OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

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

RESTRICTED

18837

DP/ID/SER.A/1439
20 February 1991
ORIGINAL: ENGLISH

REGIONAL NETWORK ON PESTICIDES FOR ASIA AND THE PACIFIC

DP/RAS/88/031

INDONESIA

Technical report: Pesticide Industrial Policy*

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 Mr. R.S. Mathur,
consultant in pesticide industrial policy

Backstopping officer: B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

2/

* This document has not been edited.

V.91-21758

CONTENTS

		Page
1.	An Approach to Developing Pesticide Industrial Policy	1
2.	Evolution of Industrial Policy in India	4
3.	Status of Pesticides Industry in India	7
4.	Demand, Consumption Pattern and Marketing Infrastructure	15
5.	R&D and Technology	24
6.	Equipment and Packaging	32
7.	Environmental Conservation, Pollution Control & Safety	39
8.	Pesticide Registration in India	44
9.	World Pesticide Scene	48
10.	Pricing and Tariff	52
11.	Agenda for Developing a Framework of Policy	56

Annexure I	a)Production of Technical Grade Pesticides in India	65
	b)Quantity of Various Pesticides Imported during the years from 1988-89 to 1989-90	68
	c)Export Statistics of Agro Chemicals	70
Annexure II	Local Manufacture of Technical Grade Material (Summary) 1982-83 to 1988-89	71
Annexure III	Pesticides Imported during the years 1982-83 to 1986-87	72
Annexure IV	Import of Pesticides for Public Health	74
Annexure V	Sale and Distribution Points of Pesticides	75
Annexure VI	Gaps Between Supply and Demand by 1994-95	76
Annexure VII	New Chemicals Introduced in Indian Market during the last 5 to 10 years	78
Annexure VIII	Name of Firms who Introduced Agro Chemicals during last 10 years	79
Annexure IX	Stage of Manufacture for Selected Pesticides	80
Annexure X	List of Equipment Required for Manufacture of Pesticides	81
Annexure XI	List of Equipments Required for Formulation of Pesticides	83
Annexure XII	Market Concentration and Differentials in Estimated Fair Selling Price of Technical Pesticides and Actual Selling Price	84
Annexure XIII	Unido Substantive Comments	85

CHAPTER - 1

AN APPROACH TO DEVELOPING PESTICIDES INDUSTRIAL POLICY

Objectives

Broadly the report has the following objectives:

i)To study in depth the present pesticides scenario in all its aspects particularly those relating to manufacture, technology and marketing, in India in the backdrop of the existing situation in the RENPAP region as also the International context.

ii)While analysing the various aspects of pesticides industry to identify gaps in the existing regime or policy thrust that need correction or adjustment in the light of future requirements.

iii)To suggest on the basis of (1) and (2) above an "Agenda" for developing an integrated pesticides industrial policy taking into account the Indian experience.

Assumptions, Rationale and Parameters

Any industrial policy which may or may not be sector-specific presuppose a degree of Governmental intervention to ensure directional changes consistent with certain predetermined policy goals. To that extent, the concept of industrial pesticides policy would be relevant in the politico-economic context of countries where such an intervention to achieve the desired goals is not only possible but also considered desirable. At least for the purpose of this report, it would be necessary to keep this perspective in mind. The term "Pesticides" is used in this report in a generic sense and includes all the product groups like insecticides, weedicides, herbicides, fungicides, rodenticides etc. Thus wherever reference has been made to the term "pesticides", it invariably includes all the form sunless specific reference is separately made to each category.

Product Groups

Pesticides Industrial Policy will have to centre around the following product groups:

i)Basic materials which are popularly known as technical grade pesticides.

ii)Formulations, i.e. the form in which pesticides are actually applied which are of different kinds e.g. granules, dusting powders, emulsifiable concentrates, suspension concentrates, microemulsions etc.

iii)The chemical intermediates used for manufacture of technical pesticides.

Sub-elements of the Policy

While an integrated pesticides industrial policy should cover all aspects of pesticides starting from research through manufacture to marketing and application, for the purposes of this report, the aspects connected with application would be less highlighted and the emphasis will be more on R&D, technology, manufacturing and marketing, since the focus is on "Industrial Policy". However, while formulating a policy, it is necessary to identify certain sub-elements on which the overall industrial policy should focus.

It is only possible to broadly identify such as pects since it will all depend on the degree of concern of certain regions/ countries whic.: in turn would depend on the overall objectives of Government policy and the special circumstances of the country. Besides, there may have to be trade offs between different aspects of the policy to balance competing claims of various interests and concerns. Nevertheless, given these diverse constraints, the following elements can be focussed upon:

i)Regulation of industrial production in desired areas and priorities through licensing.

ii)Research and Development, upgradation and transfer of technology.

iii)Indigenisation and basic stage of manufacture.

iv)Quality control and related issues.

v)Environmental pollution, safety and hazard management.

vi)Pricing and tariff structure.

Special Characteristics of the Pesticides Industry

It would also be necessary to keep in mind certain basic charac teristics of the pesticides industr which distinguish it from o.her sectors of the industry while formulating a pesticides policy. Some of these are:

i)The industry is highly R&D-intensive requiring an ongoing R&D effort involving large expenditure. This expenditure is going up over the last few years and the results in the shape of dis covery of new molecules have been slowing down corresponding to the exper diture made.

ii)The pesticides industry is characterized by a comparatively high obsolescence rate. This is an important factor which has to be taken into account while formulating any policy for the indus try.

iii)The industry is also, by and large, characterised by closely-held technologies. The question of transfer and absorption of technology particularly for the developing countries, therefore, assumes significance and has to be an important element of policy thrust.

iv)The pesticides industry operates under fairly stringent controls and regulations of quality and registration procedures. Prior approval of a regulatory agency is required even to intro duce a new product.

v)Finally, the most important characteristic of the pesticides industry is that it is regarded as highly toxic and a potential danger to environmental conservation. The industry the world over is perceived as among the most polluting and hazardous because of the nature of chemicals that are used in it. Not only at the manufacturing stage, even at the application stage, pesticides cause a lot of concern among large sections of population about possible damage that their application may cause to the human beings. It is this growing concern which should form an important backdrop to development of any policy for the pesticides industry.

Span of Regulations

The formulation of any industrial pesticides policy would require consideration of the factors enumerated in the foregoing paras. But all these may not be relevant to the same degree in all cases and situations.

The range of policy regulations would necessarily vary from country to country and situation to situation and would therefore consist of a very wide band. Besides, the policy to be determined by different countries should reflect the concerns of the policy makers with different issues at any given point of time and this would also determined the "span of regulation or control". For instance, the need to conserve foreign currency or otherwise may determine emphasis on indigenisation or freedom to import. The determinants of the Pesticides Industrial Policy would not only be conditioned by the socio-political predilections of the Government of the day, the constraints of the economy, the overall environment but also by the capacity of the different players to apply pressures. This is exemplified strikingly in the wide range of controls on the application of pesticides in different States of the U.S.A., which range from extremely stringent controls in the State of California to almost non-existent controls in the State of Nebraska.

Rationale for an Integrated Policy

Pesticides are used both in health care as well as in agriculture. The third and the growing use of pesticides specially in the developed countries is the area which is popularly known as "Household use". The registration of pesticides is determined in most countries by the user, namely, the Agriculture Ministry; the toxicity and the harmful effects of the human body are the concern of the Health Ministry and the overall issue of environmental degradation is dealt with by the Ministries concerned with Environment and Pollution; and the possible deleterious effects on the health of those involved in manufacture by the Labour Ministry. In countries like India, there is another agency, namely, the Industry Ministry which deals with the licensing of all industries including the pesticides industry and therefore looks after the manufacturing aspect. The users, manufacturers, environmentalists who are the major players, may have different points of view and to that extent areas of concern. There is, therefore, need to have an integrated pesticides policy with a view to relating in a coordinated manner the diverse objectives of state policies that are sought to be achieved. The underlining objective of all industrial pesticides policy would be to ensure safe, hazard-free, pollution-free manufacture of pesticides which are necessary for the needs of society and also to ensure safe and hazard-free application of these. However, there may be subsidiary objectives of attaining self-reliance and giving impetus to development thereby giving access to larger sections of the population to the benefits of the fall-out of industrial development in general.

Structure of the Report

A word about the way this report is structured would be in order at this stage. The perspective has already been underlined in the preceding paragraphs. The evolution of an industrial policy in India would be discussed in the following chapter to give a background to the licensing and control regime followed by the detailed treatment and analysis of the various elements of the policy in the context of the Indian situation. The existing pesticides scenario with reference to technology, R&D, production capacity, market potential, infrastructure, environmental safety in manufacture of pesticides, marketing and distribution infra structure; existing registration procedure, will be discussed in different chapters. While the focus will be on the Indian situation for purposes of comparison, reference will also be made to the RENPAP region as well as the international scenario. Finally, it is proposed to develop an agenda for a comprehensive policy in the context of the Indian conditions but one which may be of some relevance to the developing countries of the Asian and the Pacific Region

CHAPTER - 2

EVOLUTION OF INDUSTRIAL POLICY IN INDIA

Regulatory Framework for Industries In India

It is necessary to have an idea about the regulatory frame work for industries in India in order to have a better appreciation of the complexities of Industrial regulations. Industrial production in India is regulated through a licensing regime covering a wide range of activities. The basic regulatory provi sion is the Industries (Development & Regulation) Act. In addition, there are regulations like Monopolies & Restrictive Trade Practices and Foreign Exchange Regulations Act which have been framed with a view to checking the growth of monopolies or market dominance and regulation of foreign equity respectively. In addition, there are certain other provisions which are contained in various guidelines and press notes issued from time to time laying down parameters in respect of licensing - related issues. Broadly, the Indian regulatory system has the following characteristics:

i) There is a broad division of industries on the basis of ownership into public sector (Government owned), private sector, joint sector (partly Government owned) and the foreign sector (foreign equity of more than 40%).

ii) There is also a very broad, though flexible, demarcation of area of activities assigned to each sector.

iii) Industries are also divided into sectors on the basis of investment in land and equipment as small scale (investment upto Rs. 3.5 million) medium and large scale, and also the "tiny" sector.

iv) There are restrictions on import of technology and capital which are governed by Foreign Exchange Regulation Act and import-export regulations.

v) There is prioritisation, of industries but such a prioritisation is basically relevant, in the present context, with reference to import of capital and technology, and ownership pattern between foreign and Indian sector.

The entire regulatory regime as evolved over the years is in consonance with the basic economic goals of the Government, namely self reliance and allocation of resources (both capital and material) in accordance with predetermined national priorities. Resource allocation is sought to be affected through the instruments of licensing and regulating financial flow through term lending institutions and both these have been used to channelise investment in the desired sectors. The Industrial Policy Resolution of 1956 formed the basis of the policy that has subsequently been followed. Although the Government of India had passed an Industrial Policy Resolution in 1948 itself, it only broadly defined the role of industrial development in the overall economy of the country. The Resolution passed in 1956 was more precise and gave direction to the industrial development of the country, and inspite of shifts in emphasis over the years in licensing and related issues, the basic structure created by the Industrial Policy Resolution of 1956 still remains in tact. Broadly, the Industrial Policy Resolution of 1956 determined the following thrusts for the industrial development of the country:

i)It accepted implicitly the principle of a mixed economy providing for the existence of the public and private sectors:

ii)It placed the public sector at "commanding heights of the economy" giving to it a major role in generating the necessary impetus to industrial development;

iii)It categorised industries where State was expected to take the initiative in establishing new undertakings but which allow the private enterprise to supplement the efforts of the State; and the third included the residuary industries the future development of which was left to the initiative and enterprise of the private sector.

The policy spelt out in the Resolution of 1956 was reviewed from time to time and the Government came out with Industrial Policy Statements in 1973, in 1977 and in 1980. Basically all these Policy Statements reflected the concerns and priorities of the Government of the day and also took into account he changing scenario - both domestic and international - and made corrections and adjustments keeping these factors in view. For instance, the Policy Statement of 1973 addressed itself specially to the growth of industrial monopoly and market dominance by unfair means - tendencies which were evident at that time. It made certain adjustments to tackle these tendencies by passing regulations to check these. Similarly, the statement of 1977 laid special emphasis on the interaction between the agricultural and industrial sectors of the economy and segmented the industry further by providing for what is known as the "tiny sector". It also laid emphasis on development of village and rural industries. The Statement of Industrial Policy of 1980 takes into account the fact that the country had reached a take off stage in the indus trial development and laid emphasis on optimum utilisation of installed capacity; achieving higher productivity, promoting export-oriented industries; and producing high quality and inter nationally competitive products.

It is obvious that the p licy guidelines or thrusts indicated from time to time had less to do with the ideological slant of the Government of the day than to a recognition of the ground realities of the situation. It can be said on hindsight that the policies which have been followed over the years were all rele vant at the points of time when these were spelt out. For in stance, initially the private sector basic infrastructure of industry which needed greater State participation and involve ment. There was also reluctance on the part of private sector to invest in projects having a longer gestation period and offering lower returns. The situation, however, changed over the years and necessary directional thrusts were given through policy pronouncements, while taking cognizance of these changes. While sectoral prioritisation of industries has been the key note of policy over the years, concepts like the minimum economic size, higher emphasis on quality and competitiveness, greater utilisa tion of installed capacity have of late been given more impor tance. There has also been a distinct liberalisation both in policy and procedures for promoting rapid industrial growth. An important concern which flows from the basic objective of self- reliance has been the role of the foreign sector in India's industrial development. While there have been restrictions on injection of foreign equity in the Indian corporate sector, there has been considerable liberalisation in this area also during the last few years and the foreign sector has been assigned a role in high technology areas while its participation is regulated in such a way that investments made are in tandem with the priori ties and objectives of State policy.

The Indian Government has from time to time come out with Industry - specific policies considering the special characteristics of certain industries Thus, specific policies have been formu lated for the Textile industry, the Drug industry, etc. But so far no policy specific to the Pesticides industry has been formu lated. Nevertheless, there are certain provisions in the Indus trial po'icy which are peculiar to the pesticide industry. These relate to a provision that at least 50% of Technical grade pesti cides manufactured by a

company in the organised sector would be made available to non-associated Formulators and a provision for Broad-banding of certain group of pesticides. The former is intended to check monopolistic tendencies and encourage manufac ture of formulations in the small scale sector and the latter is meant to provide flexibility to the manufacturer within a li censed capacity and this has been done to ensure that the exist ing capacity is utilised to the optimum levels and the manufac turer does not have to come to the Government for approvals of switching from one product to another within the same band. Apart from this, however, there are no specific provisions regulating licensing for the pesticide industry as such, even though a separate registration procedure, as distinct from licensing does exist as is the case in most countries of the world.

CHAPTER - 3

STATUS OF PESTICIDES INDUSTRY IN INDIA

India has 15% of the world's population and 2.5% geographical area, 40% of which is available for cultivation. With the present population of 700 million expected to cross 1,000 million meter in 2000 A.D, the pressure eon increasing food production is under standable. Besides, India is primarily an agricultural country, its population living in 0.6 million villages, more than 50% of which have a population of less than 500. More than 50% of the agricultural holdings are marginal and the average holding is very much smaller than those in the United States and Western Europe. The total food production in India in 1985-86 was 150.4 MT which has risen to an expected 178 MT in the year 1988-89. However, given the rate of increase in population, the expected requirements of food grains by the year 2000 AD would be 220 MT. Since most of the area available for cultivation has already been put to use and per hectare yield has also only a marginal potential for further increase, the need to conserve whatever is produced becomes even more acute. According to the present estimates, 50% of the potential of food production in India is lost due to insects, pests, plant pathogens, weeds, rodents, etc. More than 40,000 insects have been recorded in India of which 1000 have been listed as potential pests of economic plants. Of these, only 500 have been found to cause serious damage at some time or the other and of these 500, 70 have been causing damage consist ently.

Pesticides have, therefore, been given the status of an essential input in increasing agricultural production by preventing crop losses before and after harvesting. Insecticides also have a significant role in combating diseases caused by insects bearing disease. The term "Pesticides" includes insecticides, fungicides, weedicides, rodenticides, nematicides, etc. Pesticides are manufactured as technical grade chemicals having higher purity and then converted into formulations which are of different forms and which are actually applied for controlling of pests. Over 137 pesticides are registered for use in India, out of which around 60 are indigenously manufactured. Details of pesticides manufac tured, imported and exported are given in Annexure-I. The follow ing major pesticides are being manufactured in the country:

Insecticides:

Aluminium Phosphide, BHC, DDT, Dichlorvos, Dimethoate, EDTC Mixture, Ethylene Dibromide, Ethion, Fenitrothion, Lime Sulphur, Lindane, Malathion, Methyl Bromide, Nicotine Sulphate, Oxydemeton Methyl, Methyl Parathion, Phosphamidon, Pyrethrum extract, Quinalphos, Monocrotophos, Carbaryl, Endosulfan, Fenvalerate, Phorate, Phosalone and Temephos.

Fungicides:

Aureofungin, Barium Polysulphide, Copper Oxychloride, Cuprous Oxide, Ferbam, Mancozeb, Maneb, Nickel Chloride, Organomercuri als, Sulphur Colloidal, Sulphur Wettable, Sulphur Dust, Streptocycline, Thiram, Ziram, Zineb and Carbendazim, Tridemorph.

Rodenticides:

Cumafuryl, Warfarin, Zinc Phosphide

Nematicide:

Metham N-Sodium

Weedicides:

2,4-D, Paraquat, Fluchloralin, Isoproturon, Butachlor, Roundup.

Plant Growth Regulants:

Chloromequat Chloride, Napthalene Acetic Acid.

Structure of Production and Capacities

As already indicated in Chapter II, Indian industry in general is broadly segmented into large and medium sector which are clubbed together and known as the "organised sector" and the "small scale sector". This segmentation is based on the value of investment in plant, machinery and land and in the case of small-scale sector, this ceiling was till recently Rs. 3.50 million (US $ 0.194 million), which has recently been raised to Rs. 10 million. There is another aspect which is important to keep in mind and that is that while there is greater regulation of the organised sector, there is very little regulation of the small scale sector. The information base for the small scale sector is, therefore, practically non-existent as compared to the organised sector.

The history of the use of pesticides in India can be traced to the import of DDT for malaria control which was followed by the use of BHC for locust control in 1948. Thus the use of pesticides in public health programmes is much older in India as compared to the use in agriculture. Indigenous production of pesticides began in 1952 with the setting up of DDT and BHC plants and by 1958, India was manufacturing 5 basic pesticides with a total production of 5460 MT. By 1977, 42 different pesticides were manufactured in the country aggregating 40658 MT. The annual rate of increase in volume of production between 1966 and 1977 was around 9.9% which incidentally was much higher than the average annual rate of agriculture of industries, which covered around 3 to 5%. The production of pesticides during 1978 was 44,000 MT of which BHC and DDT accounted for 76.4%. India is now the largest manufacturer of basic pesticides among the South Asian and African countries excluding Japan with a total installed capacity of over 100,000 MT. The break up of the capacity of different groups of pesticides in the organised sector in India is given below:

Table 1 : Production Capacity Of Different Groups Of Pesticides

	Licensed capacity	Installed capacity	Letter of intent	DGTD registration
Insecticides	92,429	94,579	7,430	13,140
Fungicides	13,769	13,934	500	895
Rodenticides	1,344	1,344	-	-
Herbicides/Plant growth regulants & New Pesticides	7,859	9,939	1,900	13,500
Fumigants	2,378	2,378	-	-
Total	**117,779**	**122,174**	**9,880**	**27,535**

*The letter of intent indicates the fact that these capacities are in the process of being created.

It would be seen from the above that the installed capacity is now around 125,000 MT in the organised sector. The indigenous production of pesticides during the years 1982-83 to 1988-89 is given in Annexure II.

A detailed statement of installed capacity and production of Technical grade pesticides during the year 1985-86 to 1989-90 giving details of product-wise manufacture has already been given in Annexure I.

The following conclusions can be drawn from the above figures:

i)There is a continuing preponderance in terms of tonnage though not value of DDT and BHC in the manufacture of pesticides in India and in 1986-87 out of a total production of 56186 MT, these two accounted for as much as 33519 MT which works out to almost 60% of the total production. However, this includes use in both public health as well as agriculture:

ii)The capacity utilisation has been poor throughout being around 55% only. The maximum utilisation of capacity has been in DDT, Phosphamidon, Endosulfan, Monocrotophos, Dimethoate, Pho rate, and organo-mercurials. However, apart from DDT and to a certain extent, Endosulfan, capacities of other items were small.

iii)There continued to be a preponderance of insecticides in the overall manufacturing product-mix which was more than 80% of the total manufacture followed by Fungicides, which was slightly over 8% and the remaining groups were quite insignificant. However, it is interesting to see that over the years insecticides have shown a declining trend in production as a percentage of the total production and both fungicides and herbicides have shown an increasing trend, herbicides reaching a level of 3.9% as compared to 1.6% in 1982-83 and fungicides raising from 5% to 8.1% in 1986-87 and then declining to 6.8% in 1988-89. Similarly, while Insecticides have been declining from 90.5% in 1982.83 to 84.7% in 1986-87, there has been a slight increase in the years 1987-88 and 1988-89 being around 86.7% Nevertheless, the declining trend is certainly visible. This is primarily due to the fact that the Government have decided to peg the use of DDT in the Public Health sector to a level of 10,000 MT (Technical) in the year 1989. Nevertheless, the trend of increasing use of Herbicides, which may be due to introduction of higher levels of mechanisation in agriculture, is distinctly visible.

In addition to the technical grade manufacture, an assumption has also been made of the capacity for formulation in terms of basic material. It is interesting to see that the distribution of the formulation capacity in the organised sector is skewed and there is a preponderance for formulation capacity in the Western region of Maharashtra with very little capacity in the Northern region of M.P. and U.P. Table 3 will illustrate this point.

The above distribution could be explained on the basis of the use pattern prevalent in the country, a predominant use being in the cotton crop, which is concentrated mainly in the western region of the country. But more about the use pattern later.

Apart from the organised sector, which consists of around 20 units manufacturing technical grade and formulation in the country, there are more than 350 small scale units engaged in the manufacture of pesticides formulation in India. Unfortunately, the information and data base in the small scale sector is

Table 3 - Statewise Pesticide Formulation Capacity in India

S No.	State	Capacity (formulation in terms of basic material (tonnes)
1.	Maharashtra	39,727
2.	West Bengal	3,036
3.	Gujarat	5,934
4.	Kerala	6,516
5.	Tamil Nadu	4,300
6.	New Delhi	3,744
7.	Andhra Pradesh	4,004
8.	Madhya Pradesh	550
9.	Uttar Pradesh	500
10.	Goa	1,296
11.	Karnataka	1,296
	Total	**69,407**

very limited and there is hardly any information available on the manufacture of technical grade pesticides in the small scale sector, although the small scale units are engaged in the manufacture of technical grade pesticides also. All the different types of pesticides formulations, namely, dusting powders, wettable powders, emulsifiable concentrates and granules are being manufactured by the small scale sector. 2,4-D, Sodium salt, Zinc/Aluminium Phosphide and Copper sulphate, etc. are some of the technical grade pesticides being manufactured by the small scale units.

Even though it is difficult to assess the total capacity of manufacture of pesticides formulation in the small scale sector, based on the figures available with the Development Commissioner, Small Scale Industries, the installed capacity for various categories of formulations in respect of 350 small scale units is given below:

Table 4 : Installed Capacity of Manufacture of Pesticides Formulation in the Small Scale Sector

Type of Pesticides Formulation	Installed Capacity in 350 small-scale units (MT)
Dusting Powder	630,000
Wettable Powders	65,000
Emulsifiable Concentrates	100,000
Granules	25,000

The Office of the Development Commissioner, Small Scale Industries had collected actual data for the production of various pesticides formulations during the three years ending in 1982 in respect of 200 small scale units. These production figures are based on the information furnished to the Development Commission er by these small scale units themselves and it is, therefore, presumed that these figures reflected the information in respect of more efficiently run units, the other presumption being that the share of production of the remaining units would be insignificant.

Table 5 : Actual Production in Small Scale Sector

Type of Formulation	Actual Production (in MT) by 200 Small Scale Sector Units		
	1980	1981	1982
Dusting Powders	133,000	149,0001	44,000
Wettable Powders	7,800	13,500	11,500
Emulsifiable Concentrates	5,800	6,400	5,900
Granules	300	1,100	900

The above data would show that the percentage utilisation of installed capacity in the small scale sector is even lower par ticularly in case of emulsifiable concentrates and granules. The percentage utilisation on the basis of the available data in the small scale sector works out as under:

Dusting Powders	-	40%
Wettable Powders	-	30%
Emulsifiable Concentrates	-	10%
Granules	-	7%

The average capacity utilisation on the basis of the above would work out to around 36%. However, if one takes into account the fact that information in respect of 150 odd units is not avail able, which may be presumed to be less efficient, this average would go down further.

Apart from the small scale units in the private sector, the State Government owned Agro Industries Corporations and Cooperative Marketing Federations have also made significant contribution to the manufacture of formulations in India. These units have been set up in the state of Andhra Fradesh, Gujarat, Haryana, Punjab, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu. It would be seen from the comparison with Table - 3 that these units have primarily been set up in States having comparatively low capacity for formulation in the organised sector. However, in terms of production, these units have been making a significant contribution as would be seen from the Table - 6, which is based on data furnished by 79 such units.

The figures given in Table - 6 as also those in Table 5 would show that there has been a declining trend of production in the small scale sector including the units in the State sector since 1981. The reason for this is that during 1981, the earlier ban on creation of pesticides formulation capacity in the organised sector was relaxed and some capacity was permitted to be created in the organised sector also. Obviously, this has resulted in lower performance and growth of the small scale sector in formu lations.

Table 6 - Production of Formulation in State Owned Unit

Type of Formulation	Production During 3 Years 1980	1981	1982
Dusting Powders	23,800	27,500	23,400
Wettable Powders	3,500	1,000	-
Emulsifiable Concentrates	400	500	700
Granules	-	-	-

These units are mostly getting the technical grade material from the large companies in the organised sector and formulating it for them in a number of cases. Apparently, the relaxation of restriction on creation of additional formulation capacity in the organised sector has resulted in some of those units in the large scale sector which were getting their formula tion manufactured from the small scale units doing it themselves.

Profile of the Pesticides Industry

The Indian pesticide industry can broadly be divided into (i) multi-national companies, (ii) Indian companies in the organised sector (iii) Public sector companies and (iv) small scale sector. There are two companies manufacturing pesticides in the public sector, viz. Hindustan Insecticides Limited and Southern Pesticides Corporation Limited., 57 companies in the Indian organised sector manufacturing pesticides; 12 companies which are multina tionals. A discussion on the manufacturing capacity and the number of companies in the small scale sector has already been done in the preceding paragraphs and

Table 7 : Market Concentration (1985-86) for Important Technical Grade Materials

S.NO.	Technical Grade	Name of the Company	Market Concetration (% of market)
1.	BHC	Kanoria Chemicals	59
2.	DDT	Hindustan Insecticides Ltd	100
3.	Malathion	FICUM Organics	28
4.	Parathion Methyl	Bayers	99.8
5.	Metasystox	Bayers	100
6.	Fenthion	Fonthion	100
7.	Dimethoate	Rallis India	77.4
8.	DDVP	Ciba Geigy	100
9.	Quinalphos	Sandoz	84.5
10.	Monocrotophos	Ciba Geigy	45.1
11.	Phosphamidon	Ciba Geigy	75.5
12.	Thimet(Phorate)	Cyanamid	62.9
13.	Ethion	Shaw Wallace	39.4
14.	Endosulfan	Excel	70.1
15.	Fenvalerate	Gujarat Insecticides Ltd	31.3
16.	Cypermethrin	Bharat Pulverising	38.79
17.	Copper Oxychloride	Travancore Cochin Chemicals	100
18.	Dithion	Indofil	100
19.	Paraquat	Indian Expo Ltd	100
20	Aluminium Phosphide	United Phosphorous Ltd	54.4
	Total Production of 20 products		**51,811 MT**
	Total Production of the Remaining Products		**3,037 MT**
	Share of 20 products of total production		**84.5%**

they do not contribute substantially to the overall production of the country. In terms of turnover the Indian industry at present would be of the order of RS. 6000 million, which would be around US $ 300 million. It is, therefore, a very small industry even though it is growing. The market share of a number of selected pesticides of major companies in India is given in Table - 7.

It would be seen from Table 7 that the multi-national companies dominate the scene in India at least in respect of the technical grade material other than items like BHC, and DDT. Thus, Bayers has almost 100% market share in Parathion Methyl, Metasystox, Rallis India has a major share in Dimethoate, Ciba Geigy has a major share in Phosphamidon and a substantial share of 45.1% in Monocrotophos; Fenthion has 100% share in the product Fenthion, Cyanamid has a major share in Thimet Phorate and Sandoz has a major share of 84.5% in Quinalphos. However, Public Sector, Hindustan Insecticides Limited has 100% share in DDT and the Indian company, Kanoria Chemicals has a 59% share in BHC. There fore, although in terms of value and in terms of the number of products, the multi-national companies dominate the Indian industry scene, in terms of quantity, it is the Indian Public Sector Company together with the Kanoria Chemicals which account for almost 60% of the total production of pesticides since these two items, viz. DDT, and BHC account for a higher percentage in terms of volume of production. Some of the Indian companies like Excel, United Phosphorous, Gujarat Insecticides Limited etc. have done extremely well and are taking an increasing share of market in their respective products. Excel in particular has capitalised on the growing Endosulfan market and has captured 70.1% of the market share of this product.

Licensing Policy

Pesticides industry is included in Appendix I of the current Licensing Policy and, therefore, companies which are FERA compa nies (having a foreign equity of more than 40%) and those which come under the Monopolies and Restrictive Trade Practices Act are eligible for applying for new units for the manufacture of Technical Grade Pesticides. It is important to omention this point since normally there are restrictions on the FERA and MRTP Companies, but in the case of technical grade pesticides, these companies are permitted to create new capacities, perhaps due to the fact that the manufacture of pesticides involves high degree of technological capability and also a high degree of concern for safety and environmental con servation. All fresh capacities for licence are permitted with the condition that 50% of the production of Technical grade material should be given to non-associated formulators. This has been done with a view to preventing creation of monopolies which is always inherent in all industries which are technology- intensive as the pesticide industry is. There is no industry- specific licensing policy for the pesticides industry, unlike the case of the Drug industry and the textile industry etc. and apart from the above provisions, Broad banding is permissible in a number of products of pesticides. This has been done keeping in view similarity of chemical composition or manufacturing process, potential for using either the same plant or machinery with minor modifications or with addition of some balancing equipment and potential to offer wide product range to save consumers or industries. Broadbanding really means that any manufacturer can manu facture any product given in the particular brand even though he possesses a licence or approval for a different product in the same brand without the necessity of getting a fresh approval. Pesticides have been broadbanded into the following groups:

i)Mercury compounds

ii)Organo-phosphorus compounds

iii)Carbamate group of pesticides

iv)Organo chlorine compounds

v)Synthetic pyrethroids

vi)Carbamates/thiocarbamates

vii)Fumigants-Bromine based

viii)Fumigants-Phosphorous based

Except for the FERA and MRTP Companies which have to apply for a licence, the pesticides industry has been delicensed recently in June 1988 with a view to providing encouragement to setting up of these units, with the exception of 9 Technical pesticides. These pesticides are carbaryl, Quinalphos, Dimethoate, Aluminium phosphide, Isoproturon, Phorate, Monocrotophos, Carbendazim and Fenitrothion. These pesticides have been taken out from the scheme of delicensing in view of the hazardous process involved as also the potential for pollution.

As regards formulations there was a ban in 1974 on creation of additional formulation capacity since there was an over capacity available in the country. However, in July 1981, creation of additional formulation capacity was allowed in respect of State and Central Public Sector Undertakings and cooperatives. As of now, all pesticides/insecticides formulation based on technical material obtained from sources other than own manufacture require compulsory licensing, a decision which was taken after a review found that too much of additional capacity was being created and the utilisation of existing capacity was declining.

CHAPTER - 4

DEMAND, CONSUMPTION PATTERN AND MARKETING INFRASTRUCTURE

Consumption

The consumption of pesticides (technical grade) can be computed by adding production to imports. Even though India is almost self-sufficient in its requirement of pesticides, it imports some of the newer and more sophisticated pesticides. However, access to details of the import is limited. The data available from the Pesticides Association of India which can only be regarded as indicative of import of pesticides for local use and forms the basis for account of consumption of pesticides. This data is indicated in Annexure III. However, the data for the imports of pesticides for public health programme is more reliable and has been collected by the Ministry of Health which is given in Annexure IV and relates to the years 1982-83 to 1985-86. The entire import of pesticides for the public health programme is for the National Malaria Eradication Programme. Together with the data available for production which has been given in Chapter 3, the trend of consumption of pesticides beginning from 1954 shows a phenomenal rise from an initial consumption of 434 MT in 1954 to 58950 MT in 1978. The one notable feature is that with consumption of herbicide picked up after 1973 and increased by 76% till 1977-78. During the period 1985-86 pesticide consumption was estimated to be above 60,000 MT (in terms of technical grade which includes 3000 MT imported wholly in the form of DDT 75% WDP for public health programme and 2225 MT for agriculture). Out of the total of 60,000 MT, 12,000 MT was used for public health of which DDT, BHC and Malathion took the major share. Since the public health programme is a central programme, access to accurate data is easier than in the case of agriculture. The consumption of pesticides during the last 5 years for public health purpose is indicated in the following table:

Table 1 : Consumption of Insecticides During Last Five Years (For Public Health)

	DDT in terms of		BHC in terms of	Malathion in terms of	
	75%wp	Tech.MT 50% wp	Tech.MT	25% wp	Tech.MT
1982-83	17000	12750 8000	4000	3000	830
1983-84	12333	9250 7000	3500	3200	890
1984-85	13333	10000 6600	3300	3260	910
1985-86	15200	11400 7141	3570	388	110
1986-87	15200	11400 7141	3570	388	110
1987-88	15000	11250 9000	4500	35	10

The above information is regarding the purchase which was centrally made and does not include figures for purchase made directly by the State Government. The consumption of pesticides for agricultural purposes is very difficult to compute in exact terms since the end users are very large number of farmers and they are spread all over the country and there is no systematic system of collecting data from them. Even though agriculture is a state subject, plant protection in India is a joint responsibility of Central and State Governments. But because of the inherent difficulties envisaged in collecting the data from millions of farmers even the Central Directorate of Plant Protection is not in a position to have the same. Efforts are being made to collect and compile information regarding pesticide use through quantities actually sold by suppliers at different places. However, a broad assessment of the consumption of pesticides for agricultural purpose can be made by adding total production and imports and subsequent consumption

of pesticides in health programme which in 1987-88 in terms of technical material was 15760 MT; the total consumption in agricultural was 45564 MT which indicates that the consumption of pesticides for public health programme is 1/3rd that of the consumption of agriculture. There is a third user of pesticides which is broadly classified as the house hold use which is not covered in the above figures separately but is most likely included in the figures for agricultural use. Unlike the developed countries, the use of pesticides for the house hold sector is comparatively limited and confined to the urban areas. But with growing urbanisation its use should increase.

The annual pesticide use for different crops between 1979-80 to 1982-83 in terms of value, is given in the following table:

Table 2 : Annual Pesticide Use for Different Crops During 1979-80 to 1981-82

S.No.	Crop	Pesticide Use 000' Rupees (1970/71 prices)
1.	Rice	2100 to 2300
2.	Cotton	6400
3.	Millets	100
4.	Groundnut	325
5.	Gram	81
6.	Rapeseed & Mustard	81
7.	Other Pulses	195
8.	Soybean and Sunflower	11
9.	Wheat	175
10.	Sugarcane	87
11.	Jute	45
12.	Tobacco	20 to 25
13.	Vegetables	300
	Total	**9929 to 10134**

The above table would indicate that the maximum use of pesticides is for the cotton crop being Rs. 6400 million followed by rice which is Rs. 2300 million. In percentage terms the total use for cotton crop works out to around 64% followed by rice which is 23%. This is somewhat different from the position obtaining in other Asian countries, particularly RENPAP countries where the consumption pattern shows a 40% use in the rice crop followed by 30% use in fruit and vegetable crops, and cotton averages only 8% use. This could be due to the fact that the climatic conditions in India are somewhat different from the rest of the region with less moisture and humidity therefore giving rise to conditions of less pests in the cereal crops.

Even though consumption of pesticides in the agriculture sector has been showing steady growth, compared to the growth in agricultural sector, the overall consumption in this sector has not matched the former. Some of the reasons for the short fall in consumption can be as follows:

- abbarent weather conditions
- high cost of pesticides vis-a-vis lower selling price of agricultural produce
- inadequate farmers education in scientific choice and use of pesticides
- inadequacy in the distribution and sale point spread uniformly throughout the country
- increase in price of raw material has made the finished product costly
- introduction of low volume, high synthetic pyrethroids which would amount for a drop in the growth rate of consumption in terms of volume.
- comparatively high cost of intermediates, solvents, emulsifiers and packaging material.

The above reasons notwithstanding the low demand of pesticides as compared to increase in the demand for other agricultural inputs has been a cause for concern. A study undertaken by the National Council of Applied Economic Research of 22000 farming households in 1976-77 revealed that on an average 20% crops had been affected by insects and diseases, not to mention weeds and rodents. But only 7% of the area received plant protection cover.

Distribution Infrastructure

The distribution of pesticides in India is presently multichannel and the following main channels are in operation:

- The state department of agriculture
- Cooperatives and Agro-Industries Corporations

Private trading

Presently 77000 sale points are in operation in the country. The breakup of these sale points is as follows:

Sale points arranged by the State Govt. Depts	4973
Sale points arranged by institutional agencies	16237
Sale Points by Private Traders	Balance

The statewise position is given in the list at Annexure V.

The existing spread of sale points would indicate that it is not uniform and very uneven. For instance, in the State of Gujarat 3277 sale points which would mean 45% are operated by the cooperatives while in MP 55% are operated by the cooperatives but the position in some of the major states is just the opposite. In Bihar 84% of the sale points are operated by the private trade and in Maharashtra 89% of the sale points are operated by private trading. Tamil Nadu with 82% in the private trading and Uttar Pradesh with 87% in the private trading are in the same position.

The pattern of dispersed of the sale points in the states is further distorted by the fact that the biggest state in the country namely Madhya Pradesh in terms of area, has sale points numbering 5457 while the biggest in terms of population namely UP, the number is only 8105; in Tamil Nadu which is a very small state both in terms of population and area there are 9644 sale points. States like Gujarat which has 7355,

Andhra Pradesh which has 9386 and West Bengal are also comparatively smaller than UP and MP. These four states among themselves account for 44% of the total number of sale points in the country.

One reason for this apparent distortion can be the cropping intensity and the fertilizer use, since it is noteworthy that most pesticides in India are sold through channels which distribute fertilizer also. However, the above figures show that there is need for strengthening the distribution network in the country and to have it more evenly distributed.

Demand

Major areas of consumption of pesticides are broadly -

a) Agriculture

b) Public Health

c) Household Sector

As already indicated, use in the household sector is not separately demarcated and this use is reflected in the consumption shown against the agriculture sector. To that extent the demand projections can also be shown as between the agriculture and the public health sectors. A sub-group on pesticides appointed by the Government of India recently worked out certain demand projections on pesticides broadly, the methodology was based on the data as reflected in the report of the earlier working group of 1984 plus information collected from Ministries of Agriculture and Health and other Government agencies as well as various trends showing consumption of pesticides. The National Council of Applied Economic Research has made certain demand projections for pesticides used in agriculture sector in 1980 but the actual consumption based on production and import was found to be quite at variance with the report. There was no consistency in this either in that while in the earlier years the estimated consump tion based on production plus import was higher than the project ed demand, from the years 1980-81 onwards, the actual consumption declined vis-a-vis the projected demand. This would be clear from the table given below:

Table 3 - Projected Demand and Consumption of Pesticides

Year	Projected demand for Agriculture (MT) plus import (MT)	Estimated consumption Based on production (Figures in MT)
1978-79	944,170	56,000
1979-80	46,329	50,000
1980-81	49,124	45,000
1981-82	52,572	47,000
1982-83	56,633	50,000
1983-84	61,347	55,000
1984-85	66,700	
1985-86	72,694	

Another method used by the 1984 Working Group was to base the demand on the targets of the Plant Protection Division of the Agriculture Ministry obtained from each State and Union Territory. The states and the union territories were asked to submit estimated demand of pesticides itemwise after taking into consideration factors like consumption, intersubstitutability and the target area proposed to be brought under intensive/ extensive plant protection programme within the resources available. There after the requirement of pesticides was worked out roughly on the basis of area to be covered under high yielding varieties of crop and the total plant protection coverage. The logic for this was that it was presumed that the use of pesticides would be directly proportional to the increase in the area under the high yielding varieties.

The above was the methodology used in 1984, but the Working Group of 1990 did not have access to this kind of information and based its projections on the demand forecasted by the Ministry of Agriculture in 1984.

The Sub-group on pesticides appointed by the Government of India in 1989-90 outlined the following factors which need to be taken into account for demand forecasting.

- Area under high yielding varieties under each crop and likely annual increases.
- Area under assured irrigation and likely increase
- Present level of fertilizer consumption and likely increase
- Targets to be covered under pesticides
- Marketing trend in each crop region of the country.

However, a task force of plant protection for the 7th Five Year Plan set up in the Ministry of Agriculture found that planning was not possible because of lack of availability of data and methodology of forecasting. The existing data collection system in the agriculture sector is extremely inadequate and therefore in the ultimate analysis the sub-group on pesticides forecasted demand on pesticides depending upon the trend analysis and end- use analysis, but found that the trends of use were more weighted in favour of potented new generation pesticides. It also decided that the fore casting can be done for each and every pesticide crop potential of every pesticide was different and not for pesticides in general. Another assumption that the sub-group made was that conditions would be normal in which variables such as the amount of rain, fertilizer consumption, pest occurrence etc. would be normal. The sub-group assessed the demand of each pesticide under different categories such as pesticides required for seed treatments, fungicides, rodenticides, herbicides and insecticides. The sub-group found that by adopting this methodology it was easier to forecast the demand for all groups of pesticides except insecticides as major inter-substitution was possible in case of insecticides only. Therefore, the demand of insecticides was estimated by assuming a mix of insecticides of high dosage, moderate dosage and low dosage varieties respectively. The study group took the demand assessed for 1986-87 as the base for forecasting demand upto 1994-95 and gave the forecast as per table - 4.

Table 4 - Demand Forecasting of Pesticides

	(Figures of Technical Material in MT)		
	1976-77	1989-90	1994-95
Insecticides	84,17	392,750	100,050
Fungicides	17,038	18,557	20,270
Herbicides	3,920	5,220	6,365
Rodenticides	1,200	1,500	1,970
Fumigant	223	310	460
Total	**106,354**	**118,437**	**129,115**

Public Health

Pesticides in India find an extensive use in public health programme like malaria control. The National Malaria Eradication Programme collects data on the use of pesticides in this programme and the figures of consumption of pesticides in the public health programme are more reliable than in the case of agriculture programme since the data base is firmer here, the Govt. controlling most of the distribution. The demand for public health programme is also easier to forecast since this is related directly to the increase in the population on the basis of a 100% coverage. The consumption of pesticides in the public health programme from 1982-83 to 1987-88 and the estimated production based on population increase upto the year 2000 AD are indicated in the following table:

Table 5 : Further Estimated Production as per Population

	DDT in terms of	BHC in terms of		Malathion in terms of	
	75% wp	Tech. MT	50% wp	Tech. MT	2 5% wp	Tech. MT
1988-89	23292	17469	41083	20542	21087	5858
1989-90	23766	17825	41848	20924	21546	5985
1990-91	23766	17825	41849	20425	21546	5985
1991-92	24206	18155	42628	21314	21933	6092
1992-93	24649	18487	43415	21708	22320	6200
1993-94	25089	18816	44191	22096	22070	6308
1994-95	25529	19141	44970	22485	23094	6415
1995-96	25937	19452	45753	22876	23499	6528
1996-97	26414	19810	46529	23264	20895	6638
1997-98	26855	20141	47305	23652	24291	6748
1998-99	27293	20470	48074	24037	24687	6858
1999-2000	27724	20793	48634	24317	25074	6965

The above estimates would show that the demand for DDT. BHC and Malathion had been showing an upward trend. However, an important point has to be considered here and that is the one related to resource constraint. Since the entire Malaria Eradication Programme depends on governmental resources which are under tremendous pressure, the projections made on the basis of population for future demand may not be quite valid. Besides, there are other factors like decentralisation of procurement of insecticides at the state level and the possibility of reordering at the state level which may result in the programme being given a lower priority.

There is another factor which has to be kept in mind while projecting the demand for pesticides in the National health programme and that is the growing pressure on the Government to ban DDT which constitutes the major component of the demand in the health sector. Like other countries, Govt. of India is under great pressure from environmentalists and other groups to ban DDT altogether. The use of DDT has already been banned for agriculture purposes but there are complaints that the DDT which is used in the National health programme also found its way to the agriculture sector. Although Govt. of India has not taken a final view in the matter it has been decided that the use of DDT for the National health programme would be pegged at levels obtaining in 1988. There is no legal back up for such a decision and this decision is only an administrative decision. Nevertheless given the pressure on the use of DDT the demand of DDT and consequently the demand for use of pesticides for public health purposes is not likely to match the estimated projections.

Breakup of Sectoral Demand

The demand which has been forecast for the year 2000 AD indicates that the agriculture sector would continue to dominate but the public health sector would considerably increase its demand in terms of percentage. This is of course assuming that the demand in the public health sector goes at levels proportionate with the increase in population - an assumption which is highly fallacious as mentioned in the foregoing paragraphs. According to the per spective plan for the year 2000 AD the following is the demand scenario:

a)	Agriculture Sector	1,00,000 MT
b)	Public Health	52,100 MT
	Total	**1,52,100 MT**

According to the above calculation the overall compound growth rate for the year 1994-95 work out to a modest 2% and even this growth rate assumes the following favourable factors:

- continuing increase in emphasis of agriculture production
- continued increase in irrigated area
- enhanced awareness in plant protection assuming the cost/benefit ratio of pesticides
- encouragement for the production of new pesticides from the Government
- intensive extension work
- continued extension of the modern agriculture practices

As would be seen the above demand projections hold good only for the agriculture sector and given the constraints indicated earlier, there is no justification for assuming an increase in the use in the health sector.

Market Potential

While the demand for use of different categories of pesticides has been assessed, it is equally important to have a look at the 'market potential' as derived from the assumption of demand which is based on certain trends and is worked out exponentially. In this connection it would be interesting to see that India constitutes only 1.9% of the total market for pesticides, being the order of 245 million US dollars. The USA with about 33% of the total world market is the largest consumer followed by Western Europe (24%),

and Japan (11.5%). This is against the back ground of India having about 15% of the total world population, 2.5% of geographical area with 40% of the total are being available for cultivation. Considering the fact that it is estimated that upto 50% of the potential of food production is lost due to insect etc. there is obvious potential for increased use of pesticides which is very low both in terms of per hectare and in terms of per capita.

Apart from the obvious potential for increase in the use of pesticides in agriculture, the following table would show a skewed pattern of cropwise use of pesticides.

Table 6 - Cropwise use of Pesticides

Crop	Pesticide Share (%)	Crop area (%)
Cotton	52-55	5
Rice	17-18	24
Chillies/Vegs/Fruits	13-24	3
Plantation	7-8	2
Cereals/Millets/Oilseeds	6-7	58
Sugarcane	2-3	2
Others	1-2	6

The above table would reveal that cotton crop has 55% share of pesticides, with only 5% of the crop area, while cereals use only 6 to 7% pesticide with 58% of the crop area. Obviously, the area of cereals and oil seeds is the one which offers tremendous potential for increase in the use of pesticides and should point at the future growth and development of pesticide industry. Similarly, the distribution between the different sub-groups of pesticides in India also shows a preponderance of insecticides while entire RENPAP region shows the same trend in which 87% of the total formulated products constitute insecticides and only 7% herbicides, in the case of India the position is that there are 80 percentage of insecticides, and 8 per cent of Fungicides. The high demand for herbicide in USA and Western Europe can be attributed to mechanised agriculture while the high insecticide consumption in India in particular in Asia in general can be attributed to almost around the year tropical agriculture. However, as and when mechanisation takes place, which is bound to happen, there should be a growing market for weedicides and herbicides in India. In fact this market has shown an increasing trend in the recent past and Isoproturon which was practically unknown till about 5-6 years back has shown increasing consump tion in recent years. Therefore, in terms of potential, the herbicide market should show a growing demand. On the other hand, the present predominance of DDT, BHC and Malathion which account for almost 60% of the total production of pesticides in India (in terms of quantity even though not in terms of value) is bound to give rise to a change in that DDT and Malathion are going to be reduced in percentage terms both in value and quantities and other pesticides which have exclusively agriculture use are showing an increase. It is not necessary that such an increase should manifest itself on a proportionate basis in terms of quantity since the emphasis now is on more active and more selective pesticides which are capable of being applied at rates much lower than what was the case in the past. This rend is bound to increase in India also since there is a growing concern of environmental conservation and the need to reduce the load on environment as a result of the pesticide use.

On the basis of the assessment made by a Working Group set by the Government of India, the demand of different types of pesticides likely to arise in 1994-95, the likely production by that period and the gap between the demand and production is given in the Annexure VI.

It would be seen from the above that the pattern of production and capacity is such that there are not many items where there is a large gap between the demand and likely production. This is so because, as indicated, better utilisation of the production capacity can take care of the requirements. The major areas where production will have to be increased are Endosulfan, Monocrotophos, Copper Sulphate and to a smaller extent, Aldrin, Chlordane, Heptachlor, Chlorpyriphos, Metaxuron and Benthiocarb.

CHAPTER - 5

R&D AND TECHNOLOGY

Concept of R&D

R&D with reference to the pesticides industry would broadly involve the following three types of activities:

a) Development of new molecules which would come in the category of basic research

b) Process and product development. This would involve development of process for manufacture of products or molecules already discovered.

c) Development of new formulations and forms of application

d) Resolution of plant-specific bottlenecks and related process problems.

While most companies allocate their R&D expenditure on all the above activities, for the purpose of discussion here, the activity indicated at (d), is being excluded since it does not entirely qualify as an R&D activity leading to substantial developments of a general nature.

Existing Infrastructure

The research and development work relating to pesticides in the country is being carried out in Central Scientific and Industrial Research laboratories (CSIR), Indian Council of Agricultural Research (ICAR) laboratories, Agricultural Universities as well as R&D Centres of various industrial houses both in the private and public sector.

The CSIR laboratories which are Government controlled have contributed a significant share in the development of technologies for manufacture of pesticides. Some of these are Regional Research Laboratory, Hyderabad, the National Chemical Laboratory, Pune and Regional Research Laboratory Jorhat. The main focus of research being done in these laboratories has been that relating to the activity indicated in (b) above, i.e. for developing indigenous technologies for manufacture of molecules already discovered elsewhere. These laboratories have not developed any new molecules as such. In fact, inspite of the infrastructure available, India has not been able to contribute a single molecule for commercial exploitation as a pesticide. Nevertheless, the technologies developed in respect of certain known insecticides in the CSIR laboratories have been commercially utilised to a very large extent. Roughly all these laboratories in the Government sector including the Hindustan Insecticides Limited R&D Centre are developing technology for over 40 products and their intermediates which are at different stages of commercialisation.

Besides the CSIR laboratories, many manufacturers of pesticides both in the Government and the private sector have their own R&D Departments possessing good infrastructural facilities. Hindustan Insecticides Limited which is the major Government company engaged in the manufacture of pesticides has established a well-equipped Research & Development Centre. This Centre is also primarily engaged in the process development for pesticides and their intermediates. Besides, there is a UNDP/UNIDO project

which is being implemented by the Hindustan Insecticides Limited and which again is primarily concerned with development of pesticides formulation capability in the country. The Centre is engaged in developing technology for newer and safer formulations, making detailed studies on raw materials required for formulations and is also engaged in developing trained manpower for the pesticides formulation industry in the country. Besides, there are a number of companies in the private sector which have inhouse R&D facility and which are actively engaged in the development of various types of pesticides technology. These companies are : (i) Ciba-Geigy, Bombay/Goa, (ii) Sandoz, Bombay (iii) Searle/Monsanto, Bombay, (iv) Alchemie Research Centre (Indian Explosive Ltd.), Bombay/Madras, (v) Rallis India, Bombay/ Bangalore, (vi) Excel Industries, Bombay, (vii) NOCIL, Bombay, (viii) Frederick Research Institute, Coromandal Indag), Madras ((ix) Multichem, Baroda, (x) Union Carbide, Bhopal (since closed), (xi) Cyanamid India, Bombay, (xii) Atul Products, Bulsar, (xiii) Bharat Pulverising Mills, Bombay, (xiv) Pesticides India, Udaipur, (xv) Sudarshan Chemicals, Pune.

The work, connected with the technology development of pesticides like toxicology studies, residue analysis etc. is being carried out in other CSIR laboratories, which are equipped for carrying out these specific tasks. For instance, Central Drug Research Institute (CDRI), Lucknow and Industrial Toxicology Research Centre (ITRC), Lucknow are equipped for pesticides toxicology testing facili ties, Ccentral Food Technological Research Institute (CFTRI), Mysore is equipped for analytical work on pesticides toxicology evaluation on insects and residue in food is being carried out in ICAR laboratories and agricultural universities like Indian Agricultural Research Institute, New Delhi; Punjab Agricultural University, Ludhiana, Haryana Agricultural University, Hissar; Agricultural University, Pantnagar, etc. Similarly, the R&D work on environment related problems particularly those related to pollution is being handed by National Environmentqal Engineering Research Institute (NEERI), Nagpur and ITRC, Lucknow.

It would be seen from the above that there exists reasonable infra-structure for R&D in India both in the public and private sectors and that there is sufficient trained manpower also available for this work.

Some Major Developments In R&D

The major developments in the field of R&D in the country have been influenced in recent years by the following major factors:

1.Intense awareness amongst the public regarding the environmental effects of pesticides and the need to incorporate stringent regulatory measures

2.The possibility of using non-lethal methods of insect con trol applying such tools was chemosterilant, hormonal and beha viour altering chemicals.

However, inspite of substantial efforts and investments made with regard to (2) above, only a few JH analogous like methoprene and CGA 13353 have reached commercial stage and that too for only small volumes of applications.

A major development has been the discovery of synthetic pyre throids. However, inspite of the enthusiasm generated by this group in the early stages of introduction, it is found that these lack a number of desired qualities. Fenvalerate developed by Sumitomo group and Fluvalinate developed by Zoecon Corporation have shown major departure from the original pyrethroids. This clearly indicated a new lead in the area. The acetylenic pyrethroid developed by Sumitomo and released as S-2852 was found quite e fective for flushing cockroaches on heated pads and in mosquito coils. Similarly, molecules which do not have a

chiral centre such as oxime ether or molecules in which there is ready epimerisation such as DDW 417, MTI-500 of Sumitomo are some of the more recent advances in the synthetic pyrethroids family.

Proinsecticide Strategy

The knowledge gained by the study of the metabolism of pesticides is now being applied specially to design modified forms of known pesticides in such a way that the resistance will be generated against the pests at the site of action. This approach known as pro-pesticides approach has been examined in its incipient stages and is worth looking at for future development.

Proinsecticidal Methyl Carbamates

N-methyl carbamate insecticides like carbofuran and carbaryl are effective insecticides. The fact that N-acetyl derivates of methyl carbamate have reduced their mammalian toxicity without loss of insecticidal activity had led to discovery of pro- insecticidal agents like carbosulfan of FMC, ONCOL of Otsuka, CGA 73210 of Ciba Geigy etc. However, a word of caution is in order with reference to these pesticides since their success depends to a large extent on the development of a safer non-MIC technology for the carbamate group of compounds. This is particularly relevant in the Indian context since the world's biggest disaster as a result of gas leak was caused in Bhopal in India in 1984 and this was the result of leakage of MIC gas. Following that, there has been a practical ban in India on fresh creation of capacity of carbamate group of compounds.

Proinsecticidal Organo Phosphate

The concept of pro-insecticides has been extended to some organo phosphorous compounds like Methamidophos; Acephate is one of the analogous of Methamidophos that has been synthesised and shown to have much less mammalian toxicity while retaining the same basic activity at the site of action.

Proinsecticidal Pyrethroids

The new synthetic pyrethroids are reported to have yielded derivatives which become insecticidal pyrethroids after metabolic conversion to the original compounds by the insects. Tralomethrin and Tralocythrin, the dibromo adducts of deltamethrin and cy permethrin, oximetha pyrethroid and their N-methyl as well as formamide derivatives are illustrations of this approach. This area has special relevant in the context of the issues of environmental safety.

New Targeted Insecticides

The majority of new pesticides have been developed as a result of the advances and knowledge of the chemical interaction with living organisms. They are generally much more active than older pesticides and also more selective. Greater activity would imply a lower per hectare application which has in many cases been reduced to in terms of grams of active ingredients per hectare instead of kilogram per hectare. This is very important in the light of the need to reduce the load on environment and in addition most of these are readily bio-degradable, thus further reducing any adverse environmental effects. Pesticides users are required to handle smaller quantities of active ingredients.

It has been possible to achieve greater selectivity through research on specific targets taking advantage of differences between species. This would mean that a high level of activity against the target pests may be accompanied with low toxicity to man and the environment. Some of the examples of such pesticides

are amidines of which chlorodimefuron, Amitraz and Dipnfen are well known examples which act by inhibiting the enzyme monoamine oxidase.

Herbicides

The well known herbicidal chemicals like 2,4-D, triazene, ureas, diphenyl ethers and non-selective ones like paraquat have been dominating the field for quite some time and a long awaited break-through in this field has occurred by the discovery of chlorosulfuron and sulfometuron which are effective at much lower dosages of 5-30 gm. per hectare. While herbicides and weedicides in India have not been in use to the same degree as insecticides, there is a growing potential for the use of herbicides and re search will have to focus on development of combination products.

The concept of high selectivity has been used in the field of herbicides by the development of chemical antidotes. When used along with herbicides, these chemicals, selectively protect crops from herbicide injury. Some typical examples of this are given below:

a)	1,8-naphtalic anhydride	Prevent injury in maize from the carbamate herbicide.
b)	N,N-diallyl dichloro Acetamide	Safener for EPTC in maize
c)	Flurazole	Safener for acetanilide herbicide
d)	Cyox metrinil CGA 02194	Safener for benzoacetonitrile

Development of Nature Based Pesticides

Significant steps have been taken in India in R&D for developing the natural based pesticides. Some of the examples are the synthetic pyrethroids, carbamate etc. Another related area is the use of phagorepellant which should play an important role in preventing the spread of viral diseases of plants by repelling their vectors. The crude extract of the plant called Neem containing azadirachtin as the repelling factor is also of considerable interest. However, some of these compounds like dihydro cypera quinone are even more potent inhibitors of oxidative phosorylation than rotenone but much simple to synthesis. Phytoallexins and alleopathic agents represent a new approach being followed in the area of natural products.

Microbial Pesticides

Micro organisms have been important determinants of the quality crops. In many cases these micro organisms are detrimental to crop quality but there are also examples of such organisms being beneficial to plants.

Significant advances have been made in the use of both predator/ parasites and pest pathogens. Integrated pest management schemes have been developed to take full advan tage of the relative merits of various approaches of some of the work being done in the area of research and development in the Indian laboratories in Government and public sector. However, the access to the research and development work being done in the laboratories in the private sector is rather limited for obvious reasons of confidentiality. But it can be assumed that the work being done in these laboratories would be more specific to the interest of the individual company itself. A list of new chemicals introduced in the Indian market during the 5-10 years giving details of the original introducers as well as company manufac turing the product in India are given in Annexure VII.

Similarly the names of the companies who have introduced new agro chemicals in India during the last 10 years are also given in Annexure VIII.

An analysis of the above would show that it is mostly the multi- national companies who have introduced new products in the country. Out of the 24 new products introduced, as many as 16 were introduced by multi-national companies. The reason for this preponderance of multi-nationals in the introduction of new agro chemicals in the Indian market is obvious and relates to linkages of these companies with their parents who control the world market for these products and were the major introducers of the products also. Since it is a distinct feature of the pesticides industry the world over to have a closely held technology, it is essential for developing countries in general and India in particular to have the necessary infrastructure which would enable such a transfer of technology to take place and also for such a technology to be upgraded. While there are numerous instances of transfer of technology having taken place quite successfully, there are not many instances so far of such a technology having been up graded.

The position indicated in the above paragraphs would indicate that; (a) India does possess reasonably good infrastructure both in the public health and the private sector for research and development, (b) there is also adequate infrastructure for technology to be transferred and absorbed, (c) the basic thrust of research and development has so far been for developing indigenous technology rather than developing new molecules.

While there is a need for doing some basic research for which a stage has been reached, the size of the Indian companies in terms of their turnover precludes such an activity on a large scale scene it involves not only time but also funds of an order, which can only be sustained by very large turnovers.

Technology Development for Intermediates

While it is true that around 59 technical grade pesticides are being manufactured in India indigenously a detailed analysis of some of the major pesticides shows that these are really being made from stage. This involves import of intermediates and manufacture of technical grade pesticides from these intermediates. Annexure IX which gives a list of 21 pesticides and their stage of manufacture would reinforce this point. One of the major products in use is Endosulfan. The foreign exchange outgo as a result of importing the intermediate which goes into manufacture is Rs. 112,690 /MT while the landed cost of Endosulfan finished product would be Rs. 115,000/MT. It would be seen that there is not much saving of foreign exchange to the country as a result of the so-called indigenisation. It is, therefore, an important area of concern for development of technology for intermediate required for manufacture of pesticides With the development of Chemicals and Petrochemical industry in the country, many of the materials and intermediate chemicals have become indigenously available which has played a significant role in the development of indigenous technology for pesticides. A few of the intermedi ate chemicals for which indigenous technology has been developed in the country are (i) Para nitro-meta cresol, (ii) Trimethyl Phosphate and (iii) Butenediol .

However, as indicated above, this process has just begun and should be a focus for research area in the near future.

Formulation Technology

Formulation technology has a vital role in developing products which are effective but at the same time safer and easier to handle. The distribution of different formulations types in products presently in the

market in India is given in the following table.

Table 1 - Annual Output of Formulated Products (MT/KL)

Formulation Type/Years	1983	1984	1985	1986
Dusts	5,35,074	4,87,397	3,86,452	3,45,501
Wettable Powder	22,136	27,329	25,280	28,831
Emulsifiable Concentrate	23,014	23,390	26,533	24,911
Solution Concentrate	3,667	4,006	4,498	4,462
Others	2,834	3,625	3,956	4,595
Total	**6,03,925**	**5,67,237**	**4,61,244**	**4,27,178**

It would be seen that the pesticides formulations produced and marketed in the country are mostly of the conventional type. Safety to environment, better effectiveness and better cost benefit ratio in pesticides application would necessitate development of new types of pesticides formulations like controlled release formulations, flowables, water dispersible granules, micro emulsion, etc. Nevertheless significant advances have been made in the area of pesticides formulation development in the country by various Government as well as private agencies. Initially formulation technology was exclusively dominated by the multinational companies. However, with the establishment of Pesticides Development Centre with the UNDP/UNIDO assistance and also initiation of R&D work on the development of formulations by the National labs, this gap has been reduced to a very large extent. A brief about the significant role played by the Pesticide Development Centre developed with UNIDO assistance is given below:

Pesticides Development Centre - Its Role in Developing Formulation Technology

As the farming became more sophisticated, consideration to the needs of the user of pesticide in addition to the biological requirements of crop and pest has also gained considerable significance. Further the current trend of replacing older persistent pesticides with newer, more toxic shortlived and more specific materials has paved the way for the production of more sophisticated formulations with reduced application rate, safety in handling, less critical timing and more control on placement. Thus the ideals in keeping environment safe and ecosystem in harmony, lessening the user exposure during application and specific demand for high efficiency led to a spurt in the production and use of many new generation formulations in the developed countries. These newer formulations include suspension concentrates (SC), concentrated emulsions (EW), water dispersible granules (WG) and controlled release formulations. The possibilities for the adaptation of suitable formulations technologies being employed in other areas like drugs, paints, food material etc. also helped in clearing the way for the introduction of many of these sophisticated products.

Coming to our situation, continuous efforts are to be made to catch up with the current trends in the developed countries and to venture out for a timely entry into the era of new formulations which are relevant to our needs and environment aimed at:

- maximisation of efficiency with minimum active ingredient
- minimum exposure hazard
- minimising the use of flammable, toxic and costly petroleum solvents.

In this context, suspension and emulsion concentrates, water dispersible granules and coated granular formulations with altered release properties deserve utmost attention. These proven technologies in which the problems and risks involved are somewhat clear, makes it certainly easier and safer for attempt ing a switch-over from the conventional formulations in favourable situation where a cost efficacy advantage exist or significant ecological and environmental safety aspects are involved.

In the above context the achievements of the UNDP/UNIDO assisted country project, Pesticide Development Centre implemented by the Government of India through the public sector Hindustan Insecticides Limited, worth special consideration. The project is con ceived as the second phase of successfully completed country programme "Pesticide Development Programme of India" (PDPI), for strengthening and improvement of India pesticide industry by:

i)development of newer and safer formulation technologies

ii)adaptation of efficient application technologies

iii)information dissemination for safe manufacturing practices, quality assurance, raw material specifications and sources

iv)analytical and consultancy services

The Centre located at Udyog Vihar, Gurgaon, near the Indira Gandhi International Airport (New Delhi) is well equipped in research and technology development on the various multi-disciplinary aspects of Pesticide Formulation Technology. The project is supported by UNDP input of approximately 2.2 M US $ and a corresponding Government of India input of 11.4 M Rupees.

As a result of the major thrust given by the development of project for the formulation which are safer and effective and suited to the country's needs, basic technologies have been developed for several newer generation formulations which include suspension concentrates, concentrated emulsion, water dispersible granules and encapsulated granules with controlled release characteris tics. In addition a novel self-spreading type of formulation has also been developed for selectively controlling the surface feeding/ inhabiting aquatic pests like anopheline mosquito larvae. In addition to the creation of basic infrastructure for the development and scale up of these technologies, the project has also set up training facilities to cater to the needs of the Indian Pesticide Industry, for disseminating state-of-art information on Pesticide Formulation. The Centre is supported by a well equipped analytical laboratory to cater to the needs of the pesticide industry and is also actively participating in the CIPAC collaborative testings, assisting Bureau of Indian Stand ards for development/ improvement/ standardisation of analytical methodologies.

The following services are offered by the Centre for the benefit of the pesticide formulators in the country.

i)Formulation technology development and transfer of know-how

ii)Technical consultancy for manufacture of pesticide formulations

iii)Analytical services including development of methodology

iv)Bio-efficacy testing and field trials

v)Regular training programmes and specialised courses.

In addition the Centre serves as the technical coordinating unit for Regional Network on Pesticides for Asia and the Pacific (RENPAP) project and UNDP/UNIDO in pesticide formulation technol ogy and quality control.

CHAPTER - 6

EQUIPMENT AND PACKAGING

Equipment Required for Technical Grade Manufac turing

The equipment required for pesticide industry is by and large similar to that for any other chemical processing industry. The various types of equipment can be classified into a number of groups like mechanical, fabricated items, rotating equipment, heat transfer equipment , instruments, valves, pipes and fittings, and service facilities like refrigeration, steam genera tion units, water treatment plant, material handling equipment etc.

A study shows that there is sufficient capacity as well as capa bility for the manufacture of such items in India and the Indian manufacturers also possess the requisite design and fabri cation capacity. However, there are some specialised items which still need to be imported in order to get performance of better quality.

Mechanical Equipment

Indigenous manufacturers have the capacity to undertake, design and fabricate reactors, columns, heat exchangers, storage tanks etc as per various international codes. However, a number of items like thin film evaporator, special rotary drum filter and materials like titanium are still imported. Besides, certain specialised glasslined equipments also need to be imported in the absence of adequate facilities for manufacturing the same.

As regards reactors, there are number of manufacturers capable of supplying small to medium size reactors, but large size reactors still need to be imported. Also, quality of glasslining needs upgradation.

The indigenous manufacturing industry for the manufacture of mechanical equipment is however characterized by absence of capability to meet the short delivery schedules. It is necessary that this capability is developed and the industry made more competitive. One of the reasons for the absence of this capability is dependence on imported plates and other components which themselves are long delivery items. It would be worthwhile for the more sophisticated parties to tie-up with manufacturers of international level for specialised items and manufacture these in India.

Rotating Equipments

There are number of manufacturers in the country manufacturing process pumps for mechanical application which meet the necessary international standards. These are with mechanical steel or gland package in most of the material of construction like SS, CI, alloy 20, non-ferrous metal, polymeric material and rubber lined. Water service pumps are also available in a number of designs suitable for different applications such as boiler feed, conden sate extraction and fire fighting services. But specialised pumps like metering/dose pumps are not being manufac tured indigenously, even though high vacuum pumps are available within India. Suction flowmore centrifugal tanks, are also manufactured within the country in a number of material of construction.

Pipes, Fitting and valves

All pipelines and fittings of cast steel are manufactured indigenously and these meet ASTM, BS and corresponding IS specifications. MS glasslined pipes are also being manufactured in the country but here again the number of manufacturers is very small, being one or two, and the delivery schedules are very long. In order to meet the needs for valves for pesticides needs, block and check valves in CS and SS are being manufactured in India. Entail valves, ball valves from bar stock in different types of material are also indigenously manufactured. But valves with special lining like teflon, polypropylene, though being manufac tured within the country, are not of requisite standard. The cost of these are also prohibitive. Similarly CS glasslined valves which form the major portion of requirements of valves in pesti cides plants are being manufactured in India but here again the quality is not up to the mark and the delivery periods are very long. In order to meet the total requirements of the country, reputed companies in the organised sector need to be encouraged to manufacture glasslined diaphragm valves.

Electrical Equipments

Power transformers, circuit breakers, low voltage relay valves, MCC power capacitors and motors are manufactured in India by several manufacturers. Flame proof motors and light fitting are also manufactured within the country. However, flameproof telephones and plant communication systems for hazardous zones still need to be imported.

Instruments

All instruments required by pesticide manufacturing facilities such as temperature indicators/recorders, pressure indicators/recorders, pneumatic and electronic type pressure indicators, flow indicators/control panels and accessories like cable, tubes, junction boxes, are being manufactured on requisite quality by indigenous manufacturers.

A list of equipment required for pesticide manufacturing plant is given in annexure X.

Requirement for Formulation Industry

The type of formulation which are presently being manu factured in India are mostly of the conventional type. Since these formula tions being manufactured in the country for a long time, the capability for manufacture of equipment for these formulations also exist within the country in an abundant measure. With the emphasis on development of newer type of formulations like flowables, water dispersible granules, ULV formula tions, low solvent emulsions, micro encapsulation, CR formula tions etc the need for developing capability for the manufacture of equipment required for these has recently been felt. While formulations like ULV, Low Solvent Emulsion do not require any special type of equipment, flowables, Water Dispersible Granules, micro encapsulation and CR formulations do need special type of equipment for which the capacity does not exist. Reputed fabricators of formulation equipment should be encouraged to tie up with international manu facturers for manufacturing specialised equipments. A list of equipments required for pesticide formula tion industry is given in annexure XI.

Packaging and Handling of Formulations

Pesticide products by their very nature demand special treatment in selection and design of packaging. This is so because one the one hand pesticides involves highly toxic and sensitive material during manufacture itself and on the other these have a very wide application and the applicators generally, specially in countries like India, are not sophisticated or highly adapted persons. In India the varying nature of soil conditions, extreme climates, variety of crops, and the vastness of the country have resulted in production of innumerable pests. Whereas the production centres are generally situated in the urban areas, the demand is very wide spread throughout the country. Besides the production centers are situated in the urban areas, the demand is very wide spread through out the country. Besides pesticides are seasonal demand products and higher per centage of their production is more during a shorter period of the year. These factors call for effective logistic for distribution of the products and at the same time to ensure that all national and international regula tions are adherent to. Packaging therefore plays a very vital role in achieving these objec tives.

Appropriate packaging leads to a to a number of advantages and the specific requirements and economic considerations influence the material selection and the instrument of packaging. Besides it is also essential to ensure that the product is not unduly cost escalated as a result of the expensive packaging materiel. Appropriate packaging can lead to the following dis tinct advantages:

i)Improved efficiency in handling

ii)Better warehousing and storage

iii)Protection from economic damage and deterioration from environmental conditions.

iv)Higher market acceptability of the product as a result of better packaging.

v)Better health and hygiene conditions of presentation of the product.

vi)Provides pilferproof system.

vii)Facilitates transportation and economic costs.

For purposes of packaging requirements pesticides can be classified broadly on the basis of their end use into three major categories, i.e. public health, agriculture and household. The use for public health agriculture purpose are produce in different forms like dust, wettable powder, granules liquid and paste. The use for household purposes are normally marketed in the form of tablets, liquids, pastes, aerosols etc. Thus the end use determines the broad packaging requirements.

The type and the intensity of packaging is also deter mined by the sensitivity and toxicity of pesticides. The family of pesticides are normally classified in the level of toxicity and are designed in the different colour codes as illustrated below:

Toxic level	Colour
Highly toxic	Red
Medium toxic	Yellow
Less toxic	Blue
Least toxic	Green

The package selection assumes significance in the above context. Other considerations that influence the packaging design and selection are:

a)Prevention of adulteration and induction of specialised products.

b)Dose level of application in the field and

c)Storage and transportation conditions.

The legal framework for packaging framework is provided in the Indian Insecticides Act 1968. This encourages the national standards covering packaging material methods of testings as well as various test procedures. These regulations normally spell out the safety and statutory requirements covering the pesticides production, packaging and marketing, colour codes, warning notes, product details, handling and storage requirements, disposal of use containers etc., which the pesticide manufacturers are legally required to be adhered to.

Factors Influencing package selection

Pesticides fall widely in the sensitivity as well as toxicity. Product sensitivity to atmospheric conditions particu larly moisture, air temperature and pressure need to be considered while selecting the packaging media. The other important factors include the active ingredient level largely get reduced to atmospheric conditions and the minimum shelf life conditions which is of the order of 1-2 years in most cases. Most of the usage which is determined by the dispersing techniques and the quantity per bulk versus the acreage requirement is another factor determining packaging selection. Besides for storage and transportation conditions also constitute a constraint in this regard.

Packaging Materials for pesticides

Depending upon the nature of the product and the end-use requirements, they are packed in a variety of packaging materials. In the case of dust and wettable, powder, the most common unit package adopted is a plastic suitably heat sealed and then contained in a printed paper board carton. The commonly marketed quantity is 500 gms. The paper board carton is essentially print ed with details conforming to the legal requirements. Desired number of such units are normally bulk packed in wooden contain ers.

These products are also distributed in bulk quantities of 25 kg and 50 kg pack and for public health purposes and one of the conventional medium of packaging adopted in this case is a jute bag with a plastic liner. Depending upon the sensitivity of the product, instead of a direct simple jute liner, often a laminated jute bag is used. The loose liner inside is twist tied and the outer jute bag is stitched. The laminate can be either a polyethylene liner or a craft paper liner, the bonding medium generally being bitumen.

In the case of granules, different systems are adopted and they are also marketed in different quantities like 500 gm, 1 kg, 5 kg and above. For lower quantity level, either a LDPE bag with an outer printed paper board carton or a LDPE bag with a tinplate container or a plastic container is used. For bulk quantities such as 25 kg, either an HDPE or tinplate with an inner LDPE linear is used.

The conventional medium for packaging of liquid is to use glass bottles with appropriate closure mechanism to ensure prevention of leakage. The other conventional material used is a 3 piece tinplate container wherever needed with suitable internal lacquers. A shift towards use of aluminium bottles for

small quanti ty liquid packaging is noted in recent years. The smaller units are normally 100 ml, 250 ml, 500 ml, and 1 liter. For quantities above 500 ml to about 5 liters, commonly a rectangular printed tinplate container with suitable internal lacquering is used. The bulk packaging medium in all the cases is either a corrugated fiber board box or a wooden case.

Newer Trends

With the technological developments over a period of time and with improved and newer materials and systems, a definite change in the trend of packaging of pesticides has been seen. The majority of the industries still continue to use the conven tional system of polyethylene with a printed outer paper board carton for packaging of a large number of pesticide powder and granule products. Since the introduction and acceptance of poly ethylene bags, a large number of alternatives are available either in the form of a single film or combination of materials with other film substrates and paper board materials. Availability of plastic films of the HM-HDPE, LDPE, Polypropylene and the like have definitely provided a number of alternatives to the conventionally used LDPE film and pouches. For unit packaging of dust and wettable powders, the other alternative of the type of laminated pouches which can be either a combination of different films or combination of films with aluminium foil and papers could be considered. The other useful alternative could be the lined cartons. In the event of using a laminated material, the need for adoption of dual materials like LDPE pouch with an outer carton should be further reviewed taking into consideration the economies of production and protection factors.

Glass bottles were the major packaging medium for liquid pesti cides. Due to their inherent disadvantages of higher weight and fragility, they have been slowly replaced by other packaging medium. But with the introduction of light weight, thermal resistant and coated glass containers, the adoption of such glass based packaging media may have to be looked into. The immediate alternative for the glass bottles is an aluminium based container. However, it is envisaged that these containers would face stiffer competition from the newer developments in the field of plastics, namely, PET containers and co-extruded bottles. The latter group of material scores over the conventionally available aluminium containers because of reduced tolerances, light weight, etc. Considerable changes have been entrusted in the design and material of closure which in addition to being attractive gives a better leak-proof and pilferproof mechanism.

In the area of bulk packaging the conventionally used jute bags have experienced stiffer competition from HDPE woven fabric sacks, PP woven fabric sacks and multiwall paper sacks. The former two can be made from a flat fabric or as a circular bag itself. The other entry in the field of flexible bulk packag ing medium is the high gauge polyethylene bag/sack, a laminated sack made of PP woven fabric/ adhesive/kraft. Attempts made to produce a combination material - a combination sack from jute with HDPE and PP fabric also seems give certain advantages. One of the primary advantages this combination offers is the better friction between the stacks to enable height s' ck and reduced slippage. The improved quality of jute materials with reduced oil content and bleached fabric will enhance the acceptability of jute sacks. A further improvement on the direct high gauge poly ethylene bag is to produce a co-extruded direct high gauge sack ing material/bag. Due to the advantages of coextruded technique and the combination of two or more direct materials, it facili tates use of lower gauge in comparison to high gauge monolayer film bag. Thus considerable developments have taken place in the field of flexible bulk package and hence such alternatives should be examined vis-a-vis the benefits offered by them.

The latest trend in the distribution of such products like fertilizers, cement and pesticides is the adoption of intermediate bulk containers (IBCs) of the capacity of 200 kg to 2 tones. These could be advantageouly adopted for bulk distri bution of the products and offer advantages of very low volume for empty high bag

storage, high filling speed, 2 to 3 stack high, improved productivity at filling, handling and emptying, high flexibility to meet the special needs of users, improved security level, easy cleaning for reusability and good price performance ratio. These bags can be designed as one trip bags or multi trip bags. These are generally constructed from woven PP with polyethylene or PVC liner. They are provided either with a loop mechanism so as to have one point handling or reinforced loops along the vertical edges so as to enable 4 point handling. The different types of handling devices can be inbuilt, such as basket handling like straps, handling sleeve, etc. Any other additional facilities such as protective flap for base, label holder, sampling pocket can also be built into. These IBCs quite often referred to as a "Big Bag" has become popular in the trans portation of such products like Cement, Fertilizers and Pesticides in most of the countries.

The other common bulk packaging media adopted till re cently particularly by the developing countries is the wooden cases and crates. The corrugated and solid fibre board boxes have been slowly replacing the conventionally used wood based contain ers. Since the recent past the plastic corrugated board also has been considered as a potential candidature bulk packaging system.

The advent of fibre board drums and plastics containers - carboys, drums, jerry cans, etc. can be effectively employed as an alternate to the conventionally used metal drums.

Shrink packaging is a concept of collation of the units and has posed challenge to the use of corrugated and solid fibre boxes. Shrink packaging of different types with and without tray have been found more economical in this context. The concept of shrink packaging can be employed not only for collation of smaller units but also even for bulk boxes with a pallet. This not only helps in the material handling but also provides an addi tional barrier linear for the packages and the contents thereof. Equally effec tive is stretch wrapping of the palletised load.

Probably other packaging means such as thermoformed containers, may come into use as a one dose package for some of the pesti cides particularly for household pesticides.

Dwelling of the possibility of marketing powder pesticides in tablet forms is found acceptable strip packaging of the tablets would be ideal. This would help in automation of tablet ing and strip packing, with improved productivity and more importantly considerable reduction in dust and atmospheric pollution. This will also result in better hygiene conditions for work force. The negative feature could be that such tablets and strips are normally used for pharmaceutical tablets and hence the associated potential danger.

Storage and Handling

Definite scope exists for improvements in the field of storage and handling for packaging materials and filled packages. Most of these materials being sensitive to deterioration, need appropriate storage conditions and improved materials han dling system which would help to retain their basic properties in addition to improving productivity and inventory system. Provision of appropriate rack system and dunnage system would help in this direction.

Generally the packages are marked by manual writing or the conventional stenciling system. While they may be effective to a certain extent, the demerits cannot be overlooked. In line automatic coding and marking devices as well as semi-automatic and automat ic marking systems for the bulk packages are now available which would help to improve the legibility of marking with economic advan tage. The development and design of appropriate storage system assumes greater significance in the developing

country where extremes of climate are experienced in addition to problems of pests. It is equally important that the ultimate users invariably being illiterate or poorly exposed, should be educated of the importance of appropriate storage particularly when multidose packages are handled. Design features in the containers could help to overcome possible chances of misuse and mishandling.

Package Disposal

It is not uncommon that in a developing country like India every consumer looks for recycling for the package. The pesticide manufacturer is always confronted with a major problem in this con text. He would definitely not want his container being put to use after dispensing the contents. The objective is best achieved by proper material and design selection. Education of the farmers and other end users of the products assumes greater significance. Mass communication media should be put to effective use here.

Palletisation and Containerisation

Probably in the field of transportation the adoption of unit load device (ULD) (pallet) and modern means of transportation (containers) are being neglected in most of the developing countries. While it is true that it is not an easy task to switch over to such systems in a short span of time, considering advantages of such modern handling and transportation systems offer, it would be advantageous for every manufacturer to commence implementation of such systems. The concept will have to be well understood because they have a definite relationship between the package dimensions and the use of pallet area on one hand and container volume on the other hand. In respect of the standard dimensions of the pallet and containers, the dimensions of the packages also need to be standardised so as to examine the space/ volume utilisation which is directly linked to the freight advan tages. In the context of exports, they become very realis tic as the handling facilities in majority of the countries are now redesigned to suit only palletised and containerised cargo. Thus the modular concept between the package dimensions and the pallet and container is of extreme importance.

Pollution Control

Pesticides are known toxic substances and hence their free presence in the air should be controlled to limit pollution if not avoid completely. The manufacturing practices and packaging line if carefully controlled would go a long way in this direc tion. A study of Indian situation would be highly revealing. Practically all the units still continue with their old and conventional manual to semi-automatic systems both in the produc tion and packing lines. These are also highly manually operated techniques. Obviously the chances of human harness and general pollution levels are very high. Thus these two would be the primary areas where mechanization and automation should be immediately introduced to combat pollution and towards better human safety. Appropriate packaging ensures adequate control enroute the movement of the products. Where the unit and primary containers are sufficiently strong and leakproof better care need to be exercised particularly in the case of bulk drums and flexible sacks. The latter is more easily susceptible to damage in han dling and storage and escape of pesticide through there could be of great concern. Construction of appropriate storage houses and provision of modern rack system/ ULD system as well as appropriate handling equipments would be of help.

CHAPTER - 7

ENVIRONMENTAL CONSERVATION, POLLUTION CONTROL AND SAFETY

The pesticide industry, by virtue of the fact that its production involves raw material, intermediates and final products which are highly reactive, explosive as well as toxic than is the case with most other industries, is regarded as highly polluting as well as hazardous. While the agencies connected with safety and environmental conservation including pollution do tend to get somewhat mixed up, it has to be kept in mind : a) pollution and environmental conservation and b) safety and hazard management; are two distinct, even though connected, aspects of pesticide manufacture and, to that extent would require separate treatment.

Existing Regulatory Framework

While there is a sufficiently elaborated regulatory arrangement for tackling the issues connected with pollution and environmental conservation in India the same cannot be said in respect of safety and hazardous waste management. The Govt. of India has been concerned with issues related to environmental pollution for quite sometime and has enacted the following legis lation to control pollution, which, inter-alia apply to pesticide indus tries also:

a) Water (Prevention & Control of Pollution) Act 1974

b) Water (Prevention & Control of Pollution) Cess Act 1977

c) Air (Prevention & Control of Pollution) Act 1981

d) Environment (Protection) Act 1986

In addition to the above The Central Water Pollution, Preven tion and Control Board issued MINAS i.e. Minimal National Stand ards for the Pesticides Manufacturing & Formulations industry. The Water Act of 1974 and the Water Cess Act of 1977 provide the basic framework for controlling pollutants in liquid effluents. The Indian Standards Institution and the various State Pollution Boards have prescribed standards for discharge of effluents into see and inland surface waters. The ISI guidelines are based broadly on the general potential of each industry, the efficacy of the pollution control technology.

The Air Act 1981 was a result of an increasing concern for air pollution and has a very wide ranging scope. It provides for the prevention and control and abatement of air pollution and the air pollutants can be solid, liquid or gaseous. There are however no ISI guidelines on this nor does the MINAS cover the air pollution aspect for the pesticide industry specifically. The air emission standards for the pesticide industry are still to be evolved. The Environment Act 1986 has much wider scope and re lates to all aspects of environment. The Govt and the authorities functioning in the Govt.have been given sweeping powers including the powers for closure of the polluting industry, disconnect electricity and power supply, etc. The Act also provides for strict punishments including prison terms upto five years for polluters.

The legal framework for the second aspect enumerated earlier namely safety and hazardous waste management is still rather weak and inadequate. The safety aspects primarily focus on the safety for the workers who are employed in the factories and the laws covering these are implemented by the Labour Ministry and the different agencies, the primary law is the Factories Act. Besides, quite recer tly, rules for

import, transportation, storage, manufacture and disposal of hazardous chemicals have been framed under the Environmental Protection Act. These cover all aspects of safety and hazardous wastes disposal in respect of 300 chemicals which have been listed and which include a number of pesticides.

Administrative and Institutional Framework

The administrative arrangements and the institutional framework for enforcing the laws and regulations concerning pollution and environmental conservation as well as safety and hazardous man agement are also rather weak considering the geographical area of the country. There is a Central Pollution Control Board as the apex body which is assisted by the state pollution control boards which function in every state. These primarily enforce regulations in respect of pollution and environmental conservation aspects. The regulation concerning safety and hazardous waste management have primarily been the concern of Labour Ministry and its agencies since the focus of all these so far has been the safety of the worker employed in the factories. However, the focus has been shifting recently to cover the safety for the people living in the sur rounding areas as well but no firm institutional arrangements has been devised so far to take care of these problems. There is another agency which is also involved in some aspects of safety and that is the Fire Fighting Agency. There are also certain laws in the various Urban Development Acts which impinge on the safety aspects. But as indicated earlier, there is no identifiable focal point to cover the safety and hazard ous aspects of the industry, in general and the pesticide indus try in particular, even though the Ministry of Environment has recently been designated as Nodal agency for safety and hazardous management as well.

Bhopal Gas Disaster and After

The Bhopal gas leak disaster which took place in December 1984 is considered the worst of its kind in the world. It was also a primary mover in generating concern for environmental conserva tion and safety in India. Interestingly even though the disaster was caused due to the leakage of MIC gas which again was due to gaps in the manufacturing process as well as storage facilities, the concern following the disaster spilled over to those connected with the use of pesticides par se since the item being manufac tured in this industry happened to be a pesticide namely Carbaryl. To that extent, Bhopal gas leakage disaster can be considered a water shed in generating public opinion on issues connect ed with not only safety and pollution in manufacture of pesti cides, but also in the application of pesticides. The Bhopal gas tragedy also brought into focus the poor zoning regulations and proliferation of industries in the densely populated cities in India. The locations for the various pesticides units in India show that when these were originally established they may have been away from urban settlements but urbanisation has cope up with them great faster with the result these units now stand surrounded by houses, shops and large human population. As a result, simple emissions from units are potential for increasing pressure for shifting these units away or being closed down altogether in the interest of the people living in those areas. In fact, as a fall out of the Bhopal gas disaster, the Union Carbide plant has been closed down. Further, the Govt. taking a note of the intensity of the tremendous public outrage which followed this disaster has since put a ban of manufacture of pesticides belonging to Carbaryl group since these involve manufacture and storage of MIC and Phosgne. The policy for the future manufacture of these pesticide is till under review.

Basic Issues Connected with the Pesticide Industry

The pesticide industry, as it deals with highly toxic and reactive chemicals is prone to be labelled as highly hazardous and poilut ing. This is the perception of the pesticide industry the world over not only in terms of manufacturing process but also on the application side, and the Bhopal gas leak disaster has given

an impetus to these contents in India also. Even though the major focus of these concerns is on the manufacturing aspect, even the application for utility vis-a- vis the benefits itself been called into question. One of the immediate option of these concerns has been the demand for banning a number of pesticides including DDT for their harmful effects. However, precious little has been done in the area of making application of pesticides safer and pollution free by educat ing the applicators properly. One of the reasons for this could be the very large number of farmers in India, as compared to, say, countries like USA where the number is comparatively smaller. Besides, the spread of these farmers is also much larger in India as compared to the advanced countries where Farming is confined to certain specific areas. The fact that the average size of the holding is also small in India further compounds this problem. The industry itself has also done precious little towards this problem and there is no proof to suggest that the industry has taken any major effort at educating the users in the safe and optimal use of pesticides.

The ill effects of pesticides through absorption in the soil, absence of biodegradability, absorption in water, and higher levels of residue in the human body than are considered healthy have been highlighted in t he recent past and these concern have given rise to demand for banning of and restricting the use of number of pesticides. In fact it has even been suggested that pesticides do not serve any useful purpose and their application should be dispensed with alltogether. This is an extreme view and is not shared by a majority of those in policy formulation levels of the Government, the industry as well as the users. This is so because the use of pesticides in India is comparatively lower lowest in the worth being only 1.9 % of the total and there does not seem to be a cost effective alter native to synthetic pesticides in the near future. However, the Govt. of India did appoint a committee called the Banerjee Committee taking note of these concerns and this Committee gave the following recommendations :

a)Till today 2,80,000 tonnes of DDT has been used in public health and nearly 50,000 tonnes in agricutural sector.

b)A survey of literature reveals that DDT is present in varius components of the environemnt. But, however, about the extent of contamination, the data are scanty.

c)The agricultural sector uses only a limited amount of DDT out of total availability. In 1983-84 the usage of DDT apeared to be 887 M. tonnes in agricultural sector. In contrast to this, DDT is pre-dominent insecticide for malaria control.

d)Although in some quarter, there is some apprehension that use of DDT under NMEP may result increase in insecticidal resi dues in human beings there is no concret evidence to prove it. As DDT has not so far produce acute or chronic manifestations in the community because of its use under Public Health programme and considering the enormous benefits accrued in terms of lower morbidity and mortality due to malaria and other communicable diseases - Plague and Kala-azar and improvement in nourishment. It is more practicable and pragmatic to continue to use of DDT in Public Health sphere because of the following reasons"

i)There are no reports regarding death attributable toacute DDT poisoning in India.

ii)Although residues of DDT in human tissues have been shown to be present since 1965, as yet not a single case has been reported or diagnosed suggesting the death as a result of heavy DDT residues in the victim. Cases of chronic toxicity are also unreported.

iii)Cost-wise spraying cost of DDT covbering 1 million popula tion is Rs. 33 lakhs and a change to BHC wuld increase the cost to Rs. 36 lakhs, while a change to Malathion would result in an expendture to Rs. 195 lakhs.

e)Since the persistent residues enter into the human bodies and animals through food chains, it was therefore, cau tioned that fodder cropps and feed should be free from their residues.

f)The use of DDT in public health should continue to the tune of 10,000 MT per annum till an acceptable substitute is identi fied by the Ministry of Health. However, a periodical review of its use should be undertaken.

g)The enforcement of the restrictions in use and education of the farmers should go hand in hand so as to avoid the defeat of the very purpose for which restrictions have been imposed.

h)The scientific evaluation should be taken up to find out suitable substitute of this insecticide under specific situation.

i)In order to check the pilferage of DDT meant for the purpose of public health to the agricultural sector, the possible solu tion could be by adding colour to it. Accordingly, the manufac turers could be instructed to manufacture coloured DDT for public health purposes.

j)There is an urgent need to monitor the extent of pesti cide residues in various agro-climatic zones and urban areas of the country on regular basis National Institutions.

k)In place of DDT, Endosulfan and other organophosphorous insecticide manufactured in India may be used Agricultural Sec tor.

While a number of recommendations of Banerjee Committee are still under process one of the offshoots was to ban the use of DDT for agriculture purpose and to restrict the use of DDT in public health to the levels prevailing in 1983, i.e. arund 10,000 MT (Tech.). However, it has been recently alleged that DDT being used for public health programme (primarily for the National Malaria Eradication Programme) is finding its way for agriculture and is causing problems of high toxic residues. This has been supported by a study recently undertaken by the Ganga Authority of India in the catchment area of the river Ganga where toxic residue levels in the soil have been found to be alarmingly high. The finding of these study have on the contrary, have been questioned by some experts associated with the Agricultural Ministry and the matter is still to be resolved. But the point that needs to be empha sised is that the need to restrict the use of pesticides is being felt by more and more people. One point that emerged as a result of all these concerns is that in future the load on environment will have to be reduced by going in for pesticides which require lesser per hectare application. This would need R&D efforts both for the manufacture of such pesticides as also for developing suitable formulations which should make the attainment of this objective possible.

It would also be clear from the above analysis that while the concerns for safety and hazardous in pesticide manufacturing; pollution and environmental degradation during the manufacture; and risk to human health as a result of the application have all been adequately highlighted, there are still a lot of gaps both in terms of institutional frame work as well as the legal backup to effect concrete solutions to these concerns. One striking example of this is the absence of any zoning regulation being enforced even after the Bhopal gas tragedy. It must however, be clarified that at the informed level there is a view which sometime reflects in governmental decisions that hazardous indus tries including pesticides should not be located at places

where these can cause damage to human beings. Besides the Government is also more circumspect in liberlising licencing procedures for the pesticide industry particularly for those pesticides which have been regarded as hazardous like Dimethoate even though there is a general trend towards liberalisation.

CHAPTER - 8

PESTICIDE REGISTRATION IN INDIA

The Insecticides Act, 1968, which came into force in 1971, regulates the import, manufacture, sale, transport, distribution and use of these chemicals for the sake of prevention of risk to human beings and animals. All the pesticides for indigenous manufacture, import and export are to be registered under the Insecticides Act. In India Insecticide means Pesticide and administratively authority is the Ministry of Agriculture, Govt. of India. Secretary, Central Insecticides Board and Registration Committee, Directorate of Plant Protection, Quarantine and Stor age, Ministry of Agriculture, N.H. IV, Faridabad-121 001, Har yana, is to be contacted for information on registration requirement and other related matters.

To assist the implementation of this Act, there are two high powered bodies, 'THE CENTRAL INSECTICIDES BOARD' and the 'REGIS TRATION COMMITTEE' which are the advisory as well as decision taking bodies in respect of all matters related to pesticides. Under the Act, there is a compulsory registration of all the pesticides. The manufacture, import, export and use of chemical pesticides can be initiated only after proper registration, after a close scrutiny of the data about bioefficacy and safety to human be ings, wild-lives, birds, domestic animals, beneficial parasites and predators Committee. Apart from recommending the registration for individual chemicals, the Committee also lays down the details of packing, labelling approved usage, restrictions and precautions. The Central Insecticides Board, the main governing body, which gives directions to the Registration Committee, consists of eminent scientists of the country belonging to different related disciplines.

Whenever Insecticides Board is convinced that the particular insecticide is not safe, the same is phased out and the registration of the concerned parties are withdrawn. Endrin and ethyl parathion have been thus phased out and the use of dieldrin can be made in scheduled desert areas only and that too on the advise of the Plant Protection Advisor to the Government of India, for locust control operations. The Registration Committee considering the safety has even named the pesticides which cannot be registered in India and these are given below:

1. Calcium arsenate
2. Lead Arnate
3. Carbophenthion (Trithion)
4. Azinophos Methyl (Gusathion)
5. EPN
6. Mevinphos (Phosdrin)
7. 2,4, 5-T
8. Vamidothion
9. Mephosfolan
10. Azinphos ethyl

11. Binapacryl
12. Dicrotophos
13. Thiodemeton
14. Fentin acetate
15. Fentine hydroxide
16. Disulphoton
17. Chinomethionate (Morestan)
18. Ammonium sulphamate
19. Leptophos (Phoseul)

Application for registration is submitted to Secretary Central Insecticides Board and Registration, Committee, covering generally the following points:

1.Name and address of the applicant

2.The trade name of the insecticide which the applicant is importing or manufacturing or proposes to import or manufacture

3.Chemical composition (A statement of the composition, including all ingredients and the chemical identity of the active ingredients including their stability in storage).

4.Toxicity of the products to human beings, wild life, aquatic animals (adequate toxicological data concerning the active ingre dient to be enclosed)

5.The plant diseases, insects and other noxious, animals and weeds against which it is intended to be used (Reports official or other experimental station on biological tests concerning the efficacy of the insecticide to be enclosed).

6.Instructions for storage and use including first aid and precautionary matter which are proposed for labelling

7.Methods of analysis for formulated compound and its residues.

8.Seven copies of the proposed/ existing label (including all printed or graphic matter which will accompany the package containing insecticide).

9.Manner of packaging.

The pesticide registration system in India is based on the good lines of UK and USA system and keep in view standard practices followed elsewhere, including EPA guidelines. The FAO, WHO and EPA guidelines are given due consideration by the Registration Experts to meet the national requirements.

Acceptance of data generated in other countries and emphasis/ insistence on data to be generated locally in the country and for which respects

The laboratory bound toxicological and other data are accepted by the Registration Committee but the following data are required to be generated under Indian conditions.

a)Bioefficacy

b)Residue

c)Toxicity to bees

d)Field trials and observations on other beneficial insects

e)Field trials and observations on the livestock

f)Direct field observation on the population of livestock exposed.

g)Health records of industrial workers and pest control opera tors.

Field trials and other observations regarding toxicity to other beneficial insects, livestock, direct field observations on the population and livestock exposed and health record of industrial worker and pest control operators from the other countries are accepted but applicants are advised to submit these data during the pendency of the provisional registration.

Registration categories

The following are the different categories of registration re quirement in India.

Trial clearance : A small quantity of an agro chemical can be imported for triais in India on the written permissin of the Plant Protection Adviser to the Government of India.

Provisional Registration : Where the Registration Committee allows the insecticides to be introduced for the first time in India, it may, pending any enquiry, register it provisionally for a period of two years on such conditions as Registration Committee may feel proper. During this two-year period, the registra tion holder is expected to complete the data listed on the registration certificate as deficiencies.

Regular Registration : After considering all the requirements, a regular registration is granted with no time limit by the Govern ment of India.

Post Registration Activities carried out by the Government

The Insecticides Inspectors examine and make copies of, or take extracts from the register, records or other documents kept by a manufacturer, distributor, carrier, dealer or any other person in pursuance of the provisions of the Insecticides Act and Rules and seize the same, on reasons to believe that all or any of them may furnish evidence of the commission of an offense punishable under the Insecticides Act or the Rules.

The Insecticides Inspector makes such examination and enquiry as he thinks fit in order to ascertain whether the provisions of the Act or the Rules are being complied with and for that purpose may stop any vehicle. The Insecticide Inspector can stop the distri bution, sale or use of an insecticide which he has reasons to believe is being distributed, sold or used in contravention of the provisions of the Act for a specific period.

He can take the sample of an insecticide and send such samples for analysis to the Insecticides Analyst for test.

Manufacturers and dealers are obliged to disclose places where insecticides are manufactured or kept. Any person convicted for contravening any of the provisions of this Act or of the Rules, the stock of the insecticide, in respect of which the contravention has been made, is liable to be confiscated.

The State Governments may require any person or class of persons to report all occurrence of poisoning, through the use or handling of an insecticide. The Government may also put prohibition on sale of insecticide for reasons of public safety.

Cancellation of registration certificate is published in an official gazette.

Offenses and punishment are contained in section 29 of the Insec ticides Act, 1968.

The Central Government may give directions to any State Govern ment for carrying into execution in the State any of the provisions of this Act or any rules made thereunder.

Quality Standard and Checks

Regular check is carried out by Bureau of Indian Standards (BIS) for those choose ISI as a third party guarantee regarding quality. ISI mark is not compulsory in India.

All the State and Union Territories are having at least one pesticide laboratory to carry out the tests on the pesticides samples taken by the Insecticide Inspectors.

Pesticide Industry views about Registration & Regulations

Pesticide industry, through their association have been complaining that Registration Committee (RC) takes much time in register ing the products and many testing protocols of safety and efficacy have not been clearly defined by RC. Multinational companies and their counterparts in India are of the view that confidentiality of proprietory data are not maintained and due to subsequent registrations, in USA called "me too" registrations, MNs are not interested to register their proprietory products. They also feel that registering a combination product in India is costly as well as time consuming. But these charges seem unreal istic when one sees the products being listed on pesticide schedule in India recently.

Of course, there is a scope of a lot of improvements in registra tion procedure, but, in developing countries, these improvements are brought in phases due to limited resources, continuous technology upgradation and changing concepts of environmentally friendly pesticides which farmers end users may afford. Post registration activities like licensing and monitoring are the responsibilities of State Governments. This has adopted, in principle, the FAO international code of conduct on the distribution and use of pesticides.

Both Central and State Governments organise training programmes for safe and judicious use/ applica-tion of pesticide for the benefits of manufacturers, formulators, pest control operators and farmers. Regular short-term and specific programmes are arranged at the Central Plant Protection Training Institute, Hyderabad. Relevant information bulletins have also been brought out on Pesticides and on Treatment of Pesticide Poisoning for the benefit of medical and paramedical functionaries.

Associations in the Pesticides Industry have also introduced a number of training aids/programmes for the pesticide manufactur ers/ distributors/ retailers as well as for the benefit of farmers.

CHAPTER - 9

WORLD PESTICIDE SCENE

The international position of pesticide industry as well as some scene that are taking place is being briefly touched upon in this chapter. The main purpose is to highlight the simalarities as also the differences in the internaitonal scene as compared to the Indian context, to have a better perspective.

The world market for agriculture chemcials is roughly estimated to be over US $ 20 million in 1986. The largest share of this market is attributable to the US market being 32.3% followed by Western Europe being 24%, Eastern Europe 9% and Japan 12%. India has a share of 1.9% and Indonesia that of 0.9%. The distribution of this market in terms of various product groups shows the highest percentage namely 44.5% being taken by Herbicides followed by insecticides contributing to 31.4%, fungicides being 17.6% and others being 6.5%. However, the Asian market shows a difference from this world wide trend in that insecticide contributes the highest share followed by herbicides and fungicides; insecticides having a 45% share of the market and herbicides and fungicides approximately 25% each. As regard the crop-wise use of Pesticides, the world scene shows that the largest market is for crops of fruits (mostly grapes and apples and vegetables (around US $ 3 million) followed by rise, soybean, cotton, wheat and sugarcane. Here again, the Asian market shows a different pattern than the world market and the consumption pattern shows a 40% use for rice which is the leading use, followed by 30% for wheat and vegetables, 9% in plantation, 8% for cotton, 6% for others and 4% for soybean. There is a further difference between the Asian market and the Indian market as regards the consumption pattern and in India it is the cotton crop which consumes the maximum amount of pesticides being 55 % of the total. This can be due to the fact that a) India is the largest cotton producer and (b) the climatic conditions in India are different from those in other Asian countries being less tropical and having lesser moisture and therefore being less conducive to some of the pests that are associated with wheat and paddy crops in other Asian countries. The reasons for the use of more pesticides and less herbicides in Asia as compared to the rest of the world particu larly advanced world could be the following:

a)Agriculture in USA and Western Europe is highly mecha nised against manual labour intensive situation of Asia and therefore the farmers require more herbicides.

b)In Asia, there is a round the year agriculture and there is a very vast acerage which may be the reason for high insecticides consumption.

Nevertheless, it can safely be concluded that with an increase in mechanisation the herbicide market is bound to in crease in the Asian countries also. It is also interesting to note that consumption pattern within Asia also varies considerably between different groups of pesticides. Thus, Malaysia uses a very high percentage of Herbicides being 60% against 8% insecti cides, Bangladesh is at the other end of the scale having only 2% of the herbicide consumption compared to 92% of insecticides. India has 10% herbicide consumption as against 75% of insecticide consumption and Indonesia also has a 10% herbicide consumption as against 75% insecticide consumption.

The agro chemical industries the world over is dominated by about two dozen basic companies engaged in the discovery, development and marketing of proprietary items. It is estimated that in 1987 there were 16 companies with sales exceeding 300 million us dollar and 17 companies with sales turnover of 100-300 million US dollars. While the number of manufacturers of basic pesticides world over is limited and the

emphasis is on increased turnover, it is interesting to see that in Asia the pattern is very widely dispersed while Philippines and Pakistan are known to have one basic manufacturer each. Peoples Republic of China is supposed to have 200 manufacturers while Japan has 36 and India has 20 and Indonesia 4. This is indicative of the comparatively low turnover of companies in the Asian region as compared to the world scenario. The Indian pesticide market has a total turnover of around 300 million US dollars which is almost equivalent to the turnover of a single large multinational company. The average turnover of an Indian company is quite low and the larger compa nies would be having turnovers in the range of 25 to 30 million dollars or so. This is an important point in the context of the required R&D efforts, considering the fact that the R&D expenditure is going up every year and the success rate in developing of new pesticides is going down.

It is estimated that during the 1970s and 80s around 80commercially suit able pesticides were introduced in the world market and it can safely be stated that only those companies which had a very strong R&D base had a substantial strength in improving on their market share and could maintain their lead or portion in the highly competitive pesticide market.The cost of developing a new molecule is report ed to be as high as 75 million US dollars. The break up of this cost may be as follows:

1.	Screening and evaluation	-	US $ 5 million
2.	Development	-	US $ 25 - 35 million
3.	Manufacturing	-	US $ 5-35 million
4.	Total Cost	-	US $ 25-75 million

The above cost also refrain research into the safety and efficacy of the product. To the above cost must be added another expenditure of US $ 30 million towards investment in product manufacture and development. With achieving discovery and launching for new compound has to be done by companies having access to world market and by large multi product corporation. It is in this context that the major restructuring that has taken place during the last few years has to be viewed since mergers and amalgama tions have taken place in order to develop turnover of magni tude which can sustain the growing expenditure of R&D. ICI UK bought over agro chemical business of Stauffeur, Rhone Poulenc took over Union Carbide pesticide division and Shell (USA) took over Du Pont. Similarly Fison Co in USA sold to Scherring. On the other hand Avery bought over Uniroyal agrochemical business, but has put it up for sale again. It is clear that to stay put the competition for so many well known companies has not been easy.

Some Trends in Agrochemical Development:

During the last 40 years of development of pesticides the emphasis shifted from initially used natural products inorganics/organics to organics favouring systemic compounds with Xylem and / or pholem mobile characteristics, so that protection is provided even after penetration of the pest in the plant. There is also a concerted interest in pest control agents of high intrinsic activity which work at low dosage thus limited residue contamination of the commodity and its environment. This began in late 60s when Du Pont introduced its sensational systemic benzimidazole fungicide Benomyl which saw the application rates tum bling down from several kilograms per hector to a mere 100 grams per hector with increased margin for humans and animals. This is revolutionised the product range in pyrethroid insecticides, azole and acylanilide fungicides and glyphosate and sulphonyl urea herbicides. Today the market of synthetic pyrethroids alone is estimated around US $ 1.5 million. Another significant trend has been towards greater

specificity against targets pests, which has involved research into potential sites and modes of pesticides. Thus the emphasis is shifting from broad spectrum activity pesti cides to a variety of specific compound or a combination of product which fits exactly in the given situa tion.

There has also been research in chemicals which have a known biological activity and this has resulted in the clustering to newer products among given chemical groups such as Triazole fungicides and the Synthetic Pyrethroid Insecticides. There has also been a shift in the plant protection strategy from killing to manipulating or managing pest population to keep them below economic threshhold levels. In this context, rational approaches in the design of new bioactive molecules is being increasingly employed. This involves seeking compounds that are targeted at specific pests rather than screening individuai chemicals for activity.

Formulation and Application

The environmental and health concern have resulted in a growing need to reduce the load on the environment and consequently it has become necessary that not only the amount of pesticides applied to the crop should come down dramatically but formulations should be developed which are more effective, safer and easier to handle and also enable application to be made only on the target pests. The new trend points in the direction of liquid formulation with minimum organic solvents like Suspension Concen trate, or Emulsion Concentrate and Dry Formulations with decreased dusting like water dispersible granules. The same concern for environmen tal safety as well as the need for efficient delivery had lead to controlled release formulations and the concept of standard formulations for a pesticide has given way to a local need based formulation for better efficacy. The trend towards newer type of formulation which are safer in handling and are also environmentally safer is exemplified by the percentage use of different types of formulations in France (1989) given in table - 1.

Table 1 - % Use of Different Types of Formulations in France

Formulation Type	Percentage
Emulsifiable Concentrate	19
Wettable Powder	27
Soluble Liquid	12
Suspension Concentrate	16
Granules'	6
Capsule Suspension	1
Water Dispersible Granules	3
Suspo-emulsion	1
Suspension seed dressing	3
Powder seed dressing	5
Others	7
Total	100%

Biotechnology

Like many other fields including pharmaceuticals, bio technology seems an area of the future in plant protection package too. Some of the important leads which are in site in bio technology include genetic manipulation of crop tolerance to herbicides. This would involve strategy to engineer crop for tolerance of pest chemicals which would not harm main crops. The result has been the development of crops tolerant to triazines, sulfonyl ureas and Glyphosate.

Another example of the application of biotechnology to pest control is the transfer of gene regulating protein toxin production by Bacillus Thuringiensis. The engineered plants are protected from insect feeding damage.

However, the cost involved are rather too prohibitive and it is not certain whether by bio-technological method of pest control would be able to replace the synthetic pesticide entirely and if at all, by what point of time. There are other constraints also like development of microbial agricultural/health pest control agent and development of bioengineering approaches to production of pest control agents and immunoassays for their analysis. However, in final analysis all the trend related to design, development, synthesis, formulation and application of agrochemicals, indicate the underlining increasing concern for better efficacy, safety, economy and ecological balance. All these concerns have to form the motivating force for developing new pesticides of tomorrow whether they originates from chemical synthesis or biotechnology.

CHAPTER - 10

PRICING AND TARIFF

BACKGROUND

Normally in a free market economy the price at which a product is sold should not be the concern of the policy maker and the market forces should take care of the interests of the customer. But in economies like India's, a certain degree of "market intervention" does take place on the part of the Government. In the context of Agriculture products, this market intervention takes the form of, on the one hand, determining support prices for the agricultural produce and, on the other, controlling the prices of inputs that go into agricultural products like wheat and rice every year which implies the Government's commitment to buy the product at these prices in case the Former is unable to get the same through private sources and the latter takes the shape of direct or indirect subsidies. The Fertilizer industry is an illustration of the direct subsidy mechanism where the Government fixes the Retention and pooled price for different manufacturers and those manufacturers whose retention price is higher than the pooled price get the benefit of the subsidy. This ensures that the user get the input of fertilizer at a constant price. The level of fertilizer subsidy in India at present is as high as Rs. 37,000 million which is approximately equivalent to 200 million US dollars and which constitute almost 50% of the budgetary deficit of the government % of the GDP. Other inputs like Irrigation and Electricity are also subsidised but the total amount of subsidy on these is not readily available since these operate through different State Governments and the scale of such subsidization also varies from State to State.

In the case of pesticides, the subsidy is not of an omnibus nature but is targeted subsidy which means that certain State Governments as well as the Central Government subsidise the cost of pesticides to certain target groups. Although, there is no statutory control on the prices of pesticides in India, nevertheless, in keeping with the general policy objective of making available agricultural inputs at reasonable prices to the users, the Government does intervene in different ways to check the prices of pesticides.

Pesticides Prices in India

A perusal of the prices of some of the major pesticides in use in India would indicate that these are not very high compared to those in the developed countries. The compilation of retail prices of selected pesticide products numbering 24 is given in table - 1.

This would show that most of the pesticides sell within a range of 5-8 dollars per unit. Pesticides like Cypermethrin, Fenvalerate and Carbendazim are the ones which are comparatively more expensive. However, when prices of some selected pesticides are compared with different countries in the RENPAP region then the picture that emerges is not very favourable. The figures of 1987 show that pesticides prices per kg/ltr in US dollar are lower in countries like Indonesia, Pakistan and Philippines as compared to India. For instance, the price of Carbofuran in India in 1987 was 2.87 US dollar per kg; Indonesia 0.36 US dollar per kg and in Philippines it was 1.25 US dollar per kg. The following factors can be attributed to this variation:

i)The variation in the exchange rate of currencies in different countries vis-a-vis US dollar;

ii) The variation in the level of self-reliance in Formulation and Technical material in different countries.

Table 1 - Compilation of Retail Prices of Selected Pesticide Products

S.No.	Product	Packing (Kg/Ltr)	Retail Price per kg/ltr($)	
1.	Carbofuron 3% GR	1kg	2.1	
2.	Monocrotophos 36% WSC	1 Lit	14	
3.	Carbaryl 50% WP	1 Lit	8.75	
4.	Endosulfan 35% EC	1 Lit	7.38	
5.	Fenitrothion 50% EC	1 Lit	15	
6.	Paraquat 24% WSC	1 Lit	8.0	
7.	Mancozeb 75% wp	1 kg	5.7	
8.	Diazinon 20% EC	1 Lit	5.6	
9.	Phenthoate 50% EC	1 Lit	11.0	
10.	Dimethoate 30% ECF	1 Lit	6.75	
11.	2,4-D	1 Lit	4.6	Not applicable
12.	Captan 75% WP	1 Lit	10.25	
13.	Malathion 50% EC	1 Lit	4.25	
14.	Diazinon 10% EC	-	-	
15.	Methyl Parathion 50% EC	1 Lit	9.175	
16.	Zinc Phosphide	1 kg	7.38	
17.	Cypermethrin 25% EC	1 Lit	39.0	
18.	Butachlor 50% EC	1 Lit	5.75	
19.	Quinalphos 25% EC	1 Lit	9.375	
20.	Fenvalerate 25% EC	1 Lit	21.25	
21.	Carbendazim 50% WP	1 Kg	21.6	
22.	Isoproturon 75% wp	1 kg	11.875	
23.	Chlorpyrifos 20% EC	1 Lit	10.00	
24.	Phorate 10% GR	1 kg	2.25	

NOTE : 1 US $ = 16.00

While the factor at (i) above hardly needs any elaboration, the factor at (ii) above needs to be gone into in some detail. According to available information, India has the maximum self- reliance in formulation activity being 95%. India also has the highest manufacture of Technical Grade material, as percentage of import being around 91%. As compared to these figures, Indonesia, for instance, produces 32% of domestic requirements of pesticides. The obvious inference of these indicators would be that the domestic cost of production is higher than the imported cost which gives rise to the higher price of the finished product. This should be expected in view of the high cost of indigenisation and the time taken in stabilising production on the basis of imported technology. To illustrate the point, while the retail price of Cyper-

methrin 25% was 92 US dollar per litre in 1987 it came down to 39 US dollar per litre in 1989. This was so in spite of the fact that the rupee had got devalued vis-a-vis the dollar during these two years. Thus if holding the prices at reasonable level is a major concern of the Government which it is with the Government of India, one pointer would be to suggest a cost effective indigenisation programme and not a indigenisation programme which is cost-intensive.

Tariff

Even though the major thrust of the tariff mechanism is two-fold, namely (a) Revenue accretion for the Government and (b) protection of the indigenous industry against unfair competition by imports, tariffs have been used in the recent past in India to check prices also. This has been done by progressively lowering the tariffs on major intermediates which are used for pesticides in order to enable the manufacturer to keep down their costs and at the same time by keeping higher tariffs for the finished products. The only exception in this has been those pesticides which are not manufactured in India at all and on which the level of tariffs is lower. Broadly, the tariff structure on pesticides in India is as follows:

a)	Pesticide intermediates	-	60%
b)	Those pesticides (finished products) which are not manufactured in India	-	70%
c)	Other pesticides (finished Products)	-	135%

The above structure affords a reasonable protection to the in digenous industry against unfair competition from abroad but at the same time also protects the ultimate consumer by having a lower rate of customs duty on pesticides which are not manufac tured in the country at all, compared to the rate for those which are manufactured in India.

Even though there is no statutory price control on pesticides, the Government does intervene from time to time informally to ensure that the price at which these products are being sold are reasonable. This intervention generally takes the form of an insistence on passing the benefits of any Tariff reduction to the ultimate consumer. Nevertheless, it would be seen that it is the market force of demand and supply which have determined the prices rather than this intervention, however, indirect by the Government. Annexure XII would indicate the market concentration and differentials in estimated fair selling price of certain technical grade pesticides, and the actual selling price between 1984 and 1988. BICP is the abbreviation for Bureau of Industrial Costs and Prices and this organisation is part of the Government of India and advises the Government on various policy issues of industrial pricing as also determining "Fair Prices" for certain products based on the input costs and predetermined profitability norms. This Annexure would show that in the case of Quinalphos which is a Sandoz product even though the market concentration is 76% the same was selling at prices below those estimated as Fair selling price by the BICP. However, in mosta other cases the actual price was higher than waht had been estimated by the BICP. Thus in case of Phosphamidon which is a Ciba product and where the market concen tration is 85%, the actual selling price was Rs. 140 per kg. in 1984 as compared to Rs. 74.91 estimated as fair selling price and Rs. 163.00 in 1988 as compared to Rs. 87.20. Even a product like Malathion 95% of Ficom where the market concentration of the company was only 27%, the actual selling price was higher than what had been estimated as the fair selling price.

Conclusion

The above analysis would show that while the Government of India is concerned with keeping the prices of agricultural inputs in general and pesticides in particular at reasonable levels and while the tariff mechanism has also been used to achieve this objective, the ground reality is that it is the market forces which are determining the prices rather than the other factors. It would also be seen that although India has achieved a reasonable degree of indigenisation of production, this has been achieved at the cost of the consumer since the retail prices per unit of pesticides in India are higher than in the case of those countries of RENPAP region which have not achieved the same levels of indigenisation.

CHAPTER - 11

AGENDA FOR DEVELOPING A FRAMEWORK OF POLICY

Pre-requisites And Assumptions

Any industrial policy would necessarily have to be country specific, region specific and also time frame specific; it would reflect the concerns and priorities of the Government and the society. Based on the inferences that can be drawn from this report, an attempt is being made in this Chapter to develop an approach towards formulation of such a policy with specific elements constituting an agenda for action. While the approach is specifically relevant to the Indian context, it could perhaps be followed with varying degrees of relevance in respect of other developing countries and possibly the countries in the RENPAP region. The most fundamental assumption while developing such a framework is, of course, the need to develop an indigenous pesticide industry. Such an assertion becomes necessary considering the possible situation of a trade surplus of such comfortable magnitude as to allow for free import of all the requirements of pesticides needed for the country. Such a scenario would prima facie obviate the need for development of a indigenous industry of any significant magnitude. However, in the Indian context, such a scenario neither exists at present nor is it likely to exist in the foreseeable future. Self reliance in manufacturing capacity of both Technical grade and Formulation is presumed to be the corner stone of Pesticides Industrial Policy for the purposes of developing a plan of action. Apart from this basic assumption, the following assumptions are also necessary to be made:

i)There exists the necessary legal framework for regulating industrial development

ii)There is a growing market and an unsatisfied domestic demand for pesticides

iii)There exists access, to a reasonable degree, to a reasonable level of technology

Based on the above pre-requisites and assumptions, it is proposed to highlight the major concerns of the policy makers which in turn would translate themselves into major objectives for policy and finally get reflected in macro and micro action points with reference to different elements of the policy. Before that, however, it would be necessary to briefly touch upon the broad conclusions of this report to serve as a perspective for any agenda for action.

Broad Conclusions of the Report

Some of the broad conclusions that can be derived about different aspects of the pesticide industry and related issues discussed in this report are:

1.There exists the necessary infrastructure for R&D in the country.

2.There is also in existence the necessary infrastructure required for successful transfer of technology as also upgrada tion of the same, although it does require strengthening.

3.The use of pesticides in India as compared to the world pesticides scene is very limited and the Indian market consti tutes only 1.9% of the total world market with 2.5% of the total cultivated area. Therefore, there is potential for further growth of the pesticide industry to fill the gap between potential demand and availability

4.Cotton crop with 5% of the total cultivated area accounts for 50-55% of the total pesticides use and is the largest user of pesticides, followed by paddy.

5.Among the various groups of pesticides, Insecticides constitute the largest group in terms of usage being 80 per cent and weedicides and herbicides constitute the smallest use at present. This is contrary to the pattern prevalent in the developed countries but in consonance with the pattern prevailing in most Asian countries. Higher levels of mechanised agriculture in future could change this pattern dramatically and to that extent there is potential for higher use of herbicides.

6.There are sufficient capacities for the manufacture of technical grade as well as formulation of pesticides but these are sufficient in relation to the present level of usage and the likely projection in the immediate future.

7.The breakup of consumption between different sector of usage of pesticides shows that consumption in public health is almost 1/3rd of that in agriculture. It is also evident that while the consumption for public health use has been stable for the last few years, the use in the agriculture sector has been increasing. The demand projections for the year 2000 indicate a total re quirement of 1,00,000 MT for agriculture sector and 29,000 MT for public health sector;

8.Of the total production of pesticides in India, BHC, DDT and Malathion constitute over 60% in terms of tonnage. However, in terms of value the percentage of these three is only 13.

9.There is a fairly high degree of self-reliance in respect of formulated pesticides being 95% as against 5% imported which compare very favorably with some of the other countries in the RENPAP region and is lower than that in South Korea and China. This is also the case with technical grade manufacture where 91% of the production is indigenous.

10.While a fairly large number of pesticides around 60 are being manufactured indigenously, the manufacture in most cases is from penultimate intermediates which have to be imported in the country, with limited value addition.

11.The high cost of manufacture of technical grade pesticides compared to other countries is also reflected in the comparatively higher retail prices of most pesticides which are many times higher than the prices (converted into dollars) prevailing in most other RENPAP countries. A comparison between the prices prevailing in India and Indonesia reveals that there is an in verse relationship between the degree of indigenisation and the retail prices.

12.Multinational companies dominate in terms of turnover as well as market share of most pesticides in the country.

13.There is a heightened concern for safety as well as environ mental conservation and pollution control in recent years spe cially after the Bhopal gas disaster. This concern manifests itself both in the shape of more severe restrictions for the manufacture of hazardous pesticides as well as in growing appre hensions about the possible ill-effects of excessive use of pesticides on the human health.

14.There is a skewed geographical pattern of consumption as well as manufacture of different pesticides with both consumption and manufacture being concentrated in certain areas, even though formulation capacity in more evenly distributed.

15.The turnover of the Indian companies is very small as compared to large International companies. The total turnover of the Indian industry is around 300 million dollars and the average turnover of a large Indian company is around 25-30 million dollars. This small turnover restricts the capacity of the companies to take up any worthwhile research and development effort.

16.Research and development work being carried out in India both in the Government and the private sectors is primarily aimed at process research as also research in development of new formu lations; there is hardly any basic research.

Any agenda for action for formulation of an integrated Pesticides Industrial Policy would have to take cognizance of the above factors.

Some major concerns of Policy Makers and Possible Objectives

Any Pesticides Industrial policy that can be developed while taking cognizance of the existing situation as indicated above, will have to revolve around the concerns of the policy makers with various issues connected with the industry and its users and will have to aim at achieving certain predetermined objectives which reflect these concerns. Some of these concerns and objectives have complementary effect while others may be apparently contradictory and it should be the purpose of an integrated policy to harmonise these. While concerns of the policy makers would vary from time to time, presently the following can be listed as some of the major concerns:

a)Concern with safety in manufacture and use of pesticides.

b)Concern with environmental degradation and pollution that manufacture and application of pesticides may result in.

c)Concern with conservation of hard currency and to that extent restrictions on import.

d)Concern with self-reliance in industry in general and pesti cide industry in particular.

e)Concern with making available to the Farmer all agricultural inputs including pesticides at rea sonable prices.

Taking cognizance of the above concerns, the following very broad objectives for a policy emerge:

1)To focus Research and Development for developing pesticides which entail a minimum load on environment.

2)To develop indigenous technology for the manufacture of pesticides within the country and to facilitate transfer and upgradation of such a technology from outside.

3)To achieve a high degree of self-reliance in the manufacture of pesticides;

4)While developing self-reliance in the industry, to simultaneously ensure that the prices of pesticides are kept at reasonable levels. In other words, to aim at cost-effective indigenisation of the industry and market intervention wherever necessary to ensure reasonable prices.

Keeping in view the above concerns and objectives, the factors relating to the present status of the industry emerging from this report and the special characteristics of the pesticide industry indicated in Chapter I, it is proposed to delineate in some detail on Agenda for action for a policy framework with reference to the various elements of policy, in the following paragraphs. While in most cases action points at the macro level are being spelt out, in some cases micro level action has also been indicated.

R&D and Technology

It has already been observed that Basic research, i.e. research involving discovery of new molecules is becoming increasingly costly the world over and is highly investment-intensive both in terms of time and money, with correspondingly decreasing returns in the form of molecules actually discovered. Such an expenditure can be of the order of 50 million US dollars and can take as long as 15-20 years to achieve commercial exploitation. It also re quires isolation and synthesis of as many as 15-20 thousand new molecules. It is also being seen that such an expenditure is sustainable only by companies having high turnover and possibly access to global markets. The state of recent mergers in the pesticide industry the world over can partly be explained by a growing constraint on this pricing R&D expenditure with the present turnover. Thus, even though in India the necessary infrastructure for doing basic research exists, such an activity can only be a very long term goal given the size of the average India company in terms of its turnover. The only way that such an expenditure can be sustained is to pool the resources of Government and private R&D facilities and to work together at basic research. It should, therefore, be the policy of the Government to encourage such a pooling of efforts. Nevertheless, as our immediate and shorter term strategy, the emphasis should be on process research and development of more effective formulations. The concern with safety and environment makes it incumbent on the industry to develop such pesticides as to reduce the load on environment. In other words, it should be ensured that small doses of pesti cides are used per hectares than is the case now. While this can be done through development of new molecules also, at least to some extent the same results can be achieved while concentrating on newer and more effective formulations which attack only the targets and not the surrounding area. Given the existing infra structure of formulation technology the UNDP assisted Pesticides Development Centre should be made the focal point of Formulation research and better coordination and active involvement of the industry should be ensured in this.

Another question that has to be addressed here is the one relating to research and development on biological pesticides and the extent to which this needs to be encouraged. The advantage as well as disadvantages of biological and chemical pesticides respectively are as follows:

Biological Pesticides	**Chemical Pesticides**
Advantages	
1.Less environmental contamination	1. Ease of handling
2.Species specificity	2. Broad spectrum
3.Less persistence, quick degradation	3. Less effect of environment on efficacy.
4.Harmless to human beings	
5.Safe to parasites and predators	

Disadvantages

1.Slow action so not useful in emergency	1. More environmental pollution
2.Sometimes may have detrimental effect on similar but economically important species.	2. More persistence less degradation
3.If mutation occurs could become very and predators dangerous	3. Harmful to parasites
	4. Harmful to human beings if not properly used.

It will be seen from the above that while it should be the policy of the Government to encourage development of biological pesti cides given the fact that India does have a rich growth of herbs and plants, this would have to be a long term objective rather than short term and also that encouragement of biological pesticides would have to be done very carefully considering some of the possible harmful fall-out of the same. Besides, the high cost of going in for the biotechnological option would also ensure that at least in the short run the chemical pesticides will have to be encouraged with suitable riders that make for development of such pesticides which are environment-friendly.

On Technology development, it has been seen earlier that the pesticide industry is characterised by closely-held technologies. This would mean a comparatively limited access to technology for the developing countries which will have to be satisfied with whatever technology is available. This is also one of the reasons for multinational companies to dominate the Indian market in most of the newly developed products. Therefore, in respect of Technology, a good policy option would be to further strengthen the infrastructure for Technology absorption and Technology upgrada tion within the country so that transfer of technology is not only facilitated but the same could also be upgraded. It would, however, be appropriate to focus on development of indigenous technology and design capability for carefully selected products in order to make the technological thrust effective. Some of the areas could be:

1.Technology for a high volume demand product where repetitive import of technology is anticipated. Progressive penetration into technology, process engineering and design areas to be aimed at,

2.Where a break-through technology for a product is claiming a high premium in licence fee;

3.Technology for products that are nearest to the market.

4.Technology for newer formulation

Given the need for effective absorption and upgradation of technology, the role of a pilot plant assumed importance. The following action points regarding upgradation of pilot plants need to be pursued:

1)Scale up and reactor design.

2)Developing design techniques for critical equipment

3)Vendor development and developing capability to specify special equipment systems.

4)Selection for optimum control strategies.

At the micro level, a Working Group recently set up by the Government had recommended development of indigenous technology for the following products:

Insecticides:

1. Acephate
2. Actellic (Pirimiphos Methyl)
3. Amitraz
4. Synthetic-Pyrethroids
5. Chlorobenzilate
6. Etrimphos
7. Cycloprate
8. Fenamiphos

Fungicides

1. Carboxin
2. Edifenphos
3. Trivax
4. Dodine
5. Metalazxyl
6. Thiophenate Methyl
7. Entaconazole
8. Propioconazole
9. Chloro Benzthiazole

Herbicides

1. Chlorosulfuron
2. Sulfometuron Methyl
3. Metoxuron
4. Met Benzthiazuron
5. Anilophos

Safety and Environment

Safety and environment is a high concern-area particularly with reference to the pesticide industry. It has been seen that there is sufficient legal back-up for regulations on environment and pollution related issue as well as on safety related issues. The Bhopal gas disaster had also given rise to serious public concern on these aspects. However, as brought out in this report, at the ground level, nothing much seems to have been done to prevent repetition of such tragedies than a better realisation for the industry about its responsibility. It is also seen that there is a multiplicity of agencies involved in implementing the various provisions relating to safety and environment. It is suggested that the policy should take care of the following aspects in this regard.

i)Location of pesticide plants

ii)Centralisation of agencies for looking after pollution and safety control schemes.

iii)Encouragement to hazard-based management technology.

iv)Careful selection of processes of manufacture.

At a micro level the following suggestions can be considered:

1)The location for a pesticide plant should be such as to provide for close proximity to existing chemical plants that provide the bulk of the intermediates used for the manufacture of end-products.

2)Strict zoning regulations should be imposed while locating new pesticide plants.

3)Pollution disposal facilities in areas where there is a concentration of pesticide industry should be centralised on the pattern of centralised sewerage disposal facilities.

4)Detailed hazard management practices should be finalised and enforced.

5)Fiscal and financial concessions should be given to the pesticide industry to encourage installation of equipment that reduces hazards and pollution;

6)Licensing authorities should encourage selection of process es which are "basically" safe. Efforts should be made to select the least hazardous route with due regard to the overall economics.

7)A detailed environmental impact assessment should be compulsorily carried out before any project of pesticide manufacture is finalised;

8)During the process design, hazardous and operatable study (HEZOP) should be conducted.

9)Safety audit should be made mandatory for all pesticide plants during operation.

10)Risk analysis of specifically identified hazards should be carried out; this should be done also before a detailed engineering is completed.

11)Proper labelling of the finished products as well as material in process should be statutorily enforced in pesticide indus try and special label be affixed on packages bearing emblems pictorially representing particular dangers.

Licensing and Registration

The licensing policy of the Government should be in accord with the objectives and concerns set forth earlier. Indigenisation of the industry should be encouraged but to take care of the concern of the consumer, such indigenisation should be cost-effective. It has been seen that the retail prices of the pesticides in India are comparatively higher than in the case of other RENPAP countries. The major reason for this is not absence of competition or monopoly but a high cost of manufacture which in turn is due to a comparatively higher level of indigenisation. All this would show that while indigenisation has been achieved, it has been at a very high cost. On the other hand, while on paper, a large number of technical grade pesticides are manufactured indigenously, the stage from which most of these are

manufactured is not basic and it is only the penultimate stage. The penultimate intermediates are still being imported and there is very little value addition. The Government policy should, therefore, determine a phased indigenisation programme for all major pesticides. This can be done for each products by Experts and should indicate the period by which a particular product could go basic in manufacture. The import of raw materials and intermediates should also be linked with this programme. The viability of such a phased indigenisation programme should be examined in terms of the domestic resource cost of production, with a suitable shadow rate of Foreign exchange. All companies manufacturing Technical grade pesticides should be asked to tailor their manufacture in accordance with the approved programme. At the same time, technologies for manufacture of intermediates should also be encouraged. While technology for some of the intermediate chemicals like para-nitro-meta cresol, Trimethyl Phosphate and Butene diol has been developed in India, a Working Group set up by the Government has identified the following intermediates of chemicals for development of technology:

1. 2,6-Diethyl aniline
2. 2,6-Dimethyl aniline
3. 4-Chloro Benzyl Cynamide
4. Acetone
5. Diketone
6. N,N-Diethyl guanidine
7. Ortho phenyline diamine
8. 4-Chloro-3-Phenyl oxy benzyl alcohol
9. 4-Fluoro-3-phenyl oxy benzyl alcohol
10. 3,5-Dimethyl aniline

Another important aspect of licensing and registration policy relates to protection for newer technology. There is need for policy support to facilitate transfer of technology from outside the country. The present patents and registration laws for Agro- chemicals are not conducive to such a transfer. The term for patents in India is only 7 years from the date of filing for Agro-chemicals which is quite inadequate. Besides the Indian Patent Act recognises only the process patent and not the product patent. Similarly, there is no gap between registration of a product by a company developing it and another company which can register it subsequently. Even though the company registering the product subsequently is required to submit independent data in respect of the product, in practice the original registrant finds that he is not being given adequate protection for his efforts. It is, therefore, essential that both the Patents Acts and the Insecticides Act are amended in such a way as to facilitate the transfer of technology to India from other countries. The patents issue is a highly contentious issue and is being debated at various levels but even without making any basic changes in the structure of the Act, perhaps some modifications could be considered with the limited objective of facilitating the technology transfer.

Pricing Policy and Tariff

There is no statutory price control on pesticide industry in India. Yet there is a concern for keeping the prices low for the consumer. Such a concern is understandable in the Indian context where an average farmer has very low levels of income and where farming is a means of sustenance rather than a means of earning profits as is the case with developed countries. On the face of it, the ideal policy option would be to control prices statutorily. However, such an option is fraught with administrative logis tics and other problems and is not likely to achieve the desired result. It may also adversely effect production by serving

as a disincentive. The basic objective being to ensure the availability of the product to the consumer at reasonable prices, to the extent this objective is subserved by the operation of free market forces of demand and supply, there may not be any need for a statutory control once it is ensured that adequate production is generated to meet the demand. However, abberations are caused in the free play of market forces due to :

a) Monopoly

b) Market dominance

c) Shortages

It has been found in the study that the Indian situation is not characterised by either monopoly or shortages although there is market dominance of some companies which control over 70% of the market share in a number of products. But the basic reasons for the comparatively high prices seems to be the high cost of production and the policy thrust should, therefore, be (a) to reduce the cost of production and (b) to have selective market intervention to take care of abberations if any caused by market dominance. The tariff mechanism should be fine tuned in such a way that it is used in the interest of the consumer rather than for the protection of the indigenous industry. In other words, the custom duty structure should be made flexible in order to ensure that the product is available to the consumer at reasona ble prices. This would certainly require a lot of fine tuning and it will have to be ensured that indigenous manufacturer is also protected from the effects of dumping.

In order to encourage indigenous production of Technical grade pesticides as well as to meet the objective of reasonable prices, a flexible tariff mechanism coupled with cost-effective phased indigenisation programme will have to be followed in tandem.

What has been indicated in the foregoing paragraphs is an agenda for action for developing a Pesticide Industrial Policy and does not purport to be a total policy by itself. The latter will depend on a lot of dynamic factors as also the perspective of the Government and the industry, but it is expected that some of the suggestions that have been indicated would certainly make for the growth of a pollution-free, safe, environment-friendly as well as consumer-friendly pesticide industry in the country.

PRODUCTION OF TECHNICAL GRADE PESTICIDES IN INDIA

Items/Technical Pesticides	1985-86 Cap.	1985-86 Prodn.	1986-87 Cap.	1986-87 Prodn	1987-88 Cap.	1987-88 Prodn.	1988-89 Cap.	1988-89 Prodn.	1989-90 Cap.	1989-90 Prodn
INSECTICIDES										
1. BHC	41.9	25.6	41.9	23.4	45.2	25.70	45.2	26.60	45.2	28.4
2. DDT	9.0	5.2	9.0	8.0	9.0	8.60	9.0	6.70	9.0	7.5
3. Malathion	11.8	4.3	12.0	2.7	10.3	2.70	10.3	3.70	12.3	2.8
4 Metasystex	0.2	0.3	0.2	0.2	0.2	0.10	0.2	0.40	0.2	0.2
5 Methyl Parathion	2.7	1.5	2.7	1.2	2.7	1.40	2.7	1.70	2.7	1.5
6. Fenitrothion	1.1	0.9	0.6	0.08	1.4	0.08	1.1	0.03	1.4	.
7. Fenthion	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.05	0.3	0.1
8. Dimetheote	1.6	1.1	1.6	1.1	2	1.1	2.0	1.8	2.0	1.3
9. Phosphamidon	1.1	1.1	1.1	1.1	1.3	1.2	1.3	1.3	1.3	1.4
10. D.D.V.P.	0.4	0.5	0.5	0.4	0.7	0.7	0.7	0.9	0.7	0.9
11. Quinalphos	1.3	0.8	1.3	0.8	1.3	0.8	1.4	1.0	1.4	1.4
12. Ethion	0.4	0.5	0.4	0.2	0.6	0.2	0.6	0.3	0.6	0.3
13 Carbaryl	7.0	0.04	2.0	0.05	2.0	.	2.0	.	2.0	.
14. Monocrotophos	1.1	1.8	1.2	1.9	2.3	2.1	2.5	2.5	2.4	3.1
15. Endosulfan	2.4	2.5	2.4	2.2	4.0	2.0	4.0	4.5	4.0	4.5
16. Phorate	1.1	1.1	1.2	1.5	1.5	1.4	1.8	2.0	2.3	1.9
17. Phosalone	1.0	0.1	1.0	0.07	1.0	0.04	1.0	0.2	1.0	0.2
18. Fenvalerate	0.6	0.5	0.5	0.3	0.6	0.4	0.7	0.6	0.7	1.0
19. Orthrne	.	.	.	.	.	.	.	.	0.1	.
20. Cypermethrin	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.2	0.3	0.4
21. Phenthorte	.	.	.	.	.	.	.	.	0.6	.
FUNGICIDES										
1. Copperoxychloride	2.4	0.8	2.4	1.8	2.4	1.1	2.4	1.3	2.4	0.8
2. Caprafol	0.1	0.06	0.1	0.05	0.1	0.8	.	.	0.1	.
3. Diathane	3.4	2.4	3.4	2.9	3.4	2.4	3.4	3.0	3.4	2.6

Items/Technical Pesticides		1985-86		1986-87		1987-88		1988-89		1989-90	
		Cap.	Prodn.	Cap.	Prodn.	Cap.	Prodn.	Cap.	Prodn.	Cap.	Prodn.
4.	Captan	0.1	0.05	0.1	0.07	0.1	0.03	0.1	0.2	0.1	0.4
5.	Nickel Chloride	0.3	·	0.3	·	0.3	·	0.3	·	0.3	·
6.	Thiacarbamate	·	·	·	·	·	·	3.4	3.0	3.4	2.6
7.	Organo-Merourials	0.1	0.1	0.1	0.2	0.1	0.1	0.1	·	0.1	·
8.	Sulphur	·	·	·	·	·	·	0.1	·	2.0	·
9.	Zirum	·	·	·	·	·	·	·	·	0.07	·
10.	Copper Sulphate	·	·	·	·	·	·	·	·	3.0	·
11.	Mancozeb	·	·	·	·	·	·	·	·	3.0	·
12.	Kitazin	·	·	·	·	·	·	0.2	·	0.2	·
13.	Atrazine	·	·	·	·	·	·	0.1	·	0.1	·
14.	Carbendazin	0.7	0.1	0.7	0.1	0.4	0.2	0.4	0.2	0.4	0.2
HERBICIDES											
1.	2,4-D	2.1	0.8	2.1	0.8	2.0	0.5	2.0	0.7	2.0	0.7
2.	Butachlor	·	·	·	·	2.0	0.3	2.0	0.1	2.6	0.3
WEEDICIDES											
1.	Isoproturon	1.6	0.7	1.6	0.9	1.6	1.0	1.6	0.8	2.50	0.86
2.	Paraquat	0.5	0.1	0.5	0.2	0.5	0.2	0.5	1.4	0.5	1.0
3.	Dalapon	0.1	0.02	0.1	·	0.1	·	0.1	·	0.06	·
4.	Diuron	0.2	0.06	0.2	0.1	0.2	0.02	0.2	·	0.2	·
5.	Fluchloralin	·	·	·	·	·	·	0.06	·	0.06	·
6.	Plant Growth Regulants	·	·	·	·	·	·	1.0	·	2.0	·
7.	Cycocil	0.1	0.02	0.1	·	0.1	·	0.1	·	0.1	0.01
8.	Alpha Napthyl Acetic Acid	0.02	·	0.02	·	0.02	·	0.02	·	0.02	·
RODENTICIDES											
1.	Ratafin	0.05	·	0.05	·	0.05	0.04	0.05	·	0.05	·
2.	Comfungi	·	·	·	·	·	·	·	·	0.05	·

Items/Technical Pesticides	1985-86 Cap.	1985-86 Prodn.	1986-87 Cap.	1986-87 Prodn.	1987-88 Cap.	1987-88 Prodn.	1988-89 Cap.	1988-89 Prodn.	1989-90 Cap.	1989-90 Prodn.
3. Zinc Phosphide	02.	0.2	1.2	0.4	1.2	0.4	1.2	0.3	1.2	0.4
4. Wargarn	-	-	-	-	-	-	0.05	-	0.05	-
5. Aluminium Phosphide	1.8	0.9	1.8	1.3	1.8	0.7	1.8	0.4	1.8	0.6
6. Methyl Bromide	0.3	0.05	0.3	0.07	0.3	0.07	0.3	-	0.3	-
7. E.D. Bromide	0.2	0.05	0.2	0.04	0.2	0.05	0.2	-	0.2	-
ANTIBIOTICS										
1. Aureofungin	0.5	-	0.5	-	0.5	-	0.5	-	0.5	-
Total	**102.3**	**54.9**	**97.1**	**56.2**	**105.3**	**56.9**	**107.5**	**64.1**	**122.08**	**65.8**

Source : Department of Chemicals & Petrochemicals

QUANTITY OF VARIOUS PESTICIDES (WITH THEIR CIF VALUE) IMPORTED DURING THE YEARS FROM 1988: -89 TO 1989-90

1.Quantity in Tech. Grade (MT)
2.Value in Rs. (000)

S.No.	Pesticide	1988-89		1989-90	
		Qty	Value	Qty	Value
A.	INSECTICIDES				
1.	Allethrin(Synthetic Pyrethrum)	5	9657	6	15087
2.	Acephate	39	3968	34	3989
3.	Aldrin	57	5850	26	3040
4.	Cartap Hydrochloride	40	4045	11	1186
5.	Chlordane	2	139	12	866
6.	Carbofuran223	22	3336	72	12325
7.	Carbaryl	230	12417	29	1863
8.	Chloropyriphos	68	9736	34	5378
9.	Diaazinon	5	481	5	669
10.	Dichlorvos	22	892	32	1420
11.	Fenvalerate	84	26072	-	-
12.	Fluvalinate	11	10019	-	-
13.	Dimethate	20	1129	8	470
14.	Formothion	75	5095	-	-
15.	Heptachlor	42	2551	62	5150
16.	Methid Parathic	97	3121	128	4589
17.	Methomyl	71	23421	-	-
18.	Monocrotophos	655	45997	81	7144
19.	Phenthoate	15	1114	34	3293
20.	Propoxur	27	14748	30	17161
21.	Thimeton	44	3073	-	-
22.	Trichlorophon	3	78	-	-
23.	Diflubenzuron	1	495	-	-
B.	FUNGICIDIES				
24.	Benomyl	3	546	-	-
25.	Captan	126	5476	15	891
26.	Carbendaxim	4	363	7	732
27.	Captafol	-	-	-	-
28.	Dinocap	9	1292	9	1437
29.	Dodine	-	-	-	-
30.	Ediphenophos	45	6244	78	11069
31.	Kitazin	30	1923	30	2350
32.	Mancozeb	160	5205	-	-
33.	Metalaxyl	6	6308	-	-
34.	Wettable Sulphur	-	-	40	376
35.	Thiphanate Methyl	3	184	15	1500
36.	Thiram	30	670	-	-
C.	WEEDICIDES				
37.	Altrazine	76	3657	-	-
38.	Butachlor	876	36739	222	9398
39.	Alachlor	10	419	-	-
40.	Benthiocarb	32	1484	145	8112
41.	Dalapon	6	169	12	336
42.	Diuron	15	1135	12	1249
43.	Dicamba	-	-	-	-

S.No.	Pesticide	1988-89 Qty	1988-89 Value	1989-90 Qty	1989-90 Value
44.	Glyphosate	133	35710	-	-
45.	Oxyflurfen	-	-	1	419
46.	Paraquat dichloride	13	717	32	1846
47.	Simazine	2	113	-	-
48.	Propanil	-	-	5	397
49.	Triallate	-	-	5	357
D.	PLANT GROWTH REGULATORS				
50.	Ethephon	5	948	4	695
E.	FUMIGANTS				
51.	Bromodiolone	-	-	-	-
52.	Methyl Bromide	-	-	3	147
F.	ACARICIDES				
53.	Dicofol	-	-	150	11240
54.	Tetradifon	9	1683	-	-
	Total	**3240**	**298820**	**1389**	**136181**

EXPORT STATISTICS OF AGRO CHEMCIALS

(Rs in lakhs)

Items	1987-88 (Est)	1988-89 (Est.)	1989-90 (Est.)	Major Destinations
Nicotin Alkaloids	13.3	5.6	8.2	France, Japan
Nicotin Sulphate	169.1	277.5	167.7	Japan,UK, FRG
Aluminium Phosphide	135.4	231.4	299.8	Thailand, Kuwait, UAE, Jordan, Grece, Mexico, Pakistan, USA, Keniya, Frnace, FRG, Indonesia, Austrlia, etc.
Lindane	-	234.1	167.6	Singapore, Italy, UK, Nether land, Austria, Argentina, Frnace etc.
Zinc Phosphide	46.8	36.8	84.2	Philippines, Sudan, Djibouti, Thailand, UAE, USA, FRG, Japan, Kenya
BHC Dust	2.3	0.4	3.0	UAE
Endosulfan Tech.	469.1	613.1	987.4	Netherlands, Australia, USA., Spain, Brazl, Thailand, Belgium, Hongkong, FRG., Italy, Mexico, Argentina, etc.
Quionalphos	25.0	0.5	19.6	U Switzerland
Melamine	121.6	22.9	-	Japan, FRG
Malathion	372.6	210.1	452.9	France, Yugozlavia, Iraq, USA,. Netherland, Belgium, Bangladesh, Italy, Australia etc.
Insecticides/ Pesticides/Others	2682.6	4792.5	12410.8	USSR, France, FRG, Mexico, Netherlands, Italy, Singapore, UK, Switzerland, Liberia, Ethiopia, Iraw, Philippines, Thaiwan, Belgium, Thailand, etc.
Total	**4037.8**	**6427.9**	**14601.2**	

LOCAL MANUFACTURE OF TECHNICAL GRADE MATERIAL
(SUMMARY), 1982-83 TO 1988-89

Qty in MT/KL

Insecticide Group	1982-83 Qty.	%	1983-84 Qty	%	1984-85 Qty	%	1985-86 Qty	%	1986-87 Qty	%	1987-88 Qty	%	1988-89(Estimated) Qty	%
Insecticides	53079	90.5	54359	90.4	51525	88.0	47882	87.2	47602	84.7	49370	86.7	551770	86.9
Fungicides	2987	5.0	3015	5.0	3946	7.0	4552	7.0	47882	7.0	4010	7.0	4030	6.8
Herbicides	938	1.6	580	1.0	1200	2.0	1557	3.0	1730	3.1	2180	3.8	2340	3.9
Rodenticides	306	-	340	-	355	*	283	*	429	0.8	460	0.8	650	*
Fumigants	702	1.2	1081	2.0	1202	2.0	1106	2.0	1452	2.6	820	1.5	800	1.3
Others	678	1.2	770	1.3	381	*	263	*	421	0.7	80	*	10	*
Total	58630	100	60145	100	58617	100	54910	100	56186	100	56920	100	59600	100

* Indicates less than 1%

Annexure - III

STATEMENT SHOWING THE QUANTITY OF VARIOUS PESTICIDES IMPORTED DURING THE LAST FIVE YEARS (1982-83 TO 1986-87) AS PER THE INFORMATION RECEIVED FROM DIFFERENT SOURCES

Tech. Grade (M.T)

S.No.	Pesticides	1982-83	1983-84	1984-85	1985-86	1986-87
A.	**INSECTICIDES**					
1.	Acephate	45	79	-	-	-
2.	Aldrin	54	80	89	25	59
3.	Chlordane	16	28	22	22	19
4.	Carbofuron	36	20	50	-	-
5.	Carbaryl	-	-	-	-	16
6.	Chlorpyriphos	134	151	90	27	70
7.	Diazinon	7	7	65	2	18
8.	Dichlorvos	37	39	74	59	27
9.	Dimethoate	46	37	29	-	-
10.	Endosulfan	249	-	249	-	-
11.	Ethion	20	55	-	-	-
12.	Formothion	-	-	-	-	10
13.	Heptachlor	18	12	33	3	26
14.	Methyl Parathion	-	22	210	35	108
15.	Monocrotophos	545	546	428	30	10
16.	Phorate	117	149	103	7	-
17.	Phosalone	5	-	-	-	-
18.	Phenthoate	25	26	27	33	56
19.	Propoxure	20	26	27	33	56
20.	Synthetic Pyrethroids	17	48	6	-	0.34
21.	Thiometon	-	-	-	-	15
B.	**FUNGICIDE**					
22	Benomyl	2	-	-	-	-
23.	Captan	73	49	116	29	57
24.	Carbendazim	5	-	20	-	-
25.	Captafol	-	80	15	-	10
26.	Dinocap	16	22	-	-	9
27.	Dithianon	-	-	-	-	0.13
28.	Ediphenphos	25	55	122	82	61

S.No.	Pesticidses	1982-83	1983-84	1984-85	1985-86	1986-87
29.	Kitazine	-	45	-	15	
30.	Mancozeb	14	24	29	217	-
31.	Sulphur	56	37	135	95	126
32.	Thiophenate methyl	-	-	10	3	15
33.	Thiram	28	12	48	-	-
34.	Ziben	2	16	-	-	-
C.	**WEEDICIDE**					
35.	Atrazine	50	40	5	-	340
36.	Alachlor	-	-	8	-	-
37.	Butachlor	933	859	1317	1231	706
38.	Benthiocarb	133	1178	262	108	123
39.	Delapon	-	32	42	37	10
40.	Diauron	-	-	-	-	2
41.	Dicamba	-	-	287	-	-
42.	Isoproturon	19	470	-	-	-
43.	Paraquate	5	5	35	13	17
44.	Siazine	-	-	2	11	5
45.	Popanil	-	-	-	20	-
D.	**PLANT GROWTH REGULATOR**					
46.	Ethepjon	2	-	3	1	6
E.	**FUMIGANT**					
47.	E.D.B	-	-	-	-	17
F.	Acaricide					
48.	Dicofol	87	118	73	122	165
49.	Tetradifon	3	1	1	1	12
Total		**2844**	**3352**	**4129**	**2256**	**1933.47**

Source : Pesticides Association Of India

IMPORT OF PESTICIDES FOR PUBLIC HEALTH

Year	Name of the Insecticides	Quantity of formula-tions(M.T)	Equivalent Technical Material	Approx Cost Rs. lakhs
1979-80	DDT 75% WDP(USSR	4000	3000	355.98
1980-81	DDT 75% WDP (USAID)	10000	75000	1580.00
1981-82	Malathion 50% WDP(USAID)	5445	2720	1843.55
	Abate Technical(USAID)	21.13	20	4.48
			18240	
11981-82	DDT 75% WDP (USSR)	4000	3000	356.02
	DDT 75% WDP (USAID)	4900	3675	620.16
			6675	
1982-83	DDT 75% WDP (USSR)	4000	3000	393.32
	DDT 75% WDP (free foreign exchange	5000	3750	905.15
			6750	
1983-84	DDT 75% WDP	4905	3680	482.32
1984-85	DDT 75% WDP	4840	3630	703.20
1985-86	DDT 75% WDP	4694	3520	562.67

Source : National Malaria Eradication Programme

Annexure - V

STATEMENT SHOWING THE SALE/DISTRIBUTION POINTS OF PESTICIDES BEING OPERATED BY VARIOUS AGENCIES AS REPORTED BY STATES/U.Ts.

S.No.	Name of State/U.T.	Distribution Points			Total
		State Deptt.	Coopera-tives	Private Trade	
1.	Andhra Pradesh	820	2810	6156	9786
2.	Assam	22	10	1075	1107
3.	Bihar	466	500	5000	5966
4.	Gujarat	-	3277	4038	7315
5.	Haryana	436	83	1051	1570
6.	Himachal Pradesh	70	4	198	272
7.	Jammu & Kashmir	88	5	525	618
8.	Karnataka	-	1026	4252	5278
9.	Kerala	400	886	1123	2409
10.	Madhya Pradesh	457	3000	2000	5457
11.	Maharashtra	68	450	4126	4644
12.	Manipur	19	26	54	99
13.	Meghalaya	-	-	27	27
14.	Nagaland	-	-	12	12
15.	Orissa	6	1840	670	2516
16.	Punjab	118	90	1692	1900
17.	Rajasthan	170	400	1540	2110
18.	Sikkim	-	-	-	-
19.	Tamil Nadu	774	1007	7863	9644
20.	Tripura	-	-	-	-
21	Uttar Pradesh	932	337	7312	8581
22.	West Bengal	-	323	6932	7255
23.	Andeman & Nicobar	35	-	-	35
24.	Arunachal Pradesh	-	-	-	-
25.	Chandigarh	-	1	5	6
26.	Delhi	12	4	163	179
27.	Dadra & Nagar Haveli	10	-	-	10
28.	Goa Daman & Diu	0	150	-	159
29.	Mizoram	50	-	-	50
30.	Lakshadweep	-	-	-	-
31.	Pondicherry	11	8	56	75
	Total	**4973**	**16237**	**55870**	**77080**

GAP BETWEEN SUPPLY AND DEMAND BY 1994-95
(ALL FIGURES OF TECHNICAL MATERIAL IN M.T)

S.No.	Name of the Pesticide	Demand 1994-95	Likely Production 1994-95	Gap 1994-95
A.	INSECTICIDES			
1.	BHC	47,000	-	-
2.	DDT	21,470	9,088	12,382
3.	Aldrin	350	-	350
4.	Chlodrane	150	-	150
5.	Chlordane Heptachlor	150	-	150
6.	Endosulfan	4,470	2,400	2,070
7.	Lindane	50	50	-
8.	Malathion	6,550	6,550	-
9.	Methyl Parathion	3,500	3,500	-
10.	Methyl O.Demeton (Metasystox)	400	400	-
11.	Fenitrothion	300	300	-
12.	Dimethoate	1,700	1,700	-
13.	Phosphamidon	1,400	1,150	250
14.	DDVP	450	450	-
15.	Quinalphos	-	1,000	-
16.	Phenthoate	150	120	25
17.	Monocrotophos	2,700	2,000	700
18.	Fenthion	350	300	-
19.	Chlorpyriphos	350	-	350
20.	Diazinon	150	150	-
21.	Formothion	100-	100	
22.	Thimeton	45	-	45
23.	Thosalone	400	400	-
24.	Acephate	110	75	35
25.	Phorate	1,250	1,250	-
26.	Carbaryl	1,500	1,500-	
27.	Carbofuran	650	500	-
28.	Aldicarb	75	75	-
29.	Pyrethroids	780	780	-
30.	Ethion	200	200	-
31.	Dicofol	150	150	-
32.	Tetradifon	20	20	-

S.No.	Name of the Pesticide	Demand 1994-95	Likely Production 1994-95	Gap 1994-95
B.	FUNGICIDES			
1.	Carbendazim		200	200
2.	Carboxin/Oxycarboxin	60	60	-
3.	Thioacarbomates (Thiram/Ziram)	200	200	-
4.	Organo Mercurial	175	175	-
5.	Captan	150	150	-
6.	Edifenphos	130	-	130
7.	Dithiocarbamates (Mancozeb,Zineb)	2,550	2,550	-
8.	Tridemorph	40	40	-
9.	Captafol (Difolatan)	175	175	-
10.	Kitazin (IBP)	80	80	-
11.	Copper Oxychloride	1,500	1,500	
12.	Copper Sulphate	5,400	-	5,400
13.	Nickel Chloride	70	70	-
14.	(a) Sulphur (Dust)	8,050	-	-
	(b) Sulphur(WP)	1,300	-	-

NEW CHEMICALS INTRODUCED IN INDIAN MARKET, PARTICULARLY BY THE MULTINATIONAL COMPANIES, DURING THE LAST 5-10 YEARS

	Product	Name of Introducer/Patentee	Company in India Manufacturing the Product
A.	Synthetic Pyrethroids		
	Cypermethrin	NRDC, UK/Mitchel Cotts, UK	1. NOCIL , Bombay 2. IEL, Madras 3. BASF, Bombay 4. BPM, Bombay 5. Gujarat Insecticides, Ankleshwar
	Fenvalerate	Sumitomo Chemical Co. Japan	1. United Phosphorous,Ankaleshwar 2. Searle India, Bombay 3. Rallis, Bombay 4. Gujarat Insecticides,Ankaleshwar
	Deltamethrin(Decis)	Roussel Uclaf, France	1. Roussel Pharmaceuticals, Bombay
B.	HERBICIDES		
	Isoproturon	Hoechst A.G, West Germany	1. Hoechst, Bombay 2. Gharda, Bombay 3. Montari, Delhi 4. Paushak, Baroda
	Pendimethalin (Stomp)	American Cyanamic Co.	Cynamid India Limited
C.	FUNGICIDES		
	Dithianon (Delan)	Celamerck Gmbtt & Co. (FRG)	E.Merck, Bombay
	Dodine	Kenogard VTAB (Sureden)	Montari, New Delhi
	Metalexyl (Ridomill)	Ciba-Geigy Ltd., Switzerland	Ciba-Geigy Bombay
	Thiophamate Methyl(Topsin)	Nippon Soda, Japan	Motilal Pesticides, Mathura
D.	INSECTICIDES (For use in Andhra Pracesh)		
	Fluvalinate	Sandoz, Switzerland	Sandoz India Ltd., Bombay
	Fenpropathrin	Sumitomoto Chemical Co, Japan	Rallis, Bombay
	Triazophos	Hoechst AG, West Germany	Hoechst, Bombay
	Methomyl(Lannate)	E.I.Du Pont, France	Corornandal, Madras

NAME OF THE FIRMS WHO INTRODUCED AGRO-CHEMICALS DURING LAST 10 YEARS

1.	Cypermethrin	M/s. Indian Explosives Ltd., Calcutta
2.	Decamethrin	M/s. Hoechst Pharmaceuticals Ltd., Bombay
3.	Fenvelerate	M/s. Rallis (I) Ltd., Bangalore
4.	Isoproturon	M/s Hoechst (I) Ltd., Bombay
5.	Permethrin	M/s. Bharact Pulversising Mills (P) Ltd., Bombay
6.	Pirimiphos Methyl	M/s Indian Explosives Limited Calcutta
7.	Acephate	M/s. Bharat Pulverising Mills (P) Ltd., Bombay
8.	Benthiocarb	M/s. Pesticides India, Udaipur
9.	Fluchloralin	M/s. BASF India Ltd., Bombay
10.	Captafol	M/s. Rallis India Limited, Bombay
11.	M.E.M.O.	M/s. Excel Industries, Bombay
12.	Metoxuron	M/s Sandoz India Ltd., Bombay
13.	Carbandazim	M/s. BASF India Limited, Bombay
14.	Aldicarb	M/s. Union Carbide, Bhopal
15.	Diathianon	M/s. E. Merck India Ltd., Bombay
16.	Coumachlor	M/s. Pest Control India Ltd., Bombay
17.	Diflubenzuron	M/s. Coromandal Indag Products (I) Pvt. LKtd
18.	Glyphosate	M/s. Monsanto Chemicals (I) Pvt. Ltd., Bombay
19.	Kitazine	M/s. Pesticide India, Udaipur
20.	Methabenzthiazuron	M/s. Bayer (India) Ltd., Bombay\
21.	M.S.M.A.	M/s. Farm Chemicals (P) Ltd., Bombay
22.	Pendimethalin	M/s. Cynamid India Ltd., Bombay
23.	Temephos	M/s. Cynamid India Ltd., Bombay
24.	Metalxyl	M/s. Hindustan Ciba Geigy Ltd., Bombay

STAGE OF MANUFACTURE FOR SELECTED PESTICIDES

S.No.	Name of Insecticides	Third Last Stage	Second Last Stage	Value Addition/kg
1.	Butachlor		2,6 Diethylaniline	Rs. 44
2.	Endosulfan		i) Hexachloro Cyclopentadiene ii) Cis-2 Butene-1,4-diol	Rs. 70 Rs. 81
3.	Isoproturon		p-Cumidine	Rs 132
		Cumene		
4.	Phosalone	o-Amino Phenol		Rs. 41
5.	Cypermethrine		DVC ester	Rs. 300
6.	Captan		Tetrahydro Phthalic anhydride	Rs. 14
7.	Fenithrothion		p-nitrometacresol	Rs. 26
8.	Ethion		Methyline Bromide	Rs. 92
9.	Diazinon		2-Isopropyl-4-methyl-6 hydroxy pyridine	Rs. 39
10.	Oxy-demeton Methyl	Ethythio Ethanol		Rs. 106
11.	Fenthion		p-Methyl mercapto-m-cresol	Rs. 67
12	Fenvalerate	p-chlorotoleune		
13.	Acephate		o,o-dimethyl phosphoiroamido thioate	
14.	Phorate		Ethylmercaptan	
15.	Temephos		i) 4-4'-thiodiphenol ii)Dimethylthiophosphoryl chloride	
16.	Atraxine	i) Cynunic Chloride ii) Monoisopropylamine iii)Mono ethylamine		
17.	Carboxin	i) Acetanilide ii) B-mercaptoethanol		
18.	Paraquat	Pyridine		
19.	Fluchloralin		i) N-propyl-N-hydroxy ethylamine ii) 2,6-dinitro-4-trifluro methyl chloro benzene	
20.	Carbaryl	L-naphthol		
21.	Tridemorph	Propylanilide Tridecylamine		

LIST OF EQUIPMENT REQUIRED FOR MANUFACTURE OF PESTICIDES

A. *MECHANICAL EQUIPMENTS*

1. M.S. Reactors with Agitator
2. S.S. Reactors with Agitator
3. G.L. Reactors with Agitator
4. Distillation Stills with Columns
5. Strippers
6. Driers
7. Vac Rotary Drum Filter
8. Vac Belt Dryers
9. Falling Film Evaporators
10. Wiped Film Evaporators
11. Crystallisers
12. Gas Absorbers

B. *ROTATING EQUIPMENTS*

13. Centrifugal Pumps
14. Metering Pumps
15. High Vac. Pumps
16. Suction Blowers
17. Barrel Mounted Pumps
18. N2 generating units
19. Centrifuge
20. Low temp pumps

C. *HEAT EXCHANGERS*

21. S.S. Shell and Tube type heat exchanger
22. M.S. Shell and tube type heat exchanger
23. M.S.G.L. Shell and Tube Type Heat Exchanger
24. Titanium Heat Exchanger

D. *TANKS STORAGE/BATCH*

25. M.S. Storage and Batch Tanks
26. S.S. Storage and Batch Tanks
27. M.S.G.L. Storage and Batch Tanks
28. HDPE Storage/Batch Tanks
29. P-P Storage/Batch Tanks
30. High Pressure/Vac. Recenars
31. Phase Separators

E. *PIPES & FITTINGS AND VALVES*

32. M.S./S.S. Pipe Line and Fittings
33. MSGL Pipe Line and Fittings
34. PP/HDPE Pipe Line and Fittings
35. Various Types of Valves for flow control manual or automatic

F. *INSTRUMENTS*

36. All process control instruments like temperature, pressure and flow indicators/Recorders
37. High/Low level alarms
38. Magnetic/non magnetic liquid level indicators
39. Temperature Controllers
40. Pressure Controllers

G. *ELECTRICAL EQUIPMENTS*

41. Power Transformers
42. L.T. Relay Switches
43. M.C.C.
44. Circuit Breakers
45. Flame Proof Motors
46. Flame Proof Light Fittings
47. Flame Proof Communication Systems

LIST OF EQUIPMENTS REQUIRED FOR FORMULATION OF PESTICIDES

A. *POWDER FORMULATION*

1. Micro Pulverizers
2. Crushing Machines
3. Rotary Valves
4. Raymond Mills
5. Fluid Energy Mill
6. Blender
7. Plough Shear Mixer
8. Screw Feeders
9. Cyclone Separators
10. Bag Fitters
11. Blowers
12. Silos
13. Material Handling and Conveying System
14. Sieve Shaker
15. Filling and Bagging Machines

B. *GRANULAR FORMULATION*

16. Batch Bins
17. Silos
18. Screw Mixers
19. Granulators
20. Fluid Bed Dryers
21. Pneumatic Conveyers
22. Bucket Elevators
23. Silos
24. Sieve Shaker
25. Disintegrator
26. Weighing and Bagging Machines
27. Rotary Drum Mixers

C. *LIQUID FORMULATION*

27. Jacketed Mixing Tanks
28. Metering Pumps
29. Pumps
30. Barrel Mounted Pumps
31. Cartridge Filters/Pressure Filters
32. Filling and Sealing Machines
33. Storage Tanks for Solvents

D. *NEW FORMULATION LIKE FLOWABLES, MICRO EMULSION, CR MICROCAPSULES, ULV INVERT EMULSIONS*

34. Dyno Mills
35. Colloid Mill
36. Mixing Tanks
37. Metering Pumps
38. Batch Mixing Tanks
39. Mixing Tanks with High Speed Turbine type Stirrers
40. Dilution Tanks
41. Chilled Water Facility
42. Weighing Machines

MARKET CONCENTRATION AND DIFFERENTIALS IN ESTIMATED FAIR SELLING PRICE OF TECHNICAL PESTICIDES AND ACTUAL SELLING PRICE - 1983-84 AND JANUARY 1988

S.No.	Technical Grade Pesticide	Name of Co.	Market Con- (% share of market)	BICP's centration Fair selling Price(Rs./kg)	Actual Estimated price 1983-84	Inflated BICP's selling fair selling price for Jan.88	Inflated Estimated Market Price
1.	Quinalphos (70%)	Sandoz	76(1983/84)	181.86	168.84	211.8	196.6
2.	Monocrotophos(68%)	Ciba	76(1983/84)	138.31	135.00	161.1	157.2
3.	Phosphamidon(92%)	Ciba	86(1983)	74.91	140.00	87.2	163.0
4.	Methyl Parathion(80%)	Bayer	97(1983)	53.44	61.50	62.2	71.6
5.	Dimethoate(90%)	Rallis	91(1982/83)	63.71	85.68	74.2	99.8
6.	Dithane Z-78 M-45	Indofil Indofil	100(1984)	44.47 43.27	43.94 51.32	51.8 50.4	51.2 59.8
7.	Paraquat (Fair price of Form N.A.)	IEL	100(1984)	60.19	85.00	70.1	99.0
8.	BHC (99%)	IEL	-	7.61	6.90	8.8	8.0
9.	Malathion (95%)	Ficom	27(1983)	29.03	33.00	33.8	38.4
10.	Al. Phosphide	Excel	51(1983)	72.65	107.50	84.6	125.2
11.	Endosulfan ((0%)	Excel	81(1983)	102.13	103.85	118.9	120.9
12.	DDT (100%)	HIL	60(1983/84)	25.06	26.95	29.22	31.4

UNIDO'S SUBSTANTIVE COMMENTS

REGIONAL NETWORK ON PESTICIDES FOR ASIA AND THE PACIFIC

DP/RAS/88/031

Technical report of Mr. R.S. Mathur

Introduction

The report gives a detailed account of the pesticide scenario in India and discusses the issues related to an integrated pesticide industrial policy, and how it could be developed in a country like India.

Comments

Due to great concern in many countries over the indiscriminate use of pesticides, many developing countries are thinking in terms of developing a national strategy for the strict control in the production, use and disposal of pesticides. These could culminate in a national integrated pesticide policy which could form the guidelines for the control of pesticides so that the country at large could enjoy the benefits of pesticides and reduce the side effects to the minimum. The report gives an agenda of items that should be taken into account to develop an integrated national policy. On the safety and environment issue the report broadly covers all the aspects related to pesticide industry and an interesting statement 'the Bhopal gas disaster has not done anything to prevent repetition of such tragedies' is a clear caution to the country that more money and dedication need to be diverted to clean up industries and pesticide industries could be the first group that could be looked at on national level by a progr[illegible] approach.