrade these establishments.

ACTIVITIES: A detailed study on the state of the establishments to conduct tests on locally available raw materials and to recommend ways of strengthening these establishments to conduct the

necessary tests in order to produce standardised products.

UNIDO INPUTS: 1 Consultant

TITLE: ENVIRONMENTAL IMPACT ASSESSMENT

DURATION: 3 Months

BACKGROUND AND JUSTIFICATION: There are various environmental considerations which are of paramount importance in any pesticides industrial system. Thus before embarking on a large scale improvement of the system, especially if it includes a formulation plant, it is imperative that an environmental impact assessment (EIA) be conducted.

Environmental considerations include potential occupational hazards and environmental pollution in the operation of the pesticides formulation plant. These may however influence the site of the plant, the design, construction and operation of the plant and waste disposal. The plant should be located on level ground, not subject to flooding, ideally away from towns or at least not on the windward side and accessible to a source of labour. For the disposal of wastes, an evaporation pond should be constructed to reduce contamination of nearby water and food supplies, which may cause damage to human and animal health, kill fish and damage crops.

DEVELOPMENT OBJECTIVES: To improve agricultural productivity, health and veterinary sectors through increased use of inputs while preserving the environment.

IMMEDIATE OBJECTIVES: To assess the possible deleterious consequences of the project to the environment and to recommend ways of reducing these negative effects.

OUTPUT: A comprehensive report on the effects of the project to the environment and pertinent recommendations to reduce any negative effects.

ACTIVITIES FOR OUTPUT: A comprehensive study and an assessment of the environmental effects of improving the pesticides industrial system especially the formulation plants.

UNIDO INPUTS: 1 Consultant experienced in EIA.

TITLE: FEASIBILITY STUDY ON IMPROVEMENT OF PRIVATE DUST FORMULATION PLANT.

DURATION: 3 Months

BACKGROUND AND JUSTIFICATION: There are various environmental considerations which are of paramount importance in any pesticides industrial system. Thus before embarking on a large scale improvement of the system, especially if it included a formulation plant, it is imperative that an environmental impact assessment (EIA) be conducted.

Environmental considerations include potential occupational hazards and environmental pollution in the operation of a pesticides formulation plant. These may however influence the site of and waste disposal. The plant should be located on a level ground, not subject to flooding, ideally away from towns or at least not on the windward side and accessible to a source of labour. For the disposal of wastes, an evaporation pond should be constructed to reduce contamination of nearby water and food supplies, which may cause damage to human and animal health, kill fish and damage crops.

DEVELOPMENT OBJECTIVES: To improve agricultural productivity, health and veterinary sectors through increased use of inputs while preserving the environment.

IMMEDIATE OBJECTIVES: To assess the state of the plant and recommend measures for its improvement or otherwise, to a fully operational dust formulation plant

OUTPUTS: A comprehensive report on the state of the formulation plant together with measures for its improvement.

ACTIVITIES FOR OUTPUT: A detailed study on the state of the dust formulation plant.

UNIDO INPUTS: 1 Consultant

TITLE: FEASIBILITY STUDY ON LARGE SCALE MINING OF POTENTIAL CARRIERS.

DURATION: 1 Year

BACKGROUND AND JUSTIFICATION: For local pesticide formulation, it is extremely important that cheap, readily available raw materials of consistent quality are available for use at all times. These will undoubtedly reduce freight costs, insurance, long shipping lines etc.

CARRIERS AND DILUENTS:

In view of the presence of these locally available raw materials in Ghana, it is imperative that large scale mining must be conducted of the more relevant ones such as kerosene and dolomite. Hence a feasibility study on the large scale mining of potential carriers should be conducted.

DEVELOPMENT OBJECTIVES: To increase agricultural productivity, health and veterinary sectors through increased inputs using as best as possible locally available raw materials.

IMMEDIATE OBJECTIVES: To assess the possibility of large scale mining of locally available raw materials for use as potential carriers.

OUTPUTS: A comprehensive report on the feasibility of large scale mining of potential carriers.

ACTIVITIES FOR OUTPUTS: A detailed study on the feasibility of large scale mining of potential carriers.

UNIDO INPUTS: 1 Consultant

TITLE: FEASIBILITY STUDY ON IMPROVEMENT OF PEST MANAGEMENT BY THE GHANA COCOA BOARD.

DURATION: 4 Years.

BACKGROUND AND JUSTIFICATION: The Ghana Cocoa Board (COCOBOD) is responsible for cocoa, coffee and shearnuts while the Ministry of Agriculture is responsible for all other agricultural crops. Within the Cocobod, the Cocoa Services Division (CSD) is responsible for preharvest plant protection matters whilst the Infestation Control Department is charged with the responsibility of prevention of post-harvest losses in cocoa, coffee and shearnuts.

The Cocobod holds 49% shares in both the Abuakwa formulation plant and the Tema Chemicals Ltd. who formulates Unden-200EC and PP Kumakate respectively, entirely for the Cocobod.

Distribution to the farmers is conducted by the Cocobod and prices are competitive. The Cocobod subsidises the pesticides sold to farmers and is launching a campaign to educate farmers on pesticide use and other issues.

Distribution by the Cocobod is done through its distribution network i.e. from Tema and Kumasi to the regional depots, then to district offices and to the rural areas. There are however major marketing and distribution bottlenecks due to inefficiency precipitated by serious attitudinal problems though Cocobod subsidises the product.

Thus major policy decisions would have to be made to improve the marketing and distribution of the product.

DEVELOPMENT OBJECTIVES: To improve agricultural productivity through increased inputs such as pesticides.

IMMEDIATE OBJECTIVES: To improve pest management by the Cocobod.

OUTPUTS: A comprehensive report on the state of pest management by the Cocobod and ways for further improvements.

ACTIVITIES FOR OUTPUTS: A detailed study on the feasibility of improving pest management by the Ghana Cocobod.

UNIDO INPUTS: 1 Consultant

TITLE: STRENGTHENING THE PLANT PROTECTION AND REGULATORY SERVICES DIVISION.

DURATION: 4 Years

BACKGROUND AND JUSTIFICATION: The Plant Protection and Regulatory Services Division (PPRSD), is a unit within the Ministry of Agriculture under the Crop Services Department. It is responsible for all plant protection matters except cocoa, coffee and shearnuts which are taken care of by the Ghana Cocoa Board. The Headquarters of the PPRSD located at Pokoase is poorly equipped with limited equipment, staff and vehicles. There is no library

or reference collections for pest identification and the ten regional offices have little or no equipment and supplies.

In all, there are five units within the PPRSD namely (a) Post-entry quarantine (b) Re-entry Survey and Control (c) Plant Pest and Disease Survey and Control (d) Seed Inspection and Certification and (e) Special Services.

The Seed Inspection and Certification Unit is non-functional whilst the facilities in the others are poor. The largest unit namely the Plant Pest and Disease Survey and Control Unit is responsible for the detection, identification, monitoring and control of plant pests and diseases. This unit has no reliable reference collections and materials to aid pest identification. Pesticides for emergencies are very low in supply and pesticide application equipments are few, old and inefficient. Protective clothing and other basic pest survey equipment such as hand lenses, insect collecting equipment, specimen bottles are grossly inadequate or not available. Vehicles i.e. motorcycles, bicycles and vans are a major problem. Camping equipment is lacking and there is no forecasting of pest outbreaks. In addition, there is also a shortage of trained manpower. The Special Services Unit responsible for emergency pest outbreaks is presently together with the PPRSD cooperating with the Africa-wide Biological Control Programme of IITA in the control of the cassava mealy-bug and the green spider mite.

The PPRSD also provides advice on improved plant protection methods to individual farmers and large-scale commercial farmers..

DEVELOPMENT OBJECTIVES: To improve agricultural productivity through increased inputs including pest management.

IMMEDIATE OBJECTIVES: To strengthen the PPRSD to conduct its various activities.

OUTPUTS: A strengthened PPRSD within the Ministry of Agriculture capable of :

(a) Carrying out surveys to determine the extent and intensity of pest infestation.

(b) Developing early warning systems to enable forecasting and timely control.

(c) Rehabilitating or replacing equipment and facilities.

(d) Upgrading technical knowledge.

(e) Carrying out improved plant quarantine as the first line of defence.

ACTIVITIES FOR OUTPUTS:

(a) Equipments and materials to aid pest identification and\ reliable reference collections.

(a) Conduction of surveys to determine the extent and intensity of pest manifestation.

(b) Developing early warning systems.

(c) Replacing or rehabilitating equipment and facilities.

(d) Upgrading technical and managerial skills of staff.

(e) Conducting improved quarantine as the first line of defence

UNIDO INPUTS: Provision of reference collections and materials to aid pest identification, material to aid pest identification, pesticides for emergencies, pesticides application equipment, protective clothing, other basic pest survey equipment i.e. hand lenses, insect collecting equipment, specimen bottles, vehicles (motorcycles, bicycles, vans) camping equipment, forecasting facilities.

TITLE: STRENGTHENING THE POST-HARVEST DEVELOPMENT UNIT.

DURATION: 4 Years

BACKGROUND AND JUSTIFICATION: As a demonstration of the Ministry of Agriculture's concern for the adverse effects of post-harvest losses on the country's economy and the standard of living of the small-scale rural farmer, a seperate unit, the Post-Harvest Development Unit, has been set up to disseminate appropriate post-harvest technology packages that will reduce post-harvest losses estimated between 20 and 30%.

The UNDP/FAO funded Project GHA/96/007 : Strengthening of the Post-Harvest Development Unit, is providing technical assistance to the Post-Harvest Development Unit.

Some major activities carried out by the Unit include:-
- Formal and in-service training;
- Production and dissemination of appropriate post-harvest technology packages for adoption by small-scale farmers;
- Introduction of improved storage structures e.g. the improved narrow storage crib that hastens drying and prevention of maize from mould and rodent attacks;

- Introduction of solar driers;
- Promotion of traditional pest control methods such as smoking and use of wood ash;
- Proper application of insecticides at the farm level;
- Village level tomato processing;
- Survey of the larger Grain Borer;

Some achievements of the Unit are the following:-

- Production of a training manual for crop post-harvest technology for the training of farmers by extension staff;
- Training of 240 trainers (24/region) to conduct post-harvest training activities in the 10 regions of the country;
- Development of appropriate technology packages that reduce post-harvest losses in cereal grains and cowpeas;
- Demonstration of the potential of a village level tomato processing methods;
- Detection of the Larger Grain Borer in Ghana and the formulation of the programme to contain and control it;
- Assistance to the University of Ghana to establish a diploma course in post-harvest technology;

Future plans include:-

- The expansion of the Unit into a division;
- Development of appropriate technology packages for the major perishable crops;
- Containment and control of the Larger Grain Borer;
- Co-operation with donor agencies assisting rural communities in post-harvest activities.

It is a reality that successes recorded in agricultural production in recent years have been due in part to the effectiveness of the post-harvest reduction system put in place by the Post-Harvest Development Unit.

UNDP funding to the project comes to an end in April, 1990. However, due to its success so far, it has become necessary for the Ghana Government to seek some funding from the United Nations Industrial Development Organisation (UNIDO) to help further strengthen the Unit.

It has been proposed that the Unit, due to its impact on the overall agricultural promotion program, should be expanded into a Division. To effectively run as a Division, external assistance will be required to:

- Provide laboratory facilities. This is required to help monitor, for example, pesticide residues left on produce after storage period.
- Provide equipment for national crop losses assessment. It is estimated that national post harvest losses is between 20 and 30%. However, actual losses for different

crops will have to be determined.

- Provide new vehicles and/or spare parts for the existing vehicles in the Unit. There is no need emphasising the importance of vehicles and/or spare parts in such an undertaking. The nature of some of the feeder roads really puts great strain on our vehicles.
- Provide training for staff. The most important function of the Division will be to train field extension staff in appropriate post-harvest technology methods. They will in turn train farmers. External training to upgrade the technical know-how of the Divisions staff will also be needed.

A detailed list of requirements will be provided when this proposal is accepted.

DEVELOPMENT OBJECTIVES: To improve agricultural productivity by reducing both pre and post harvest losses of crops.

IMMEDIATE OBJECTIVES: To reduce post harvest losses of crops by disseminating appropriate post-harvest technology packages by the Post-Harvest Development Unit.

OUTPUTS: A strengthened Post-Harvest Development Unit which could be expanded into a Division.

UNIDO INPUTS: Detailed list to be provided by the Unit and will include laboratory facilities, equipments, vehicles and spares and training fellowships. Laboratory facilities to help monitor pesticides residues on stored products. Equipment for national crop loss assessment, vehicles and/or spare parts for existing vehicles. Training for staff members (External training for staff at Msc and Phd Levels). These will train the field extension staff who would in turn train the farmers.

ACTIVITIES: Expansion of the Unit into a division; development of appropriate technology packages for the major perishable crops; containment and control of the larger grain borer; cooperation with donor agencies assisting rural communities in post harvest activities.