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FEASIBILITY STUDY ON THE ESTABLISHMENT OF A MULTI-PURPOSE PESTICIDE FORMULATION PILOT PLANT

DP/NIR/87/017

FEDERAL REPUBLIC OF NIGERIA

Technical report: Market and technical survey*

Prepared for the Government of the Federal Republic of Nigeria
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Prof. Stefan Mosiński, expert in pesticide formulations

Backstopping officers: G. Rezek, Feasibility Studies Branch
B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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* This document has not been edited.

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Explanatory Notes

- References to dollars are to USA dollars.
- The monetary unit in Nigeria is the naira (₦).
- During the period covered by report, the mean value of naira in relation to the United States dollar was:

  1 USA dollar official rate 4.8 - 5.3 ₦

  " " autonomous rate about 9.5 ₦
- A comma /,/ is used to distinguish thousands and millions.
- A full stop /./ is used to indicate decimals.
- App. or app. is used to indicate appendix.
- G is used to indicate grams
- L or l is used to indicate litters.
- ml is used to indicate mililiters.
- mn is used to indicate millions.
- MT is used to indicate metric tonnes.
- Q is used to indicate quantity.
- V is used to indicate value

Technical

D - Dusting Powder
EC - Emulsifiable Concentrate
F - Fungicide
FW - Flowable Suspension Concentrate
G - Granules
H -Herbicide
I - Insecticide
S - Solvent
SD - Seed Dressing
St.pr. - Storage Pesticide Product
WP - Wettable Powder
WSC- Water Soluble Concentrate
ULV- Ultra Low Volume
a.i. - active ingredient or technical pesticide

Organization (not explained in the text)

SNCCL Swiss Nigerian Chemical Company Ltd.
SCOA Societe Commerciale Ouidentable Afrique.

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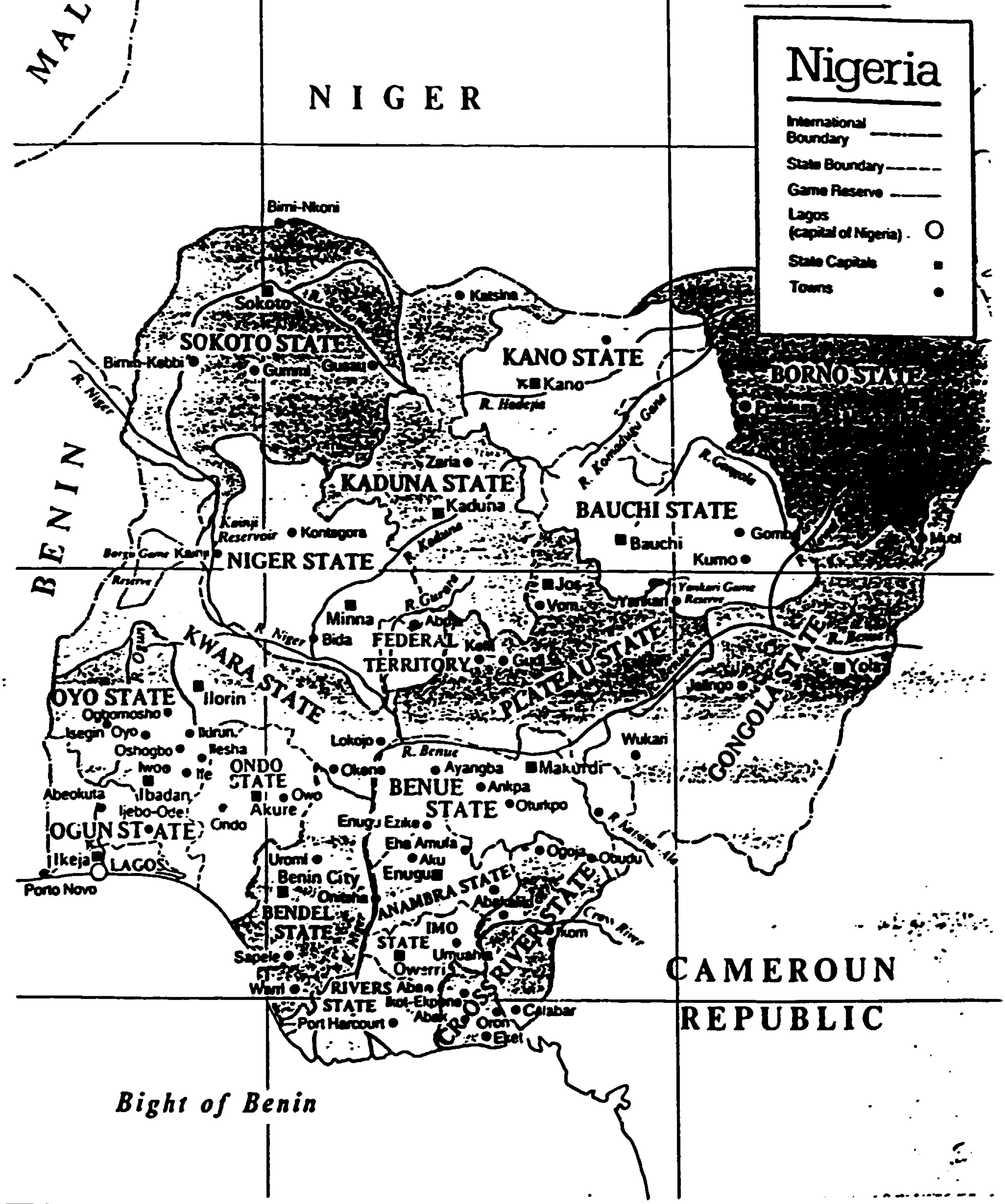
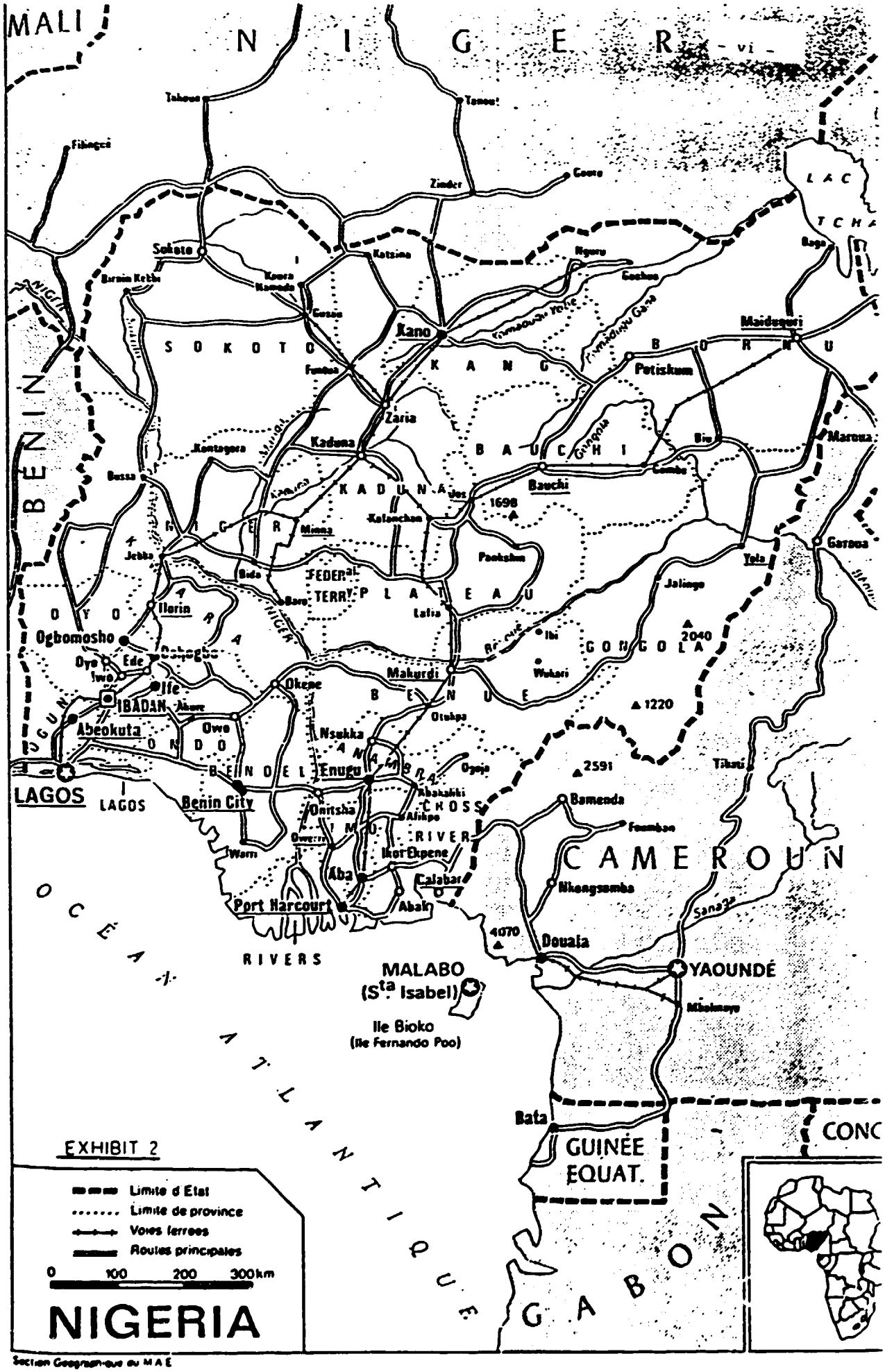

Nigeria
International Boundary
State Boundary
Game Reserve
Lagos (capital of Nigeria)
State Capitals
Towns
MALI
NIGER
BENIN
CAMEROUN
REPUBLIC
Bight of Benin
SOKOTO STATE
Sokoto
Birnin-Kebbi
Gummi
Gusau
Birni-Nkoni
R. Niger
KANO STATE
Kano
Katsina
R. Hadejia
BORNO STATE
KADUNA STATE
Kaduna
Zaria
R. Kaduna
BAUCHI STATE
Bauchi
Kumo
R. Gongola
Kainji Reservoir
Kontagora
Borgu Game Reserve
NIGER STATE
Minna
Bida
R. Gurara
FEDERAL TERRITORY
Abuja
Keffi
Gugi
Jos
Vom
Yankari
Yankari Game Reserve
PLATEAU STATE
GONGOLA STATE
Yola
Jalingo
Wukari
Mubi
R. Benue
KWARA STATE
Ilorin
OYO STATE
Ogbomosho
Oyo
Iseyin
Ikirun
Ilesha
Oshogbo
Iwoo
Ife
Ibadan
Abeokuta
Ijebo-Ode
ONDO STATE
Akure
Owo
Ondo
OGUN STATE
Ikeja
LAGOS
Porto Novo
Lokojo
Okene
BENUE STATE
Ayangba
Ankpa
Makurdi
Oturkpo
R. Katsina Ala
Enugu Ezike
Eha Amufu
Aku
Enugu
Uromi
Benin City
Onitsha
BENDEL STATE
Sapele
Warri
ANAMBRA STATE
Abakaliki
IMO STATE
Owerri
Umuahia
Aba
RIVERS STATE
Port Harcourt
Ikot-Ekpene
CROSS RIVER STATE
Ogoja
Obudu
Ikom
Cross River
Calabar
Oron
Eket
5
10

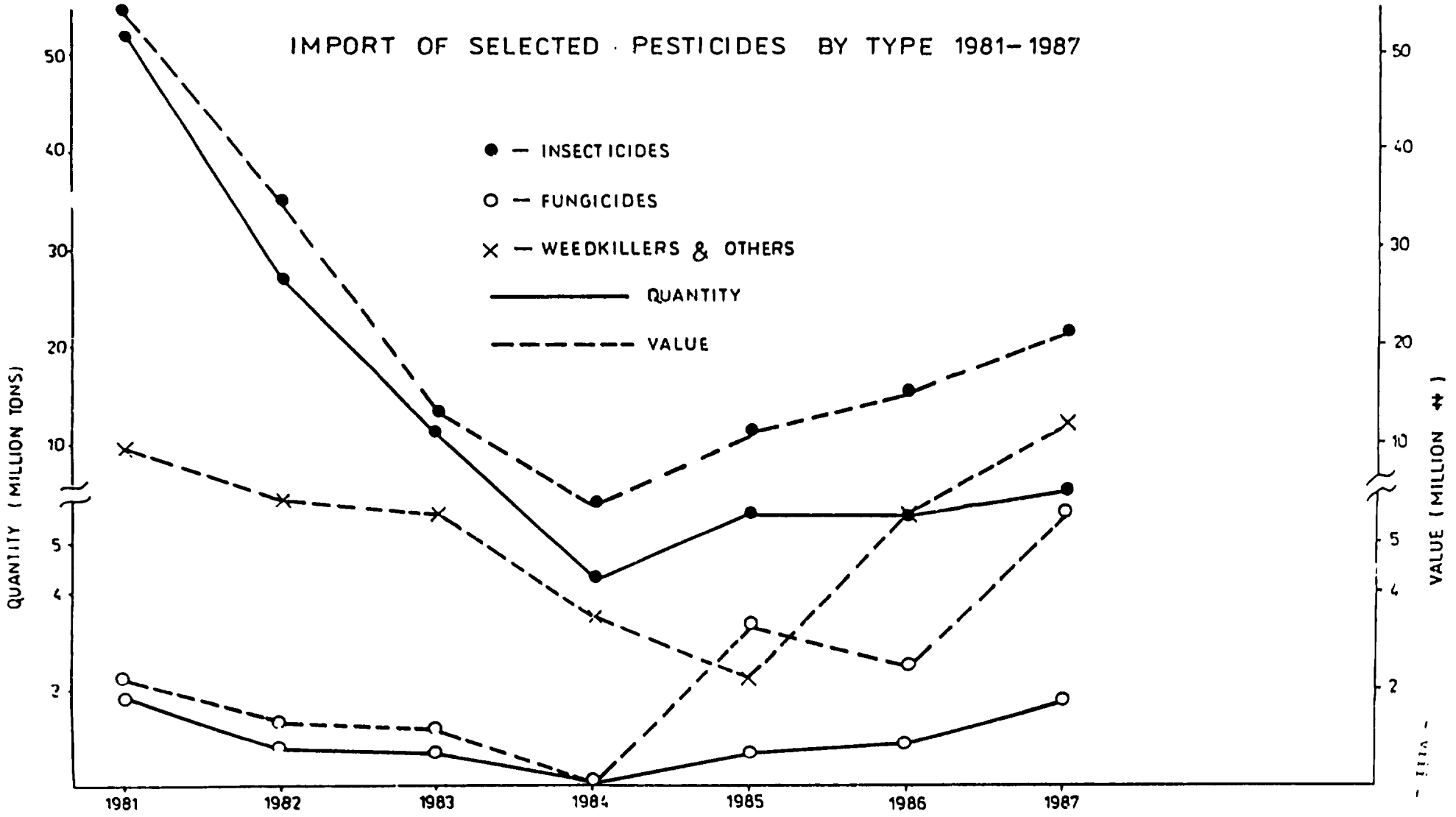

MALI
NIGER
BENIN
Sokoto
Kano
Zaria
Kaduna
Bauchi
Maiduguri
Potiskum
Yola
Garoua
Jalingo
Makurdi
Ogbomosho
Ilorin
Ibadan
Abeokuta
Ife
Oyo
Ede
Okene
Nsukka
Enugu
Benin City
Onitsha
Owerri
Aba
Port Harcourt
Abakaliki
Afikpo
Ikot Ekpene
Calabar
Abak
Ogoja
Bamenda
Foumban
Nkongsamba
Douala
YAOUNDÉ
Mbalmayo
Tibati
Bata
GUINÉE EQUAT.
GABON
CAMEROUN
LAGOS
RIVERS
CROSS RIVER
MALABO (Sta Isabel)
Ile Bioko
(Ile Fernando Poo)
OCEAN ATLANTIQUE
SOKOTO
KANO
BORNU
BAUCHI
KADUNA
PLATEAU
BENUE
GONGOLA
1698
2040
1220
2591
4070
EXHIBIT 2
Limite d Etat
Limite de province
Voies ferrees
Routes principales
0 100 200 300km
NIGERIA
Section Geographique du M A E

Nigerian Kilometre Chart

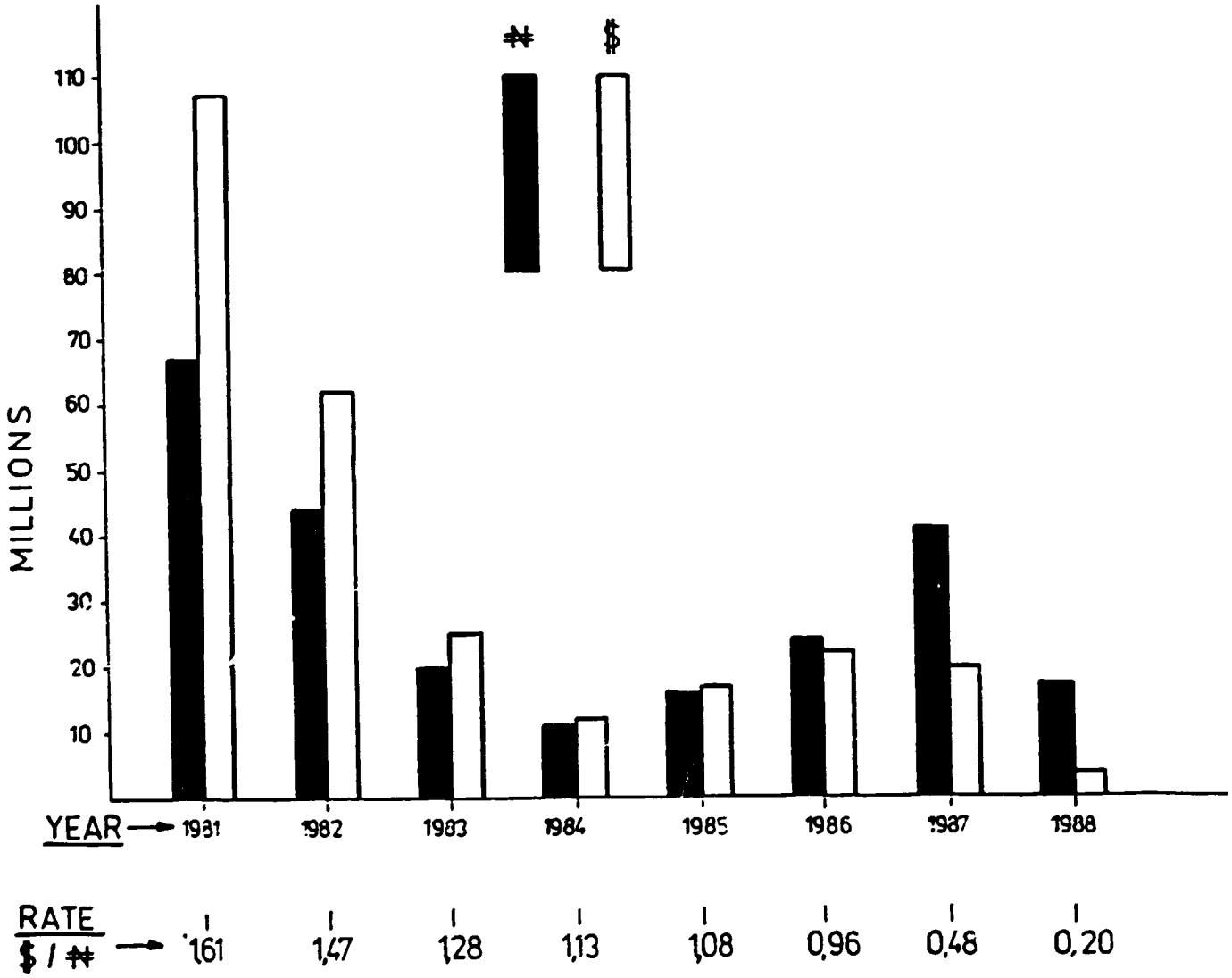
EXHIBIT 3

Approximate distance in kilometres travelling by car on main roads.

	Abeokuta 1	Akure 2	Bauchi 3	Benin City 4	Calabar 5	Enugu 6	Ibadan 7	Ilorin 8	Jos 9	Kaduna 10	Kano 11	Katsina 12	Lagos 13	Maiduguri 14	Makurdi 15	Minna 16	Onitsha 17	Owerri 18	Port Harcourt 19	Sokoto 20	Yola 21
2	282																				
3	1155	910																			
4	326	170	941																		
5	799	637	1039	447																	
6	573	416	734	246	315																
7	77	205	1070	324	658	590															
8	239	209	918	401	892	615	162														
9	1013	778	122	819	924	606	946	784													
10	837	789	399	950	1054	837	752	590	286												
11	1088	1050	292	1187	1318	1025	1009	847	440	261											
12	1184	1129	521	1255	1491	1205	1068	1005	594	434	173										
13	101	346	1208	320	784	577	141	303	1083	893	1150	1323									
14	1605	1372	462	1399	1408	1195	1507	1365	590	868	586	766	1680								
15	992	572	458	500	580	268	955	830	336	492	751	882	887	920							
16	749	634	591	565	871	586	668	494	456	297	558	610	736	1053	440						
17	465	309	879	139	334	108	464	620	689	851	1113	1283	476	1272	374	668					
18	543	385	878	217	201	140	545	679	756	915	1186	1354	555	1350	450	739	78				
19	741	518	997	325	261	253	658	856	863	1007	1325	1457	689	1440	519	937	206	198			
20	946	929	779	1121	1537	1294	882	720	725	486	561	426	1020	1078	1076	630	1341	1409	1538		
21	1512	1188	424	1046	1123	808	999	1321	546	828	716	838	1422	430	686	1002	916	992	1048	1189	


IMPORT OF SELECTED PESTICIDES BY TYPE 1981–1987
● — INSECTICIDES
○ — FUNGICIDES
× — WEEDKILLERS & OTHERS
QUANTITY
VALUE
QUANTITY (MILLION TONS)
VALUE (MILLION ₹)
50
40
30
20
10
5
4
2
1981
1982
1983
1984
1985
1986
1987

VALUE OF IMPORTED PESTICIDES 1981–1988



ABSTRACT

The main goals of the mission were: to assess the role of agriculture and the use of pesticides at the national level and within the Ondo State, to examine the structure and operation of local pesticide formulation industry and to find out if there is necessity as well as possibility to undertake the new PF-s plant.

The report presents a detailed treatise on agricultural scene as well as market analysis regarding importation, production and usage of pesticide formulations and their active ingredients in the protection of the particular crops.

Statistical data concerning importation of PF-s during the period 1981-1988 ilustrated rather low level of consumption of pesticides in Nigeria. The main reasons for this phenomena are the lack of economical motivation of small holding farmers to use pesticides, as well as inadequate level of knowledge of how and when to use PF-s - a condition indispensable for the effective usage of pesticides.

The main users of pesticides in Nigeria are the modern farm holders as well as the farmers cultivating cash crops. There are many varieties of modern pesticides on Nigerian market which are supplied to the users through the Nigerian offices of the international companies. Some of them deal with packing of PF-s and some others formulate rather simple PF-s in their own formulation plants. The World Bank sponsors some of the agricultural producers to import the bigger quantity of PF-s directly from the overseas companies.

Most of the raw materials needed for PF-s have to be imported from abroad. There are at present no local aromatic solvents, emulsifiers, dispersing agents and ready to use (of required quality) mineral carriers or diluents. A lot of minerals are distributed all over the country but only few of them are exploited. They are also not processed in the way so that they can be used in production of WP-s of pesticides. One or two of these minerals are used by local formulators for the production of dusts.

At present there is no local production of aromatic solvents but the production of some of them is anticipated by NNPC company in 1992. Then it will be possible to use them in local production of EC-s. The local instalations for production of EC-s are utilized only at 30 per cent of capacity and for this reason the erection of a new production factory for this type of formulation is questionable.

The main pesticides whose local consumption amounts to about 50% of the total consumption of pesticides in Nigeria in 1986 are: fungicides - copper sulphate or cuprous oxides and insecticides Gammalin-20 - an EC of Lindan. They are used mainly in Ondo State to protect very important cash crop - cocoa trees. Copper sulphate is used by farmers to produce Bordeaux Mixture and is not used by formulators to produce PF-s. Also cuprous oxide are available on the international pesticides market exclusively in the form of WP-s. Gammalin-20 can be produced by local companies in larger quantities than at present, if warranted.

The very modern and safe PF-s, for production of which no organic solvents and mineral carriers are needed, are water suspension concentrates or flowables (WF -s). Their consumption is already quite considerable and owing to their advantages in usage and in production they will be used in larger and larger amounts.

The other PF-s productions which should also be very quickly undertaken in Nigeria, are Ultra Low Volume formulations (ULV-s) and granules (G-s). In both of these formulations the concentration of active ingredients (a.i.) is in general very small and it is why their importation from abroad is very uneconomical. The soivents for ULV-s as well as carriers for some of granules are locally available. The granules are at present used in smaller amounts than should be. They are handy applicable formulation and from the standpoint of application are better than others, which require sprayer or duster, very often too costly for small farmers.

Another problem which should be quickly solved is the problem of testing the quality of PF-s and their raw-materials. There is no laboratory in which such testing could be regularly done. Therefore it might happen that products not only of little value and low effectiveness, but also dangerous for farmers and environment may be used. This unfavourable situation has to be improved by organizing and outfitting appropriate analytical laboratory.

Based on the findings of this report, it is recommended that a feasibility study be undertaken of a pilot plant for the production of the aforementioned pesticide formulations, namely, water flowables, pesticides granules and ultra low volume (ULV) formulations.

INTRODUCTION

The future prosperity of Nigeria will depend, to a large degree, on highly productive and efficient agriculture. That is why it is necessary to usher the new strategy of scientific farming by introduction of high yielding varieties, improved seeds, chemical fertilizers, plant protection chemicals and other modern farm management practicises. The strongest activity in the above field is especially important (since from the oil boom in the 1970's) when the country has unfortunately become a heavy importer of agricultural commodities. In the 1960's many of these commodities were exported.

Many indexes relative to the output of and input to agricultural sector in Nigeria are often worse than those in other developing countries. Such indexes for Nigeria, Kenya and Pakistan have been compared in App. IV, p.52.

In recent years the Federal Government has taken or is in the process of taking a series of measures including: privatization of parastatal agricultural enterprises, encouragement of private promotors to invest in agriculture, incentives for using local agricultural inputs and developing local items to substitute a part of the imported products (see App. VIII, p.57).

It is against this background that Federal Ministry of Industry requested UNDP/UNIDO to explore the opportunity of establishing in Nigeria a multi-purpose pesticide formulation plant to cover the country needs, at least partly, in the field of agriculture and health, whereby the inputs of the plant would include suitable and locally available raw materials, intermediates and other inputs.

According to the job description of this mission, the consultant should undertake the following main activities:

1. Assess the role of agriculture and the use of pesticides at the national level and within the Ondo State.

2. Survey and analyse the demand and supply of pesticides, both in solid and liquid forms, and describe the characteristics of the selected pesticides by active ingredients.

3. Select and describe the required raw materials for the formulations identified under /2/ above.

4. Assess and analyse the raw material option with respect to /a/ imported materials and /b/ locally available and suitable materials. Ascertain the extent and nature of laboratory testing required.

5. For each raw materialdescribe characteristics in terms of quality properties, source of supply, quantities available and unit costs.

6. Prepare a report which will cover the above mentioned activities and include recommendations for follow-up action.

Taking into consideration the diverse and broad based scope of the study, the main text of the report has been divided into four sections to facilitate its perusal. Conclusions and recommendations, wherever appropriate, have been included in the main text of report and also outlined as a separate section. All the relevant data referred to in the body of report have been included in appendices. Most of these data have been collected by the expert from various agencies including Parastatals, Agricultural Development Authorities, Statistical Office, Chemical Companies-Distributors and Traders of Pesticides, Research Institutes, World Bank Agencies and Cooperatives.

1. AGRICULTURAL SCENE

1.1. Role of agriculture (1)

Agriculture continues to be a very important sector, accounting for an estimated 28% of GDP in 1986. Agriculture is above all important, however, in that it accounts for the employment of an estimated 66% of the labour force (see App. 1 p.49).

From a major world exporter of agricultural commodities in 1960, Nigeria has become a net importer. Agricultural production has failed to keep pace with population growth, domestic food prices have risen sharply and the cost of food imports has risen to levels widely considered unacceptable. Food shortages in 1983 and 1984 drew public attention to the long neglect of agriculture and over-dependence on food imports. This neglect is due to a variety of causes: the Civil War, drought, low investment and infrastructural inadequacy, but above all, the oil boom which led to an import-intensive culture, a ruralurban exodus, and a high exchange rate for the naira which made agricultural exports not competitive and imports artificially cheap.

Nigeria's bill for imported foods in 1987 was of the order of ₦ 1.6 billion. (The situation is ilustrated in the Appendix II p.50). Analogically, as the production of food crops, the production of cash crops also dropped in recent years. This decline is shown in the App. III, p.51

Priority attention is now being given by Federal and State Governments to agriculture, however the available statistics do not show yet significant progress (see Appendix VI p.

1.2. Characterization of Nigerian farms (2)

Size of farms

Generally, in most parts of Nigeria the land which is farmed by the family is small, of the order of one to four hectares only. The average farm size is held to be 0.65 ha, although there is considerable variation with farms in the north (e.g. in Borno) averaging 1.7 ha and in the south (e.g. in Ogun) averaging 0.36 ha.

Fragmentation of holdings is very widespread; although the average farm is 0.65 ha, the average area of land controlled by a farming is 1.09 ha.

A few farmers have larger farms in the southern states. Further north, in the drier areas the size of the farms increases somewhat to between four and ten hectares. It is estimated that a very small fraction of the farms in Nigeria are large, say one hundred hectares and above, whether they are for food production or "cash crop" plantations. Traditionally, cash crops refer to industrial export crops like cocoa, cotton, ground nuts, palm oil and rubber.

Nowadays, one may include some food crops like maize, rice, etc. which farmers consciously produce to sell for cash. Larger farm statiscics are fragmentary. In the past, these larger farms were often owned by retired professionals including politicians and army officers and are generally believed not to have been well run. This can be seen by comparison of the data concerning yields of production for different crops by small and modern holding farms (see App. VI, p.55).

In the last two years, however, there has been an increasing tendency for companies to acquire large farms (mainly for rice, maize and poultry) in a process of backward integration and in order to ensure stability of supply. The large farm sector is not yet significant in terms of overall national agricultural production, but is of considerable interest to agrochemical companies as it constitutes an increasingly important and above all stable outlet for their products.

Apart from the size of the farm being small, a family may have several farms scattered discontinuously over a wide territory, sometimes very distant from one another, so that the family may not be able to work on all of them at the same time. Two further characteristics about the size of the farms are: firstly, it is usually difficult to expand the size of the farm both because of the reluctance of the farmers to part with their land and because of price, which may be beyond the reach of small scale farming family which desires to purchase it. Secondly, when the head of the family dies the family's smallholding is fragmented.

Location on farms

Because of the mode of development in areas which are remote from the urban centres, most of the farms are inaccessible to motor vehicles. The commonest links are footpaths bicycle or donkey. This poses two transportation problems. Firstly, it is difficult if not impossible for tractors to reach these farms for farm operations. Secondly, it is difficult for cars and lorries to reach these farms with farm inputs or to evacuate farm produce from them.

Family labour

The small-scale farmer generally works the farm with the family's labour. Therefore, the cost of labour is low. Previously the size of the available family labour was high as there were many wives and children. In the past twenty years the size of the available family labour was reduced, slowly at first but more drastically in the past decade or so. Firstly, the father is no longer able to support many wives for economic reasons. Secondly, the introduction of universal primary education schemes has drawn school-age children into the schools away from fulltime work on the farm. Thus in many cases the farm work is left to the father, his wives and the pre-school-age young children. Another characteristic of the family labour is that the average age of the father and his wife is increasing so that the older they get the less active they are on the farm.

Hired labour

It is a common practice for the more prosperous small-scale farmers to hire temporary labour to work on their farms at critical stages of the farming cycle. More recently hired labour has become scarce for various reasons and what is available is unreliable and expensive and beyond the reach of the small farmer. Consequently, the small farmer is unable to expand his operations beyond what he and his immediate family can handle.

"A large portion of food crops grown in some parts of the country are left unharvested because of the high cost of hiring labour. The unharvested crops are subsequently destroyed by bush fire caused by unknown persons. The situation to be one of the major reasons for soaring cost of food stuffs in the country. Labourers, the farmers claimed, now demand as much as 1,600 ₦ to harvest a farm land the size of a football pitch as against about 500 it used to be" (Sunday Times, Dec. 18th, 1988).

Traditional agro-technologies

The agro-techniques are still simple and poor:

- the small farmers produce their own seeds in general yet from unimproved stock so that yield potentials are low;
- their cropping system involves mixed cropping in which several crops are planted on the small piece of land in various combinations in space and time;
- mostly they do not use modern farm chemical inputs (fertilizer, pesticides) and have no special soil fertility maintenance nor soil conservation methods and practice shifting cultivation for both, which is a relatively cheap system;
- they have learnt their farming systems through practice, from welltried traditions from their elders whom they trust, and have reached equilibrium with their agroecological environment, so that they trust their own judgement and can calculate their risks and chances with a remarkable degree of satisfaction, thus, they ensure food supply for their families' survival mostly on very small pieces of farmland and often produce a surplus for sale.

Sceptisism from failed promises

The small farmer is a very shrewd economist, who has demonstrated his readiness - over and over again - to try something new and does not need to be pushed if the economic

advantages are clearly demonstrated. He will also subsequently jettison an ongoing enterprise as soon as he determines it to be failing. The historical growth and fall of the rubber, cocoa and cashew plantations in Nigeria confirm this. Also, on a recurring pattern many small farmers will accept to try new, improved crop varieties and production practices recommended to them by agricultural extension agents; subsequently, they may determine that there is little or no improvement over their traditional varieties and practices - sometimes they may prove to be inferior.
The farmer becomes sceptical. Consequently, the agricultural extension agent looses credibility and has great difficulty to extend new "improvements" subsequently.

Considering what has been said above one can expect that small holding farmers will be using more pesticides if they find that their income in such case is higher.

Restricted access to services and amenities

The small farmer's circumstance is further characterized by restricted access to cash; his cash earnings from the sale of his produce are low and he has little access to government's institutionalised credit, agricultural extension services, market and market information and social amenities in his rural area.

1.3. Agricultural marketing and marketing organizations

In 1977 six commodity boards were established to undertake the purchase, storage, and marketing of cash crops. These were:

/i/ The Nigerian Cocoa Board
/ii/ The Nigerian Cotton Board
/iii/ The Nigerian Groundnut Board
/iv/ The Nigerian Palm Produce Board
/v/ The NIgerian Rubber Board
/vi/ The nigerian brains Board

Their function was to reconcile the interests of producers and consumers. In fact they displeased both parties and were held to be not efficient enough.
In 1986 the function of the above boards was suspensed.

In April 1986 the Minister of Agriculture announced that these boards were to cease trading in June and to be liquidated by the end of the year. Effectively, therefore, they had little impact on agricultural marketing during 1986. Their demise was little mourned.

Agricultural marketing is now to be left entirely in the hands of the private sector, with minimum guaranteed prices to be recommended by the Price Intellingence Agency of the Federal Ministry of Trade. How such prices are to be guaranteed remains unclear.

1.4. PARASTATAL ORGANIZATIONS CONNECTED WITH AGRICULTURE

There are many organizations connected with agriculture in Nigeria, and their inter-relationship is not always clear. The most important, however, is the Federal Ministry of Agriculture, Water Resources and Rural Development (FMA). The various departments, parastatal organizations and state-owned companies under the unified and re-structured FMA can ne broadly classified as follows:

A. Policy advice and formulation, data collection, monitoring and co-ordination

The following departments are designed to assist in the formulation of development programmes and projects:

/a/ The Federal Department of Rural Development

This department is primarily responsible for the funding and supervision of Agricultural Development Projects (ADPs). As a result, it works closely with the World Bank.

/b/ The Federal Department of Agriculture

This second largest department has responsibility for crops and small scale agro-industrial projects such as rice-husking mills, maize-shellers and cassava-graters.

/c/ The Federal Department of Forestry (FDF)

/d/ The Federal Department of Fisheries (FDF)

/e/ The Federal Liverstock Department (FLD)

Its functions fall into two categories:

/i/ Veterinary: the FLD undertakes extension work on animal health, including the selling of vaccines. Much of the work is conducted in conjunction with state governments.

/ii/ Production: the FLD runs several small and relatively isolated projects in fields including artificial insemination, hatcheries, etc. However, the department's production role is being reduced.

/f/ The Federal Department of Agricultural Co-operatives (FDAC)

The FDAC services co-operatives throughout the country. It is a predominantly advisory body, although it undertakes a small amount of training. It does not procure. The co-operative movement is particularly strong in the western states and in Kaduna, Anambra, Cross River and Bauchi.

/g/ The Federal Department of agricultural Land Resources (FDALR)

The FDALR is responsible for data on arable land reserves both potential and under cultivation.

/h/ The Federal Department of Water Resources (FDWR)

/i/ The Federal Department of Planning (FDP)

The FDP is responsible for overall strategy and co-ordination together with the collection and analysis of information. The Ministry also plans to establish an agricultural statistics and data bank.

/j/ The Agricultural Investment Bureau (AIB)

/k/ Federal Department of Pest Control

This Department is responsible for assessing Nigeria's pesticide requirements. It may acquire a new role when a pesticide control decree (intended to prevent the export to Nigeria of harmful pesticides that have been banned elsewhere) is promulgated, but at present is not very effective. Its headquarters are in Kaduna.

/l/ Fertilizer Procurement and Distribution Unit

This Unit is responsible for procurement and distribution of subsidised fertilizer. Its functions are being increasingly commercialized.

B. Implementation of approved policies and programmes

The organizations concerned with the implementation of development programmes and projects in the field are subdivided into parastatals and state-owned companies. The parastatals are:

/i/ the River Basin and Rural Development Authorities (RBRDAs);

/ii/ the Nigerian Agricultural and Co-operative Bank (NACB);

/iii/ the Federal Pest Control Service;

/iv/ the National Seed Service;

/v/ the National Livestock Project Unit.

The most important of these parastatals are the RBRDAs and the NACB.

1.5. Agricultural research

There are 19 research institutes concerned with agriculture and related industries, including forestry, fisheries, food processing and the use of indigenous raw materials for industrialization. These institutes are managed by the Federal Ministry of Science and Technology.
In addition to national research institutes, the International Institute of Tropical Agriculture (IITA) at Ibadan has a remit which includes Nigeria and the lowland humid tropics. There is considerable feeling in Nigeria that much of IITA's work is excessively academic.

Some of the national institutes are the following:

- National Veterinary Research Institute
  PMB 2001, KANO, tel. 0-64-625468
- Rubber Research Institute
  PMB 1043, BENIN Sapela Rd.
- Government Agricultural Research Institute
  Samaru, ZARIA, tel. 069-32003
- Cocoa Institute of Nigeria
  Ondo, ONDO, ST.
- National Cereal Research Institute
  Badeggi
- Nigerian Institute for Oil Palm Research
  Benin
- Nigerian Horticultural Institute
  Ibadan
- International Institute of Tropical Agriculture
  Ibadan, PMB 5320, tel. 413244, 413315, 413440,
  telex 31417 TROBIB
- Federal Institute of Industrial Research
  Oshodi, LAGOS PMB 21023, Ikeja, tel. 521010

Experiments with pesticides are also conducted at the departments of the following universities:

Department of Agricultural Engineering. Ahmadu Bello Univ. Zaria
Department of Agricultural Biology, Ibadan University
Department of Chemistry. Ife University. Ondo st.
Sugar Research Institute. University of Ilorin.
Department of Chemistry. University of Benin.

The Nigerian journal where some papers concerning pesticides are published is: Samaru Journal of Agricultural Research.

1.6. Extension Services

Ministry of Agriculture and National Resources (MANR)

Within each state the MANR has responsibility for the provision of specialist technical services. In most states there are five divisions: agriculture, liverstock, veterinary, forestry and engineering. Under the agricultural division there are separate departments with responsibility for agro-service centres and plant protection.
In some states the MANR is being reorganized into two divisions , agriculture and engineering, and constituted as a new department of agricultural extension services.
Separate units for agro-service centres, plant protection and input supply are still retained, while veterinary services, live.stock and fisheries are retained in a new department of animal resources. The Forestry Commision remains as an independent agency with its own board and MANR serving as the parent ministry. All state MANR services are controlled centrally from the state capital with field operations spread over 5 to 10 geographic zones representing groups of local government council areas (LGAs).
At each zonal office there is a zonal agricultural officer and under him are district extension officers.
Superimposed on this administrative structure is a network of agro-service centres (ASCs).

Each ASC comprises a 500 t fertilizer store, storage for agrochemicals and seeds, and a house for a centre manager. The ASC is intended to serve as a centre for both technical and commercial services.

Agricultural Development Project Extension Services (ADP-s)

The more effective extension services are those provided by the ADP-s but these projects are only able to service a limited number of farmers.

1.7. Magnitude of Crop Losses

It is a fact that losses in yield of crops due to ravages of pests are considerable. Serious crop failures have occured due to attack of insects and disease. The attack of insects on crops has taken place both in the field during the vegetation of crops as during the storage of grains. Similarly the plant diseases may develope as well on plants, during their vegetation as during their storage. Also weeds, if they are not eradicated from the cultivated field of crop, suppress the vegetation of crop.

Substantial crop losses occur in all regions of the world, including those where pesticides are most widely used. North and Central America with an annual loss of 28.7 per cent for all pests, rank behind Europe with 25 per cent and Oceania with 27.9 per cent. Africa and Asia have the highest losses, more than 40 per cent. The losses in Africa caused by insects, diseases and weeds have been estimated accordingly at 13.0, 12.9 and 15.7 per cent respectively./3,4/.

Unfortunately there is no published data concerning the losses of crops caused by pests in Nigeria. It argues that there has hardly been any consistent and systematic effort to work out losses of crops due to pests on scientific basis. In the absence of reliable estimates, various guesses seem to have been put forth by different agencies.

It is estimated e.g. that 100,000 ha of rice field were economically affected by Army worms Spodoptera spp. in 1986, and 70,000 ha by grasshoppers, princip ally Zonocerus variegatus. There were no evidence of insecticide use against these pests in spite of crop losses of up to 50 per cent /1/.

The estimation of losses of crops as well as their yield increase due to pesticide make a basis for economical and reasonable usage of pesticides (benefit-cost ratios of pesticide treatment). The results of these experiments, being carried out in Agricultural Institutes or Agricultural Faculties of Universities, should be taken into account in establishing the economic treshholds for treatment of crops.

1.8. Agriculture in Ondo State

The area of Ondo State in the year 1985 was 2.096 thousand hectars that is 2.27% of the total area of Nigeria (92,231 thousand ha).

The population at that time was estimated at 4,692,000 that is 4.85% of the total population (96,641,000).

The main plant crops and their planted area were in 1988 as follows:

Maize. . . . . 5 00,000 ha
Cocoa. . . . . 300,000 ha
Rice . . . . . 250,000 ha
Cassava . . . . . 250,000 ha
Oil palms. . . . . 80,000 ha
Coapeas . . . . . 5,000 ha

The institutions responsible in Ondo State for the developing of agricultural sector are the following:

Ministry of Agriculture and Natural Resources,
Oba-Ile Road, Akure.

Ministry of Commerce and Industry
N N Secretariat, Oda Road, Akure

Ondo State Cocoa Development Unit
Axquinas Colledge Rd., Akure.

Source: - Rural Infrasctructures in Nigeria.
Federal Department of Rural Development.
October 1981.V.2, State Anexes.

- A.A. Eleynini, Director Food Tree Crops
Department, Ministry of Agricultural Extension
Service, Akure, Ondo St.

2. AGROCHEMICAL PROCUREMENT, MARKETING AND DISTRIBUTION

2.1. Supply of agrochemicals

2.1.1. Local production

There is no local production of agrochemicals in Nigeria; all requirements are imported. Chemical and Allied Products (CAPL-ICI), Swiss Nigerian Chemical Company (CiBA-GEIGY) and National Oil and Chemical Company (Nolchem-Shell) have repacking plants in Lagos. CAPL-ICI and NOLCHEM-SHELL have also formulation plants. The first one in Ibadan for production of EC´s and the second one in Apapa-Lagos for production of EC´s and in Port Harcourt for dusts formulation. The output of CAPL plant for EC-s is 1,500 MT/year and the similar plant of NOLCHEM company 10,000 MT/year. The output of NOLCHEM dusts plant is 2,160 MT/year. There are no production units for other pesticide formulations, but two other companies, that is RHONE-TOTAL and RALLIS (a new Indian company in Kaduna) informed about the intention to start also the production of other formulations.

The Swiss Nigeria expresses the same intention but the implementation will start only after the stabilization of economic situation and when the local demand for pesticides will increase.

All raw materials needed for EC formulation, namely active ingredients, solvents and emulsifiers are imported. The local dusts formulations are produced from imported highly concentrated WP-s, eg. Vetox 85 (Sevin), by mixing them with local China Clay.

2.1.2. Trade

There is now no restriction on import of agrochemicals, but also there are no reliable statistics concerning this import. This situation may improve as the trade database is being computerised under an ECOWAS (Economic Community of West African States) programme. The statistics obtained by the author, (see App. XI-XV, p. 60-64, and Exh.4 and 5, p. viii and ix) they may not be accurate. There are for instance marked differences between the import data for the year 1987, obtained from Federal Office of Statistics (App. XI, p.60) and those obtained from Federal Pharma-

ceutical Inspector (App. XII, p.61). According to the first source, the value of import of pesticides amounted to 40,831,800 ₦ whereas according to the second source, only 7,275,840 ₦ or about 5.6 times less.

There are also some doubts resulting from the comparison of importation and consumption of pesticides. According to the data shown in App. XI, p.60, the average yearly value of import in the years 1983-1986 amounted to 17,531,870 ₦ whereas the value of consumed pesticides in agriculture in 1986 amounted to 50,220;000 (see p.30)

Such data may imply that in 1986 some long stored pesticides were used, which in general, is not practical. (Guaranty period of quality of PF-s is usually not longer than two years).

The main problem in trade, in the present unstable economic situation and high rate of inflation (see exhibit 2), is the long time which elapses between the purchasing order and delivery of product from abroad.

The import of ready products is realized by international or local trade companies and also by World Bank Agency and bigger state or private agricultural farms.

Smuggling is also a significant feature of the market, particulary in the west. Substantial quantities of gamma HCH in particular, manufactured by Tina Chemicals in Ghana, find their way into the cocoa sector.

2.2. Government policies and regulations

2.2.1. Registration

There is at present no law on the registration of agrochemicals in Nigeria. It is believed that legislation on the matter is to be forthcoming in the near future. Reputable companies would welcome it, as it is hoped that it would curb or at least inhibit the activities of a profusion of unscrupulous and/or inexpert operators.

2.2.2. Procurement

The demise of the Commodity Boards in 1986 has led to a substantial reduction in the share of agrochemical sales accounted for by some kind

of tender arrangement, and consequently must ultimately lead to an increase in the importance of the open market, though no settled pattern has yet emerged. Nevertheless, the ADPs constitute a very significant proportion of the market (estimated at 20-30%); most of their purchases are on a tender basis, and frequently directly with overseas suppliers. State governments, sugar plantations and the Nigerian Tobacco Corporation are also important clients who operate tender systems. There is considerable inter-company trading and it is not uncommon for companies or individuals with an established agrochemical interest to be awarded agrochemical tenders.

2.2.3. Tarrifs and Cost of Ocean Freights

Tarrifs depend on the type of pesticides and are as follows:

Insecticides 30%; Herbicides 5%; Fungicides 5%

Cost of Ocean Freights 0.2 - 0.25 USA cents/kg;

Clearing charge 5 - 10% of CIF value.

It has been generally agreed that abolishing or at least considerably reducing the above costs would contribute to a lower local price for pesticides and consequently raise consumption.

2.2.4. Price control and subsidies

No price control over agrochemicals is exercised, but the importance of ADP purchases and their ability to purchase overseas via the World Bank if domestic prices appear excessive can provide sometimes an indirect means of price control.

At the federal level there are no subsidies offered on agrochemicals, and at other levels they are uncommon. However, it was reported in April 1987 that Ondo State was purchasing large quantities of copper sulphate for distribution at subsidised prices to cocoa farmers.

2.3. Distribution and marketing

2.3.1. Organization of import

Anyone with the necessary funds and motives can and does import agrochemicals.

2.3.2. Main agrochemicals companies

There is a considerable amount of brokerage and irresponsible activity within the agrochemical industry. In this section details are given only of those companies having an established and relatively stable place in the agrochemical market.

Chemical and Allied Products Ltd (CAPL) - (ICi)

CAPL was the leading agrochemical company in 1986, with approximately 30% of the market and sales of ₦ 9.90 mn excluding direct import. (see table 1 p.27).

CAPL dominates the important cocoa insecticide market with Gammalin gamma-HCH). Although there are several competing brands of gamma-HCH, Gammalin enjoys farmers' brand loyalty. Gammalin is intended primarily for use on cocoa, but enjoys substantial sales in the north where there is no cocoa. It is used for termite control and for a myriad other purposes including river fishing.

CAPL's next most important product is Actellic (pirimiphos-methyl) which dominates the grain storage sector. The product is at present being intensively advertised for the use of stored grain.

The third most important product is Gramoxone, followed by pyrethroids in Electrodyn formulations sold to ADPs mainly for use on cowpeas and cotton.

Other products sold in important quantities are the seed dressings Fernasan (thiram) and Bronocot (bronopol) and the aphicide Pirimor (pirimicarb). As is true for other brand of fungicides, the fungicide Perenox (copper oxide), formerly used in significant quantities on cocoa, has fallen into disuse as a result of low cocoa prices and the import licence system. The sharp increase in cocoa prices, however, together with the abolition of the import licences, gives grounds for optimism over the re-introduction of the product.

CAPL has a field staff of nine representatives based in regional offices and a development team of nine which includes three expatriates.

Swiss Nigerian Chemical Co Ltd (CIBA-GEIGY)

Swiss Nigerian was the second largest agrochemical company operating in the Nigerian market. In 1986 it had an estimated share of 20% excluding direct sales, equivalent to sales of approximately ₦ 6.6 mn The company has almost doubled its market share since 1982. This is largely due to its energetic marketing of herbicides, particulary the range of atrazine based products which dominates the greatly increased maize herbicide sector.

The company concentrates on food crop herbicides. Its range of insecticides is less successful, although it has some success with Basudin (diazinon). Damfin (methacrofos) has been recently introduced for the treatment of storage pests, but will have difficulty making way against the well established Actellic. In general, however, Swiss Nigerian and CAPL do not compete for the same sectors of the market.

Swiss Nigerian has an exclusive distribution arrangement with the well networked SCOA motors, doubtless one of the reasons for the company's success in recent years. It has a sales staff of 20, distributed between headquarters in Lagos and area offices in Kaduna, Enuga and Ibadan.

The Agricultural Division activities also includes carrying out of trials and development of products through the various Research Institutes in the country, training programmes and workshops for extension workers and also organizing the field days for farmers. The aim of these activities is to ensure that farmers, through the extension workers, know how best to use crop protection agents, with a great emphasis on safe and effective usage of pesticides. A well organized distribution net-work is established in all the States of the Federation with technical staff in those areas offering technical advice to farmers.

National Oil and Chemical Marketing Co Ltd (Nolchem Shell)

Nolchem is a partnership company. 60 per cent of shares belong to Federal Government and 40 per cent to Shell Co. Through the head office at the Eagle House, 38/39 Marina, Lagos, Nolchem operates via a net-work of district offices and depots located at Apapa and Oregun in Lagos Ibadan, Ilorin, Enugu, Benin, Port-Harourt, Kano, Kaduna and Jos. The districts maintain a close link with a chain ofindigenous distributors who service the farmers at the grass roots. Commercialy and technicaly the company operates through a team of seasoned agronomists, whilst a team of development agronomists liaise closely with Agricultural Research Institutes and Universities to evolve the product for future marketing. Pesticide formulations are supplied from the company's formulation plant at Apapa (EC-s) and Port Harcourt (dusts) and by direct importation from Shell International Chemical Company and other

reputable manufacturers including Sandoz, Degesch, Du Pont and Sumitomo.

Nolchem's share in the internal agrochemical market has contracted from an estimated 26% in 1981 to some 15% in 1986. representing approximate sales of N4.95 mn. Tne reasons for this decline are not entirely clear, but CAPL appears to have been the main beneficiary, since Nolchem's major products are insecticides. Sales of Kokotine (gamma-HCH) for cocoa are important, although significantly less (perhaps one third) than Gammalin. Use of Ripcord (cypermethrin) on cowpeas and cotton has been completely displaced by CAPL's pyrethroids. Sales of Vetox 85 (carbaryl) are substantial (approximately N 1.5 mn).

Sales of Aldrex (thiram + aldrin) continue to be significant. Nolchem has been the exclusive distributor of Monsanto's Roundup (glyphosate), but is now being joined by Rhone-Total.

Nolchem is planning to enter the presently insignificant but potentially large rodenticide market with the introduction of Storm.

Dizengoff Agric Ltd

This company is a division of W A Dizengoff Ltd, which distributes a wide range of machinery and goods through its own network of branches in Lagos, Ibadan, Benin, Ilorin, Port Harcourt, Enugu, Calabar, Kaduna Kano , Jos and Sokoto.

In spite of concentrating entirely on herbicides (largely atrazine) mainly through the tender market, Dizengoff enjoyed an estimated 11% of the 1986 internal market with its mainly Israeli produced herbicides. It maintains a staff of only 3 agronomists. It is thought that Dizengoff will find it difficult to maintain its present sales level in the face of the anticipated downturn in herbicidide consumption.

Rhone-Total Nigeria Ltd

RHONE-TOTAL is an affiliated company of RHONE-POULENC AGROCHIMIE which ranks among the very top agricultural chemical companies world-wide. RHONE-POULENC AGROCHIMIE operates its own agricultural research station in West Africa (Republic of Cota d'Ivoire) to ensure

that the products they market are perfectly adopted to work in tropical environment. RHONE-TOTAL is the only company to have its own field trails and experimental plots in Nigeria (at Olokoto, Oyo State). RHONE-TOTAL has a team of 9 well trained and highly motivated Nigerian Agronomists who carry out hundreds of field experiments yearly. The company operates five branches (Ibadan, Kaduna, Owerri, Kano and Yola) and its products are available throghout the nation at the CFAO (STRUCTOR) STRUCTEC outlets. RHONE-TOTAL is an energetically managed newcomer to the Nigerian agrochemical market and has already captured an estimated 10% share of the market. The large majority of its sales are direct to ADPs, with rapidly increasing sales of Sherpa Plus (cypermethrin + dimethoate) in particular, as well as of the herbicide Ronstar (oxadiazon).

RHONE-TOTAL is one of the few companies not adopting a "wait and see" policy. It plans to expand its operations through its acquisition of the Union Carbide range and is marketing Vetox 85 (carbaryl), Temik (aldicarb) and Larvin (thiodicarb), as well as opening a formulation plant in the near future.

RHONE-TOTAL is also involved in the development of production of AEROSOL-INSECTICIDES.

The production of aerosols diffusers amounts to 3 million/year. The a.i. used for this production is cypermethrin and the liquid propeler-methyl chloride. Besides RHONE-TOTAL, several other companies produce also this type of formulation. The main ones are:

Mobil-Insecticides	- Lagos
Noil-Shelltox	- "
Johnson Wax	- "
Rokana-Industry	- "
Gongon	- Kano
Agip-Pest	- Lagos
Uniflit/Unipetrol	- Lagos

BASF (Nigeria) Ltd

BASF enjoyed an estimated 8 % of the agrochemical market in1986, due largely to its dominance of the rice herbicide market with Basagran (benzatone), although it also sells Basamid G (dazomet) for tobacco,

Perfekthion (dimethoate) for various food crops, and is planning to introduce the fungicide Bavistin (carbendazim). The majority of BASF sales are direct from West Germany and the three agronomists based in Lagos offer an advisory service rather than engaging in sales.

Nigerian Hoechst Ltd

This company has been virtually inactive in the agrochemical market in the last two years. Sales of the fungicide Brestan (maneb + fentin acetate) have collapsed since the abolition of the Cocoa Board, which was a major buyer. Improved cocoa prices should lead to a sales recovery since it is believed that the product has a good reputation with farmers. Similarly, it is hoped that Capsitox (gamma-HCH) will recover its position as a rival to Gammelin (gamma-HCH). Sales of Decis (deltamethrin) have been insignificant for the last four years, but there are plans to introduce Decis in a ULV formulation for use on cotton. Detia gas (aluminium phosphide) is still used in some quantities in large-scale storage and cocoa export shipping. One agronomist is retained in Lagos headquarter and there are seven branch representatives, each combining a veterinary with an agricultural function.

Unichem Nigeria Ltd (Bayer)

UNICHEM-NIGERIA Ltd. is the authorized distributor for BAYER AG. West Germany. This division is responsible for the marketing of plant protection and public health products. Full technical support in all areas of application is provided through varied specialists from BAYER AG, Leverkusen.

UNICHEM has not been trading in agrochemicals in recent years as a result of difficulties experienced in obtaining import licences. However, regular quantities of the ovicide Quelatox (fenthion) are imported directly from the parent company. A company structure for pharmaceuticals already exists and as import licences have been abolished, it is anticipated that the company will renew agrochemical trading when and if it becomes clear that the market has steadied.

RALLIS Co.

It is a new Indian company which belongs to Indian Tata group and which

plans to start the production of pesticide formulations in Kaduna. Rallis Co. will produce pesticide formulations of their own technical materials such as butachlor, monocrotophos, dimethoate, endosulphan and captan.

Pfizer Limited

The activities of this company are presently confined to the formulations which are used for veterinary purposes. They are mainly antibiotic formulations based on tetramycine.

In the year 1989 the company will begin to deliver and later also to produce the acaricide formulations which will be used to combat the African thiks the vectors of dangerous cattle diseases. The formulations are based on synthetic pyrethrin-cyhalothrin which were elaborated and are now produced by British Cooper Co. Two of the EC-s formulations are destinated for dipping or spraying and one, organic solution, for direct handpouring of cattle.

The company expects to sell about 500,000 litres of formulations of value of about 3 million USA dollars. The main advantage of these new formulations is that they make the cattle immunized against Tse-tse flies.

The old less effective products used before were Supona of Nolchem-Shell Co. and Asulton of Bayer Co.

2.3.3. Marketing and distribution of pesticides /5/

The Nigerian pesticide market can not at present be described as organized. While professional marketers with good technical know-how of pesticides should handle the marketing, it has become a market for all comers. About 90% of the pesticides used in Nigeria are imported while local formulation depends on about 70% of imported raw materials for its production.

Because of unorganized marketing of pesticides, estimates of the market sizes and shares is complicated and to some extent approximate. A large tonnage of products may be sold in one year, followed by years of limited sales. The same can be said about import of pesticides. About 60% of pesticides purchases in Nigeria are through the complex tendering process, where actual needs are often exagerated leading to stock pilling of products from one year to the other. There is no separate pesticide legislation

Table 1

MARKET SHARE BY COMPANY: 1986 CROP YEAR

Company	Approximate sales		%
	₦ mn	US $ mn	
Swiss Nigerian Chemical Co Ltd	6.60	4.89	13
Chemical and Allied Products Ltd	9.90	7.33	20
National Oil and Chemicals Marketing Ltd	4.95	3.67	10
Dizengoff Agriculure Ltd	3.63	2.69	7
Rhone-Total Nigeria Ltd	3.30	2.44	7
BASF (Nigeria) Ltd	2.64	1.96	5
Nigerian Hoechst Ltd	1.98	1.47	4
Others	17.22	12.76	34
TOTAL	50.22	37.20	

in Nigeria although one is being expected soon and the present regulation under the Drug Act is not adequat and in fact not practicable.

Distribution and marketing of pesticides although generally problematic is being handled professionaly by reputable international pesticide companies. The World Bank sponsored Agricultural Development Projects has tremendously helped in the distribution of pesticides through various well organized farm centres and outlets. Similar activity indicates The Nigerian Agricultural Cooperative Marketing Organization (NACMO) which was registered as a national Apex Cooperative in July 1987. NACMO has three main activities: supply of fertilizers; distribution of agricultural inputs (agrochemicals, seeds, tools); and interest at marketing of foodcrops.
The ADP-s to a large extent also import pesticides directly into the country.

The introduction of the Foreign Exchange Market has made the pricing of pesticides very critical and the cost of pesticides has become one of the important elements in computing the cost of production of crops.

2.4. Agrochemical product choice

2.4.1. Farmer awareness and attitudes

The large majority of farmers are illiterate and in possession of very limited resources. Not surprisingly, therefore, attitudes towards the use of agrochemicals are not highly sophisticated. Indeed, one of the difficulties experienced by agrochemical companies is that farmers do not understand why there should be a price differential between different formulations of the same active ingredient.

In general it can be said that the use of agrochemicals is still in its infancy in Nigeria, although insecticide use is well established on cocoa, cotton and cowpeas, and the necessity of fungicide use on cocoa is, in general, recognized. The awareness of the benefits of agrochemical use is far higher by the ADPs; Nigerian farmers are mainly conservative and slow to adopt innovations. This is understandable, as most have limited resources and practise traditional risk protection techniques of mixed cropping within a bush-fallow system.

Oneconsequence of farmers' conservatism is that once a product is well established, farmers tend to remain loyal to it. Thus, Gammalin is by far the leading cocoa insecticide, even though there are several identical brands of gamma-HCH in competition.

It should be stressed, however, that the slowness of Nigerian farmers to adopt agrochemicals on a large scale is rooted in economic rationality.

2.4.2. Availability of product

Ensuring availability of product is an area of very considerable difficulty in the Nigerian market; few companies succeed in striking the right balance between maintaining adequate stocks and holding large surpluses. The part of market instability due to the importance of the tender sector should be in the process of improvement following the abolition of the commodity boards; similarly, the abolition of thearbitrarily operated import licence system will ultimately lead to more predictable demand. Nevertheless, the fluctuations of the naira on the one hand, and highly unsettled producer prices on the other, make it extremely difficult for companies to determine a reasonable sales policy. Furthermore, the large distances involved, the shortage of competent personnel at middle management level, the seasonality of demand and the large number of small consumers all make a satisfactory solution to the problem of adequate product availability extremely difficult to achieve.

Table 2

MARKET FOR VARIOUS AGROCHEMICAL FORMULATIONS IN 1986

(quantity (Q) in MT, value in '000 N)

Type	EC		WP		FW		ULV		D		G	
	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V
I	948.8	15.436	185 0	2,285	-	-	591	1,760	240 0	0,040	285 0	430
H	421	5,922	62.5	1,000	761	8,870	-	-	-	-	1 8	100
F	-	-	300.0	1,200	-	-	-	-	-	-	-	-
SD	-	-	0.1	0,090	-	-	-	-	8 2	1,300	-	-
St.Pr	20 0	400	-	-	-	-	-	-	130 0	1,300	-	-
Totals	1389 9	21,758	547.6	4,575	761	8,870	591	1,760	378 2	2,640	286.8	530

Type	WSC		Others		
	Q	V	Q	V	Totals V
I	32.5	565	-	1,000	21,516
H	100 0	984	-	-	16,876
F	-	-	1,500	2,300	8,000
SD	-	-	-	-	1,390
St.Pr.	-	-	-	0,238	1,938
R	-	-	-	0,200	0,200
Others	-	-	-	0,300	0,300
Totals	132.5	1549	6,000	4,038	50,220

2.4.3. Application constraints

The principal constraints on application of agrochemicals are financial. Escalating costs of all products puts them out of the reach of many small farmers. Linked to this is the expense of spraying equipment; a knapsack sprayer presently costs between ₦ 350 and ₦ 450, which is approximately half the net annual income that a farmer in the state of Niger, for example, can expect to derive from a hectare of maize.

One non-economic constraint on agrochemical application is the very widespread practice of mixed cropping.

2.4.4. Quality of products (6).

The type and quality of imported pesticides are based on information supplied by the manufacturers. The Nigerian Federal Department of Pest Control (in Kaduna) Service does not undertake any form of routine testing neither does it conduct any research that would enable it to advise the government on the suitability of the pesticides. There is, therefore, no way to ascertain that the information supplied by the manufacturers is correct and sufficiently comprehensive or that the active ingredients have not undergone degradation at the time of storage. Storage facilities at the depots and in the agricultural establishments are grossly inadaquate. Some pesticides dissolved in volatile and flammable organic solvents are stored under uncontrolled temperature conditions. Other pesticides are delivered in large metal drums, which are left in open fields under the intense ultraviolet radiation of the sun and long periods of heavy rains.

3. POSSIBILITIES OF DOMESTIC PRODUCTION OF PF-s

Before taking out the decision about the production of PF-s, the following preconditions should be determined:

- the domestic market for various types of PF-s;
- availability of local raw materials for PF-s;
- availability of local packaging materials;
- availability of technical staff able to organize and to conduct the PF-s production and marketing.

The present Nigerian situation with regard to the above mentioned preconditions is discussed below.

3.1. The present and forecast future market for various types of PF-s

According to available statistics (see Appendix XVII and table 2) the Nigerian Market for PF-s in 1986 was as follows:

EC-s	1,399,800 l	(35.4%)
FW-s	761,000 l	(19.3%)
WP-s	637,500 kg	(16.1%)
ULV-s	591,000 l	(15.5%)
D-s	387,600 kg	(9.85)
WSC-s	132,500 kg	(3.4%)
G-s	39,300 kg	(1 %)

As it is seen from the above display the EC-s, ULV-s and WSC-s amounted all together to 2,123,399 l which corresponded to 54.3% of all PF-s market. This quantity was composed of different quantities of 28 formulations of various pesticides. The main PF was Gammalin EC, used mainly against capsids, the pest of cocoa trees. The quantity of this formulation = 452,500 L amounted to 32.3% of all EC-s.

For different reasons and mainly because of the unstable economical situation, the Nigerian market for PF-s in 1986 can not be treated as representative for projecting the future PF--s market for the next years. The main factor influencing such market is the cost performance for using of pesticides in crop protection which depends upon the cost of PF-s and the income which farmers obtain from their agricultural products.

According to the opinion of some of the managers of international companies located in Nigeria the pesticide market should after the normalization of economical situation be growing at about 5 - 10% annualy. Such opinion is not however shared by some of representatives of Federal or State Governments. According, for example, to the information obtained from Mr. A.A. Eleyinini (see par.1.8,p.16) the demand for different pesticides only for Ondo State should be as follows:

Cocoa trees

Area planted	300,000 ha
Area protected	240,000 ha (80%)

Quantity of pesticide needed:

Insecticide

Gammalian 20/EC/; doze: 5 l/ha; application: 4/year

240,000 x 20 l = 4,800,000 l/year

Fungicide

$CuSo_4.5H_2O$; doze: 2 kg/ha; application: 5/year

240,000 x 10 kg = 2,400,000 kg/year

Maize

Area planted	500,000 ha
Area protected	50,000 ha (10%)

Insecticide

Vetox 85 /WP : doze: 1 kg/ha; Application: 1/year

50,000 x 1 kg = 50,000 kg/year

Herbicide

Primektra /FW /; doze: 5 l/ha; application: 1/year

50,000 x 5 l = 250,000 l/year

Rice

Area planted	250,000 ha
Area protected	25,000 ha (10%)

Herbicide

Risane (EC), doze: 5 l/ha; application: 1/year

25,000 x 5 l = 125,000 kg/year

Cowpea

Area planted 5,000 ha

Area protected 500 ha (10%)

Insecticide

Nuvacron (WSC); doze: 5 l/ha; application: 1/year

500 x 5 l = 2,500 l/year

Herbicide

Galex (EC); doze: 5 l/ha; application: 1/year

500 x 5 l = 2,500 l/year

Cassawa

Area planted 250,000 ha

Area protected 25,000 (10%)

Insecticide

Gammalin 20 (EC); doze: 1.5 l/ha; application: 1/year

25,000 x 1.5 l = 37,500 l/year

Herbicide

Diuron 80 (WP); doze: 2 kg/ha; application: 1 /year

25,000 x 2 kg = 50,000 kg/year

Consequently the global demand for particular PF-s, for Ondo State are as follows:

EC - 4,965,000 l
WP - 2,500,000 kg
FW - 250,000 l
WSC - 2,500 l

The above mentioned demand and especially that for EC-s and WP-s would suggest that much bigger future consumption of PF-s than those in 1986 (compare data in App. XVII pp. 66-68) can be expected.
Similar conclusion can be drawn also from the very small area of planted food

crops which were protected in 1985 (see App. VII p.56).

3.2. Availability of local raw material for PF-s

It is the general opinion that Nigeria is very rich in minerals which could be used in production of PF-s. The information about the resources of these minerals are periodically given in local newspapers and also in the Yellow Directory. Some of these informations are given below:

"A high quality grade of clay deposit with an estimate reserve of 1.5 million tons has been discovered along Mini River near Lokeja. It is being proposed that they would form part of essential raw materials in the manufacturing of cement. Other clay deposit are also found at Kagara in Kogi local Government. It is believed that China Clay deposits exist in Irepodum and Ifelodum local Government of state".

"Though untapped the Niger state is blessed with a number of minerals: gold, silicon, limestones copper, kaolin, lead, marble, columbit, etc. While the availability of some in commercial quantities has not been ascertained it is believed that there are many that will meet the expectations of the serious investors. It is confirmed that ceramic, glass, terazzo tile industries, among others, can be properly developed in the state."

"Large deposits of clay which could form a raw material for some industries abound within Ogun State. Kaolin deposits have been identified in Abeokuta. Good quality of clay suitable for burnt brick industry exists in large quantity in Oke-Eri, Isara."

"In Bauchi State the commrcial quantities of clay and silica sand were discovered. Sand suitable for the manufacturing industries of glassware have been identified in Doba area of Akko Local Government Area of State."

"Plateau State is one of few states that is endowed with a lot of mineral resources. Some of these have been exploited since the beginning of the century, while additional exploratory work is required to establish the full extent of some precious stones, coal, radioactives."

Unfortunately all of the above informations refer to the beds of minerals being placed underground. Before, however, being used as pesticide carriers or diluents these minerals have to be processed that is washed, dried separated , etc. (see also Appendix XIX, pp 74 - 77).

According to the information obtained from the Federal Ministry of Mines, Powers and Steel (see App. XXIII) the main mineral which is exploited in Nigeria is limestone. In 1987 the quantity of 2,627,409 tons was exploited by 6 of mines. According to the same source the quantity of exploited kaolin amounted to 177.3 tons. This kaolin mined in Abedcuta in Ogun State is used in the Richware Ceramic Ind. Ltd. - Lagos for the production of pottery. But for this production it is not necessary to dry it and wash. Only some impurities like sand are separated by sedimentation. The other type of kaolin namely China-Clay is exploited by Nigeria Clay UKPOA company in Anabra and is used in oil well driling.

According to the information obtained from Engr. Bisi Mabogunje, the technical Director of Richware Ceramic Co.

there is no company in Nigeria which is supplying the dry and accordingly prepared mineral carriers which could be used in PF-s production. Engr. Mabogunje assumed, however, that appropriate processing, necessary to prepare the kaolin of needed quality, could be done in his company.

The other raw materials which are used in production of PF-s are organic solvents. The ones which were commonly used in formulation of EC-s - the most used PF-s in Nigeria - were aromatic solvents of xylene type. These kind of solvents are yet not produced in Nigeria. There is however information (see App. IX, p.58) about commisioning in 1992 the production of p-xylene. Because however of its too high melting point it has not been used as pesticide solvent. Para-xylene is produced by isolation from the mixture of xylenes by cristalization. It is why the ortho-xylene will, most probable, be also available.

It should be however mentioned , at this place, that usage of p-xylene as the solvent in the production of EC-s is nowadays considerably limited because of its too low flash point (see App. XIX/2, p.78). Instead of it, the safer solvents of higher flash points (such as mixtures of mesitilenes or methylnaphtalenes) are used. But these type of solvents will not be produced in the near future. One of these type of solvent, namely AROMASOL, imported from ICI Co. England, is presently used in local production of EC-s. In some cases the mixtures of p-xylene with the solvents of higher flash point can also be used in this production.

According to NNPC plan the following solvents will be available in 1989, 1992 and 1995 (see Appendix IX p.58).

Deparafinized Kero Solvent	Commisioning date	1988
Iso-propanol	"	1992
Ortho-xylene (most probably)		
Dioctyl Phtalate	"	1995
2-Ethyl Hexanol	"	1995

All of these solvents can be used as solvents or cosolvents for Ec-s and for ULV-s (the details of solvents see Appndix XIX).

The surfactants which are used in production of WP-s and FW-s (wetting and dispersing agents) and in production of EC-s (emulsifiers) are not and will be not produced in Nigeria in the near future.

3.3. Availability of local packaging materials

The most usual containers for liquids are tight head steel drums which are frequently used to transport bulk quantities. Where required, suitable lacquer linnings are used to counter incompability between the product and the metal container. Composite drums are of similar external appearance but are fitted with a blow moulded inner plastic liner. These drums provide, what's in effect, a double skin, and are used to transport products which are incompatible with lacquered steel.

Composite drums are considerably more expensive than their steel only counterparts and are gradually being replaced by drums made entirely of plastic.

Tin plate containers are manufactured from mild steel sheet on which is deposited a thin coating of tin. The interiors are generally left plain, but, if necessary, may be coated with a lacquer linning.

Tin plate is widely used for small packs as they are relatively cheap.

High density polyethylene (HDPE) containers are now extensively used for packaging pesticide formulations, especially water based products (e.g. WSC-s and FW-s). However, because formulations based on aromatic hydrocarbon solvents may permeate HDPE they cannot be packed in it. All of these packaging containers are or can be produced in Nigeria, but nearly all of raw materials needed for their production have to be imported. The situation will be improved when HDPE is produced in Nigeria which, is scheduled for 1992 (see Appendix IX).

3.4. Availability of technical staff

There are many companies which are dealing with supplying, marketing and distributing of pesticide formulations and in which experienced Nigerian specialists are working .
There is, however, lack of specialists which would have experience in production of PF-s, managing of plant and testing of products.

4. C ONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

From the data concerning the import and usage of agrochemicals (see App. and XI p.59-60 and Exhibits 4 and 5 p.viii-ix) rather low average consumption of technical material has been shown. The amounts of active ingredients which were used in different PF-s were as follows: (calculated by author)

fungicides	6,150	MT
herbicides	779	"
insecticides	385	"
storage products	11	"
seed dressings	8.7	"
Totals	7,334.7	"

Taking into account that area of arable land in 1986 amounted to about 28,000 thousands of ha (see Appendix I p.49) one can calculate that the average quantity of technical material used in an area of 1 hectar amounted to 0.28 kg. This quantity is very low, not only in comparison with the quantity used by the developed countries (from several to any where from ten to twenty kg/ha, but also in comparison with comecon countries (1.5 to several kg/ha).

The very small amount of agrochemicals used by Nigerian agriculture is clearly visible also from the data indicating the area of food crops protected by pesticides. In 1986, for example, the per cent of area protected by insecticides amounted to 2.73% and those protected by herbicides to 1.76% (see App. VIII p.58).

Such small usage of agrochemicals from one side, and the Government effort to increase the output of crops from the other side, constitute the justified basis for growth of pesticides consumption. This increased consumption will also result from the larger usage of fertilizers, whose production started in Nigeria in 1988 (see App.VIII p.57). (The larger usage of fertilizers results in the increased population of crop pests).

In connection with the above, the main recommendation concerns the organizing the pilot plant for the new, not yet produced, pesticide formulations. During his mission, however, the author had possibility to be acquainted with the various short-comings in different pesticide activities.

Although they are not connected directly to the main task of the mission they should be taken into consideration by the Nigerian Authcrities. Some of these shortcomings, pointed out in the report make the basis of the additional recommendations. They, together with the main recommendation should contribute to the more effective and more economical usage of agrochemicals by Nigerian farmers.

4.2. The main recommendations

4.2.1. New Pesticide Formulations Plant in Ondo State

The main task of the mission whose results are presented in this report was to give answers to three questions - is there the need to build a pesticide formulation plant in Nigeria, what conditions are required for organizing such production, and in the case of a positive answers, what further action should be undertaken. The intention to build and organize a new PF-s plant had been submitted by Ondo State Authority. This intention has been to some extent motivated by:

quite serious demand of the State Ministry of Agriculture on pesticides (see par. 3.1. p.32) and envisaged possibility of using the local raw materials for the production of PF-s.

The present mission has discovered the following facts:

1. The main pesticides used in large quantities in Ondo State (for protection of cocoa trees) are:
   fungicide copper sulphate and insecticide Gammalin-20
   The presumable yearly demand of these two pesticides is as follows (see p. 33):

Copper sulphate	2,400 t/year
Gammalin-20	4,800 t/year

   This quantity amounts to 95 per cent of all pesticides to be used in this state. It is large enough to justify the intention of organizing the local production . However, other factors have to be also taken into account before a decision is made. The factors are as follows:
   a. Copper sulphate is technical pesticide which is used as such or as a raw material to prepare Bordeaux mixture. This mixture, however, is in general, prepared directly by the farmers just before spraying, by mixing copper sulphate with water and lime and not by producer as WP.

And so, the copper sulphate is not used as technical pesticide in the production of PF-s. Other copper fungicides which can be used instead of copper sulphate (such as cuprous oxides) and used as WP-s (Perenox, Cocobre) are produced exclusively in the form of WP-s. They do not exist on the market as technical materials.

b. Gammalin-20 is EC - the 20 per cent solution of Lindan in aromatic solvent (see App. XIX/2 p.78).
There is no production in Nigeria of the required types of solvents for this formulation and their production is not envisaged until ✓ 1992 (see App. IX p.58). In that case the production of Gammalin-20 (similarly as with other EC-s) has to be carried out on the basis of imported solvents.

Moreover taking into account that two pesticides companies viz. CAPL and NOLCHEM have production installations for EC-s, which are utilized only at 30 per cent of their production capacity, the erection of the new installation for this production, seems to be unjustified.

2. The intention to build the new PF-s plant is also motivated by advisability of utilizing local minerals which are abundant all over the country.
Regarding this question, the following should be explained:
The main PF-s for which production the mineral carriers are used are the following: dusts (D-s), wettable powders (WP-s) and granules (G-s).
The consumption of D-s and WP-s is comparatively small and will be diminishing in the future. It is caused by safety considerations of usage of pesticides. The powdered formulations which are not very safe for farmers, as well as for environment, are gradually displaced by water suspension concentrates (FW-s), in which the mineral carriers are not in general used. Besides, the production of WP-s in Nigeria, as in other countries with hot and wet climate, is very difficult and expensive.

4.2.2. New Pesticide Formulations Plant in Nigeria

The following PF-s should be produced in Nigeria

in the first place:

water flowables (WF-s) or more precisley water suspensions or emulsions concentrates;

pesticide granules;

ULV formulations.

The FW-s are safer than WP-s and EC-s as well during the production as during the usage, and therefore are more and more popular on the world market.

The solvents, as in the most cases also the mineral carriers are not needed for their production. The main components are technical pesticide and water. They amounted to 95 per cent of all components. The other 5 per cent are surfactants and thickeners. The process of formulation of FW-s is comparatively simple (see App. XX and Fig. A p.81). More complicated is the choice of surfactants and thickeners

The production of WF-s can be initiated by one of the Nigerian companies, such as e.g. Nol-Chem, Swiss-Nigeria and CAPL, or eventually by a new Nigerian company as a joint-venture with some of the mentioned or independently with the help of UNIDO.

The other suggested PF-s which are not yet produced in Nigeria are granules and ULV-s. For both of them the needed raw materials viz. limestone and kerosine solvents are available in Nigeria. On the ULV production line also some of EC formulations (those for which the aromatic solvents are not needed) may also be produced.

Before however the preparation of the suggested production would be undertaken the perspective market for the proposed formulations as well in Nigeria as in neighbouring African countries, should be assessed. Also the possibility of purchasing the modern technical pesticides, on the foreign markets should be verified.

To get the full information about the pesticides which should and could be produced, as well as about the economical output of the new formulation plant, the feasibility study is requested.

• In App. XII,p.62, XIV,p.63 and XXI, p.83
The manufacturers of some of the pesticides have been shown.

It should not be presumed that the functions of the exi sting international companies can be replaced with this or any other programme. The international company products, quality and service were universaly admited and praised by every knowledgable persons questioned by the author. Their continuing contribution appears essential to the health of Nigerian pest management.

4.3. Additional recomendations

4.3.1. Organization of Laboratory for Quality Control of Pesticide Formulations

There is no laboratory in which permonent control of quality of PF-s is carried on. So it can be expected that products often of no standard value can be used for crop protection. It is obvious that using of such deteriorate products is not only economicaly inefective but also can be dangerous, as well for farmers, which use them, as for an environment (the usage for instance of deteriorated Malathion in Pakistan caused the death of a dozen or so people). Therefore, it is recommended to establish, in one of the leading Agricultural Research Institute, a laboratory for chemical analysis and physicochemical testing of PF-s. Physicochemical tests, which besides of the chemical analysis should be performed in checking of the quality of PF-s have been specified in App. XXII p. 84.

Taking into account that such prominent specialists of crop protection as prof. Anthony Judowei from University of Ibadan and dr. L.Okezie Akobudu, the author of an excelent monography "Weed Science in the Tropics", are engaged in the scientific Work in IITA, this institute is suggested for the proposed laboratory.

The Federal Government of Nigeria should ask UNIDO to engage two international experts, one a chemical analyst and the second one physicochemist, both specialists in pesticide formulations, to come to Nigeria to organize such laboratory and train the counterparts in the methods of analysis and testing of P.Fs. The chemical analysts should be employed for at least one year and physicochemist for half a year.

It is also suggested that analytical chemist should visit other research institutes to check their outfit in analytical instruments and scope of their analytical work.

One may also expect the necessity of outfitting the projected laboratory with the new laboratory instruments. Appropriate sum of money for such outfitting has also to be anticipated.

The laboratory can also serve as a testing resource to assist the Federal and States Governments improve registration regulations and

support quality assurance programmes. Several inert ingredient investigations are suggested, including granular carrier identification or development, clay carriers for powders, solvents and surfactant identification. A continuing intercation with the Nigerian Standards Institute should be established.

4.3.2. Statistical Information

Reliable statistical information, in official bulletins, concerning pesticides import and consumption with regard to type of pesticides and their formulations is not readily available.

This information which can be sometimes obtained from the persons responsible for the collection and collation of data (Federal Office of Statistics or Chief Pharmaceutical Inspectorate in Lagos) are not always in accord. Besides, it happens that imported products which are not pesticides, are collated in informative lists as pesticides (e.g. sulphur imported for match-making industry and Celit imported for sugar industry). It also happened that the lists of imported pesticides have such names as "pesticides", "herbicides", "insecticides", "fungicides" or "agrochemicals" which do not inform about the type of pesticides or their formulations.

It is recommended to ask UNIDO to assist in training of people responsible for statistics concerning the importation of pesticides.

4.3.3. Expansion of Distribution Network

Inadequacy of sales outlets in rural areas is an important factor inhibiting pest control measures. The NAFCO, World Bank agency and chemical companies should be asked to expand their network so as to ensure at least one distribution point within 10 - 15 kilometers radius of consumption areas.

4.3.4. Subsidies and Incentives

Because of too high cost, most farmers are not interested in owning spraying and dusting equipments and this may hamper plant protection work. "Equipment Banks" should be established in the rural areas to lease machines to the users. Also to establish service workshops in which the appropriate crop protection services could be ordered would also be helpfull.

4.3.5. Modern Holding Farmers Actvivity

According to the statistical data (see Appendix V and VI pp 54-55) the yield of agricultural productions of modern holding farmers is in general lower than that of small holding ones. Such results of the modern farms, where the usage of pesticides and mechanization is much more common than in the small holding farms, can have disadvantageous influence on the popularization of usage of pesticides by small holding farmers.

The reasons of lower yield of agricultural production of modern holding farmers should be analysed by the appropriate agricultural departments of states and pertinent measures taken.

4.3.6. Strengthening the Federal Department of Pesticides in Kaduna

In order to: infuse a greater depth in the proper planning and promoting judicious use of pesticides and to provide a national perspective to effective coordination of plant protection work in the regions, through regional states staff as well as Parastatals, the strengthening of the Federal Department of Pesticides in Kaduna is recommended. To begin with a service of an international expert (agrotechnician with crop protection specialty) for a minimum period of one year, to streamline the activities of this department, to train his counterpart and

also to implement some of the other recommendation which are here suggested, may be required.

Assistance from FAO in this regard is recommended.

4.3.7. Stimulation of farmers into usage of pesticides

Although it is common for the modern holding farmers to use pesticides, many small farmers still do not use them. The majority of these farmers who grow mainly food-grain crops, other food crops and edibleoil crops, and who constitute the majority of the farming community, are not using, or if, only negligible quantities of pesticides.
It is due to the lack of appropriate information or knowledge, lack of financing or credit, and inadequate return on the produce sold by farmers.

To stimulate the farmers into usage of pesticides the following actions should be undertaken:

1. Major emphasis should be placed on the training of farmers in the safe and effective use of pesticides under the programmes being developed or to be developed under the Goverment, UNIDO, FAO or industry sponsorship.

2. Demonstrations should play a major part in the training programmes. The demonstrations should be made on a scale appropriate to local farm holdings, and should be properly conducted and supervised, so that the cost and benefits, as well as the way of applying pesticides would be clear to farmers.

3. In addition to and in support of demonstrations on the use of pesticides, appropriate training materials should be developed. These should be carefully developed and then adopted to suit local needs and conditions.

4. In the initial stages, when pesticides are being introduced in a new area or on new crop, subsidies on the cost of pesticides and on application equipments might encourage their proper introduction into use.

5. Farmers should be assured by Federal and States Governments of a reasonable return for produce.

6. Credit on reasonable terms might be provided by Governments through farmers associations or co-operatives. Crop insurance may also be necessary to protect the farmer in the case of crop failures.

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APPENDIX I

TOTAL AND ECONOMICALY ACTIVE POPULATION
IN 1970 AND 1986
(unit 1000)

YEAR	TOTAL	IN AGRICULTURE	ECONOM. ACTIV. (total)	ECONOM. ACTIV. (in agric.)
1970	57221	40 602 (70,9%)	23 635 (41,3%)	16 771 (41,3%)
1986	98578	65 210 (66,1%)	37568 (38,1%)	24 852 (66,2%)

TOTAL AND EXPLOITED AREA
IN 1970 and 1986

(unit 1000 ha)

	1970	1986
Total land	92 377	92 377
Land area	91 077	91 077
Arable land	27 420	28 550
Permanent crops	2 480	2 535
" pasture	19 843	20 960
Forest and wood land	19 400	14 700 (?)

Source: FAO Production Yearbook (1986) v.40 FAO Statistic Series No 76(1987)

TRADE VALUE FOR SOME RAW MATERIALS AND COMMODITIES FOR 1987 AND 1986

(unit million ₦)

	1987			1986		
	Trade value	Import	Export	Trade value	Import	Export
Total	45,276	15,698.1	29,577.9	12,577.1	1,918.6	8,739.9
Crude Petroleum			28,154.0			8,328.7
Cocoa beans			732.0			370.7
Palm kernels			46.0			7.5
Rubber			107.0			33.0
Food (total)		1,646.4			802.0	
Wheat and Spelt		60.8			273.8	
Sugar		230.9			132.2	
Fish and Fish Preparation (including stock fish)		451.8			104.0	
Milk		247.6			62.0	
Rice		*			0.2	
Malt		250.9			67.8	
Others		404.4			162.0	
Chemicals, drugs, plastics, res. s		1,527.3			681.5	
Paper products, iron, steel, cement etc		3,940.6			1,237.1	
Others		8,583.8				

Source: The Punch Nov. 12. 1988

APPENDIX III

NIGERIA'S PRODUCTION OF FARM PRODUCE (Various Sources)

Year	Cocoa	Palm Kernels	Natural Rubber	Cotton
1973	214894 M/T	-	66250 M/T	(Bales of 181.43)
1974	214461 "		78000 "	-
1975	217493 "	-	67750 "	-
1976	166378 "	-	52500 "	453126
1977	206888 "	175370 M/T	59250 "	219152
1978	136898 "	239479 "	57500 "	206039
1979	172000 "	230762 "	56250 "	161620
1980	-	208878 "	44500 "	149820
1981	-	193863 "	48500 "	115820
1982	-	186930 "	-	108825
1983	-	130155 "	-	

Source: Rubber Statistical Bulletin Vol. 35 No. 6 March 1981, p7

AGRICULTURAL STATISTICS

FOR NIGERIA (N), KENIA (K) AND PAKISTAN (P)*

YEAR - 1987

	N	K	P
1. Population (unit: 1000)			
1.1. Total	102 079	22 405	104 960
1.2. Agricultural	67,175 (65.8%)	17,520 (78.8%)	57,093 (54.4%)
1.3. Labor force	38,597 (37.8%)	9,003 (40.2%)	31,299 (29.8%)
1.4. Agricultural	25,400 (37.8/24,8%)**	7,043 (40.8%/31.43%)**	16,005 (28.03%/15,2%) **
2. Total Arable + perm. Crops land in ha. for 1000inhabitants	304.5	105.8	195.6
3. Agricultural products on 1000 inhabitants in MT. ***			
3.1. Total cereals	103.44	116.6	174.12
3.2. Root crops	346.8	73.6	6.19
3.3. Total pulses	10.28	20.5	7.5
3.4. Oil Crops	12.63	1.02	5.87
3.5. Total meat	8.67	12.54	9.82
3.6. Milk	3.32	11.12	111.45

Appendix IV (continuous)

	N	K	P
4. Food Supply (caput/day)			
4.1. Calories (numbers)	2136[1)]	2051	- n.d.
4.2. Proteins (grams)	46.6	56.7	- n.d.
4.3. Fats (grams)	44.0	37.0	- n.d.
5. Means of production			
5.1. Tractors agricultural in uses on 1000.000 ha of arable + perm. crops	33	359	762
5.2. Fertilizer production (unit 1000 MT)	5	-	1126
5.3. Fertilizer consumption in kg/ha	10.8	46	73.5

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1) data for the year 1985

n.d. - no data

• - Compiled from data of Country Tables Basic Data On The Agricultural Sector Economic and Social Policy Department of FAO.

••- First number in brackets refers to per cent calculated with regard to agricultural population and the second one with regard to total population.

•••- To get more reliable comparisons, the data shown in p.2 should be taken into account and then data shown in p.3, should be divided by 2.87/304.5/105.8/or 1.56/304.5/195.6/.

APPENDIX V

DATA FOR SOME OF MODERN AGRICULTURAL HOLDINGS IN 1985/86

SUMMARY SHEET FOR FOOD CROPS AREA, PLANTED AND HARVESTED AREA, PRODUCTION AND YIELD

CROP	Nr. of holdings	Area planted ha	Area harvested ha	Production tonns	Yield kg/ha
MAIZE	484	20,624.9	20,126.16	31,391.39	1559
YAM	259	102,096	98,150.38	99,080.57	1009
RICE	232	5,486.36	5,368.86	8,035.60	1496
G.CORN	313	8,601.58	8,378.86	6,345.09	757
CASSAWA	326	5,049.95	3,988.31	22,721.34	5696
BEANS	144	3,112.18	3,010.59	1,566.69	520
MELON	45	266.41	264.9	410.4	1540
PLANTAIN	154	509.34	427.94	649.26	1517
MILLET	151	6,086.82	5,907.82	4,205.82	711
PEPPER	20	295.84	156.52	NFD	-
COFFEE	1	44.53	2.02	0.57	282
COCOA	33	710.91	689.91	123.49	178
RUBBER	47	2,842.95	2,505.45	2,762.72	1,102
OIL PALM	122	5,808.80	5,353.26	15,115.76	2,826
CITRUS OR ORANGE	45	415.07	391.01	976.91	2,498
MANGO	12	153.8	153.8	378.1	2,458
G.NUT	165	4,043.4	4,023.71	2,610.55	648
KOLA NUT	6	19.81	17.31	158.75	7,437
COTTON	20	1,135.00	1,084.0	523.8	482
CASHEW NUT	10	387.09	387.09	NFD	-
PENEAPLE	20	66,44	57.5	38.78	674

Source: Federal Office of Statistics, Lagos, Broad Street, Mr. H.C.Eteama

APPENDIX VI

AREA (A), PRODUCTION (P) AND YIELD (Y) OF MAJOR CROPS IN NIGERIA

Area in 1000 ha; Production in 1000 tons, yields in kg/ha

CROP	1977/78 [1]			1985/86 [1]			1987/88 [1]			1985/86 [2]		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
MILLET	3,089	2,579	834	3,727	3,683	988	3,705	2,338	631	5,907	4,205	711
MAIZE	610	777	1,273	1,556	1,826	1,173	1,137	1,137	1,193	20,126	31,391	1,559
G.CORN	3,480	3,326	955	4,677	4,822	1,031	3,182	2,636	828	8,378	6,345	757
YAM	577	6,661	11,544	783	9,473	12,098	755	8,416	11,147	98,150	99,080	1,009 (?)
CASSAVA	198	2,900	14,646	184	1,930	10,485	303	3,110	10,264	3,988	22,721	5,696
RICE	245	408	1,665	121	266	2,198	267	591	2,213	5,368	8,035	1,496
COTTON	278	267	960	45	30	666	257	334	1,299	1,084	523	482
G.NUT	763	603	790	694	532	766	897	612	682	4,023	2,610	648
BEANS	1,552	411	264	1,405	642	456	1,813	745	410	3,010	1,566	520
MELON	164	142	865	120	205	1,708	175	258	1,474	265	410	1,547
COCOYAM	83	399	4,807	64	373	5,828	120	906	7,550	-	-	-
TOTAL [3]	11,039	18,473	3,509	13,376	23,782	3,399	12,611	21,303	3,426	-	-	1,490
%	100	100	100	121	128,5	96.8	114.2	115.3	97.6			

1) Source: Federal Office of Statistics, Agric. Survey Division, Lagos, LancasterHouse, Mr. Fred OKUKUNO

2) Federal Office of Statistic, Lagos, Broad Str. 36/38, Mr. H.C. ETEAMA

3) Total Yield was calculated as average yield of all crops.

Note: The data of the last of three columns refer to the modern holding farms and area is expressed in ha, whereas production and yield in kg/ha. For comparison of average yields of small and modern farms the numbers between the lines have been in calculations omited. Then average yield for modern farms for 9 crops amounted to 1490 kg/ha for small one 2,163 kg/ha.

APPENDIX VII

AREA OF MAJOR CROPS - PLANTED AND PROTECTED in 1986

Area in '000 ha

Crop	Area planted	Area protected		
		I	H	F
Food crops				
Millet	3,400	10 (o.29) *	n.u.	n.u.
Sorghum	3,300	30 (0.9)	20 (o.6)	n.u.
Cowpeas	3,000	130 (4.3)	15 (0.5)	n.u.
Maize	2,200	55 (2.5)	165 (7.5)	n.u.
Cassawa	1,500	130 (4.3)	15 (0.5)	n.u.
Yams	955	37 (2.46)	12 (0.8)	n.u.
Rice	720	25 (3.47)	42 (5.83)	n.u.
Soyabeans	125	n.d.	n.d	n.d.
Cocoyams	40	n.d.	n.d.	n.d.
Wheat	30	n.d.	n.d.	n.d.
Total	15,270	417 (2.73)	269 (1.76)	
Cash crops				
Oil palm	2,230	8 (0.35)	n.u.	n.u.
Cocoa	800	160 (20)	35 (4.37)	160 (20)
Groundnuts	600	25 (4.16)	n.u.	n.u.
Cotton	250	92 (36.8)	6 (2.4)	n.u.
Rubber	200	n.d.	n.d.	n.d.
Wheat	30	n.d.	n.d.	n.d.
Total	4,110	285 (6.93)	41 (1.0)	160 (3.89)

* The number in bracket indicate per cent of area protected.

Explanations: n.u. - not used; n.d. - no data.

Remark: The inadequacy of data collection in Nigeria, the extensive areas involved, the low proportion of agricultural production that is commercialized and the prevalence of mixed cropping all combine to produce conflicting and unreliable information about area and production. For some crops such data are totaly lacking. The above table is based on Landel Mills Report/1/ and although this is believed to be most reliable, all such data should be treated as approximate.

APPENDIX VIII

CONSUPMPTION OF FERTILIZERS DURING 1987 year

N P K 15/15/15	295,000 tons
Urea	70,000 "
Diammonium Phosphate	19,000 "
NPK 12/12/17 + 2 MgO	32,000 "
SSP (Single Superphosphate)	80,000 "
MOP (Muriet of Potasium)	10,000 "
Calcium Ammonium Nitrate	115,000 "
T o t a l	621,000 "

In the year 1988 the domestic production of Urea and NPK has been started by the National Fertilizer Company of Nigeria. The capasity of the company's factory amounts 700,000 ton/year.

Source: informations imparted orally by S.S.Oredota, Chief Agric. Officer, Fed. Ministry of Agriculture, Fertilizer Procurement, 141 Ahmadu Bella Way, Victoria Island, tel. 610826.

APPENDIX IX

INDUSTRIAL RAW MATERIAL PRODUCTS FROM NIGERIAN

NATIONAL PETROLEUM CORPORATION (NNPC) PETROCHEMICALS*

Phase I Plans

location	Product	MT/yar	Commisioning date
Ekpan (Warri)	Polypropylene	35.000	March 1988
	Carbon Black	18.000	
Kaduna	Linear Alkyl Benzene	30.000	
	Heavy Alkylate	2.700	
	Benzene (for lab.)	15.000	
	Deparafinized Kero Solvent	38.000	

Phase II Projects

Location	Product	MT/yar	Scheduled for completion
Eleme, near Port - Harcourt	Etylene/Propylene	375.000/150000	1992
	Butene-1	22,000	"
	Polypropylene (LLDPE/HDPE)	270,000	"
	Terephtalic Acid	65,000	"
	Polyester Chips	75,000	"
	Para Xylene	45,000	"
	Iso-propanol	20,000	"
	Caustic/Chlorine	110.000/100,000	1995
	Vinyl chloride Monomer	145,000	"
	Polyvinyl chloride	140,000	"
	Dioctyl Phtalate	35,000	"
	2-Ethyl Hexanol	26,000	"
	Phtalic Anhydryte	15,000	"
	Ethanoloamine	5,000	"

* SOURCE NNPC Information leaflet

APPENDIX X

MARKET VALUE FOR AGROCHEMICALS 1986 (1)

C R O P	INSECTICIDES =N='000	FUNGICIDES =N'000	HERBICIDES =N'000	SEED DRESSING =N'000	STORAGE PRODUCT =N'000	TOTALS	%
Rice	620	*	3,040	*	*	3,660	7.36
Maize	1,212	*	7,340	500	*	9,052	18.20
Millet	*	*	600	200	105	905	1.82
Sorghum	540	*	1,200	300	317	2,357	4.74
Groundnuts	400	*	*	100	*	500	1.00
Cassava	436	*	658	*	*	1,094	2.20
Oil Palm	*	*	314	*	40	354	0.72
Cocoa	11,760	7,200	720	*		19,680	39.58
Cotton	2,418	*	474	90	*	2,982	5,99
Sugar cane	*	*	1,490	*	434	1,924	3,88
Cowpeas	3,130	*	1,040	200		4,370	8.78
Others	1,000	800	*	*	1,042	2,842	5.72
TOTALS	21,516	8,000	876	1,390	1,938	49,720	100.00

APPENDIX XI

IMPORT OF SELECTED PESTICIDES BY TYPE, 1981 - 1988

COMMODITY	1981		1982		1983		1984		1985		1986		1987		1988	
	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000	quantity M.ton	value ₦'000
DISINFECTANTS	16,082.8	18,153.7	11,533.7	16,660.4	3,828.8	4,788.1	1,944.4	2,098.7	6,332.9	13,098.5	9,403.4	20,610.1	7,450.0	25,475.5	*)	
INSECTICIDES	52,770.8	55,248.0	27,171.9	35,220.2	10,846.2	12,975.1	4,246.6	7,040.1	5,601.5	10,260.6	5,639.1	15,553.7	7,487.1	22,252.0		
FUNGICIDES	1,927.4	2,121.4	906.8	1,313.4	773.5	1,170.7	25.3	104.8	771.2	3,447.4	892.7	2,558.5	18,054.8	5,677.3		
SHEEP, CATTLE DRESSING; WEED KILLERS a. RAT POISON ETC.	•••	9,944.0	•••	5,917.6	•••	5,581.3	•••	3,548.2	•••	2,217.6	•••	5,669.5	•••	12,902.5		
TOTAL		67,313.1		42,451.2		19,727.1		10,693.1		15,925.6		23,781.7		40,831.8		17,002,990
VALUE IN $		108,374		62,403		25,250		12,083		17,199		22,830		19,599		3,400,598
RATE $/N	1.61		1.47		1.28		1.13		1.08		0.96		0.48		0.2	

Source: FEDERAL OFFICE OF STATISTICS (Mr. H.C.ETEAMA)

*) The disinfectants are not pesticides and for that are not included in total value

Appendix XII

VALUE OF VARIOUS KINDS OF PESTICIDES IMPORTED DURING 1988

TYPE	IMPORTER	VALUE ₦	PERCENT	
A. AGROCHEMICALS				
1. Herbicides	see App. XIV	7,263,823	55.77	
2. Fungicides	" App. XV	2,344,453	18.0	
3. Insecticides	" App. XIII	1,994,886	15.33	
4. Nonspecified pesticides	Swiss-Nig.	254,776	1.95	
" "	Rhon-Total	1,166,023	8.95	
Total agrochemicals	(1 - 4)	13,023, 961	100.00	76.6
B. MOSQUITO COILS	Johnson Wax	1,440,578		8.47
C. RODENTICIDES	CAPL	499,733		
	Johnson Wax	77,251		
" total		576,984		3.39
D. RAW MATERIALS FOR PESTICIDES				
	CAPL	1,200,079		
	NOIL	330,381		
	Johnson Wax	225,632		
total		1,756,092		10.32
E. VARIOUS NONSPECIFIED PRODUCTS		205,375		1.22
GRAND TOTAL (A + B + C + D + E)		17,002,990		100.00
Value in US $:		3,400,588		
Value of pesticides imported during 1987:				
Grand total:		7,275,840.4		
Value in US $		3,492,403.3		

Source: Federal Pharmaceutical Inspector PMB 2007 Medical Compound YABA, Lagos, Mr. A.A.Aiego, Mr. Taiwo

APPENDIX XIII

TYPE AND VALUE OF INSECTICIDES IMPORTED DURING 1988

	Trade Name	Common Name	Producer	Importer	Value in ₦
	Perfektion	Dimethoate	BASF	Basf-Nig.	300,380
•	Actelic 25 EC	Pirimifos	ICI	CAPL	279,781
••	Cymbush	Cypermethrin	ICI	Dizengof	135,358
	Rotenon	Rotenon	Canada	Talon Nig.Ltd	8,189
	Phostoxin	ALP	W.Germany	Corment nig.	71,542
	Nuvan 100 EC	DDT	Ciba-Geigy	Koenez Nig.	216,710
•	Polytrin Curacon	Cypermethrin Profenos	" "	Swiss Nig.	2,855
	Monocrotophos	Monocrotophos	Various	Maize Pdt.	151.987
	Methylparathion	Parathion methyl	"	"	60,980
	Nuvan 100 EC	DDT	Ciba-Geigy	Swiss Nig.	192,822
•	Temik K	Aldicarb	USA	Rhone Total	21,566
	Sevin	Carbaryl	France	Mrs.Afcoff	120,562
•	Dimecron	Phosphamidon	Swiss	Swiss Nig.	43,948
•	Karate	Cyhalotrin	U.K.	CAPL	30,049
•	THiodan 35 EC	Endosulfan	W.Germany	HOechst Nig.	71,280
•	Sherpa	Cypermethrin	U.K.	CAPL	191,139
	Karate	Cyhalotrin	U.K.	CAPL	72,615
	Insecticide	Insectidicide	U.K.	Toley	22,723
					1,994,486

Per cent shares of various importers:

6 of international companies	1,150,654 (57.7 %)
1 of agricultural company	212,967 (10.6 %)
4 domestic companies	630,865 (31.7 %)

Source: Federal Pharmaceutical Inspector PMB 2007
Medical Compound YABA, Lagos, Mr. A.A.Aiego
Mr Taiwo

• denotes that only one company produces the product

•• " " two companies produce the product

APPENDIX XIV

TYPE AND VALUE OF HERBICIDES IMPORTED DURING 1988

	Trade Name	Common Name	Producer	Importer	Value in ₦
*	Gesatop Z 500 W	Simazine	Ciba-Geigy	Swiss Nig.	115,181
*	Dicuran 500 FW	Chlorotoluron	"	"	33,606
	2,4-D Amine	2,4-D Amine	W.Germany	Nig. Sugar Co.	148,585
*	Stomp 500 EC	Pendimethalin	Am.Cyanam.	Nig. Chem.	416,377
*	Cotoran	Fluometuron	Ciba-G.	Swiss Nig.	414,836
*	Ronstar	Oxadiazon	Rhone-Poul.	Rhone-Total	405,496
*	Basamaize	Prynachlor	Monsanto	BASF Nig.	238,597
*	Basagran	Bentazon	W.Germ.	" "	340,192
*	Septer	Imazaquin	USA	Rhone-Total	551,689
*	Gramuron	Paraquat/Diuron	ICI	Agric-Chem.	539,273
	Atrazine	Atrazine	Israel	Nig.Sugar Co.	449,587
	CIRM	?	Austria	" "	1,727,856
*	Riiof 5395 EC	Piperofos	Ciba-Geigy	Swiss Nig.	340,972
	Diuron 80		W.Germ.	Mrs. Afcoff	69,924
	Asulox	Asulan	May-Baker	Rhone-Total	127,228
	Gramoxone	Paraquat	ICI	CAPL	203,672
*	Fuzilade	Fluazitop	ICI	"	129,926
*	Cytoran	Fluometuron	Ciba-Geigy	Bauchi	251,940
	Herbicidex	Herbicidex	Ciba-Geigy	IITA	75,432
	"	"	"	Maize Pdt	47,958
			Total value		7,263,823

Percent of shares of various importers:

5 of international companies 3,403,285 (56.85%)
3 of agricultural companies 3,044,772 (41.90%)
2 of domestic companies 815,766 (1.25%)

Source: Federal Pharmaceutical Inspector PMB 2007
Medical Compound YABA, Lagos, Mr. A.A.Aiego,
Mr. Taiwo.

* see explanation on p.62
** " " " "

APPENDIX XV

TYPE AND VALUE OF FUNGICIDES IMPORTED DURING 1988

Trade Name	Common Name	Producer	Importer	Value in ₦
Copper Sulphate	Copper Sulphate	W.Germany	Oysa Cocoa Dev.	463,567
Bronocot	Bronopol (BPC)	U.K.	CAPL	149,632
"	"	U.K.	CAPL	436,013
Bayt an WP-5	Triadimenol	W.Germany	Unichem Nig.	14,888
Ridomil Plus	Metalaxyl	"	SwissN ig.	165,335
Apron Plus	"	Ciba-Geigy	"	118,718
Fungicide	—	W.Germany	Cormant Nig.	216,169
"	—	Holland	Dizengoff	295,340
"	—	Ciba-Geigy	Swiss Nig.	118,718
"	—	W.Germany	Cormont	177,658
Pyramine	chloridazon	Japan	Johnson	163,327
			Total value	2,344,453

Per cent of shares of various importers:

3 of international companies	1,308,846 (55.8%)
1 of agricultural company	463,567 (19.7%)
4 of domestic companies	572,040 (24.5%)

Source: Federal Pharmaceutical Inspector PMB 2007
Medical Compound YABA, Lagos, Mr.A.A.Aiego, Mr.Taiwo

APPENDIX XVI

IMPORTED AND LOCAL FARMER PRICES FOR SOME OF PESTICIDES IN 1988

PRODUCT	IMPORTER	IMPORT PRICE ₦/kg	FARMER PRICE ₦/kg	MARGIN %
A. HERBICIDES				
1. Gramoxone	CAPL	13.5	17.1	26.6
2. "	Affot Nig.	21.85	-	-
3. 2,4-D Amine	CAPL	8.9	15.0	68.5
4. Cotoran	S iss Nig.	32.3	50.4	57.3
5. Galex	"	32.8	43.3	32.0
6. Gesatop 500 FW	"	20.5	33.0	60.0
7. Basamaize	BASF	14.8	29.5	99.3
B. INSECTICIDES				
1. Dimecron 50 SCW	Swiss nig.	7.5	38.6	514.6
2. Polytrin 50 SCW	Swiss Nig.	12.24	31.9	260.6
3. Nuvan 100 EC	"	29.2	47.0	161.0
4. Actelic 25 EC	CAPL	14.75	45.0	305.0
5. Kerate 2.5 EC	"	3.4	9.5	1456.0
6. Cymbush 1.8 ULV	"	11.7	26.5	226.5
C. FUNGICIDES				
1. Perenox	CAPL	17.0	28.3	66.6
2. Ridomil Plus	Swiss Nig.	55.4	70.8	27.8
3. Copper Sulfate	Rhone Total	?	40.6	
4. Copper Sulfate	Cysa Cocoa Dev.	2.47	-	
5. Copper Sulfate	Coop.Supp.Nig.	2.91	-	

D. COST OF RAW MATERIALS AND VALUE OF GAMMALIN 20 EC FORMULATED LOCALLY

Price of raw materials	Charge for 1 l	Cost of raw material
Lindan 77.65 ₦/kg	200 G	15.53
Solvent 6.64/l	750 ml	4.98
Emulsifier 10 ₦/kg	50 G	0.5
Import duty 30 %		6.3
	Total	27.31
	Farmer price of Gammalian 20 EC	45.0 ₦/L
	difference	17.69 ₦

MARKET VALUE FOR VARIOUS AGROCHEMICAL FORMULATIONS 1986

A. EC OF INSECTICIDES

Brand	% a.i.	Q '000 L	V '000 ₦
Aldrex	40	50	800
Cymbush	10	82	1,968
Sherpa	28.0	12.8	1,080
Polytrin	44	9.0	250
Decis	3	3.0	200
Basudin	60	27.0	432
Nogos	50	50	235
Capsitox	20	30	720
Gammalin	20	452.5	6,516
Kokotine	20	150	2,160
Ultracide	40.5	2.5	75
Acctelic	50	10	200
Unden	20	50	800
Totals		948.8	15,436

D. WP OF INSECTICIDES

	% a.i.	Q '000Kg	V '000₦
Vetox	85	165	1,485
Electron	50	20	800
Totals		185	2,285

B. EC OF HERBICIDES

Brand	% a.i.	Q '000 L	V '000 ₦
2,4-D	60	25	150
MSMA	72	25	240
Basagran	50	150	1,750
Bladex	50	20	140
Risane	32	20	140
Galex	50	20	400
Dual	50	15	250
Codal	36	40	702
Ronstar	25	40	800
Stomp	50	40	1,000
Propanil	46	40	350
Totals		431	5,922

E. GRANULES

		Q '000 kg	V '000 ₦
Furadan	3	10	100
Basucdin	10	27.5	330
Roundup		1.8	100
Totals		39.3	530

C. EC OF STORAGE PRODUCTS

Brand	% a.i.	Q '000L	V '000₦
Acctelic	25	20	400
Totals		20	400

F. ULV OF INSECTICIDES

Cymbush	1	500	1,200
Pirimor	5	91	560
Totals		591	1,760

G. FW OF HERBICIDES

Gezatop Z	50	75	750
Gesaprim	50	4,800	
Primagram	50	80	1,000
Primektra	50	25	300
Gardoprim	50	60	1,200
Cotoran	50	16	320
Roundup	36	25	500
Totals		761	8,870

MARKET VALUE FOR VARIOUS AGROCHEMICAL FORMULATIONS 1986 - continuous

H. DUSTS

Brand	% a.i.	Q '000 L	V '000 N
Aldrin	2.5	240	40
Actelic	2	130	1,300
Aidrex T	30	52.4	450
Fernasan	45	15.2	850
Totals		387.6	2,640

OTHERS WP-S

		'000 kg	'000N
Atrazine (H)	80	62.5	1,000
Koicide (F)	50	60	240
Perenox (F)	50	240	960
Bronocot (SD)	0.6	90	
Totals		452.5	2,200

APPENDIX XVII/3

MARKET VALUE FOR VARIOUS AGROCHEMICALS FORMULATIONS 1986

WP OF HERBICIDES

Brand	a.i.	Q '000 kg	V '000 ₦
Atrazine	80	62.5	1,000

WP OF FUNGICIDES

Koicide	50	60	240
Perenox	50	240	960
Bronocot	28	0.6	90

OTHER FUNGICIDES

Bordeaux mixture	1,500	6,000

WSC OF HERBICIDES

	a.i.	Q '000 kg	V '000 ₦
Gramoxone	28	100	984

WSC OF INSECTICIDES

Nuvacron		32.5	565

VARIOUS FORMULATIONS

	V '000₦
Insecticides	1,000
Fungicides	800
Storage products	238
Rodenticides	200
Others	238
Totals	8,538

APENDIX XVII:

SHORT CHARACTERISTIC OF PESTICIDE FORMULATIONS (7,8)

Pesticides, with few exceptions, are sold and used as formulations. Formulating a pesticide improves its performance and increas its safety to the consumer. Pesticides are originally manufactured as technical grade (active ingredient or a.i.). In this form they are unsuitable for direct use because of the following reasons:

- They have unsuitable physical characteristics. They are generally waxy or lumpy solids or viscous liquids. In this form they are difficult to apply;
- They have a high purity and hence the required dose is difficult to disperse. The quantity involved is very small to be evenly and effectively dispersed over the specified area;
- The toxicity of the a.i. is much higher compared to the formulations. Thus application of a.i. is not only hazardous but its handling needs specialised training and knowledge;
- The a.i. does not have the ideal physico-chemical characterictics to give the best pest control while formulations have this.

Formulations contain the active ingredient in a definite concentration together with other materials like inert carriers, emulsifiers, wetting agents, solvents, thickners, anticaking agents, encapsulants etc.

According to the intended mode of application the common formulations can be grouped as follows:

A. FOR SPRAYING AFTER MIXING WITH WATER/OIL:

i) Emulsifiable Concentrates (EC)
ii) Wettable Powders (WP or WDP)
iii) Water Dispersible Granules
IV) Suspension or Emulsion Concentrates called also Flowables (FW)
V) Ultra-Low-Volume Concentrates (ULV)
VI) Water Soluble Concentrate (WSC)

B. FOR DRY APPLICATIONS DIRECTLY FROM THE CONTAINER:

I) Dusts (D)
II) Granulars (G)
III) Encapsulated granulars

C. FOR APPLICATIONS AS A GAS OR VAPOUR:

I) Fumigants

II) Smoke generators or tablets which vaporise

III) Aerosols and pressurised sprays

D. OTHER FORMULATIONS

i) Seed protectants (dry or liquid)

II) Baits for rodents, slugs, flies, cockroaches etc.

Particular technical material can be used in different PF-s and their effectiveness can also be different. The choice of formulations will depend on the technique of distribution of pesticide as well as on the kind of protected crop.

MAJOR FORMULATIONS

1. Emulsifiable Concentrates (EC)

These are concentrated solutions of the technical grade material containing an emulsifier to help the concentrate mix readily with water for spraying. When an emulsifiable concentrate is added to water, the emulsifier causes the oil to disperse uniformly throughout it producing an opaque emulsion. For best results, the solvent system must be immiscible with water. The most generally used solvents are the xylene type, the heavy aromatic naphtha type or, occasionally when the solubility of the pesticidal chemical is sufficient, aliphatics of the kerosene range.

Because of their convenience for the user, emulsifiable concentrates may be considered the most popular form in which pesticide formulations are used. They are expected to perform well under a wide variety of conditions and to withstand a number of extremes of packaging and storage. Functionally, emulsifiable concentrates must disperse spontaneously in waters of all hardness and with the aid of gentle agitation remain uniformly dispersed throughout the spraying period.

2. Wettable Powders (WP)

When an inert dust is impregnated with the pesticides, and a wetting and dispersing agents are incorporated, the resultant powder, if mixed with water, forms a fine suspension. Wettable powders may usually contain 50 % of a.i. but may even be mixed at proportion of 85 % a.i.

The quality of water-dispersible powders is judged by the rapidity of

of wetting when mixed with water and suspendibility in water whem mixed in practical dilutions for field application. The speed of wetting can be increased by the proper choice of wetting agents which reduce the interfacial tension between the particles and the water. Good suspendibility is attained by reducing the particle size, preferably to below 325 mesh (44µm). Surfactants of the dispersant class are generally added to water-dispersible powder as part of the regular formulation to prevent the agglomeration of particles and, in turn, decrease the rate of sedimentation, which is a function of particle size. Exceptionally fine particle size which further improves suspendibility is sometimes attained by air-milling the product to a particle size of 10 µm or less. Water-dispersible powders are frequently used for the slurry treatment of seeds as well as in a variety of spraying techniques.

3. Flowables

Flowable formulations have also been identified as suspension concentrates or water-dispersible concentrates. They consist of a fine dispersion of a water-insoluble pesticide in water. The particle size of the particulate is generally of a narrow size distribution in the range of 2-3 µm. Flowables generally contain greater than 40 per cent solids by weight per unit volume of dispersion. They are designed to be very stable with little sedimentation and are easily dispersed in water-soluble polyelectrolyte and a non-ionic surface agent. The flowable formulation may be used directly, as in a ULV-type application, or diluted with appropriate amounts of water.

4. Aqueous concentrates

Aqueous concentrates are concentrates of pesticidal chemicals dissolved in water. The most frequently encountered pesticidal type found in this form is the salt of a herbicidal acid. Because the herbicidal acid is the nominal active ingredient, concentrations are generally expressed in terms of amount of acid-equivalent per unit volume. Since these active ingredients are soluble in water, there are generally no problems of miscibility, dispersibility or suspendibility. The exception occurs when magnesium, calcium or iron of natural waters used for dilution may cause an insoluble precipitate; remedies do, however, exist for this situation.

APPENDIX XVIII

5. Dusts:

These are probably the simplest of formulations and the easiest to apply. In a formulated dust usually the following three types of mixtures are found:

I) undiluted toxic agent e.g. sulfur dust used for control of mites and powdery mildew

II) toxic a.i. plus an inert diluent and is the most common dust formulation usually sold as 2%, 5% or 10% a.i. dust.

Dusts are the least effective and, although prices are lower, have the least economic return. Dusts give poor deposit on the target plants. It has been calculated that not more than 10-15 % of the applied material is retained on the surface.

6. Granular pesticides

This is a formulation in which the pesticide is contained in small granules of inert material, either as a coating on the surface of the inert granules, or as an impregnated toxicant in the build-up of the granules. The pesticide granules are necessarily much smaller in size than fertilizer granules. The a.i. content of the granules varies from 3% to 10% but, may be sometimes even upto 25%. The size of the granules varies from 20 to 80 mesh (i.e. the number of grits /granules/ per inch of the sieve through which they have to pass). Granular pesticides can be applied on to the soil, or may be placed in the whorl of leaves depending on the nature of pest control required.

Granular insecticides may be more economic to apply since placement applications are possible with them. Being soil applied formulations, they are generally less harmful to beneficial insects such as bees etc. For systemic insecticides, granule application is excellent since they are placed in the root zone.

7. Seed dressings

Seed dressings may be either a liquid or a dry type; and there are variations within each type. Two of the most important requirements of a seed dressing are that the seed dressing must not interfere with the plantability of the seed; and that the seed dressing must not diminish the viability of a seed. In addition, it is most desirable, however seldom achieved, that the seed

dressing is non-toxic and does not constitute an adulteration if the seed is later to be fed to livestock. Seed dressings must often contain a dye which colours the seed to indicate the chemical treatment. Certain seed dressings have been developed in dry concentrate form for the addition to seed grains in a planter box as controls of insects or diseases from the time of planting until after the seed germinated. Water-dispersible powder types of seed-treating formulations are used for the slurry treatment of feed as well as liquid types of certain emulsifiable concentrates and water-dispersible concentrates.
The concentration of the cative ingredient in seed-dressing formulations follows the same rules and limitations as other liquid and dry formulations.

8. Ultra Low Volume sprays (ULV)

ULV applications are so formulated that in many instances they do not need any further dilution or, if needed, with only a small quantity of diluent carrier (water or oil). The total volume required with the ULV formulations is from 2 to 4 litres per acre. These formulations require specialized application techniques, and helicopters or fixed-wing aircrafts fitted with spray booms are used. With Ultra Low Volume applications, drift may be a problem.

APPENDIX XIX/1

CHARACTERISTICS OF SOME OF RAW MATERIALS FOR PF-s

1. Mineral carriers and diluents (9,10)

Mineral carriers have a wide variety of applications in the field of agricultural chemicals. Their properties are so broad and valuable that they find use with nearly all types of pesticides. They appear both as powders and as absorbent granules, with both simple and complex properties and compositions.
At the most basic level of use, the minerals can simply provide a surface area to carry the a.i. At the most elegant level, they provide a highly poroous structure that carries the a.i. by intracrystalline and capillary sorption.
Those mineral carriers fall into two groups - nonabsorbent and absorbent types.

The nonabsorbent mineral carriers include quartz sand, limestone, kaolin, and ball clay, talc and pyrophyllite. Often both the quartz sand and limestone are in a highly pulverized form to improve the surface area per unit of weight. Such products can carry a limited amount of agricultural chemicals owing to their nonporous character and relatively high bulk density. Of greater interest are the kaolin and ball group and the talc and pyrophyllite group. These groups are silicates that possess a layer structure and exhibit platey-type particles.. They are soft and pulverize easily into very small particle sizes. They provide the principal bases for insecticidal dust. They also find use in wettable powders and dry flowables. Incorporation of these minerals facilitates the grinding of low-melting-point pesticides for powder applications.

The absorbent minerals include montmorillonite, attapulgite, and diatomite. These find use in the form of absorbent granules for a wide variety of insecticides and herbicides. They have high absorptivity, low density, and good resistance to attrition and are widely available and low in cost. Montmorillonite and attapulgite are complex silicates, whereas diatomite is simply amorphous silica. Of the three, montmorillonite and attapulgite are by far the most used in absorbent granules.

Most of the mineral carriers are processed by the following steps:
after mined they are hauled to the plant and shreded into small pieces.
Then the material is dried in rotary dryer to reduce the moisture. This process can run in two steps. At first at lower temperature and secondly at the higher one. After being dried, the product is crushed and grinded in various grinding machines. The degree of fines depends on the destiny of carrier. That one destinied for granules has lower fines than that one destinied for WP-s.
After crushing or milling the product goes over flights of screens to remove oversized or undersized materials (carriers for granules) or are separated

by air floating method (carriers for WP-s). This method is also often necessary for separation of some natural impurities of the carriers.

The very important characteristic of carriers destined for production of PF-s is their invariable quality standard. For that reason such carriers which belong to the Kaolin, Attapulgit and Montmorillonit groups are often washed off from soluble impurities.

Dust diluents and carriers can be classified as follows:

Classification of Insecticide Dust Diluents and Carriers

BOTANICAL FLOURS

- Soybean flour
- Tobacco flour
- Walnut shell flour
- Wood flour

MINERALS

- Elements
  - Sulfur
- Oxides
  - SILICON
    - Tripolite
    - Diatomite
  - CALCIUM
    - Calcium lime
    - Magnesium lime
  - CARBONATES
    - Calcite
    - Dolomite
  - SULFATES
    - Gypsum
  - SILICATES
    - Mica
    - Vermiculite
    - Talc
    - Pyrophyllite
- Indeterminate
  - Pumice
  - SILICATES (cont.)
    - Clays
      - Montmorilloroid Group
        - Montmorillonite
        - Saponite
        - Notronite
        - Sauconite
        - Hectorite
      - Kaolinite Group
        - Kaolinite
        - Dickite
        - Anauxite
        - Halloysite
        - Meta-Halloysite
      - Attapulgite Group
        - Attapulgite
        - Sepiolite
      - Unidentified
  - PHOSPHATES
    - Apatite

SYNTHETIC MATERIALS

APPENDIX XIX/1

- The characteristics of diluents or carriers should be given according to the following data sheet.

Data Sheet for agricultural Dust Diluent or Carrier

CLASSIFICATION:
TRADE NAME:
PRODUCER

1. Mineralogical Analysis:
2. Average Chemical Analysis
3. Where Mined:
4. How Packaged:
5. How Processed:
6. Price:
7. Color:
8. Abrasion Index or Hardness:
9. Specific Gravity:
10. Volume weight:
11. Particle size:
12. Particle shape:
13. Screen Analysis:
14. Maximum Sorptive Capacity:
15. pH:
16. Refractive Index:
17. Cation Exchange Capacity:
18. Specific Surface:
19. Flowability:
20. Wettability:
21. Dustability:
22. Compatibility:
23. Other Chemical and Physical Properties:
24. Special Features:
25. Literature Published On Product:

Why some of mineral carriers have to be processed, becomes clear from the following information.

"In order for a pesticidal carrier to be acceptable for widespread commercial use, it must not appreciably reduce the activity of the pesticide it carries it must be substantially nonphytotoxic and, when formulated with the pesticides, yield a nonphytotoxic and nontoxic product which will not produce any adverse effects to plant and environment life. Additionaly the carrier should have great absorptivity for the proposed pesticides it will carry, as it is highly desirable that the formulated product be free-flowing or substantially so, in its routine handling. The formulated product made therefrom must give acceptable results regarding its suspensibility in an aqueous slurry, and must be able to suspend itself and the pesticide it carries without an appreciable tendency for the particles to flocculate.

While many of the known carriers posses some of the necessary characteristics mentioned above, it is the usual observation that some, and frequently many, of the requirements are lacking in the known carriers.

It has been discovered that the foregoing objects may be satisfied and the above discussed disadvantages overcome by a modification of the hydrothermal reaction of a silica source, e.e. diatomaceous silica, quartz, silica gel and calcium oxide source, e.g., slacked lime by introducting carbon dioxide during this reaction to produce a carbonated calcium silicate and/or an intimate of mixture of very fine divided silica plus calcium carbonate. By controlong the ratios of lime to silica, the temperature of reaction, and the time and duration of admiting carbon dioxide, products of various different properties can be produced." (12)

APPENDIX XIX/2

2. Solvents

Because most pesticidal chemicals are insoluble in water, it is necessary to use some form of organic solvent for the preparation of liquid formulations. The different types of solvents for pesticide formulations are classified by composition, chemical type, structure or function. In pesticide formulation work, it is convenient to classify the solvents as polar or non-polar. Among the non-polar solvents, the most important economically are the hydrocarbon and petroleum distillate solvents. The polar solvents include ketones, esters, glycols, glycol ethers and acid amides. The hydrocarbon and petroleum distillates are further classified as aliphatic or aromatic types for a functional, as well as an economic, distinction.

The formulation chemist may encounter water-miscible and water-immiscible types among the polar solvents. Although there may be a broad choice of available polar solvents, the question of water miscibility, together with other factors including economics, will influence the choice. The important functional properties of the solvents used in formulating pesticides are:

- distillation range and boiling point
- specific gravity (density)
- Kauri-butanol value
- aromatic content
- flash point
- solvency
- water miscibility
- viscosity
- toxicity
- colour
- odour

Because of solvency, ready availability and comparatively low price Xylene has been popular with formulators as solvent for EC-s. Manufacturers of EC-s, on the other hand face restrictions with respect to the handling, storage and transportation of solvents having low flash points. These restrictions usually take the form of labeling requirements, but in some cases the uses of solvents with flash points below a certain limit is prohibited In some industries, insurance costs using high flash solvents are less than when using low flash materials. To assist pesticide manufacturers and formulators, solvent suppliers have developed a range of solvents which grades can be chosen to

comply with or avoid labeling requirements. Undoubtedly legislation is encouraging a move to solvents of high flash points. European manufacturers who market their product in the USA, for example, are moving away from xylene to avoid the "red label" which is mandatory in the US for transportation of products with a flash point below 100°F (38°C). In Germany, a law which restricts the storage of more than three tonnes of formulated product if the flash point in below 55°C, has encouraged a move from xylene to Solvesso 150 or equivalent solvents. The solvents from which grades can be chosen to complay requirements are as follows:

Solvent	FLASH POINT °C	
Xylene	27	
Solvesso 100	45	
Aromasol H	49	Aromatic
Solvesso 150	56	solvents
Solvesso 200	100	
Exsol D 60	63	Hydrogenated
Exsol D 80	78	petroleum
Exsol D 100	108	fractions
Isopar L	64	isoparaffinic
Isopar H	77	solvents

Remark: All mentioned above solvents except Aromasol H are the products of Essochem Europe, Machelen, Belgium.
Aromasol H is produced by ICI Ltd. London S.W. 1 England

In reference to xylene the following information is also important:

"... the EPA(U.S. Environmental Protection Agency) had a list of inert which they consider to be "bad actors" for one or more reasons Xylene, probably the single most used component in pesticide formulations, was on this list. The EPA had not been able to develop a regulatory stance on xylene at that time. Therefore there were hundreds of Applications for Registration that were on hold at the EPA waiting for this policy to be developed. Landis Associates client alone had over fifty Applications for Registrations which were

stopped in the registration process because they contained 3-50% xylene in the formulation. On 22 January 1987 the Agency came out with a revised List 1 (List of Inerts of Toxicological Concern) and List 2 (Inert with a High Priority for Testing). Xylene and xylene range solvents have been moved from List 2 to List 1". (13).

APPENDIX XX

UNIT PROCESSES IN PESTICIDE FORMULATIONS

The manufacture of pesticide formulations involves a number of processes, the most important of which are the dry mixing and grinding of solids, the dissolving of solids in liquids, liquid impregnation, blending and packaging. A considerable amount of very practical engineering is involved in each of these steps.

DRY MIXING, or blending, is the process most often used in formulating. Uniformity of product is always important, but it is particularly critical in dilute dusts which contain only a few per cent of toxicant. Ribbon blenders of various designs are used for this application, as they give the best mixtures of the bulky powders in the shortest time.

GRINDING is an essential operation in the formulation of most pesticides. Many pesticides are solids, and these must be reduced to sub-sieve size when making them into dust concentrates or wettable powders. The toxicant is premixed with the carrier, and fed into the mill, which is usually a hammer mill, if relatively coarse dust is required. A good formulator watches his throughput rates carefully; slow rates are, of course, inefficient, but a rate that is too fast will cause overheating in the mill and result in considerable down-time for clean-out. In the preparation of high-suspendibility wettable powders for public health use, an extremely fine particle size is required. Such products are groundin a fluid energy mill, or air mill. Here the material is fed into a circular or oval chamber, where jets of high-pressure air cause it to circulate violently, and to break down to a very fine size because of the repeated particle collisions. This is one of the most effective milling methods known. Unfortunately, it is also an expensive method, because of the high energy requirements supplied in the form of compressed air. Because of the high operating cost, efficiency of operation and maximum throughput rates are essential.

LIQUID IMPREGNATION is of particular interest. The liquid is sprayed onto a bed of carrier, which is kept tumbling in order to present a continuously fresh surface to the spray. The formulator is faced with the problem of attempting to get some of the spray on each particle, and this may be impossible if the carrier is highly absorptive and the quantity of liquid is too small. However, if the formula has been worked out correctly, the quantity of liquid will be adequate, and the formulator can get good coverage by spraying the liquid through nozzles having low delivery rates, while turningover the bed of carrier at a rapid rate. Ribbon blenders can be used for this process, if the product is a dust or a dust concentrate. However, a tumbler blender is preferred for impregnating granular carriers, as ribbon blenders tend to break down the granules and cause an excessive amount of fines.

APPENDIX XX

PRODUCTION TECHNIQUE FOR FW-S

In greater number of cases the milling process is necessary in production of FW-s. The choice of method of grinding depends on the physical properties of pesticide (its hardness and melting point). Some times however, it can happen that process of milling is not necessary. This will be the case when enough small particles of pesticide are obtained in the process of its synthesis. (What has taken place e.g. in the production of copper oxychloride, atrazine or pyramine). In such a case, the processof production of FW consist of mixing of such fine particles of pesticide with water, dispersing and wetting agents and other adjuvants. The process of mixing is performed in such mixers which are commonly used for mixing of flowable pastes e.g. flowable oil paints or enamels.

If however, the pesticide particles are not fine enough, are not too hard and have not too low melting point, the dry grinding, by using one of the commonly used mill,can be used.

From up to date experience it is known that the best fine milling is obtained by the wet process and that the best device for this type of milling is bead or pearl mill.

These are the sand mill type very widely used for the processing of printing points. In these mills a mixture of grinding elements (Ottawa sand or specially prepared hard ceramic pearls) and product to be milled (grinding stock) is rotated by an agitator on which grinding discs are mounted. The mill be vertical or horizontal, batch or continuous.

The vertical types of mill are exemplified by the MOLINEX PE 075 and the horinzontal mills by DYNO-MILL. Both are the closed type mills and therefore such disadvantages of milling process like air entrainment and foaming are eliminated.

APPENDIX XXI

Common and Trade Names and Manufacturers of Herbicides *

Trade names and manufacturers listed are the original and/or most common source(s) of the herbicide listed. The list is provided as an aid to readers who are more familiar with trade names than common names. No attempt is made to include all trade names or manufacturers of a herbicide nor is any discrimination implied against similar products available from other sources. A complete listing of common names, trade names, pronunciation, chemistry, trade names, and manufacturers is available on the back cover of *Weed Science* and/or in the *Herbicide Handbook* from the WSSA, 309 West Clark St., Champaign, IL 61820.

Common Name	Trade Name	Manufacturer
acetochlor	Harness	Monsanto
acifluorfen	Blazer	BASF
	Tackle	Rhone-Poulenc
alachlor	Lasso	Monsanto
ametryn	Evik	CIBA-Geigy
amitrole	Amitrol	Rhone-Poulenc
AMS	Ammate X NI	DuPont
asulam	Asulox	Rhone-Poulenc
atrazine	several	several
barban	Carbyne	United Agri-Products
benefin	Balan	Elanco
bensulide	Prefar	ICI Americas
bentazon	Basagran	BASF
bensulfuron	Londax	DuPont
bifenox	Modown	Rhone-Poulenc
bromacil	Hyvar	DuPont
bromoxynil	Brominal	Rhone-Poulenc
	Buctril	Rhone-Poulenc
butachlor	Machete	Monsanto
buthidazole	Ravage	Sandoz
butylate	Sutan	ICI Americas
CDAA	Randox	Monsanto
chloramben	Amiben	Rhone-Poulenc
chlormuron	Classic	DuPont
chloroxuron	Tenoran	CIBA-Geigy
chlorpropham	Furloe	PPG
chlorsulfuron	Glean	DuPont
clethodim	Select	Chevron
cinmethylin	Cinch	DuPont
clomazone	Command	FMC
cloproxydim		Chevron
clopyralid	Lontrel	Dow
cyanazine	Bladex	DuPont
cycloate	Ro-Neet	ICI Americas
dalapon	several	several
dazomet	several	several
DCPA	Dacthal	SDS Biotech
desmedipham	Betanex	Nor-Am
diallate	Avadex	Monsanto
dicamba	Banvel	Sandoz
dichlobenil	Casoron	Uniroyal
dichlorprop	several	several
diclofop	Hoelon	Hoechst-Roussel
diethatyl	Antor	Nor-Am
difenzoquat	Avenge	American Cyanamid
dinoseb	several	several
diphenamid	Enide	Nor-Am
dipropetryn	Sancap	CIBA-Geigy
diquat	Diquat	Chevron
diuron	Karmex	DuPont
endothall	Endothal	Pennwalt
EPTC	Eptam	ICI Americas
ethalfluralin	Sonalan	Elanco
ethofumesate	Nortron	Nor-Am
fenoxaprop	Whip	Hoechst-Roussel
flamprop	Mataven	Shell U.K.
fluazifop	Fusilade	ICI Americas
fluazifop-P	Fusilade 2000	ICI Americas
fluchloralin	Basalin	BASF
fluometuron	Cotoran	CIBA-Geigy
fluorochloridone	Racer	ICI Americas
fluoroglycofen		Rohm and Haas
fluridone	Sonar	Elanco
fomesafen	Reflex	ICI Americas
fosamine	Krenite	DuPont
glyphosate	Roundup	Monsanto
haloxyfop	Verdict	Dow
hexazinone	Velpar	DuPont
imazapyr	Arsenal	American Cyanamid
imazaquin	Scepter	American Cyanamid
imazethapyr	Pursuit	American Cyanamid
isopropalin	Paarlan	Elanco
isouron	Conserve	Elanco
isoxaben		Elanco
lactofen	Cobra	PPG
linuron	Lorox	DuPont
MAA	several	several
MCPA	several	several
MCPB	Thistrol	Rhone-Poulenc
mecoprop	several	several
mefluidide	Embark	3M
metham	Vapam	ICI Americas
methazole	Probe	Sandoz
metolachlor	Dual	CIBA-Geigy
metribuzin	Lexone	DuPont
	Sencor	Mobay
metsulfuron	Ally	DuPont
MH	several	several
molinate	Ordram	ICI Americas
napropamide	Devrinol	ICI Americas
naptalam	Alanap	Uniroyal
norea	Herban	Nor-Am
norflurazon	Zorial	Sandoz
oryzalin	Surflan	Elanco
oxadiazon	Ronstar	Rhone-Poulenc
oxyfluorfen	Goal	Rohm and Haas
paraquat	Gramoxone	ICI Americas
pebulate	Tillam	ICI Americas
pendimethalin	Prowl	American Cyanamid
perfluidone	Destun	3M
phenmedipham	Betanal	Nor-Am
picloram	Tordon	Dow
profluralin	Tolban	CIBA-Geigy
prometon	Pramitol	CIBA-Geigy
prometryn	Caparol	CIBA-Geigy
pronamide	Kerb	Rohm and Haas
propachlor	Ramrod	Monsanto
propanil	Stam, Stampede	Rohm and Haas
propazine	Milogard	CIBA-Geigy
propham	Chem Hoe	PPG
pyrazon	Pyramin	BASF
pyridate	Tough	Gilmore
quizalofop	Assure	DuPont
sethoxydim	Poast	BASF
siduron	Tupersan	DuPont
simazine	Princep	CIBA-Geigy
sulfometuron	Oust	DuPont
tebuthiuron	Grasian	Elanco
terbacil	Sinbar	DuPont
terbutryn	Igran	CIBA-Geigy
thiobencarb	Bolero	Chevron
triallate	Far-go	Monsanto
triclopyr	Garlon	Dow
tridiphane	Tandem	Dow
trifluralin	Treflan	Elanco
2,4-D	several	several
2,4-DB	Butyrac	Rhone-Poulenc
vernolate	Vernam	ICI Americas

* SOURCE: Weed Technology, April 1988, V:2, No 2

AIM OF THE PHYSICAL PROPERTIES AND AVAILABILITY OF CIPAC METHODS

Physical Property	Aim of Property	Applicable to * formulations	Availability of CIPAC Methods
1. material soluble/insoluble in a solvent	to determine the purity or impurity of the product	TC, SL	Soluble: MT.4,5,6,7,9 71, 76, 87, 90 Unsoluble: MT. 8, 10, 11, 16, 27, 35
2. Acidity-alkalinity-pH	to ascertain decomposition of the act. ingred., deterioration of physical properties, danger of corrosion.	TC, DP, WP, GR, EC, SL, UL, SC	MT. 31, 66, 75
3. water content	id.	TC, DP, WP, GR, EC, SL, UL	MT. 17, 30, 40
4. dry sieve test	to limit particles of unwanted sized	DP, GR	MT.59
5. flowability	to ascertain the free flowing nature of the product	DP, GR	MT. 44 revised (for DP) no method for GR
6. dustability	to ascertain the ability of dust to be dispersed	DP	No CIPAC method, but WHO/EQP/4R2
7. wet sieve test	to avoid the blockage of spray nozzles	WP, SC	MT. 59.3
8. suspensibility	to determine that a sufficient amount of a.i. is still in suspension to give a satisfactory, homogeneous and effective spraying	WP, SC	MT. 15 (for WP)
9. wettability	to ascertain the product is rapidly wetted when added to water	WP	MT. 53

Physical Property	Aim of Property	Applicable to formulations*	Availability of CIPAC Methods
10. persistent foam	to avoid exessive foam when filing the spry tack	WP, EC, SC	MT. 47.1 MT. 47.2 (for SC)
11. flash point	to evaluate the danger of flammability	EC, SL, UL	MT. 12
12. viscosity	to evaluate the flow properties of liquid	UL, SC	MT. 22
13. emulsion stability	to evaluate the stability of the emulsion on standing	EC	MT. 36, 20
14. re-emulsification	to evaluate the ability to be re-emulsified after standing	EC	MT. 36
15. pour-tap bulk density	to provide information for packaging and application requirements	DP, WP, GR	MT. 33
16. dispersability	to assure that the product is adequately dispersed throughout the spray tank	WP, SC	MT. 160 (for SC)
17. cold test	to evaluate the danger of crystallization or separation of ingredients in cold climate	EC, SL, UL, SC	MT. 39
18. Heat stability	to evaluate the influence of temperature and time on the chemical and physical stability	DP, WP, EC, UL, SC, GR, SL	MT. 46

* Code of Formulations: TC - Technical
DP - Dusting powder
WP - wettable(water-dispersable) powder
EC - emulsifiable concentrate
SL - soluble concentrate
UL - ULV formulations
GR - granules
SC - suspension concentrate

APPENDIX XXIII

DATA CONCERNING EXPLOITATION OF LIMESTONE AND KAOLIN

FEDERAL MINISTRY OF MINES, POWER AND STEEL

MINES DIVISON

LAGOS

P.M.B. No. 12574

Telegrams MINES

Telephone 686232

Ref. No. MMPS.113/Vol.VI/1830

Date 30th November, 1988

The Senior Industrial Development
Field Adviser
United Nations Development Programme,
Office of the Resident Representative In Nigeria
P. O. Box 2075,
Lagos.

Sir,

Establishment of A Multi-Purpose Pesticide Formulation Pilot Plant

I I am directed to refer to your letter reference No. NIR/87/017 of 23rd November 1988 on the above subject and to inform you that, whereas Kaolin, Silica (Sand), Diatomaceous Earth and Limestone are known to occur in Nigeria, Gypsum is not yet known to occur in this Country in any significant quantities to justify commercial exploitation.

2. Reserves of known Limestone deposits are as shown below:

Location	State	Reserves in (M/T)	$CaCo_3$ Content	SiO_2 Content
1. Ukpilla	Bendel	10,161,000	91.60	3.47
2. Jakura	Kwara	46,606,000	97.00	-
3. Ubo	Kwara	22,000,000	96.00	-
4. Igumale	Benue	110,161,000	77.00	13.75
5. Ogbolokuta	Benue	5,080,000	-	-
6. Yander	Benue	67,059,000	94.80	2.25
7. Gboko	Benue	-	-	-
8. Okene	Kwara	-	-	-
9. Ife-Ota	Ogun	-	-	-
10. Sokoto	Sokoto	-	-	-
11. Ishielu	Anambra	-	-	-
12. Akamkpa	Cross River	-	-	-

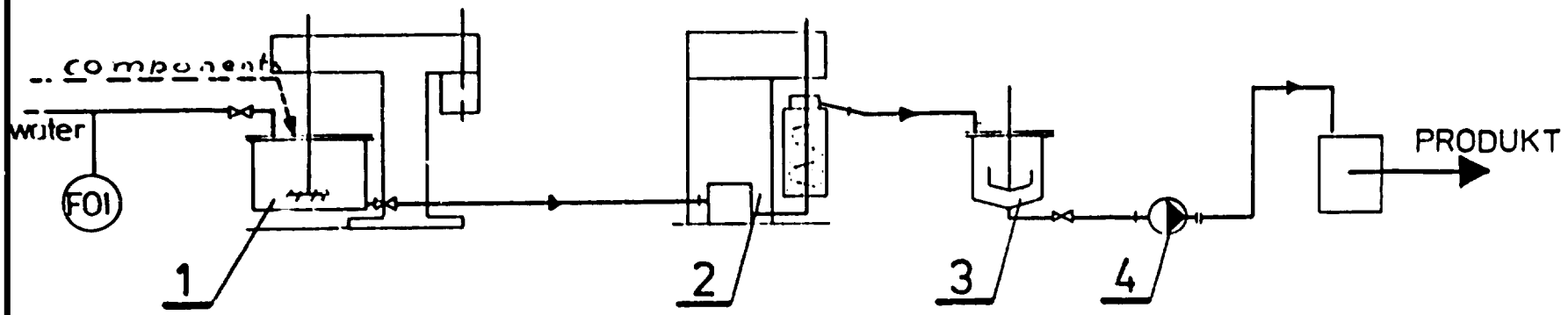
(b) The mineral, kaolin is known to occur in Abeokuta in Ogun State but information on the Reserves is not available here.

(c) Production figures in respect of Limestone and Kaolin for 1986/87 which I hope would be of assistance to you are as follows:

Mineral	Production in Metric Tonnes 1986	1987
Kaolin	158.67	177.30
Limestone	1,847,376.00	2,627,409.00

3. For detailed information on Talc/Soapstone, Silica (Sand), Gypsum and Diatomaceous Earth, contact the Nigerian Mining Corporation on the 7th Floor, Federal Secretariat, P.M.B. 2154, Jos.

4. You would need to obtain from this office a copy of a Mining Publication titled " Guildelines for Mining Operations in Nigeria". This Guildeline contains procedure for entry into Mining Industry and to obtain a licence to purchase and possess Minerals.



1	MIXER
2	PEARL MILL
3	CONTAINER - MIXER
4	METERING PUMP

FIGURE A

SCHEME OF PILOT INSTALATION FOR PRODUCTION OF LIQUID FLOWABLE FORMULATIONS

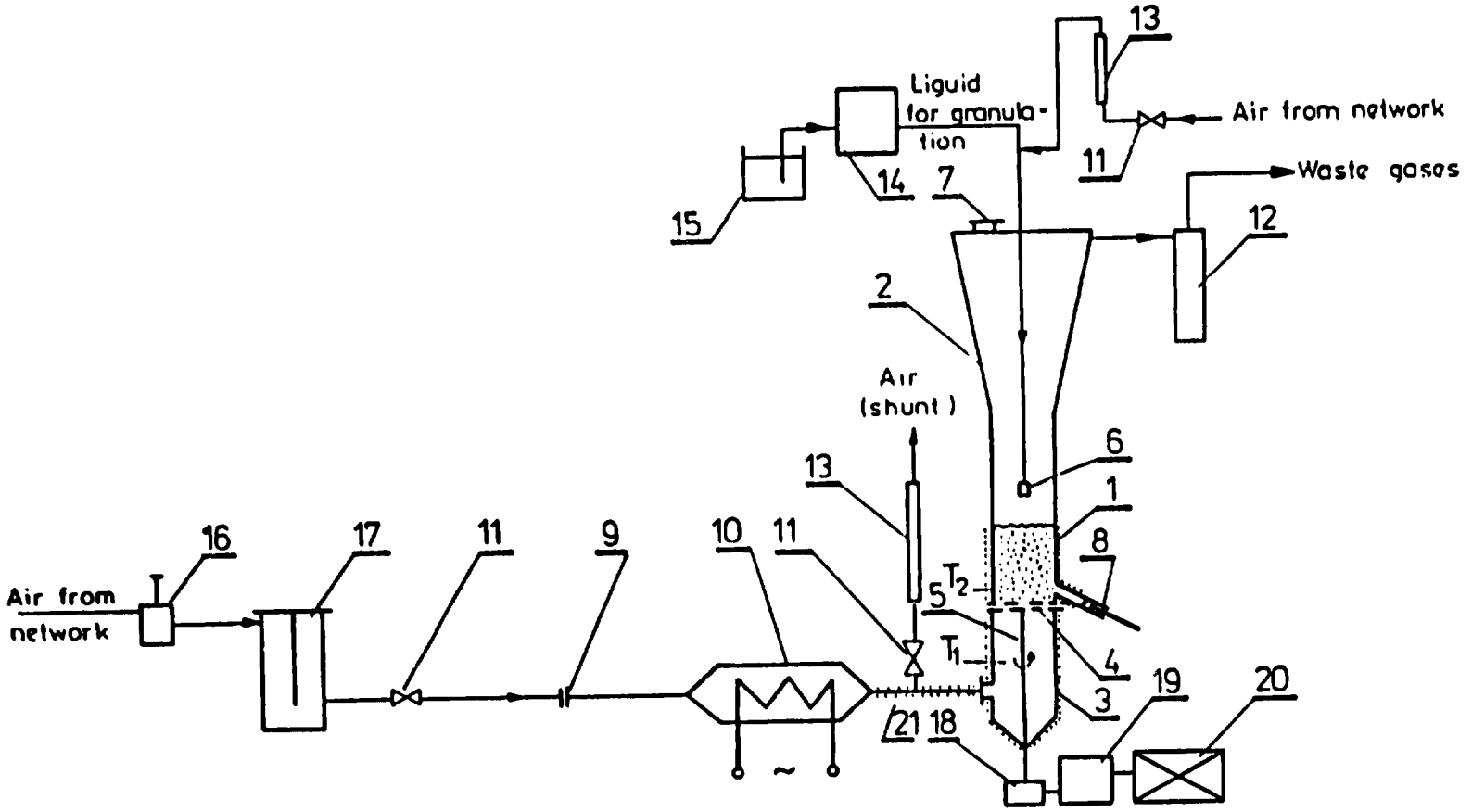
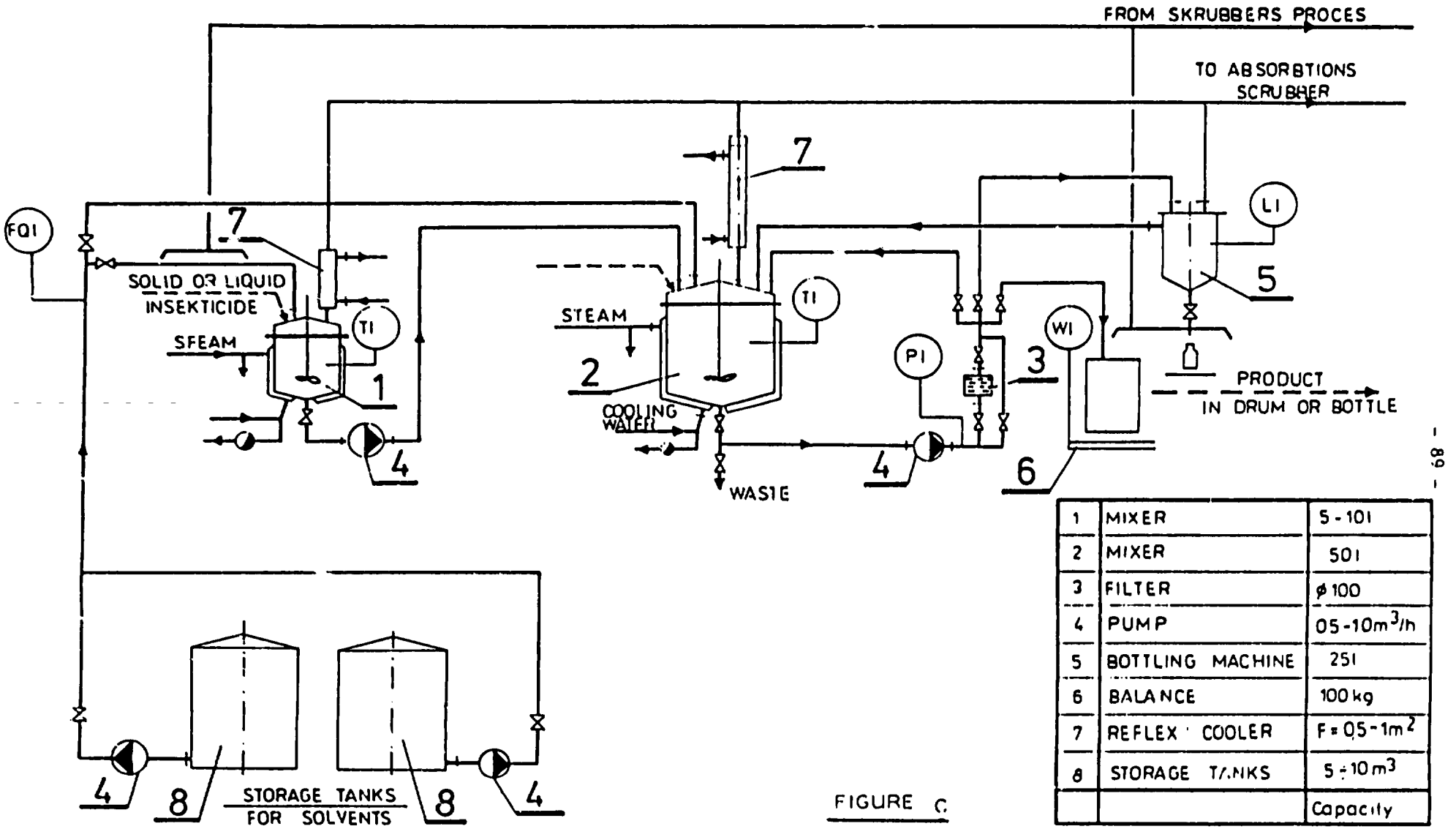


FIGURE 8

SCHEME OF PILOT INSTALATION FOR FLUIDIZAL GRANULATION

1 - FLUIDIZATION COLUMN, 2 - CONICAL PART OF FLUIDIDIZATION COLUMN, 3 - LOWER PART OF FL. COLUMN, 4 - PERFORATED BOTTON, 5 - MECHANICAL MIXER, 6 - SPRAY NOZZLE, 7 - CHARGING INLET, 8 - PRODUCT OUTTET, 9 - MEASURING REDUCER, 10 - HEATER, 11 - CONTROL VALVES, 12 - BAG FILTER, 13 - ROTAMETERS, 14 - FEEDER PUMP, 15 - SOLUTION CONTAINER, 16 - PRESSURE REDUCING VALVE, 17 - OIL SEPARATOR, 18 - AXIS GEAR, 19 - VARIABLE GEAR, 20 - ENGINE, 21 - ADDITIONAL ELECTRIC HEATING

T_1, T_2 - POINT OF MEASURING OF TEMPERATURES; INLET AND OUTLET OF AIR.



1	MIXER	5 - 10 l
2	MIXER	50 l
3	FILTER	ϕ 100
4	PUMP	0.5 - 10 m^3/h
5	BOTTLING MACHINE	2.5 l
6	BALANCE	100 kg
7	REFLEX COOLER	F = 0.5 - 1 m^2
8	STORAGE TANKS	5 ÷ 10 m^3
		Capacity

FIGURE C

SCHEME OF PILOT INSTALATION FOR PRODUCTION OF LIQUID FORMULATIONS