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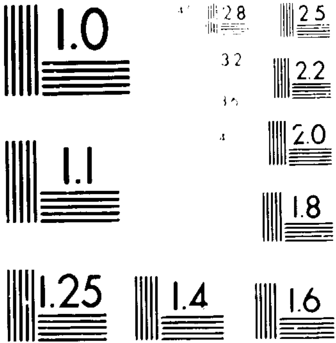
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



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REGIONAL NETWORK FOR PRODUCTION MARKETING
AND CONTROL OF PESTICIDES IN ASIA AND THE FAR EAST
DP/RAS/82/006

Indonesia.

Technical report: Consultation on research and development
for pesticide production in Indonesia*

Prepared for the Government of Indonesia
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of Karoly Szabo,
consultant on pesticides

United Nations Industrial Development Organization
Vienna

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1. Introduction

The government of Indonesia fully recognizes the importance of a healthy and productive agriculture in the global development of the national economy and provides a wide range of support programmes to achieve the strengthening of the agricultural production. One link in this scheme is the distribution of a number of key pesticides to farmers at a subsidized price through agricultural intensification programs (BIMAS and INMAS) and special intensification programmes (INSUS).
The result of concerted efforts has been a dramatic increase in agricultural production best illustrated by the fact of doubling the rice production during the last six years, from 11 to 22 million t/y. Pesticide consumption showed a good correlation with increases in agricultural products by registering an about 20 percent gain per annum and by attaining by 1982 a market value of more than US $ 150 million/yr. In addition to the agricultural pesticides the country has been using increasing quantities of insecticides, mainly DDT, for public health programmes.

All pesticides were imported until recently, some in form of technical material some as formulated end products. However with the increasing financial burden improved by costly imports and a gradual build-up of the petrochemical industry the local production of selected large volume pesticides became attractive and the establishment of production units for four agro-pesticides and DDT has been accomplished or is being implemented. The domestic production of eight other pesticides in substantial demand in the country has been licenced.

In order to support and secure a well planned and orderly development of local pesticide industries the government appointed a research and development unit within the Institute for Research and Development of Chemical Industry (IRDCI) which is to carry out R & D tasks in the field of pesticides. The institute is under the Agency for Industrial Research and Development, Ministry of Industry, thus its programme is coordinated with national development objectives.

In addition to the above functions the organization also coordinates regional development activities as in the case of the UNDP/UNIDO project, Regional Pesticide Development Network (DP/RAS/82/006), in which Indonesia participates. The subject mission has been requested as part of the regional project programme with the following terms of reference :

Title : Consultant on Pesticide R & D and Manufacture.

Duration: One month

Duties : 1). Review current status of research and development in the field of manufacture of pesticide technical materials.

2). Provide guidance in utilization of local resources for the manufacture of technical grade materials.

3). Assist in preparation of feasibility studies for the establishment of active ingredient manufacturing plants.

4). Assist in initiating a study of natural pesticides and their production.

5). Assist in setting-up a pesticide pilot plant.

Some of the terms of reference, particularly point 3 seemed to be incompatible with the duration of the mission and required clarifications. It has been agreed that the realistic requirement of point 3 would be a proposal concerning potentially attractive pesticide projects, the feasibility of which should be studied, with a short outline of the suggested methodology. It was also felt that a review of the pesticide industries and market requirements will be covered by the mission since they could have a determining role in setting up R & D objectives.

2. Use of Pesticides in Indonesia

The use of pesticides in Indonesia is fully sub-ordinated to the important objective of the Five Year Development Plant (Pelita) to increase food crop production, primarily rice. To reach the target agricultural intensification programmes (BIMAS and INMAS for rice) and special intensification programmes (INSUS), covering secondary crops such as maize, soybean, mungbean, peanut and vegetables, have been initiated and put at work. These schemes were largely instrumental in doubling rice production in seven years, which tops 22 million tons/yr, while in 1975 stood at about 11 million tons/yr. Data available for a basket of secondary crops including maize, soybean, mungbean, peanut, cassava , sweet potato and shorgum, indicate a 50 percent growth in the output for a two year period stretching from 1979/1980 to 1981/1982.

Pesticides for the above production scheme are provided by the government at a strongly (about 80%) subsidized uniform price. This may partly explain the enormous growth trend in pesticide usage, or at least distribution, during recent years. Another factor could be the relatively new practice of double cropping (secondary crops) promoted by the Government and steadily gaining momentum. Thus in the 1979/1980 wet - season and 1980 dry season about 6,500 tons pesticides were distributed growing to approximately 15,000 tons in the 1981/1982 - 1982 season. More than 80% of the pesticides included in the BIMAS, INMAS and INSUS programmes are insecticides, the rest is divided among fungicides and rodenticides. This is explained by the types of crops included, climatic and social conditions. No weed killers are distributed at subsidized price because labour is relatively cheap and the unemployed labour force is rather large, particularly in Java, where the large majority of the population lives.

Pesticides included in the BIMAS, INMAS and INSUS programmes in the 1981/82 and 1982 crop season were as follows :

Insecticides	Fungicides	Rodenticides
Fenitrothion	Chlorthalonil	Brodifacoum
Monocrotophos	Mancozeb	and other
Diazinon	Acylalamine	Coumarin derivatives
Phentoate		
Carbofuran		
Carbaryl		
MIPC		
BPMC		
Chlorpyriphos		
Fenthion		
Endosulfan		
and some combinations of the above products		

A full list of 32 subsidized agro-pesticides included in the BIMAS INMAS and INSUS scheme is appended to this report as Annex I.

In addition the Government subsidizes and implements a very extensive mosquito control programme using DDT (75% WP). In order to cover the recurring high annual DDT requirements the Government, based on a UNIDO feasibility study carried out in 1978, and in cooperation with Montrose Chemical Co, USA, has established a DDT manufacturing plant in Bogor . Annual requirements are put at betwen 2 to 3000 t/yr, however WHO forecast for 1985 and after places this figure at 5000 t/yr or more.

Weed control has been achieved by hand weeding in most rice growing countries in Asia. Experiments carried out in 1977 by the Central Research Institute for Food Crops,Bogor, showed that weeds cause 25-35% reduction in yield in irrigated rice, 75-90% in upland rice and about 45% in corn and legumes.

Low cost of hand weeding in Indonesia makes chemicals control difficult to adopt by the rice farmers. In spite of this during the last three to four years, particularly in the more sparsely populated areas (e.g. outside Java) progressive farmers started to use herbicides such as Bentiocarb/2,4D -IPE, Oxadiazon, Piperophos/2,4 D IPE in addition to 2,4D & MCPA. In spite of the relatively dramatic growth rate in the use of herbicides in food crops (50 to 200 percent/yr), this field of application is still in its incipient phase. While insecticides take about 80% of the total pesticide market in Indonesia, herbicides represent only about 9%, the bulk of the usage credited to estate crop business, which are such commodity plantations as rubber, tea, sugar cane, coffee, oil-palm, cocoa, etc.

Trends in the product mix in the pesticide usage in Indonesia and some recommendations by the Ministry of Agriculture relevant to changes in those trends are appended to this report as Annexes II to V. It can be seen that insecticides always dominated the market. In the 1960's chlorinated hydrocarbons were the market leaders, in the 70's this changed in the favor of organophosphorus insecticides and the 80's seem to be in the sign of carbamates. Fungicides show very little expansion, currently taking about 7-8% of the total market. Herbicides presently having a market share of 9%, may make important gains when the plans put forward by PELITA III to increase the area of estate crop by 200.000 ha , (present surface area is 250,000 ha) are implemented, because plantations are the most important users of herbicides.

3. Current status of research and development in the production of technical grade pesticides.

There are many pesticide formulation companies in Indonesia, most of them subsidiaries or affiliates of multi-national pesticide companies, but only two companies manufacture technical grade pesticide (i.e.active materials).

PT. PETROSIDA is a Government owned, newly formed company in Gresik, Surabaya, which has acquired production technology for four insecticides widely used in Indonesia in the BIMAS/INMAS intensification scheme.There are two organophosphorus and two carbamate insecticides in the production programme of the company, as follows :

Name of product	Type	Lic.Capacity/yr	Planned start up
Diazinon	OP	2000 tons	1983
Phenthoate	OP	650 tons	1983
BPMC	Carbamate	900 tons	1983
MIPC	Carbamate	450 tons	1983

with a total estimated investment of Rp 17,761,655,000,- or roughly US $ 18 million. Besides the economic assessment of the feasibility of the project, no physical or other research and development work was done, before a decision was reached on the production of these compounds through acquisition of know-how and engineering design. The construction of these production units is in progress.

Difficulties were met in finding a qualified supplier of know-how and licence for the manufacture of Phenthoate. The writer believes that the installed capacity of 650 t/yr for the production of phenthoate may soon prove to be low since Phenthoate and Dimethoate, another organophosphorus insecticides used in the region, have entirely analogues production schemes and they are produced in the same unit in Italy (Farmaplant) and perhaps also in Japan.

The similarity of the processess is illustrated as follows :

$$(CH_3O)_2\overset{S}{\overset{/\!/}{P}} - SH \;+\; \begin{array}{ll} 1)\ Cl\ CH_2CONHCH_3 & \text{---------}\!\!> \text{Dimethoate} \\ 2)\ Cl\ \underset{C_6H_5}{CH}COO\ Et & \text{---------}\!\!> \text{Phenthoate} \end{array}$$

Furthermore Malathion could be also manufactured in the same unit :

$$(CH_3O)_2\overset{S}{\overset{/\!/}{P}} - SH \;+\; \begin{array}{l} CH - COO\ Et \\ \| \\ CH - COO\ Et \end{array} \text{----------} \text{ Malathion}$$

Although Dimethoate and Malathion are currently considered as insecticides of limited importance in Indonesia, this situation may change,as they are more broadly used in other countries of the sub-region. Both Malathion and Dimethoate are only moderately toxic, which favor their use in tropical climates where protecting clothing can not be worn during application. As for waste control, the important problem is the handling of H_2S, a by-product in the production of (CH_3O) P S SH :

$$P_2S_5 \;+\; 4\ CH_3OH \text{------}\!\!> 2(CH_3O)_2PSSH + H_2S$$

The hydrogen sulfide can be scrubbed in alkali to make sodium hydrosulfide, or recovered as elemental sulfur in a Clauss process unit, or can be incinerated.

Diazinon represents a more complex pollution control problem, particularly in the last step of its synthesis when the pyrimidine and the phosphorus acid chloride are reacted. By-products are tetra-ethyl-pyrophosphates (TEPP) and their sulfur containing analogues, which have to be decomposed by acid-treatment, than neutralized.

BPMC and MIPC, two carbamate insecticides, pose little production problems, except for the generation of methylisocyanate from sodium cyanate and dimethyl sulfate. Toxic volatile by-products are fiared,solids go to deep well disposal, residual organics to biological treatment plant.

There are tentative plans according to which PT. PETROSIDA will also manufacture Carbaryl and Carbofuran, two additional carbamate in - secticides and possibly Malathion, in the second phase of the implementation of its pesticide production programme. Maleic anhydride will become locally available soon, that should add to the justification for the production of Malathion, particularly if Phenthoate equipment can be used.

Carbaryl production technology would have to follow the scheme of the BPMC and MIPC process, because the Union Carbide process is much more complex and would pose very serious waste disposal problems. No difficulty is foreseen in obtaining know-how for the production of these two compounds since their patents have expired, however access to alpha-naphtol, an intermediate of carbaryl, may be problematic as Union Carbide controls 90% of the world production.

Carbofuran represents a more difficult problem concerning produc - tion know-how. Not only because the number of potential suppliers is very limited, but also because of the required treatment of a series of waste materials: solids, volatiles, liquid and aqueous solution. Reference facilities are also known to emit about 0.5 kg carbofuran per metric ton of product.

Together with the first four pesticide production units (Phenthoate, Diazinon, BPMC and MIPC), PT.PETROSIDA is also erecting a flexible pilot plant unit, which should make possible testing new synthetic methods to be considered in the future and to work out refinements for the technologies adapted. This is considered a step in the right direction, a qualitative change much needed for an orderly further development of the pesticide manufacturing industry.

DDT is the fifth synthetic pesticide to be produced in Indonesia, but perhaps the first one in both volume and chronological order. A feasibility study, project number SI/INS/77/801, on the establishment of a DDT plant was carried out by UNIDO in 1978, which concluded that this project was feasible (Document No. DP/ID/SER.B/159, 6 September 1978:id. 78-5522). Following the preparation and submission of this study and document, unfortunately UNIDO has not been kept posted on the follow-up developments. It is to note with satisfaction that based on the above preparations the Government approved the establishment of a DDT plant with a licenced capacity of 7000 t/yr 75% WP end product. The know-how, equipment design came from Montrose Chemicals, USA, the largest producer of DDT. Montrose and the Government jointly established PT. MONTROSE PESTINDO NUSANTORO in Bogor and start-up of the plant took place early 1983.

In addition to the five pesticide active material production projects there are a number of others in the making covering such products as Maneb-Zineb, Cypermethrin, Piperonyl-Butoxide, Fenitrothion, Monocrotophos, Fenthion, Trichlorofon and Methomyl. At first look the manufacture of some of these products seems attractive partly because they are included in the intensification scheme, partly because know-how and engineering design look accessible. Others would be too complex and too small capacities to become economically viable. Each case would deserve a thorough study in the opinion of the author. For further details on this subject please refer to Annex VI.

As mentioned before besides the two pesticide technical material manufacturing plants there are more than 2 dozen of pesticide formulators, most of them subsidiaries or associates of multinational pesticide producers (Annex VII). These companies would not consider to establish any technical material production units or to launch any R & D activities because they feel conditions, particularly those ruling the market of (new) products, would not warrant to do so.

One factor seems to be the method of selecting products for inclusion in the BIMAS/INMAS programme. In 1970 the Minister of Agriculture established the Pesticide Committee which assists the Ministry in formulating policies for the distribution, storage and use of pesticides. The committee is composed of representatives of the Ministry of Agriculture, Health, Finance, Trade and some other Government agencies. It seems to be important to make the Ministry of Industry or some of their agencies members of the Committee, to represent the source and manufacture of pesticide. The Committee has the power of drafting decrees, recommending registration or withdrawal of it, and to select pesticides for use in the intensification schemes and aprove their subsidized distribution to the farmers.

The other factor is the marketing system, which in the intensification schemes, representing more than 80% of the total market, is entirely under Government control.. Farmers obtain pesticides from the Government at a uniform subsidized price, they are using the pesticides material without having a choice to select them (Annex VIII).

It is well known that pesticide companies are highly marketing oriented, they want to be able to keep sales information to themselves and promote their products to a maximum extent. Since in the above system there is little space for such an approach, they feel they should not risk any investment in R & D efforts, which reasonably could be done under present conditions only by Government owned companies. That is why they seem to approve the idea that new active ingredient manufacture has to be initiated and implemented by Government or parastatal organization.

In line with this philosophy the Ministry of Industry appointed R & D units in the Institute for Research and Development of Chemical Industry (IRDCI), formerly Industrial Research Institute dealing mainly with agroindustrial problem, for carrying out pesticide work.

IRDCI is under the supervision of the Agency for Industrial Research and Development, one of the Directorate General of the Ministry of Industry. The units entrusted with these tasks are the Division for Research for Fertilizer and Petrochemicals and the Division for Development of Fertilizer and Petrochemicals, pesticide considered as a major branch of petro chemicals. The Division for Research of Fertilizer and Petrochemicals has sixteen professional staff members : three chemical engineers one pharmacist, two agricultural product technologist, two industrial management graduates and eight chemical analysts None of them have broad experience in pesticide production. Most of them have less than three years professional exposure to this complex field. One core task of this mission was to assist this research group in designing a work programme for the next few years.

Shortly before this mission an international pesticide formulation expert,Dr.N.K. Pillai from India visited IRDCI for a similar exercise in the field of the pesticide formulation,his report has covered those aspects adequately so they shall not be treated here in any great depth. The major recommendations of the Pillai report are as follows :

1. Systematic testing of indigenous minerals (clays, etc) as to their suitability as pesticide carriers.
2. Development of a simple process technology for the preparation of precipitated silica.
3. Development of technology for the manufacture of emulsifiers and surface active agents.
4. Development of now formulations (slow release granular, flowables, ULV , etc).
5. Development of synergists, especially from plant material.
6. Study of pesticide formulation machinery.

In the opinion of the writer effective handling and implementation of point 3 and 5 can not be expected from the staff both for lack of experience and equipment. However the impact of the activities suggested in the other points could be significant particularly if work could be extended into pilot scale so that the results of the research work could be scaled up to a level where their field testing becomes possible. In this respect a UNDP/UNIDO assisted project similar to the one currently implemented in India has been discussed with the appropriate authorities, who expressed considerable interest in setting up a pesticide formulation center and pilot plant at IRDCI when they move to their new location in 1984/1985, which shall provide ample space for housing such a project.

As for researching production technologies for technical pesticides, IRDCI seems to be equipped and qualified for few projects. To get moving in that direction two to three organic chemists should be exclusively assigned to synthetic work. Their skills in this field could be vastly improved by working in some industries or institutions in industrially more developed countries on a fellowship. Upon return home they should be in a much better position to chart their programme which will need close coordination with the planned development of pesticide manufacture in the country and to physically equip themselves for this work. This seems to be rather modest and slow start-up for synthesis and process technology work, but meantime it is also the only effective and practical way. One may raise the question is such a unit needed at all. The moment the Government decided on starting up the manufacture of several and an ever increasing number of synthetic organic pesticides, R & D people with material knowledge and skills in the art, if not for anything else but trouble shooting and technology adaption, became indispensable.

During the initial period of acquiring the skill in the field of synthesis the Divisions for Research and Development of Fertilizer and Petrochemicals at IRDCI could concentrate on projects related to pesticides formulation and utilization of local raw materials and resources, the application of which should need less complex technics than process research. On these subjects please refer to the appropriate subsequent chapters of this report.

4. Utilization of local raw materials, resources and natural products for the manufacture of technical grade pesticides.

This chapter shall cover two tasks number 2 and 4 of the mission because many of the local raw materials and resources which could practically be considered as potential starting materials for the production of pesticide active ingredients are also of natural (botanical)origin. Of course as the down stream petrochemical products come into the the scene, more and more local materials become also available for the manufacture of synthetic pesticides. One example has been mentioned, the maleic anhydride, which is a key intermediate in the production of MALATHION, which is a very widely used organophosphorus insecticide, unfortunately not in Indonesia.

This situation with malathion raises a fundamental question: the pesticide considered for manufacture in order to utilize available raw materials should also/have a wide enough use in the country. As malathion is a widely used product all over the world, the possibility seems to be there to expand its use also in Indonesia. However this should be done only on the proof of extensive application tests with positive results and with the blessing of the Ministry of Agriculture, based on such results. Unless this happens any sizeable production of malathion should find its way into the regional or world market. That in turn would need a strong marketing effort.

To set short term goals IRDCI would have to look for products which are readily produceble from local raw materials and are used or acceptable for prompt use in agriculture or households.

Copper oxychloride could be singled out as a promising development objective. Use of this fungicide is not very extensive (confined mainly to tea plantations) only about 300 ton/year in Indonesia. However a production unit of this capacity can be profitable under certain circumtances and those circumtances seem to be assured in the country.

Cheap raw material, scrap copper is available from the Cable Factory in Jakarta and possibly from other sources. The technology of converting scrap copper in copper chloride is relatively simple and accessible. And last but not least, sales at about a stabilized level are assured.

Copper oxychloride can be prepared by two alternate processes: one dissolves scrap copper in HCl and precipitates the oxychloride with a strong base. The second method suspends scrap copper in $CuCl_2$ + NaCl solution and in the presence of a catalyst blows air through the mixture. Copper oxychloride is being formed on the surface of the scraps which is rubbed off by agitation and abrasion until all copper is used up.

These two processes could be subjected to a comparative study at IRDCI and the appropriate technology thus chosen.

Among the natural (Botanical) insecticides Rotenone, Nicotine and Pyrethrins deserves attention since the parent plants have been traditionally grown in the country.

Pyrethrum, a chrysanthenum variety, contains a highly effective , but rather unstable, insecticide in its flower. Until 1947/48 it has been commercialy grown in Central Java in the highlands around an elevation of 1900 m. Some mosquito coil supplies are supposedly still coming from that area but cultivation of pyrethrum flowers has ceased about that time in commercial sense. Pyrethrins, the active components of pyrethrum, are still used as house-hold insecticides. However their market is greatly destablized by such factors as uneven, fluctuating annual suplies, lack of cooperation among producing countries and as a result poor marketing potential. From a point of view of technology it would fit well Indonesian conditions, but taking the above mentioned negative factors in consideration plus the ever growing competition given by synthetic pyrethroids a restart of pyrethrum growing and establishment of an extraction/refinery plant could be recommended only on the following conditions :

a). a survey and study of the traditional growing areas shows that high quality pyrethrum can be locally grown and cultivation would be competitive with other (i.e. potato or other food) crops.

b). the Ministry of Agriculture, or one of its agencies is ready to organize an effective contractual scheme with highland farmers to grow and deliver pyrethrum.

c). domestic consumption would take all or an overwhelming proportion of the pyretrum extracts locally produced.

As mentioned earlier the processing (extraction/refining) of the pyrethrum flowers would not pose any great challange and UNIDO could provide technical assistance in processing if need arises.

The revival of the rotenone industry in Indonesia seems to be quite attractive at the moment. Rotenone is the trivial name of the insectidal component of the roots of certain DERRIS and LONCHOCARPUS spp of which Derris elliptica is the best known species. It has been grown in Indonesia in the Sukabumi area quite widely until 1947. The appearance of synthetic insecticides has had a strong damping effect on its use and commercial production practically ceased by the end of 50's, when also the only processing plant stopped operation. Several varieties were grown the roots of some quite high in rotenone contents.

Variety	Rotenone contents %
1. Ngani	9.3
2. Kotari	11.3
3. Pantu	7.9
4. Wulung	8.4
5. Serawak Creeping	10.2
6. Putik	8.3

The processing of Derris roots is a simple grinding, the finally dispersed powder can be suspended in water and sprayed. Its effectiveness is high, no insect resistance is known to have ever developed against rotenone. According to recent local tests it is highly active agains insects as diamond back moth, which acquired resistance against many synthetic products. In the open air it decomposes readily thus no environmental problem is encountered in its application. Its fading out from the commercial scene is attributed to lack of promotional interest among the multinational pesticides companies.

It is the writer's feeling, that if marketing of the product could be assured on the national market place, rotenone production would deserve attention. As a first step a pilot derris cultivation project could be initiated on a few hectares to ascertain that it is economically rewarding to the farmer to grow this plant. Once this is established there is little to hinder a full blown development effort because the usefulness of the product and need for short residual, environmentally friendly natural insecticides is well documented. Of course there will be still need for promotional effort to convince farmers of the advantages of using rotenone, because they do not know anymore this remarkable product, the only drawback of which is toxicity to fish, that may prevent its use in flooded rice cultures.

NICOTINE

Nicotine, an alkaloid is prepared from waste tobacco, Nicotiana Tabacum or N. Rustica, either by steam distillation in presence of alkali or by solvent extraction (Trichloroethylene) in the presence of alkali and reextraction from the solvent with dilute sulphuric acid. The alkaloid is a non-persistent, non-systemic contact insecticide and a highly effective fumigating agent with some ovicidal properties. As it is soluble in water it can be applied as an aqueous spray or formulated into a 3 to 5% dust.

The great merit of this natural insecticide is that it is obtained from an agricultural by-product, which has little or no commercial value. In spite of the continuing strong demand for nicotine on the world market. industrially developed countries have stopped its production, because they incorporate now everything formerly considered waste tobacco in the production of different smoking products primarly pipe tobacco. As a result the world demand, which is between 200 to 300 tons of nicotine, usually can not be satisfied. Major fields of use are vegetables and orchards, where the products are intended for prompt marketing, since nicotine has no residual effect and products like green salad treated with nicotine can be consumed 24 hour later. Greenhouses, particularly because of its fumigating effect, are another large segment of the nicotine market.

Indonesia grows a great deal of tobacco and has large quantities of waste tobacco. Its use for the production for nicotine would seem to be both technically and economically advantageous and the worldwide shortage in its supply may even allow exporting it to Europe, Japan and North-American. It has been noted with satisfaction that IRDCI has already initiated R & D work on nicotine recovery from tobacco wastes.

The fourth insecticide to deal with in this section is in fact a micro biological agent, Bacillus Thuringiensis. It is a selective insecticide, highly active and effective against Lepidoptera. The damage caused by the army worm to a wide variety of crops in Indonesia would alone justify the large scale introduction of this insecticide, which is considered harmless to other living organisms and as such exempt from use tolerance restrictions by the EPA in the USA.

The manufacturing process consists of subjecting a nutrientmixture feed to the successive process steps of :

1. Sterilization
2. Inoculation
3. Fermentation
4. Separation
5. Drying.

During the fermentation process regulation of the rate of air-flow and temperature is a salient point. As nutrient a mixture of soybean meal , corn steep liquor and minerals are preferred, but a wheat bran ,casein, molasses and vitamin mix is a good alternative.

For its formulation the final nutrient medium is adsorbed into a particulate inorganic carrier and nutrient substrate. Vegetable materials utilized as a carrier for or as part of the nutrient medium are preferably comminuted to provide a high ratio of surface area to volume and hence encourage vigorous bacterial growth. Inorganic carriers afford microbial insecticide culture which may be communited to a selected mesh size more readily than comparable cultures propagated on media composed eutirely from organic materials.

Preferred inorganic carriers include expanded volcanic sand, which is amply available in Indonesia in the Merapi-vulcano area, in the form of ANDESIT.

IRDCI, until recently a food industry research organization , has many facilities and trained staff for fermentation processes. It would seem logical to include the production of Bacillus Thuringiensis, in their research programme, the more so since WHO has recently found effective methods for the application of this microbiological insecticide in the control of mosquito larvae. Information on the small scale production of this agent and its application against mosquito larvae should be available from WHO, Division of Diseases and Vectors Control. Abbott Laboratories, a pharmaceutical company with some production facilities established already in Indonesia is also a producer of B.t (DIPEL WP) and could be a further source of information and know-how.

5. Preparation of feasibility studies on the establishment of active ingredient manufacturing plants.

The establishment of the feasibility of an industrial project may require a series of successive analytical steps such as project identification (selection and definition), opportunity study, pre-feasibility study and finally a full feasibility study which is basically the project formulation, followed by an evaluation and investment decision.

Not all industrial projects will require the strict implementation of all above steps. Obviously a several hundred million dollar project would demand a very rigorous execution of the above exercise, while smaller scale projects could probably be sufficiently examined and evaluated by an opportunity and subseqment pre-feasibility study. Most pesticide production projects in developing countries could be properly prepared for an investment decision by this simple approach.

An opportunity study should identify investment opportunities by analysing the following :

a). availability of natural resources (e.g. raw materials).

b). market demand and structure for the end product, including assessment of future demand.

c). current import to be substituted by new production.

d). technical and socio-economic infra structure in comparison to other countries where similar projects were successfully implemented.

e). interlinkage with other industries, indigenous or international.

f). diversification potential, e.g. pesticide for a petrochemical industry.

g). investment climate.

h). industrial policies of the country.

i). cost of production factors.

j. export possibilities.

A pre-feasibility study should be viewed as an intermediate stage between an opportunity study and a detailed feasibility study the difference being primarily in the details of the information obtained. Since a detailed feasibility study normally carries a high price tag, the pre-feasibility study will have to conclude if it is necessary for an investment decision. In many instances, particularly if the project is not oversize, the investment opportunity can be sufficiently clarified in a pre-feasibility study, which will examine, at least in broad terms, the economic alternatives of :

a). market and plant capacity : demand and market study, sales and marketing, production programme and plant capacity.
b). material inputs.
c). location and site
d). project engineering : technologies and equipment, and civil engineering cost.
e). overheads : factory, administrative and sales.
f). manpower : labour and staff
g). project implementation
h). financial analysis : investment cost, project financing, production costs and commercial profitability.

Support (functional) studies may be needed mostly when the project requires a large scale investment, and/ or is technically highly complex, and/or the marketing of the product requires special efforts. Functional studies may cover market and marketing, raw materials and inputs, laboratory and pilot plant tests, location, economics of scale and equipment selection.

A typical invesment opportunity assessment in pesticide industry, dealing with one or a small number of products, would take two to three months work by a hignly specialized consultant, or by a team of two or three of lower specialization. The duration of a pre-feasibility study may vary from 3 to 6 months with the above personnel.

The five pesticide production projects implemented by PT.PETROSIDA and PT. MONTROSE PESTINDO NUSANTARA have reached or are approaching their operational phase, therefore no particular studies are necessary at the moment. (We recall here that UNIDO carried out a pre-feasibility study on the DDT-plant in 1978 (SI/INS/77/801 - DP/ID/SER-B/159) which provided a pre-investment analysis for the establishment of the presently operational Montrose-Pestindo Nusantara plant). Supporting, functional studies may be later required though if the operation of the plants shows some problems to be rectified or expansion of the production profile comes up for consideration. A functional study on the latter subject could have the following terms of reference :

a). identification of organophosphorus insecticides that are used in substantial quantities in the country and could be manufactured in the existing facilities of Petrosida with some addition to the present facilities.

b). appropriate production processes

c). sources of raw materials

d). source of process know-how and engineering design

e). foreseeable additions to and/or changes in the present equipment/ facilities required for the production of the additional organophosphorus insecticides identified by the study.

f-j).same for carbamate insecticides.

Estimated duration of the study is two to three months, including appropriate market survey and analysis.

There are a large number of pesticides active materials considered for local production by various private firms and interests. (Annex VI) Many of these projects have been already licenced hopefully and probably based on evidence and justification presented by an investment opportunity study or a pre-feasibility study. It would seem advisable to make a pre-condition to the approval of production and investment licences by BKPM (Investment Board) the presentation of an investment opportunity - study supporting each project proposal.

In addition it is suggested that the following subjects be considered for opportunity or pre-feasibility studies by IRDCI :

a). production of copper oxychloride

b). production of rotenone

c). production of Bacillus Thuringiensis

d). identification of herbicides the potential production of which is attractive, based on market and techno-economic parameters (Du Pont considered feasible a 2000 t herbicide (diuron) plant in Indonesia already in 1975 according to information made available to UNIDO.)

6. <u>Establishment of a pesticide multi-purpose pilot plant.</u>

As mentioned in chapter 3. Petrosida has erected a flexible multi-purpose pilot plant suitable for testing production technologies and to carry out appropriate technology adaptation tests. IRDCI will also have a pilot plant at its new site, suitable for carrying out organic synthesis. This pilot plant will be based on a typical unit operation principle, including all important units as reactors, distillation vessels, decantation and transfer vessels, filters, washing and separation vessels, autocalves , crystalization and drying units, all commonly used in organic chemical operations. In view of the above there seems to be little justification for setting up a larger scale pilot plant at IRDCI for the testing and pilot production of new pesticides at this time.

Besides, as pointed out earlier, IRDCI has no qualified personnel for the operation of such a pilot plant and it may take several years until the skills needed will be acquired. Even then, one should try to avoid a duplication, with reference to the Petrosida pilot facilities.

Meanwhile there seems to be no R&D effort in pesticde formulation in the whole country with the possible exception of ALFA ABADI PESTISIDA INDUSTRI in Cirebon. Therefore it would seem very important to set up research facilities to handle R & D work in pesticide formulation at IRDCI, including a multi-purpose pesticide formulation pilot plant. The institute presently has only equipment and instruments required for quality control. For the preparation of new pesticide formulations, testing the new formulation both physically and biologically, and finally carrying out larger scale experimental formulations for field trials, IRDCI would need both bench scale and pilot scale pesticide formulation equipment, as well as equipment required in the biological screening and evaluation of pesticide formulations. This subject also came up in discussions witn other government and business organization and it seemed to be a consensus that the task of R & D for formulated products specially suitable for local conditions should be undertaken by IRDCI. The report of Dr.N.K Pillai gives a detailed account of a wide ranging work programme, IRDCI could consider and adopt for the next few years. He also indicated that the essential equipment required to carry out this type of work has been discussed with the technical staff of the institute and a list thereof, with sources whenever available, will be furnished by him. It is the impression of the writer that these communications would not relate to pilot scale equipment.

During discussions with the Ministry of Industry it was suggested that UNDP/UNIDO should provide technical assistance in establishing these pilot facilities. The Ministry of Industry was informed that a similar project is being currently implemented in India and if the Government wishes to include such a project in the next country programme cycle, which is to begin in 1985, UNDP would most likely go along with such a request. The timing would seem to be perfect since this is the time when new facilities housing IRDCI, would become available for occupancy and use.

The cost of such a project was estimated to consist of the following major components :

Component	Estd. cost US $ '000
Personnel	600
Equipment (bench + pilot scale)	700
Training	200

Assistance in drafting a project document could possibly obtained through the RENPAF scheme (DP/RAS/82/006) from UNIDO.

7. Conclusions and Recommendations

a). In the domain of technical pesticide active materials IRDCI should concentrate on the utilization of local raw materials and processing of natural products. Manufacturing of copper oxychloride from scrap copper, recovery of nicotine from waste-tobaco, revitalization of the rotenone production and production of microbiological pesticide agents (Bacillus thuringiensis) are a few examples that could be included in their work programme.

b). With the start up of the large scale production of five synthetic organic pesticides, Indonesia has entered a development stage in which capacity to carry out R & D work on the synthesis and process development of pesticides became a necessity. In order to build up such a capacity it is recommended that IRDCI take the necessary steps through official channels to secure special training in this field for two or three staff assigned to synthetic work through fellowship from UNIDO or bilateral cooperative programmes.

c). IRDCI is already working on the recovery of nicotine from waste tobacco. To expedite the scale up work to commercial level it would be helpful to secure fellowship training for one technician assigned to this problem in a working commercial plant in Europe.

d). A pilot project in Derris cultivation, to ascertain the economic value of the revitalization of this industry is recommended. It is believed that the Ministry of Agriculture could take the initiative in this project.

e). As concerns pesticide formulation research IRDCI would seem to be the logical organization to undertake it as no other organization is presently engaged in such work in the country. A recent UNIDO expert mission has focussed on a number of important questions in this field.

It would be in the national interest that R & D results could be handed over to formulation industries for use as soon as possible. For producing conclusive results broad field testing of new or improved formulations is necessary. The large scale samples for such field trial could only be produced in a pilot formulation plant, the establishment of which at IRDCI is recommended.

f). Such multipurpose pilot pesticide formulation plants have been set up with UNDP/UNIDO technical assistance in other countries. The Government of Indonesia may wish to include such a project with UNDP/UNIDO assistance in her country programme (IPF), in which case an appropriate project proposal should be worked out and officially submitted in due course, preferably before the beginning of the next country programme cycle.

g). It would seem reasonable that the Pesticide Committee invite the Ministry of Industry, responsible for the production of pesticides, to participate in the composition and work of the committee.

h). A functional study is recommended to establish the potential for future production extensions in PT. PETROSIDA'S facilities that could be taken in consideration during the next stage of development, already decided upon in principle.

Annex I.

LIST OF SUBSIDIZED PESTICIDES DISTRIBUTED IN THE BIMAS / INMAS AGRICULTURAL PRODUCTION SCHEMES

A. INSECTICIDES

1. Azinphos – Methyl
2. BPMC
3. Carbofuran
4. Carbaryl
5. Carbophenothion
6. Cartaphidrochloride
7. Chlorpyrifos
8. Cyanofenphos
9. Diazinon
10. Dichlorvos
11. Endosulfan
12. Fenitrothion
13. Fenthion
14. Isoksation
15. Malathion
16. Mefosfolan
17. MIPC
18. Monocrotophos
19. Phenthoate
20. Phosphamidon
21. Quinalphos
22. Triazophos
23. Trichlorfon

B. FUNGICIDES

24. Chlorothalonil
25. Mancozeb
26. Metalaxyl
27. Propineb

C. RODENTICIDES

28. Brodifacoum
29. Coumachlor
30. Coumatetralyl
31. Diphacinone
32. Zink Phosphide

Annex II.

LIST OF RECOMMENDED PESTICIDES FOR RICE CROP

No.	Pesticide	Stemborer	Brown plant hopper and white back planthopper	Green leaf hopper	Rice bug	Gall midge	Stink bug	Case worm and leaf roller
	Insecticide							
1.	BPMC	-	+	-	-	-	-	-
2.	carbaryl	-	+	+	+	-	+	-
3.	carbophenothion	-	+	-	-	-	-	-
4.	carbofuran	+	+	+	-	+	-	-
5.	cartap hidrochloride	+	-	-	-	-	-	-
6.	chlorpyrifos	+	+	-	+	-	-	-
7.	cyanofenphos	+	-	-	-	+	-	-
8.	diazinon	+	+	+	+	-	-	-
9.	dichlorvos	-	-	-	+	-	+	-
10.	endosulfan	+	-	-	+	-	-	-
11.	fenitrothion	+	-	-	+	-	-	-
12.	fenthion	+	+	-	+	-	+	-
13.	malathion	+	-	-	-	-	-	-
14.	MIPC	-	+	-	-	-	-	-
15.	monocrotophos	+	+	-	+	-	+	+
16.	mephosfolan	+	-	-	-	+	-	-
17.	phenthoate	+	-	-	+	-	-	-
18.	phosphamidon	+	-	-	+	+	-	-
19.	quinalphos	+	-	-	-	+	-	-
20.	triazophos	+	-	-	-	+	-	-
21.	BPMC + diazinon	+	+	-	-	-	-	-
22.	BPMC + fenitrothion	+	+	-	-	-	-	-
23.	BPMC + phenthoate	+	+	-	-	-	-	-
24.	MIPC + cartap	+	+	-	-	-	-	+
25.	MIPC + diazinon	+	+	-	-	-	-	-
26.	trichlorfon + azinphosmethyl	+	+	-	+	-	-	-

+ : recommended.

- : not recommended.

Annex XII.

LIST OF RECOMMENDED PESTICIDES
FOR SECONDARY CROP.

No.	Pesticide	Soybean					Mungbean				Ground nut			Corn/maize		
		Bean fly	soybean leaf beetle	leaf eating.	Pod borer	Pod sucking bug	bean fly	leaf beetle	Pod borer	Pod sucking bug	leaf eating	leaf spot	rust	corn seedling fly	Corn borer	downy mildew
1.	BPMC	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
2.	carbaryl	-	+	+	+	-	-	-	-	-	+	-	-	-	-	-
3.	carbofuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	cartap	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	cyanofenphos	+	+	+	+	+	-	-	-	+	+	-	-	+	-	-
6.	diazinon	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-
7.	dichlorvos	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
8.	endosulfan	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
9.	fenitrothion	+	+	+	+	-	-	-	-	+	-	-	-	-	-	-
10.	fenthion	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
11.	mancozeb	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
12.	malathion	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
13.	mephosfolan	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
14.	metalaksil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
15.	monocrotophos	+	+	+	+	+	+	+	+	+	-	-	-	-	+	-
16.	phenthoate	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
17.	propineb	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
18.	triazophos	+	+	+	+	-	-	-	-	-	-	-	-	+	-	-
19.	chlorpyriphos	-	+	+	+	+	-	-	-	-	-	-	-	+	-	-

+ : recommended

- : not recommended

LIST OF RECOMMENDED PESTICIDES
FOR HORTICULTURAL CROP

No.	Pesticide	Potato			Tomato	Onion		Cabbage cauliflower
		Nematode	Leaf beetle	Leaf blight	Leaf blight	Blight	Army worm	Silver mouth
1.	carbofuran	+	-	-	-	-	-	-
2.	cartap	-	-	-	-	-	-	+
3.	chlorothalonil	-	-	+	+	+	-	-
4.	diazinon	-	-	-	-	-	-	+
5.	fenitrothion	-	-	-	-	-	-	+
6.	mancozeb	-	-	+	+	+	-	-
7.	metalaksil	-	-	+	-	-	-	-
8.	propineb	-	-	+	+	+	-	-

+ : recommended
- : not recommended

LIST OF RECOMMENDED HERBICIDES FOR RICE CROP
IN INDONESIA

No.	Herbicide	Application			Efficacy		
		Before planting	Pre emergence	Post emergence	Broad leaf	Sedges	Grasses
	I. Lowland Rice						
1.	2,4 D dimethylamine	-	+	+	+	+	-
2.	piperophos + ester isopropyl of 2,4 D	-	+	-	+	+	+
3.	benthiocarb + ester isopropyl of 2,4 D.	-	+	+	+	+	+
4.	kalium - MCPA	-	+	+	+	-	-
5.	ester iso-octyl 2,4 D + 2,4 D - oxadiazon.	+	-	-	+	+	-
	II. Upland Rice						
1.	oxadiazon	-	+	-	+	+	+
2.	ametryn	-	+	-	+	-	+
3.	benthiocarb	-	+	+	-	+	-
	III. Tidal Swamp Rice						
1.	paraquat dichloride	+	-	-	+	-	+
2.	paraquat dichloride + diuron	+	-	-	+	-	+

+ : recommended

- : not recommended

Annex V.

Pesticides Consumption, 1978–1981

(ltr/kg as active ingredients)

Active Ingredient	1978	1979	1980	1981	Total
Insecticides					
Azinphosmethyl	–	–	–	10,399.40	10,399.40
BPMC	–	–	213,850.60	638,292.40	852,143
Carbaryl	373,349.75	501,669.15	623,994.95	814,321.25	2,303,335.10
Carbophenothion	–	–	8,399.44	11,367.56	19,767.
Carbofuran	59,351.76	10,013.79	63,074.25	120,746.63	253,186.43
Cartaphydrochloride	17,693	2,801.50	45	5,120.10	25,659.60
Chlorpyrifos	71,271.80	122,333	93,279.20	156,769.80	443,653.80
Diazinon	1,004,606.10	943,737.90	1,232,665.90	1,243,400.60	4,424,410.50
Dichlorvos	118,816.50	71,688.50	74,175	55,551	320,231.
Endosulfan	59,897,25	39,761.75	80,981.60	91,981.55	272,622.15
Fenitrothion	220,527.50	241,121	395,039.65	508,859.90	1,365,548.05
Fenthion	117,622.45	166,643.93	218,331.85	382,950.70	885,548.95
Isoctathion	4,085.75	502	–	–	4,587.75
Liptophos	59,140.80	21,203.40	5,581.50	6,938.40	92,864.10
Malathion	–	–	11,706	17,905.50	29,611.50
Nephosfolan	–	–	–	–	–
MIPC	–	–	78,926.50	195,642.60	274,569,10
Monocrotophos	–	–	50,746.12	61,0181.50	111,827.62
Phenthoate	–	111,553.80	235,131	339,338.70	686,023.50
Phosphamidon	37,523	19,466	702	70,037	127,728
Quinalphos	1,941.40	2,547.45	–	37,575.35	42,064.20
Stanofenfos	7,258	1,969.25	151.50	2.50	9,381.25
Triazophos	1,286.40	60	–	18,570.40	19,916.80
Trichlorfon	–	–	–	103,394	103,394
Total insecticides	2,154,371.46	2,257,072.44	3,376,782.06	4,890,186.84	12,678,412.80
Fungicides					
Chlorothalonil	2,068.50	1,089	–	35,984.25	39,141.75
Mancozeb	4,694.40	3,080.80	2,066.40	46,321.60	56,163.20
Propineb	7,874.30	3,385.90	30,809.80	15,001	57,071
Total fungicides	14,637.20	7,555.70	32,876.20	97,306.85	152,375.95
Total Insecticides & fungicides	2,169,008.66	2,264,628.14	3,409,658.14	4,987,493.69	12,830,788.75

Source : BIMAS Directing Unit Ministry of Agriculture.

Annex VI.

LIST OF COMPANIES AUTHORIZED
TO PRODUCE ACTIVE INGREDIENTS
IN 198.

No.	Name & Company	Location	Rated Capacity/Yr (ton)	Type of a.i.	Licency	Remarks
1	2	3	4	5	6	7
1.	PT. Petrosida	Gresik	2.000 ton 650 ton 900 ton 450 ton	Diazinon Phenthoate BPMC MIPC		SPS.No.145/IS/PMDN/83 tg.23/5-83 SPT.No.130/I/PMDN/83 tgl.30/8-83 T. Kerja : 83 orang Inv : Rp37.761.655.000,-
2.	PT. Pentraga Chemical Utama.		1.000 ton 300 ton 400 ton	Maneb Zinab Cypermethrin Piperonil-Butoxyde		SPS.No.150/IS/PMDN/83 tg.26/5-83 Perpanj.SPS.I.No.874/A.I/83-1/9 1983.
3.	PT. Kurtini Perintis Agro Industries.	Bekasi	800 ton 200 ton 500 ton	Fenitrothion Monocrotophos Fenthion		SPS.No.173/IS/PMDN/83 tgl.18/6-83
4.	PT. Sarana Upaya Patani.	Cirebon	1.000 ton 300 ton 200 ton	Phenthoate Monocrotophos Trichlorfon		SPS.No.78/IS/PMDN/83 tgl.21/2/83
5.	PT. Du Pont Sari Agro-chemicals.	Surabaya	90 ton 300.000 liter 320 ton	Methomyl Lannate L Lannate MP		SPS.No.08/IS/PMA/83 tgl.11/3/83 SPT.No. E.I. Du Pont De Nemours & Co USA. (80%) US$ 2,000,000. P. Sukanto (20%) US$ 500,000. Loan US$ 3,440,000. US$ 5,940,000. T. Kerja = 34 orang.
6.	PT. Montrose Pestiside Nusantoro.	Bogor	7.000 ton	DDT 75% Dispersible Powder.		SPS.No.72/IS/PMDN/83 tg.10/3'83. SPT.No. Inv. : Rp 5.466.700.000,- T. Kerja : 60 orang

SPS (Surat Persetujuan Sementara) - Preliminary Authorization
SPT (Surat Persetujuan Tetap) - Permanent Authorization

Annex VII.

<u>Pesticide Formulators in Indonesia</u>

(February 1982)

No.	Company	Location	Capacity/Yr	Type of product	Active Ingredients	Licensor
1	2	3	4	5	6	7
1.	PT. Inkita Makmur	Mojokerto, Jawa Timur	5.500 ton	Basudin 60 Ec	Diazinon	Ciba Geigy
				Dimecron 50 Scw	Fosfamidon	
				Brantasan 450/30 Ec	Diazinon/BPMC	
				Nogos 50 Ec	Diklorvos	
				Ridomil 35 SD	Metalaksil	
				Mibas 200/100 Ec	Diazinon/MIPC	
				Rilof H 500 Ec	Piperofos;2,4D.	
2.	PT. Bayer Agrochemicals	Cibubur, DKI Jaya	6.000 ton/Kl.	Baycarb 500 Ec	BPMC	Bayer
				Bayrusil 250 Ec	Dietkuinalfion	
				Folithion 50 Ec	Fenitrotion	
				Lebaycid 550 Ec	Fention	
				Tamaron 200 Ec	Metamilofos	
				Tokuthion 500 Ec	Profiofos	
				Dipterex 700 ULV	Trikhlorfon	
				Bayrusil 600 ULV	Kuinalfos	
				Lebaycid 1000 ULV	Fention	
				Folithion 1000 ULV	Fenitrotion	
				Dipterex SL 95	–	
				Etrofolan 50 WP	MIPC	
				Morestan 25 WP	Oksitiokuinoks	
				Curaterr 3 G	Karbofuran	
				Nemacur 5 G	Fenamifos	
				Antracol 70 WP	Propineb	
				Cuprabit OB 21	Tembaga Oksida	
				Hinosan 50 Ec	Edifenfos	
				Sencor 70 WP	Metribuzin	
				Untinex SP	Aminotriazol, Diuran, MCPA	
				Racumin	Kumatetralil	
				Racumin RB	–	

Pesticide Formulators in Indonesia (Continued)

1	2	3	4	5	6	7
3.	PT. Petrokimia Kayaku	Gresik, Jawa Timur	18.000 MT/KL	-Diazinon	-	Nippon Kayaku
				Mipcin	MIPC	
				Basazinon	Diazinon; BPMC	
				Mipcinon	Diazinon, MIPC	
				Saturn - D	Bentio carb, ester - isopropil	
4.	PT. Agrocarb	Rungkut, Surabaya	13.600 MT/KL	-Sevin 85 s	Karbaril	Union Carbide
				Sevin 5 D	-	
				Sevidol u/4G	Karbaril; Lindan	
				Sevidan 70 WP	Karbaril, endosulfan	
				Sevin 4 oil	-	
				Ethrel 10 LS	Etepon	
				Ethrel 40 PGR	-	
				Cytrolene 2 G	Metosfolan	
				Lannate 25 WP	Metomil	
				Agrolene 26 WP	Lindan	
				Ekalux 25 EC	Kuinolfos	
				Anthio 35 EC	Formotion	
				Malathion 50 EC	-	
				Altan 50 WP	Kaptan	
				Daconyl 75 WP	Klorotalonil	
				Copper Sandos	Kuprooksida	
				Manzate D	Maneb	
				Delsine MX	Karbendasim, Mankozeb	
				Zincofo l	Kaptafol	
				Benlate	Benomil	
				Round Up	Isopropil Amina Glifosfat	
				Safrotine Liquid	n.a.	
				Safrotine Aerosol	n.a.	
				Evradan 3 G	n.a.	

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Pesticide Formulators in Indonesia (Continued)

1	2	3	4	5	6	7
5.	PT. Indagro	Cimanggis, DKI Jaya	9.500 MT/KL	-Cepha 2,5 LS	Etefon	Checron
				Cepha 10 LS	-	Rohm & Haas
				Cepha 40 PGR	-	Sumitomo
				Cidial 50 L	Fentoat	
				Dibrom 8 E	n.a.	
				Dithane M-45	Mankozeb	
				Difolatan 45	-	
				Haipen LS	-	
				Indamin 720 HC	2,4-D.dimetilamina	
				Lannate L	-	
				Monitor 200 LS	Metamidofos	
				Orthene 75 SP	Asetat	
				Orthocide 50 WP	-	
				Rogor L-40	Dimetoat	
				Sumicidin 5 EC	Fenvalerat	
				Sumibark EC	-	
				Sumithion 50 EC	-	
				Sumithion L-100	-	
				Sumibas 75 EC.	Fenitrotion, BPMC	
				Tiezene 80 WP	Zineb.	
6.	PT. ICI Pesticida Indonesia	Cimanggis, DKI Jaya	2.400 ton	-Gramoxone	Parakuat Diklorida	I.C.I.
				Agrothion	-	
				Paracol	Parakuat Diklorida, Diuran.	
				Totacol	-	
				Agroxone	Kalium - MCPA	
				Ambush	Permetrin	
				Trithion	Karbofenotion	
				Klerat	Brodifakoum	
				Silosan	Pirimifos-metil	
				Perfekthion	Dimetoat	

Pesticide Formulators in Indonesia (Continued)

1	2	3	4	5	6	7
7.	PT. Pacific Chemical Indonesia.	Medan-Sumut	5.910 ton	-Dowpen Dursban 20 EC	Natrium dalapon klorpirifos	Dow Chemical
8.	PT. Demhate Hamburg Corp.	Jelambar DKI Jaya	1.000 kl/ton	-Fomadol 50 EC Lirocide 65 EC Phyllodol 50 EC Demfu M 80 Wp Demcarba 85 Wp Demicin 60 EC Trifos 50 SC/l.G. Demicide 50 EC Vebtox	Malation - Diklorfos Maneb Karbaril n.a. n.a. n.a. n.a.	
9.	PT. Harina Chemicals.	Cakung, DKI Jaya	1.320 MT/KL	-Chlordane 8 EC Dekasulfan 350 EC Diphachine 110	Klordano Endosulfan Difasinon	
10.	PT. Alfa Abadi Pestisida	Cirebon, Jawa Barat	6.400 MT/Kl	-Emulthion TM	Triklorfon,asinfos metil	Nichimen
11.	PT. Yunawati/Nachitani **		1.600 MT/Kl	-Maneb, Brestan	Maneb,timah trifenil asetat	
12.	PT. Dharma Ardha Utama **	Bekasi, Jawa Barat	1.500	-Azodrin	-Monokrotofos	-Shell International

Pesticide Formulators in Indonesia (Continued)

1	2	3	4	5	6	7
13.	PT. Rumpun Tani *	–	–	– Elsan – Elstrar	– Fentoat Fentoat, BPMC	– Nichimen
14.	PT. Bimasco Daya **	–	–	p.m.	p.m.	
15.	PT. Parama Bina Tani **	Jateng	16.300 ton	– Furadan	– Karbofuran	– F.M.C,
16.	PT. Mutukimia Utama **	Tangerang Jawa Barat	2.000 MT/Kl	– Warfarin Daconil (75 Wp)	n.a. Klorotalonil	– Shell International.

* Doesn't have own plant.

** In construction stage.

TRADE CHANNEL : "BIMAS PESTICIDES"

FORMULATOR ← Agent – – – – Dept. Agriculture
Dept. Trade
Dept. Finance
Sekr. Negara

↓

P.T. PERTANI (head office)

↓

P.T. PERTANI (district)

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P.T. PERTANI (sales unit)

↓ ↑

FARM COOP/RETAILER

↓ ↑

FARMERS

Note:

↓ flow of goods

↑ flow of demand

LIST OF PERSONS CONSULTED DURING THE MISSION.

Dr. Jr. SABET PARTOATMODJO	- Director, Directorate of Food Crop Protection, Ministry of Agriculture - Chairman of the National Pesticide Committee
Mr. SOENARYO DANUSAPUTRO,	Chief, Sub - Directorate for Organic Industry, Directorate for Programming, Directorate General for Basic Chemical Industries.
Mrs. KUSARTUTI IMAN SUBAGYO,	Chief, Sub-Directorate for Agrochemical Industries, Directorate General for Basic Chemical Industries.
Mr. J. KUSNADI	Director, Institute for R & D of Chemical Industry (IRDCI)
Mr. DJUMARMAN	Chief of Research Division of Fertilizers and Petrochemicals, IRDC.
Mr. D. KARYADI	Chief of Development Div. of Fertilizers and Petrochemicals, IRDCI.
Mrs. KARSINI	Chief of Research Div. of Organic Chemical and Fermentation, IRDCI.
Mr. KURNIA. H.	Staff, Research Div. of Fertilizers and Petro - chemicals, IRDCI.
Mrs. LILIEK, S.	Staff, Development Div. of Fertilisers and Petrochemicals, IRDCI.
Mrs. [illegible], R	Staff, Reserach Div. of Fertilizers and Petrochemicals, IRDCI.
Mrs. HENDARTINI	Staff, Research Div. of Fertilizers and Petrochemicals, IRDCI.
Mrs. SUSMIRAH, S	Staff, Development Div. of Fertilizers and Petrochemicals, IRDCI.
Dr. DANDI SOEKARNA	- Scientist (Entomologist), Bogor Research Institute for Food Crops.
Mr. ERIC F. DJOHAN	- Marketing Manager, PT. Bayer Indonesia Agrochemical Division - Vice Chairman of Pesticide Industry association.
Mr. M. ASRI NASUTION	Business and Adminitration Manager. PT. ICI Pestisida Indonesia.
Mr. M.S. SITANGGANG	Marketing Manager, PT. ICI Pestisida Indonesia.

Mr. S.M.L. TAMBUNAN	Technical Manager PT. ICI Pestisida Indonesia.
Mr. J.M.E. OGILVY	Technical Adviser PT. ICI Pestisida Indonesia
Dr. D. BAP REDDY	FAO Representative in Indonesia
Mr. F.K. IQBAL	Senior Industrial Development Field Adviser UNDP/UNIDO.
Mr. KAR DREYER	Jr. Professional Officer UNIDO.