RESEARCH REPORTS
FOR ANALYSIS AND ACTION
FOR SUSTAINABLE DEVELOPMENT OF HYDERABAD

Project funded by Federal Ministry of Education and Research (BMBF), Germany:
"Research for the Sustainable Development of the Megacities of Tomorrow"

Pesticides, Residues and Regulation: A case of vegetables in Hyderabad Market

Centre for Sustainable Agriculture

Research Report 1

FACTORS

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Research Report 1

Research Reports for Analysis and Action for Sustainable Development of Hyderabad

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Research Reports are outcomes of the Pilot Projects implemented jointly in Hyderabad by the Pilot Project Groups of the Megacity Project of Hyderabad. These reports for analysis and action focus on *knowledge generation and application* as well as on *institutions and governance structures* concerning the core issues of poverty, food, nutrition, health, transport, environment and resource degradation. This has been possible through joint research efforts, involving institutions of urban governance, integration of organisations of civil society in communication, participation, co-operation and network linking. Views and opinions expressed in the reports do not necessarily represent those of the Project Consortium.

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Foreword

The deep crisis affecting the farming community in India largely escapes the imagination of the urban population. It might be because food production is almost completely de-linked from food consumption here. Food is seen as a commodity which can be bought over the counter, with quality assured by the tag of the supermarket or a popular brand. The ecological footprint that certain food production systems and supply chains leave is largely ignored or not understood. The distress experienced by food-producing communities is invisible. Consumers also tend to ignore the implications on themselves flowing from lack of food safety.

As citizens and as consumers of food, we never relate ourselves to the farming community and always carry a feeling that the technology, policies and regulatory systems related agriculture are the concern of the farmers.

This report is the result of a pilot study on 'Pesticides, Residues and Regulation in India'. It is an attempt to break the apathy and ignorance of consumers through the analysis of how pesticides and pesticide residues in food are regulated in India and the potential implications on urban consumers.

With a lot of effort from civil society groups and concerned activists, there is now a shift towards production that is not dependent on chemicals. Concern over the health implications of toxic pesticides has also prompted some people to shift towards organically grown foods.

On the other hand, governments, agricultural research and extension system and the chemical industry continue to believe in the 'inevitability of pesticides' and continue to talk only about safer pesticides, safe use of pesticides, better regulatory systems etc. The issue of pesticide residues receives some attention only when export consignments from India are rejected or studies on pesticide residues in soft drinks or bottled water are released. The larger issues of food safety for consumers and sustainable resource management for producers are largely ignored. Working backwards, we tried to look at how pesticide residues in food are regulated in India, how pesticides themselves are regulated, recommended, the institutions involved & their functioning etc. The study used both primary and secondary data for its analysis.

Our research shows several objectionable gaps and lapses in the regulatory systems, several contradictions even at the conceptual level and gross negligence with regard to assessing and promoting safer and better alternatives.

This pilot study is part of the Sustainable Hyderabad 'Megacity Project' (http://www.sustainable-hyderabad.in).

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Centre for Sustainable Agriculture

1. Introduction

Around 203 pesticides have been registered for use in agriculture in India as of December 2006, against various pests and diseases. These pesticides can be broadly classified into Insecticides (used against insect pests), Herbicides (for killing & controlling weeds), Fungicides (against diseases) and others. Another classification is based on the chemical composition – organophosphate compounds, organo-chlorines, synthetic pyrethroids, carbamates, bio-pesticides etc.

Pesticide production and use in the country shows a different pattern from global trends – insecticide use is around 75% in the country, compared to 32% in the world. Herbicide use is only 12% in the country while worldwide, consumption is 47%. Important to note is the fact that weeding is a critical agricultural operation that provides employment to millions of poor agricultural labour, especially women, in the country. Similarly, while carbamate and synthetic pyrethroid compounds are used the most globally [45% together], in India, organophosphates constitute 50% of the consumption. Similarly, bio-pesticides are used only upto 1% amongst all pesticides in India, while worldwide, it is 12%.

Another classification of pesticides is as per their acute toxicity, as classified by the World Health Organisation. This classification includes Class Ia – Extremely hazardous, demarcated in red; Class Ib – Highly Hazardous, symbolized by an yellow triangle; Class II – Moderately Hazardous, marked by a blue triangle. Class III is known as "Slightly Hazardous" while the remaining class is supposed to be "Not likely to be Hazardous". It is to be noted here that two-thirds of the pesticides consumed here fall under WHO Class I and II pesticides. From 1998 to 2005, the decline in Class Ia pesticides has been only 2% - from 11% to 9%.

There have been reports of many different problems related to pesticide production and use in the country on the economic, ecological and health fronts. This report will focus particularly on pesticide residues in foods in India.

The current study has been taken up by Centre for Sustainable Agriculture, a non-governmental organization based in Hyderabad, Andhra Pradesh. The organization works with farmers across the state to promote ecological, local-resource-based practices in agriculture so that farming becomes viable and sustainable for farmers. Through this, livelihoods of farmers and agricultural workers is sought to be improved. At the same time, the organization also takes up research work so that larger impacts can be made on the farming community through policy influencing and lobbying on relevant issues and to make policies/programmes farmer-friendly and farmer-centric.

The study has been supported by the Humboldt University's recent efforts at creating a Sustainable Hyderabad. The main objectives of the study were:

1. to compile existing studies on pesticide residues in food and their health implications
2. to map the existing institutions, programs and policies dealing with pesticides, pesticide residues and regulation
3. to investigate the agricultural activity in terms of pesticide consumption on various vegetables at village level in the catchment of a Hyderabad vegetable market

This report presents a literature review of other such studies from various parts of the country, a picture of the vegetable cultivation and consumption in and around Hyderabad, an overview of the regulatory mechanisms in place with relation to pesticide use and the actual implementation of such regulations.

Conceptual Framework

The debate on pesticide residues in soft drinks and bottled water in India has raised awareness over contamination of our water with toxic pesticide residues. Unfortunately the debate became restricted to the quality standards and norms pertaining to drinking water and foods at the point of consumption. The more fundamental problem of contamination of all natural resources with chemical pesticide residues because of faulty and hazardous agricultural technologies at the farming level is often ignored. Without solving the basic problem, no amount of standard-setting at the consumption level is going to solve the problem, especially in a country like India where enforcement of regulations is notoriously weak or even absent.

In this context, Centre for Sustainable Agriculture took up a small study on a pilot basis to understand the pesticide load in vegetable production in those villages which are the catchment areas for the vegetables being sold in Hyderabad markets and the story behind of what is being recommended to farmers and what is being regulated. We felt that with the help of this study it would be possible to create awareness amongst consumers and producers on various issues related to pesticides and residues. Subsequently, we hope to connect the issue with production practices and the need to shift to alternatives like for non-pesticidal management [NPM] in the vegetable production system. Our attempt is also to understand and act on the importance of rural-urban linkages for lasting changes to happen at the farming level, with urban consumers actively supporting this shift by farmers. This in turn will yield beneficial results in many ways to both producers and consumers such as restoration of crop-ecology, profitable economics, improved marketing options for such produce, improvement in health etc.

Methodology

- Collected and summarized available documentation and studies (published and unpublished) on pesticide residues in vegetables in India in general and Hyderabad in particular from relevant institutions, organizations, and agencies (research, governmental, NGOs etc.).

- A quick survey on the production practices followed by farmers in the catchments of the Mehdipatnam Rythubazar (a big vegetable market in Hyderabad where farmers sell vegetables directly to the consumers) to understand the pesticides used and their status with respect to Agriculture University and Agriculture department recommendations and vis-à-vis Central Insecticide Board and Registration Committee.

- Identify and map various institutions, programmes, knowledge resources etc. that affect food quality, especially when it comes to pesticides, to understand shortcomings and ways of improving these.

2. Pesticide Residues in Foods in India

Some amounts of pesticides appear as Residues in the crop products that they are used on at the time of harvest and point of consumption. The amount of such residues varies across crops, for different pesticides and locations.

Perusal of the residue data on pesticides in samples of fruits, vegetables, cereals, pulses, grains, wheat flour, oils, eggs, meat, fish, poultry, bovine milk, butter and cheese in India indicates their presence in sizable amounts (Bhusan, 2006).

Between 1965 and 1998, the contamination of food from pesticides in India has been estimated at only 41% being free from residues, as compared to 63% being free from residues in the European Union in 1996 (Bhushan, 2006). In India, it is also estimated that 20% of the contamination is above Maximum Residue Limits [MRLs] fixed. In EU, this is estimated to be around 1.4% while in the USA, in 1996, it is reported that the contamination above MRLs is around 4.8% only.

In the 1980s, the All India Coordinated Research Project on Pesticide Residues [AICRPPR] was set up to monitor pesticide residues all over the country.

In 1999, the AICRPPR reported that with all commodities put together, 20% of the food samples tested exceeded the MRLs. Fruits, vegetables and milk are found to be highly contaminated. Monocrotophos, Methyl Parathion and DDVP, all organo phosphorus pesticides, are found to be most prevalent. These are also WHO Class I pesticides.

Even in 2001, 61% of the samples tested are found to be contaminated, 11.7% of which were also above MRLs. Recent AIRCRP reports say that contamination has come down quite a lot. The fruit samples are fine now and that around 15% of the milk samples still exceeded MRLs.

Hexachlorobenzene (HCB, a fungicide) was identified in water, human milk and human fat samples collected from Faridabad and Delhi (Nair, 1989). DDT and HCH residues were detected in groundnut and sesamum oil samples collected from Tamilnadu (ICMR, 1993).

In a multi-centric study to assess the pesticide residues in selected food commodities collected from different states of the country, DDT residues were found in about 82% of the 2205 samples of bovine milk collected from 12 states (ICMR, 1983). About 37% of the samples contained DDT residues above the tolerance limit of 0.05 mg/kg (whole milk basis).

The highest level of DDT residues found was 2.2 mg/kg. The proportion of the samples with residues above the tolerance limit was maximum in Maharastra (74%) followed by Gujarat (70%), Andhra Pradesh (57%), Himachal Pradesh (56%) and Punjab (51%). In the remaining states, this proportion was less than 10%. Data on 186 samples of 20 commercial brands of infants formulae showed the presence of residues of DDT and HCH isomers in about 70 and 94 % of the samples with their maximum level of 4.3 and 5.7 mg/kg (fat basis) respectively.

The average total DDT and BHC consumed by an adult were reported to be 19.24 mg/day and 77.15 mg/day respectively (Kashyap, R 1994). Fatty food was the main source of these contaminants. In another study, the average daily intake of HCH and DDT by Indians were reported to be 115 and 48 mg per person respectively which were higher than those observed in most of the developed countries (Kannan, 1992).

Other studies reveal the following:

1. In one study, the tested samples were found 100% contaminated with low but measurable amounts of pesticide residues. Among the four major chemical groups, residue levels of organophosphorous insecticides were highest followed by carbamates, synthetic pyrethroids and organochlorines. About 32% of the samples showed contamination with organophosphorous and carbamate insecticides above their respective MRL values (Kumari Beena et.al 2003).

2. An article from Delhi presents the development of a multiresidue method for the estimation of 30 insecticides, 15 organochlorine insecticides and six organophosphorus insecticides, nine synthetic pyrethriods and two herbicides and their quantification in vegetables. The monitoring study indicates that though all the vegetable samples were contaminated with pesticides, only 31% of the samples contained pesticides above the prescribed tolerance limit (Mukherjee Irani, 2003).

3. Samples of vegetables collected at beginning, middle and end of seasons were analysed for organochlorine levels. Maximum pesticide residues were detected from cabbage (21.24 ppm), cauliflower (1.685) and tomato (17.046) collected at the end of season and okra (17.84 ppm) and potato (20.60) collected at the middle of season. OCP residue levels in majority of samples were above the maximum acceptable daily intake (ADI) prescribed by WHO, 1973 (Neela Bakore, 2002).

4. Twelve most commonly used pesticides were selected to study residual effects on 24 samples of freshly collected vegetables. Most of the samples showed presence of high levels of malathion. DDE, a metabolite of DDT, BHC, dimethoate, endosulfan and ethion were also detected in few samples. Leafy vegetables like spinach, fenugreek, mustard seem to be most affected. Radish also showed high levels of contamination (Sasi K.S and Rashmi Sanghi (2001).

5. Vegetable samples collected at harvest from farmer's fields around Hyderabad and Guntur recorded HCH residues above MRL (0.25 ppm). Residues of DDT and Cypermethrin were found to be below MRL (3.5 & 0.2 ppm respectively) and Mancozeb residues are above MRL (2 ppm) in bittergourd only. Residues of HCH, DDT, aldrin (including dieldrin), endosulfan and methyl parathion in vegetables of Srikakulam were below MRL (Jagadishwar Reddy, 1998).

6. Detectable levels of residues of commonly used pesticides were noticed in tomato (33.3%), brinjal (73.3%), okra (14.3%), cabbage (88.9%) and 100% cauliflower samples. However the levels of concentrated pesticide residues were lower than the MRLs prescribed (Dethe, M. D. et.al 1995).

7. An experiment conducted to estimate the residues of four synthetic pyrethroids and monocrotophos recommended a waiting period of 2 days for deltamethrin, cypermethrin and permethrin as the rate of dissipation was faster and 5 days for fenvalerate and monocrotophos on *okra* fruits (Hafeez Ahmad and Rizvi S M A, 1993).

8. Wheat flour and eggs contained maximum concentration of OCP residues in a study to estimate various OCPs in different food items collected from 10 localities in Lucknow city. The estimates of dietary intake of total HCH (1.3g) and Lindane (0.2 mg) in the present study is about one and a half times higher than that proposed by ADI and 100 times the values reported from UK and US (Kaphalia B. S, et.al 1985).

9. Out of 400 food stuffs tested 23.7% were positive for pesticide residues. Higher rates were found in animal products (30%), cereals and pulses (26.3%) and vegetables (24%). Out of the

95 samples that tested positive for pesticides, malathion was detected in 44 samples (46.3%); Lindane in 27 samples (28.4%) and DDT in 24 samples (25.3%). Pesticide detection rate for green leafy vegetables during winter months was 53.3% as compared to that of rainy (8.3%) and summer months (23.1%). Corresponding figures for non-leafy vegetables were 30%, 12.5% and 19.5% respectively (Mukherjee D, 1980).

In a response to a starred question (No. 202) in the Indian Parliament on 8/8/2005, the Agriculture Minister revealed the following information:

Statement indicating the extent of pesticide residues in various agricultural commodities monitored under All India Network Project on Pesticide Residues:

On Vegetables (Cabbage, Cauliflower, Brinjal, Okra, Potato, Beans, Gourds, Tomato, Chilli, Spinach, Carrot, Cucumber, Cowpea Etc.)

Year	No of Samples analysed	Samples above MRL (%)
1999	277	10 (3.6%)
2000	712	81 (11%)
2001	796	93 (11.7%)
2002	592	54 (9%)
2003	666	35 (5.3%)
Total 1999-2003	**3043**	**273 (8.97%)**

On Fruits (Apple, Banana, Mango, Grapes, Oranges, Pomegranate, Guava Etc.)

Year	No of Samples analysed	Samples above MRL (%)
1999	122	8 (6%)
2000	378	8 (6%)
2001	378	0 (0%)
2002	359	3 (0.8%)
2003	317	1 (0.3%)
Total 1999-2003	**1554**	**15 (0.97%)**

In Milk

Year	No of Samples analysed	Samples above MRL (%)
1999	194	116 (60%)
2000	537	94 (17.5%)
2001	468	71 (15%)
2002	No study done	
2003	No study done	
Total 1999-2003	**1199**	**281 (23.4%)**

These findings are at great variance with the results from other independent studies. During the Joint Parliamentary Committee probing of the pesticide residues study reported by Centre for Science & Environment [CSE, Delhi], the Ministry of Agriculture furnished a note to the Committee on the reasons for agricultural pesticide residues being high in India (especially given the comparatively low [volume] per hectare consumption of pesticides in the country):

- Indiscriminate use of chemical pesticides
- Non-observance of prescribed waiting periods
- Use of sub-standard pesticides
- Wrong advice and supply of pesticides to the farmers by pesticide dealers
- Continuance of DDT and other uses of pesticides in Public Health Programmes
- Effluents from pesticides manufacturing units

- Wrong disposal of left over pesticides and cleaning of plant protection equipments
- Pre-marketing pesticides
- Treatment of fruits and vegetables

Rejection of Indian export consignments due to presence of chemical residues

The presence of residues in agricultural export consignments has often meant rejection of such consignments by the importing countries. Before the advent of the WTO, Indian exporters had to mostly comply with AGMARK specifications. Now, the situation is different. The most popular specifications for spices world over is now as per ASTA cleanliness specifications and also USFDA specifications. The situation gets further complicated since most counties have now set their own specifications. Non-availability of MRLs for recommended pesticides on chilli spice has become a practical problem in promoting chilli exports.

The following table shows the alert notices issued by FSAI (Food Safety Authority of Ireland), FSA (Food Standards Agency) of UK, and other organizations on the contamination of Indian foods based on the tests at importing points.

Month & Year	Importing Country	Agricultural Product	Reasons
January, 2005	UK	Chilli powder	Sudan Red
November, 2004	EU	Chilli powder	Sudan Red
March, 2004	EU	Chilli powder	Sudan Red
January, 2004	EU	Chilli powder	Sudan Red
May, 2003	UK	Grapes	Methomyl
April, 2003	UK	Grapes	Methomyl, Acephate
March, 2003	UK	Extra hot chilli peppers	Aflatoxins
	UK	'Dabur' Honey	Streptomycin
	Italy	Nutmeg	Aflatoxins
February, 2003	Italy	Chilli powder	Aflatoxins
	Italy	Chilli powder	Aflatoxins
December, 2002	UK	Curry powder	Salmonella
	The Netherlands	Chilli powder	Aflatoxins
September, 2002	Italy	Herbal products	Heavy metals
August, 2002	UK	Curry powder	Ethion
	Spain	'Cayerre' pepper	Aflatoxins
March, 2002	UK	Coriander	Rat droppings
	Italy	Chillies	Aflatoxins
January, 2002	Greece	Crushed chilli & powder	Aflatoxins
November, 2001	Germany	Curry powder	Cypermethrin, fenvalerate, phosphamidon
	Greece	Chilli powder and Red chilli	Ethion, triazophos, cypermethrin, chlorpyriphos
June, 2001	Germany	Curry powder	Cypermethrin and dicofol
May, 2001	UK	Grapes	Triazophos
April, 2001	Germany	Curry powder & chilli powder	Ethion, cypermethrin
July, 2000	Spain	Chilli	Cypermethrin

Source: The data collected from various Internet resources, and alert sites

It is interesting to know that more than 100 laboratories in the country are engaged in research on pesticide residues under the preview of ICMR, CSIR, ICAR, SAUs and enormous number of independent institutions/ organizations/ laboratories/ industries. The situation with regard to residues persists despite such infrastructure available.

3. Pesticide Regulation in India

LEGISLATIONS:

In India, the production and use of pesticides are regulated by a few laws which mainly lay down the institutional mechanisms by which such regulation would take place – in addition to procedures for registration, licensing, quality regulation etc., these laws also try to lay down standards in the form of Maximum Residue Limits, Average Daily Intake levels etc.. Through these mechanisms, chemicals are sought to be introduced into farmers' fields and agricultural crop production without jeopardizing the environment or consumer health.

These legislations are governed and administered by different ministries – the regulatory regime and its enforcement have several lacunae stemming from such an arrangement. An added dimension is that administration of the legislations includes both state governments and the central government.

The **Central Insecticides Act 1968** is meant to regulate the import, manufacture, storage, transport, distribution and use of pesticides with a view to prevent risk to human beings, animals and the environment. Through this Act, *a Central Insecticides Board* has been set up to advise the state and central governments on technical matters and for including insecticides into the Schedule of the Act. This Board, under the Chairmanship of the Director General of Health Services, consists of 29 members. Around 625 pesticides have been included in the Schedule so far. The Board is supposed to specify the classification of insecticides on the basis of their toxicity, their suitability for aerial application, to advise the tolerance limits for insecticide residues, to establish minimum intervals between applications of insecticides, specify the shelf life of various insecticides etc.

Then there is a *Registration Committee* which registers each pesticide in the country after scrutinizing their formulae and claims made by the applicant as regards its efficacy and safety to human beings and animals. The Registration Committee is also expected to specify the precautions to be taken against poisoning through the use or handling of insecticides. This Registration Committee has five members including the Drug Controller General of India and the Plant Protection Adviser to the Government of India. Around 181 pesticides have been registered by the Committee so far in India.

Then, there are other institutions like Central Insecticides Laboratory and Insecticides Inspectors to ensure that the quality of insecticides sold in the market is as per norms. The Central Insecticides Laboratory is also meant to analyse samples of materials for pesticide residues as well as to determine the efficacy and toxicity of insecticides. This laboratory is also responsible for ensuring the conditions of registration.

As per this legislation, *the central government* will register the pesticides whereas the marketing licenses are allowed by *state governments*. The general enforcement of the legislation is by the state government's agriculture department.

Both the Central and State governments have been given the power to prohibit the sale, distribution or use of an insecticide or a particular batch in a specific location for a specific extent and for a specific period by notification in the official gazette [Section 27 of the Insecticides Act, 1968]. Section 26 of the legislation states that the State Government may, by notification in the Official Gazette, require any person or class of persons specified therein to report all occurrences of poisoning (through the use or handling of any insecticide) coming within his or their cognisance to such officer as may be specified in the said notification. Based on such reports, on grounds of public safety, prohibition of sale of insecticides can be ordered and enforced. The Act also lays down penalties for producing/selling misbranded insecticides or for selling without license or for other contraventions of the Act.

While registration and licensing is done through the above mentioned processes, for banning or prohibiting a pesticide a different mechanism is used in India. Unlike in other countries where registered pesticides automatically come up for periodic reviews for their efficacy and safety (as in the case of some Scandinavian countries) or unlike in countries like Syria where a pesticide is automatically banned in the country if it is prohibited in two other countries, India goes through long processes of review and prohibition, usually through committees set up for the purpose.

Expert Committees have been appointed from time to time to review the continued use or otherwise of pesticides which are banned/restricted in other countries. As a result, 27 pesticides and 4 formulations of 3 other pesticides have been banned for use and the use of another 7 pesticides has been restricted.

The following expert committees have been set up so far by the Department of Agriculture, GoI:

- Committee under the Chairmanship of Dr.S.N. Banerjee in 1984.
- Reconstitution of the Committee under the Chairmanship of Dr.S.N. Banerjee in 1989.
- Another Committee under the Chairmanship of Director General, ICAR to review DDT and BHC.
- Committee constituted under the Chairmanship of Dr. K. V. Raman to review the pesticides during 1995.
- Committee constituted under the Chairmanship of Prof. R.B. Singh in the year 1997.

As this report is being written, there is another Committee, headed by Dr C D Mayee which is looking at the fate of at least 10 pesticides to begin with and 27 others, on whether they should be continued to be produced and used in India. These are pesticides that have been banned elsewhere in the world. Incidentally, this Committee had been set up in the last quarter of 2005, to review the toxicity, persistence, safety in use and substitutes available for the following pesticides – even after 15 months, there is no decision taken by the Expert Group.

S.No.	**Name of Pesticides**	**S.No.**	**Name of Pesticides**
1	Monocrotophos	20	Dinocap
2	Mancozeb	21	Ethofenprox (Etofenprox)
3	Quinalphos	22	Metoxuron
4	Butachlor	23	Trifluralin
5	Diclorvos (DDVP)	24	Chlorofenvinphos
6	Acephate	25	Fenpropathrin
7	Fenitrothion	26	Iprodione
8	Carbendazim	27	Benfuracarb
9	Atrazine	28	Bifenthrin
10	Pendimethalin	29	Dazomet
11	Deltamethrin (Decamethrin)	30	Diflubenzuron
12	Fenthion	31	Kasugamycin
13	Simazine	32	Linuron
14	Metaldehyde	33	Mepiquate Chloride
15	Diazinon	34	Propergite
16	Carbosulfan	35	Propineb
17	Chlorothalonil	36	Thiodicarb
18	Dalapon	37	Trichlorofon
19	Thiophanate-Methyl		

The production and use of insecticides in India is also governed by the **Prevention of Food Adulteration [PFA] Act**, 1954, under the *Ministry of Health & Family Welfare.*

This Act and its Rules lay down standards for different food articles as well as provisions for their storage, distribution and sale. The Maximum Residue Limits [MRLs] for different pesticides are regulated through this PFA Act.

The Central Committee for Food Standards (CCFS) constituted under Section 3 of the Prevention of Food Adulteration Act, 1954 advises Central/ State Governments on all matters arising out of implementation of the Prevention of Food Adulteration Act, 1954 and the PFA Rules, 1955, including review and formulation of rules, regulations and standards of food articles. The Central Committee for Food Standards (CCFS) has representatives from different Departments in the Central Government, State Governments, trade, industry, technical experts and consumer organizations, besides representatives from the National Institute of Nutrition, Central Food Technology and Research Institute and the Central Food Laboratories. The Central Committee for Food Standards (CCFS) has constituted 9 technical Sub-Committees to assist it. The "Pesticides Residue Sub-Committee" is one of them and its function is to deal with laying down limits of pesticide residue tolerance in food and also to suggest methods for their detection and estimation. In general, the enforcement of the Act is through the state governments through a system of inspections, sampling and analysis. There are Central Food Laboratories set up under the Act for the purpose of assisting the government in enforcement of the legislation.

The Food (Health) Authorities of State/UTs are responsible for implementing the provisions of the Prevention of Food Adulteration Act, 1954 and Rules, 1955. They have been advised from time to time to keep a strict vigil on the level of pesticides/insecticides in food articles, by taking samples of food articles. Data on samples tested and results thereof are required to be sent by the State Governments to the Ministry of Health for purposes of monitoring.

Currently, many pesticides have been approved for use in the country for which tolerance levels have not been fixed under the PFA Act. Of the 165 pesticides currently approved for use, tolerance levels have so far been included under Rule 65 of the PFA Rules, for only 71 pesticides. This is less than 50% of the registered pesticides. Those not included under the PFA Act include some pesticides which are termed as "deemed pesticides", which were approved prior to 1971 and for which, therefore, no data is available for undertaking risk assessment from the point of view of food safety and for fixing Maximum Residue Limits.

There are also other laws that regulate the manufacture and use of pesticides in the country. The Environment Protection Act, 1986, under the Ministry of Environment & Forests is one other such legislation. Under this Act, several Rules apply to insecticides – like the 'Manufacture, Import and Storage of Hazardous Chemicals Rules' of 1989. This is to mainly avert accidents and manage such disasters, if any. There is also a Public Liability Insurance Act of 1992, again under the Ministry of Environment and Forests, that would apply to pesticides. Other rules under the EPA like the Hazardous Waste (Management & Handling) Rules, 1989, Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 would be applicable to pesticides, as a Joint Parliamentary Committee's report notes (JPC Report, 2003).

The Factories Act of 1948 under the Ministry of Labour will apply to the manufacture of pesticides in the country. The Act consists of 12 Chapters dealing with, among other things, health, safety, special precautions to be taken in the case of hazardous processes, welfare, working hours, employment of women and young persons, leave, penalties, etc.

POLICY

Official policy of the Indian government with regard to pest management is that of ***Integrated Pest Management [IPM].*** Right from the time of the Rio Earth conference, India has been highlighting this IPM policy in all its official documents. The ICAR had also established a National Centre for Integrated Pest Management in 1998 and later shifted it to IARI in 1995.

Integrated Pest Management is defined as an eco-friendly approach for pest management encompassing cultural, mechanical, biological methods and need-based use of chemical pesticides with preference to use of biopesticides, biocontrol agents and indigenous innovation potential.

What is important to note is that there is much data generated by the agriculture research establishment in India to show that non-chemical IPM practices across crops have yielded better results in terms of pest control and economics for farmers. However, the field level use of pesticides has not changed much. The official establishment usually claims that pesticide consumption in the country has come down because of the promotion and deployment of IPM practices on the ground by the agriculture research and extension departments [as was informed to the JPC in 2003]. However, the actual progress of IPM on the ground has been quite dismal and small.

Further, the government often fails to take into account the fact that even if pesticide consumption has decreased in terms of quantities due to a shift to consumption of low-volume, high-concentration, high-value pesticides, the real picture in terms of number of sprays and costs involved is still the same for the farmers.

The government reported in the Parliament that since the 8^{th} Plan, the government has established 26 Central IPM centres. Many farmers' field schools have been set up where season-long trainings have been undertaken for master trainers. Grant-in-aid is provided to State Governments for establishment of State Biocontrol Laboratories. Twenty-nine such laboratories have been established. Government of India has also prepared IPM packages for fifty one crops with the help of ICAR.

The main measures adopted under the IPM programme are supposed to be:

- popularizing IPM approach among the farming community
- conducting regular pest surveillance and monitoring to assess pest/disease situation
- rearing biological control agents for their field use and conservation of naturally occurring bio-agents
- promotion of bio-pesticides and neem based pesticides as alternative to chemical pesticides
- inclusion of bio-pesticides in the Insecticides Act' Schedule with a view to ensure their quality
- to play a catalytic role in spread of innovative IPM skills to extension workers and farmers – HRD in IPM by imparting training to master trainers, extension workers and farmers through Farmers' Field Schools [FFSs]
- organisation of FFSs through KVKs, NGOs, SAUs etc.
- organization of short duration courses for pesticide dealers, private entrepreneurs, progressive farmers etc.

- release of grants-in-aid to states and NGOs for establishment of bio-control laboratories

A total of 9,111 Farmers' Field Schools (FFSs) have been conducted by the Central Integrated Pest Management Centres under the Directorate of Plant Protection, Quarantine & Storage from 1994-95 to 2004-05 wherein 37,281 Agricultural Extension Officers and 2,75,056 farmers have been trained in IPM. Similar trainings have also been provided under various crop production programmes of the Government of India and the State Governments.

IPM is sought to be made an inherent component of various schemes *viz.*, Technology Mission on Cotton (TMC), Technology Mission on Oilseeds and Pulses (TMOP), Technology Mission on Integrated Horticultural Development for NE, J & K, Himachal Pradesh, Uttaranchal, Technology Mission on Coconut Development etc. besides the scheme "Strengthening and Modernisation of Pest Management" approach in India being implemented by the Directorate of PPQ&S [Plant Protection, Quarantine & Storage].

In a response to a Parliamentary question, the Ministry of Agriculture expressed that most of the limitations of the IPM programme in India are connected with insufficient production of bio-pesticides and bio-control agents, the fact that the life span of bio-control agents is limited and so on.

INSTITUTIONS & PLAYERS INVOLVED:

In addition to the above laws and the above-described policy of Integrated Pest Management and its implementation, there are other institutions that are involved in the active research, promotion, marketing and use of pesticides in the country, as well as in monitoring pesticide residues. Some of these institutions are listed below:

Pesticides Industry in India:

In India, the pesticides industry value is estimated to be around 4500 crore rupees. The Indian pesticides industry is the largest in Asia and produces around 90,000 metric tonnes of pesticides annually. The average growth rates of this industry fluctuate between 3% and 15%. The production of pesticides began in the mid-1950s when the first DDT and BHC plants were set up with the help of the World Health Organisation. Flowing from a conscious and strong boost from the government, the production and consumption of pesticides in agriculture grew quite a lot thanks to the Green Revolution in the country. Most of the pesticides produced in the country are consumed in the domestic market, mainly in agriculture sector – the industry is however seeing a great spurt in exports – both in volume and value – in the recent past.

The agricultural sector consumes around 67% of the pesticides produced; within the agricultural sector, two thirds of the consumption is taken up by just a few crops like cotton, paddy, vegetables and fruits. There are around 60 large technical grade manufacturers, including some large multinational companies. The multinational companies include Syngenta, Bayer CropScience, DuPont, Monsanto and DeNocil. Prominent names amongst the Indian players are Rallis (Tata group), United Phosphorus Limited, Searle, Excel Industries, Gharda, Lupin, Aimco Pesticides Ltd, Dhanuka Pesticides, Hindustan Insecticides Limited etc. There are also more than 500 formulators who buy technical grade pesticides from the manufacturers to be processed into formulations.

In addition to the technical grade manufacturers and formulators, the marketing of pesticides involves an elaborate distributor and dealer network across the country. Just Bayer [Crop Science and Chemicals], which has a 22% market share in the pesticides market of India operates through 2500 distributors and 35,000 dealers. Similar is the network used by other large companies operating in India.

Export of Indian pesticides has been increasing over the years, while imports have increased at a slower rate too. Amongst the states in India, pesticide consumption varies. Andhra Pradesh is the largest state for pesticides market, followed by Punjab, Maharashtra, Karnataka, Haryana, Gujarat, West Bengal and Tamil Nadu.

Pesticides consumption – India – gms/hectare:

Country	1999-01
Andhra Pradesh	302
Bihar	82
Gujarat	331
Haryana	827
Karnataka	201
Madhya Pradesh	61
Maharashtra	168
Punjab	889
Tamil Nadu	261
Uttar Pradesh	285
West Bengal	372

Source: FAO stats http://www.fao.org

The pesticide consumption varies vastly across different states, depending on several factors, including cropping patterns, irrigation facilities, pest resurgence and resistance situations and so on.

The following table gives a picture of pesticide consumption, technical grade, in metric tonnes in the second half of the last decade.

Consumption of Pesticides during 1995-96 to 1999-2000 (technical grade, MT)

State	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
Andhra Pradesh	10957	8702	7298	4741	4054
Assam	316	300	284	260	260
Arunachal Pradesh	22	20	18	18	17
Bihar	1383	1039	1150	834	832
Gujrat	4560	4545	4642	4803	3646
Goa	4	2	2	4	4
Haryana	5100	5040	5045	5035	5025
Himachal Pradesh	300	300	200	276	385
Jammu & Kashmir	108	63	78	75	26
Karnataka	3924	3665	2962	2600	2484
Kerala	1280	1141	602	1161	1069
Madhya Pradesh	1748	1159	1641	1643	1528
Maharashtra	5097	4567	3649	3468	3614
Manipur	41	31	20	31	21
Meghalaya	20	20	8	9	8
Nagaland	9	9	9	9	10
Mizoram	21	18	17	16	19

State	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
Orissa	1293	885	924	942	998
Punjab	7200	7300	7150	6760	6972
Rajasthan	3210	3075	3211	3465	2547
Sikkim	26	16	16	15	0.16
Tamil Nadu	2080	1851	1809	1730	1685
Tripura	25	22	19	16	17
Uttar Pradesh	8110	7859	7444	7419	7459
West Bengal	4213	4291	3882	3678	3370
Andaman & Nicobar	7	9	4	5	5
Chandigarh	3	3	3	3	4
Delhi	76	61	65	64	62
Dadar & Nagarhaveli	7	4	4	4	2
Daman & Diu	1	1	1	1	1
Lakshadweep	1	1	1	1	1
Pondicherry	118	115	81	71	70
Total	61260	56114	52239	49157	46195.16

Source: Central Insecticides Board & Registration Committee's website www.cibrc.nic.in

The total pesticide load was one of the highest in the state of Andhra Pradesh in the second half of the 1990s as per this information.

Consumption of pesticides in various states: 2000-01 to 2004-05 (technical grade, MT)

States	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Andhra Pradesh	4000	3850	3706	2034	2133
Assam	245	237	181	175	170
Arunachal Pradesh	13	17	15	147	17
Bihar	853	890	1010	860	850
Chhattisgarh	NA	NA	NA	332	486
Gujarat	2822	4100	4500	4000	2900
Goa	6	5	5	5	5
Haryana	5025	5020	5012	4730	4520
Himachal Pradesh	302	311	380	360	310
Jammu & Kashmir	1	4	98	9	12
Jharkhand	150	36	40	56	69
Karnataka	2020	2500	2700	1692	2200
Kerala	754	1345	902	326	360
Madhya Pradesh	871	714	1026	662	749
Maharashtra	3239	3135	3724	3385	3030
Manipur	20	14	19	25	26
Meghalaya	6	6	6	6	8
Mizoram	8	26	15	15	25
Nagaland	8	7	7	7	5
Orissa	1006	1018	1134	682	692

Punjab	7005	7200	7200	6780	6900
Rajasthan	3040	4628	3200	2303	1628
Sikkim	4	2	3	3	
Tamil Nadu	1668	1576	3346	1434	2466
Tripura	11	16	88	118	17
Uttar Pradesh	7023	6951	6775	6710	6855
Uttaranchal	99	105	129	147	132
West Bengal	3250	3180	3000	3900	4000
Andaman & Nicobar	3	2	3	6	3
Chandigarh	2	1	1	0.78	0.78
Delhi	55	58	60	56	53
Dadra & Nagar H.	6	4	5	5	5
Daman & Diu	2	2	1	1	1
Lakshadweep	2	2	2	2	2
Pondicherry	65	58	57	46	42
Total	**43584**	**47020**	**48350**	**41020**	**40672**

As per the data in the above table, Haryana, Punjab, Uttar Pradesh, Gujarat and Maharashtra have once again become the highest-pesticide consuming states in this decade.

Out of the total agrochemical market in India (which varies between 4000 and 4500 crore rupees), approximately 1200 crores worth of pesticides is of counterfeit or spurious chemicals every year, as per industry's own estimates. The industry also admits that in 2000-01, in India, crop loss due to pests were about 60,000 crores of rupees despite plant protection measures! These losses are from 25% of the treated area [FICCI, 2006].

Amongst crops which consume the largest amounts of pesticides, cotton, fruits & vegetables, rice, maize, soybean etc., are to be listed.

Highest consumed pesticides in India include Monocrotophos, Endosulfan, Phorate, Chlorpyriphos, Methyl Parathion, Quinalphos, Mancozeb, Paraquat, Butachlor, Isoproturon and Phosphamidon. In volume terms, Organochlorine pesticides constitute 40% of pesticide use, followed by Organophosphates at 30%, Carbamates at 15%, Synthetic Pyrethroids at 10% and others at 5%. In value terms, Organophosphates dominate at 50%, followed by Synthetic Pyrethroids at 19%, followed by Organochlorines at 16%, Carbamates at 4%, Biopesticides at 1% and so on[1].

India is mostly a generic pesticide market (production and use of old molecules which have gone off-patent continues here).

Unlike countries like Sweden which have policies related to de-registration of molecules after a particular period, India continues to use pesticides created in the 1950s and 1960s also, which have been subsequently banned in many other countries, including developing countries like Srilanka, Syria, Indonesia, Thailand and some African countries.

1 Production of pesticides in the past few years has been provided in an annexure, as per the PMFAI [Pesticides Manufacturers and Formulators Association of India]

National Agricultural Research System [NARS]:

The National Agricultural Research System [NARS] includes the Indian Council of Agricultural Research [which is an autonomous body under the Department of Agricultural Research & Education, under the Ministry of Agriculture, Government of India] and 38 state agricultural universities, 5 deemed-to-be-universities [these are national research institutes in agriculture, dairying, veterinary science, fisheries etc.], 1 Central Agricultural University and 3 Central Universities for the North-Eastern states.

The Research set-up of the ICAR includes 47 Central Institutes, 5 National Bureaus, 12 Project Directorates, 31 National Research Centres, and 91 All-India Co-ordinated Research Projects. The ICAR promotes research, education and extension education throughout the NARS by giving financial assistance in different forms.

For communication of research findings among farmers, the ICAR maintains a network of Krishi Vigyan Kendras, and Trainers' and Training Centres along with Zonal Co-ordinating Units.

Within the **ICAR**, there is a Crop Science Division, which has a technical section on Plant Protection. Each Section is headed by an Assistant Director General [ADG], assisted by Principal Scientists who constitute middle management. The Plant Protection Section reports to have worked out the etiology, epidemiology and management of major diseases/insect pests and developed location-specific IPM modules for sustainable crop production. The Section also claims that adoption of IPM modules has helped in lowering the quantum of pesticide use.

Then there is the **Indian Agricultural Research Institute [IARI]** in the ICAR. The IARI has a Division of Agricultural Chemicals, set up long ago in 1966. The Division has a mandate to devote exclusive attention to the various aspects of research on pesticides and allied agro-chemicals. The Division generates information on pesticide development, formulation, safety evaluation, biotic and abiotic transformations and so on.

The Coordinating cell of the All India Coordinated Research Project (AICRP) on Pesticide Residues, since then re-designated as the All India Network Project on Pesticide Residues [AINPPR], is located in this Division in IARI. This Cell is supposed to serve as a link between the Division and similar other departments in various ICAR institutes and agricultural universities.

AICRP on Pesticide Residues or All India Network Project on Pesticide Residues

The Ministry of Agriculture through ICAR started an All-India Coordinated Research Project on Pesticide Residues way back in 1984-85. The aims of the project were to develop protocols for safe use of pesticides by recommending "good agricultural practices" [GAPs] based on "multinational supervised field trials"; to recommend waiting period/pre-harvest interval so that the residues in the food commodities remain well within the prescribed safe limits; and monitoring of pesticide residues in agricultural produce. The data thus generated is to be used for fixing Maximum Residue Limits. In Hyderabad the project is located in Acharya NG Ranga Agriculture University.

In 2005, a Central Sector Scheme for Monitoring of Pesticide Residues at the national level has been approved in order to ascertain the prevalence of pesticide residues at farmgate and market yards to enable remedial measures to be undertaken as required. Under this, 21 laboratories under various Ministries/Departments have been provided with equipments to undertake analysis of pesticide residues in vegetables, water, meat & meat products, and marine products.

While this might be so, the Ministry of Agriculture also feels that the inspection of fruits and vegetables for the presence of pesticide residues and other harmful substances falls under the purview of the Ministry of Health & Family Welfare [response by the Minister for Agriculture in the Parliament in December 2006]. As per the directions of the Inter Ministerial Committee constituted to review the use of hazardous chemicals and insecticides, 33 samples of vegetables have been drawn from Agricultural Produce Marketing Committee, Azadpur, Delhi since June, 2006 and tested for residues of organo-chlorine, organo- phosphorus and synthetic pyrethroids pesticides. Residues of chlorpyriphos were detected in two of these samples at the level of 0.18 ppm. 24 of these samples have also been analysed for the presence of heavy metals like lead, cadmium and arsenic. The heavy metals found in the samples of vegetables were below the maximum limit prescribed under the Food Adulteration Rules, 1955.

India also has a **National Plant Protection Training Institute**, which is located in Hyderabad. The Institute has been set up for human resource development in plant protection technology by organizing long and short duration training courses on different aspects of plant protection.

The NPPTI organizes post graduate diploma course in Plant Protection of 10 months' duration for in-service personnel of states/Union Territories and unemployed agricultural graduates, in addition to courses in analysis of pesticides formulation and pesticide residues of 3 months' duration each for the benefit of state pesticide testing laboratories, state agricultural universities etc. There are also short duration courses of 1 or 2 weeks for the extension personnel of states that the Institute undertakes.

DEPARTMENT OF AGRICULTURE IN STATE GOVERNMENTS

While the CIBRC (Central Insecticides Board and Registration Committee) in the Government of India relies on the NARS and the Ministry of Health & Family Welfare for registering pesticides, fixing MRLs, coming up with Good Agriculture Practices and so on, it is the extension department of each state government that is supposed to promote such GAPs with farmers who are the end-users of these pesticides.

They come out with recommended package of practices, based on agriculture scientists' R & D and through Agriculture Officers working along a hierarchy in the department, reach out to farmers with messages related to plant protection.

What is interesting to note is that more than the personnel of these extension departments, it is the **pesticide industry's retailers** who have a more direct access to farmers through their marketing strategies as well as because of constant downsizing of the extension departments over the years.

The pesticide manufacturers adopt a variety of strategies to promote their products with farmers – they organize demonstrations in farmers' fields, field days and melas, give freebies and organize contests. They also set targets for distributors and dealers in terms of volume of sales to be accomplished. If such targets are met, there are special incentives like taking the dealers and their families on holiday tours, gifting them with gold jewellery etc.

Farmers' economic dependence on pesticide dealers is also one of the reasons why they tend to rely on the advice of dealers and why they adopt recommendations given by the dealers, especially in the absence of consistent extension support from the department of agriculture. Dealers double up as credit suppliers in the absence of proper institutional credit facilities.

Majority of farmers also being illiterate and untrained about chemical pesticide usage, they tend to think that pesticide usage as recommended by the dealers would solve their pest management problems. There is no similarity between farmers' actual usage of pesticides to that recommended at the time of registration or later by agriculture universities and departments.

Some concepts for regulating pesticides and their residues for Food Safety

Pesticides and their contamination of food products are sought to be regulated through some concepts like Maximum Residue Limits [MRLs], Average Daily Intake [ADIs] and Good Agriculture Practices [GAPs].

Maximum Residue Limit (MRL) is the maximum concentration of a pesticide residue resulting from the use of a pesticide according to Good Agricultural Practice (GAP). It is the limit that is legally permitted or recognized as acceptable in or on a food, agricultural commodity, or animal food. The concentration is expressed in milligrams of pesticide residue per kilogram of the commodity. Under the PFA Act, MRL or Tolerance Limits (TLs) are fixed considering MRLs recommended by Codex or based on supervised trials conducted in India as well as the dietary habits of our population.

Pesticides, being toxic in nature, are supposed to be thoroughly screened for their safety, using different animal models. For this purpose, studies on acute toxicity, chronic toxicity, allergenicity etc., are undertaken. These data are evaluated and the **No-Observed-Adverse-Effect Level** (NOAEL) is calculated from the chronic toxicity studies. In case of toxic pesticides, acute reference dose is also taken into consideration. This NOAEL and Acute Reference Dose are supposed to be taken as the starting information for prescribing the tolerance limits of pesticides in food commodities. NOAEL is usually referred to in terms of milligrams of that particular pesticide per kilogram of body weight.

From this NOAEL, the **Acceptable Daily Intake (ADI)** is calculated by dividing the figure normally with a safety factor of 100. The figure 100 is taken into consideration as a multiple of 10 (10x10), where the first 10 provides for inter-species variation while the second 10 provides for intra-species variation. Therefore ADI, which is expressed in terms of mg/kg body weight, is an indication of the fact that if a human being consumes that amount of pesticide everyday, throughout his lifetime, it will not cause appreciable health risk on the basis of well known facts at the time of the evaluation of that particular pesticide. MRL is therefore a dynamic concept dependant on extant knowledge and is therefore required to be renewed from time to time.

Terminal residues of a particular pesticide on a treated crop are estimated from supervised trials, to assess the maximum residue limit which the pesticide leaves when used as per the **Good Agricultural Practice (GAP).** Data from nutritional surveys, which reflects details of the regional diet patterns and the quantum of a particular diet taken by human beings, is also needed when estimating the likely daily intake of any given pesticide through food.

Thus, the above three parameters i.e. ADI, terminal residues as per Good Agricultural Practice on the crop and the diet pattern of the population are the critical inputs needed to derive the maximum residue limits (MRLs) of pesticides in food commodities. While deriving MRLs, the loss of residues during storage, drying, cooking, washing etc., are also taken into consideration. The main objective of the risk assessment from the point of view of food safety is to ensure that the sum total of pesticide residues in the total diet does not exceed ADI, even after taking into account the possible exposure through other sources. While that is the theory behind fixing these limits, the reality is something else.

SITUATION IN INDIA

While the Registration Committee (RC) registers pesticides for their usage, their MRL in food and commodities are prescribed by the Ministry of Health and Family Welfare under PFA (Act), 1954 and rules framed thereunder.

What is alarming to note is that in India, MRL as a concept is being wrongly formulated while implementation status is worse. While pesticides are registered without MRLs being necessarily fixed before or during registration, there are no enforcement mechanisms available to ensure liability for violation of MRLs at least by the organized food industry.

During evidence to the Joint Parliamentary Committee formed in 2004, representative of the Ministry of Agriculture and the Director General of Health Services admitted that out of 181 pesticides registered at that time, tolerance limits (MRLs) have been fixed for only 71 pesticides. For another 50 pesticides, such tolerance limits were in the process of finalization. It has been concluded that there are about 27 pesticides registered in the country which do not require fixation of tolerance limits. This means 32 pesticides which are still left for tolerance limits to be fixed – for eight of these, it was decided to follow Codex norms for the time being since data was not available and was being collected. Data for 24 pesticides where are "deemed-to-be-registered" has been submitted.

A small example to illustrate the situation with regard to MRLs can be the case of Chilli crop. A list of Pesticides recommended for use as per Insecticide Act, 1968 (as per the information obtained from website of CIBRC 17-01-2007) on Chilli crop is given below.

Product Name
Carbendazim 50% WP
Phorate 10% C.G
Endosulfan 4% D.P
Quinalphos 25% EC
Fenthion 82.5% EC
Carbofuran 3% C.G.
Dimethoate 30% E.C
Endosulfan 35% E.C.
Imidacloprid 70% WS
Captan 75% WS
Fenitrothion 50% E.C.
Carbaryl 4% + Lindane 4% GR
Fipronil 5% SC
Dinocap 48% EC
Sulphur 52% flowable

However, fixing of MRLs for these pesticides presents another situation.

Pesticides for which MRLs are set as per PF Act

Carbaryl	5 ppm
Dicofol	1 ppm
Dimethoate	0.5 ppm
Endosulfan	1 ppm
Inorganic bromide	400 ppm

Monocrotophos	0.2ppm
Mancozeb	1 ppm
Quinalphos	0.2 ppm
Thiophanate Methyl	0.2 ppm

While 15 pesticides have been registered for use on Chilli crop, MRLs have been set for only 8 pesticides under the PFA. For most pesticides, MRLs are not set, and what is more, many commonly recommended new pesticide molecules are not registered for use on chillies as per Insecticide Act!

'Indiscriminate Use' or 'Indiscriminate Recommendations'?

As part of this study, an interesting exercise was taken up, to compare the data between registration recommendation for each pesticide and the recommendations of agriculture departments and finally, the recommendations by the companies manufacturing and selling the pesticides.

For example, **Acephate** is registered for use only on Cotton and Safflower in the country. It is not registered for use on Chillies, Brinjal, Cabbage, Cauliflower, Apple, Castor, Mango, Tomato, Potato, Grapes, Okra, Onion, Mustard, Paddy and many other crops where it is being used extensively now. Further, it is also being recommended by the NARS for use in other crops even without registration! Acephate is being recommended for the control of sap sucking pests in most crops. Further, MRLs have been set only for safflower seed and cotton seed for this pesticide.

Other examples of pesticides being recommended by NARS establishment, in violation of registration conditions of the CIB [against the registered status by CIB&RC] are given for two crops below.

Crop 1: Tomato

Pest/Disease	Horticulture Department*	ANGRAU**	CIB***
Spodoptera	Carbaryl 50%WP Quinalphos 25% EC	Endosulfan	Fenitrothion 50% E.C. Neem extract n-5% w/w
Helicoverpa	Carbaryl 50%WP Quinalphos 25% EC Endosulfan		Fenitrothion 50% E.C. Neem Seed Kernel Neem extract n-5% w/w
Utethesia pulchella	Carbaryl 50%WP Quinalphos 25% EC		Fenitrothion 50% E.C.
Epilachna	Carbaryl 50%WP Endosulfan 35%EC		Lindane 6.5% W.P.
Jassids	Dimethioate 30%EC + Metasystox 25% EC Monocrotophos 36%SL	Dimethioate Methyl demeton	
Whitefly			Phorate 10% C.G Malathion 50% E.C. Carbofuran 3% C.G. Dimethoate 30% E.C Neem extract n-5% w/w

Aphids			Neem extract -5% w/w
Damping Off	Thiram 2-3 g/kg seed	Thiram SEED TREATMENT Captan SEED TREATMENT COC	Captan 75% WS
Early Blight			Iprodione 50 % W.P. Ziram-80% WP
For Uniform Ripening			Ethephon 39% S.L
Mosaic virus	Insectides for vector [Whitefly] control	Insectides for vector [Whitefly] control	
Tomato spotted wilt virus	Insectides for vector [thrips] control	Dimethoate Methyl Demeton Carbofuran 3G granules	
Jalleda purugu like Epilachna		carbaryl 50 % WP Thiodicarb Endosulfan	
Aakumaadu tegulu		Captan Mancozeb	

Crop 2: Brinjal

Pest/Disease	**Horticulture Department***	**ANGRAU****	**CIB*****
Aphid		Dimethioate Methyl demeton Fipronil	Phorate 10% C.G Lindane 6.5% W.P.
Epilechna Beetle	Malathion 0.16% Methyl parathion 0.03%		Lindane 6.5% W.P.
Fruit Fly,			Lindane 6.5% W.P.
Shoot & Fruit borer,	Carbaryl 50% w.p [3 times] Monocrotophos	Carbaryl 50% WP Profenofos Cypermethrin	Cypermethrin 0.25% D.P. Lindane 6.5% W.P. Endosulfan 2% D.P. Cypermethrin 10% E.C. Chlorpyriphos 20% E.C. Cypermethrin 3% + Quinalphos 20% EC Neem Seed Kernel Based EC Containing Azadirachtin- 1% (10000 ppm) min.
Lacewing bug			Lindane 6.5% W.P.
Root knot nematode			Carbofuran 3% C.G.
Jassid		Dimethioate Methyl demeton Fipronil	Dimethoate 30% E.C

Thrips			Fenitrothion 50% E.C.
Mites	Wettable Sulphur @ 3 to 5 g/lit	Wettable Sulfur	Malathion 50% E.C.
	Dicofol @ 2.7 ml/lit	Dicofol	
	dusting Sulphur @ 20 to 25 kg/ha	Spiromeciferon	
		Propargite	
Whitefly		Acephate	
		Dimethioate	
		Methyl demeton	
		Fipronil	
Fruit Borer			Carbaryl 50% W.P
Mealy Bug [Centrococcus insolitus]	Monocrotophaos @ 0.4%		
	Malathion 0.15%		
Leaf spot			Carbendazim 50% WP
Early Blight [Alternaria solani]	Bordeaux mixture 5:5:50		
	Zineb 0.25%.		
Little Leaf [MLOs] [Vector-Jassid?]	Insecticides for vector control	Methyl demeton	
		carbofuran granules in nursery	
		tetracyclin treatment for seedlings before transplanting	
		Rogor	
		Gibberellic acid	
Mosaic virus	Insecticides for vector control		
Aakumaadu tegulu		COC	
		Mancozeb	
		Carbendazim	
Aakumaadu & Kaaya kullu tegulu		COC [2-3 times within 10 days time	

* Website, Department of Horticulture, Govt. of AP:http://www.aphorticulture.com,
** *Vyavasaya Panchangam* 2006-07, ANGRAU
*** Central Insecticides Board & Registration Committee's website www.cibrc.nic.in

As the above illustrations show, the agriculture (Horticulture) department is recommending even prohibited pesticides (highlighted in red – Monocrotophos is banned for use on vegetables in the country). It is not clear how the Horticulture department is coming up with its recommendations and the scientificity of the same!

It is not only the public sector bodies that are violating the registration rules. The pesticide industry also recommends pesticides that are in violation of the CIB registration norms, as the following table illustrates.

Insecticide Name/ Technical Name	Company name	Trade name	Company recommendations*		CIB recommendations**
			Crops	Insects	
Carbendazim 50% W.P.	Nagarjuna Agrichem Ltd	Zen	Rice	Sheath Blight	Recommended
			Maize	Brown spot	
			Cotton	Leaf spot	Recommended
			Ground nut	Tikkaleafspot	Recommended
			Peas	Powdermildew	Recommended
			Brinjal	Leaf spot	Recommended
				fruit rot.	Recommended
			Grapes	Tikkaleafspot	
			Tobaco	Leaf spot	
				Tikka leafspot	
Carbendazim 50 % WP	BASF india Ltd	Bavistin	Ground nut	Tikka leafspot	Recommended
			Cotton	Leaf spot	Recommended
			Rice	Sheath Blight	Recommended
				Blast	Recommended
			Apple	scab	Recommended
			Wheat	Loose Smut	Recommended
				Flag smut	
				Foot rot	
			Grapes	Anthracnose	Recommended
			Chillies	Damping off	Recommended
			Mango	Leaf spot	
				Blight will	
				Powdery mildew	
			Rose	Powdery mildew	Recommended
			Tobaco	Frog eye spot	
				Anthracnose	
Carbofuran 3% G	Rallis India Ltd	Tatafuran	Bajra	Shootfly	Recommended
			Barley	Aphids	Recommended
				Jassids	Recommended
				Cyst Nematode	Recommended
			Maize	Stemborers	Recommended
				Shootfly	Recommended
				Thrips	Recommended
				Climbing cutworm	
			Paddy	Brown plant Hopper	Recommended
				Gallmidge	Recommended
				Green leaf hopper	Recommended
				Leaf roller/folder	Recommended
				Hispa	Recommended
				White back plant Hopper	
				Stemborers	
				Whort moggot	
				Nematodes	
			Sorgam	Shootfly	Recommended
				Stemborers	Recommended
				Cotton grey weevil	
				Flea beefle	
			Wheat	Ear cockle Nematodes	Recommended

				Cereal cyst Nematodes	Recommended
			Cotton	Jassids	
				Grey Weevil	
				Stem Weevil	
			Jute	Nematodes	Recommended
			Ground nut	Pod borer	Recommended
				White grubs	Recommended
			Mustard	Mustard leaf hopper or miner	Recommended for miner
				Flea beefle	
				pea Aphid	
				PeaShoot fly	
			Soybean	Agromyzid fly	
				White fly	Recommended
				Root knot Nematode	Recommended
			Sugarcane	Top borer	Recommended
			Brinjal	Root knot Nematode	Recommended
				Reniform Nematodes	Recommended
			Okra	Jassids	Recommended
			Chillies	Aphids	Recommended
				Thrips	Recommended
			Cabbage	Nematodes	Recommended
			Franch bean	White grubs	Recommended
			Potato	Aphids	Recommended
				Jassids	Recommended
				Tuber Nematodes	
			Tomato	Root knot Nematode	
				White fly	Recommended
			Sweetpepper	Thrips	
			Apple	Woolly,Aphid	Recommended
			Banana	Rhizome Weevil	Recommended
				Aphids	Recommended
				Nematodes	Recommended
			Citrus	Nematodes	Recommended
				Leaf roller/folder	
			Mandarrims	Soft green scale	Recommended
				Citrus leaf miner	Recommended
			Peach	Leaf curl aphid	Recommended
			Tea	Cockchafer grubs	
			Tobacco	Green peach aphid	
				Root knot Nematode	
				Nematodes	
				Stemborers	

While the above table illustrates the situation with regard to regulatory violations by companies in the case of only two pesticides (and two companies), an annexure provides more data on this issue.

Secondly, the study found that pesticide recommendations do not match with the data produced within the NARS on resistance that had developed in insects for each of those insecticides. It is obvious that insecticide resistance data is not being generated to organically feed into recommendations on use. Farmers in this country have often been blamed for "indiscriminate use" of insecticides [not following the prescribed recommendations] but the data generated by agriculture scientists on insecticide resistance shows that farmers had good reason for this 'indiscriminate use'.

Insecticide resistance to insects

As the toxic chemicals are regularly introduced into the crop ecology for the control of pests, there are many means by which an insect/disease causing organisms can develop resistance to the toxins. As pesticide consumption in India increased from 434 metric tones in 1954 to over 90,000 metric tones till 2001, resistance to pesticides is now known in over 504 insect and mite pests in comparison to only seven insect-pests in 1954[2].

The following table provides information on resistance reported for a major pest across crops called Helicoverpa, against some popularly used pesticides in Andhra Pradesh.

Active Ingredient	Year of report	Location	Reported by
Carbaryl	2002	Madhira, Khammam	Fakruddin, B. et.al (2002)
	2002	Nalgonda	Fakruddin, B. et.al (2002)
	2002	Guntur	Fakruddin, B. et.al (2002)
Chlorpyrifos	1998	Guntur	Kranthi, K. R. Et.al (2002)
	1998	Karimnagar	Kranthi, K. R. Et.al (2002)
	1998	Madhira, Khammam	Kranthi, K. R. Et.al (2002)
	1998	Medak	Kranthi, K. R. Et.al (2002)
	1998	Prakasam district	Kranthi, K. R. Et.al (2002)
	1998	Rangareddy district	Kranthi, K. R. Et.al (2002)
	2002	Guntur	Fakruddin, B. et.al (2002)
	2002	Madhira, Khammam	Fakruddin, B. et.al (2002)
	2002	Nalgonda	Fakruddin, B. et.al (2002)
Cypermethrin	1998	Guntur	Kranthi, K. R. Et.al (2002)
	1998	Karimnagar	Kranthi, K. R. Et.al (2002)
	1998	Madhira, Khammam	Kranthi, K. R. Et.al (2002)
	1998	Mahboobnagar	Kranthi, K. R. Et.al (2002)
	1998	Medak	Kranthi, K. R. Et.al (2002)
	1998	Prakasam district	Kranthi, K. R. Et.al (2002)
	1998	Rangareddy district	Kranthi, K. R. Et.al (2002)
	2002	Guntur	Fakruddin, B. et.al (2002)
	2002	Madhira, Khammam	Fakruddin, B. et.al (2002)
	2002	Nalgonda	Fakruddin, B. et.al (2002)
	2004	Rayalaseema region	Rao, G.M.V.P et. Al (2005)
Endosulfan	1998	Guntur	Kranthi, K. R. Et.al (2002)
	1998	Karimnagar	Kranthi, K. R. Et.al (2002)
	1998	Madhira, Khammam	Kranthi, K. R. Et.al (2002)
	2002	Guntur	Fakruddin, B. et.al (2002)
	2002	Madhira, Khammam	Fakruddin, B. et.al (2002)
Methomyl	1998	Guntur	Kranthi, K. R. et. Al (2001a)
	1998	Madhira, Khammam	Kranthi, K. R. et. Al (2001a)
	1998	Mahboobnagar	Kranthi, K. R. et. Al (2001a)
	1998	Prakasam district	Kranthi, K. R. et. Al (2001a)

2 http://www.tribuneindia.com/2003/20030331/agro.htm

	1998	Warangal	Kranthi, K. R. et. Al (2001a)
Monocrotophos	1995	Rangareddy district	Kranthi, K. R. et. Al (2001a)
	1997	Guntur	Kranthi, K. R. et. Al (2001a)
	1998	Karimnagar	Kranthi, K. R. et. Al (2001a)
	1998	Madhira, Khammam	Kranthi, K. R. et. Al (2001a)
	1998	Medak	Kranthi, K. R. et. Al (2001a)
	1998	Prakasam district	Kranthi, K. R. et. Al (2001a)
	1998	Rangareddy district	Kranthi, K. R. et. Al (2001a)
	1998	Warangal	Kranthi, K. R. et. Al (2001a)
	2002	Guntur	Fakruddin, B. et.al (2002)
	2002	Madhira, Khammam	Fakruddin, B. et.al (2002)
	2002	Nalgonda	Fakruddin, B. et.al (2002)
Quinolphos	1998	Guntur	Kranthi, K. R. et. Al (2001a)
	1998	Prakasam district	Kranthi, K. R. et. Al (2001a)
	2002	Guntur	Fakruddin, B. et.al (2002)
	2002	Madhira, Khammam	Fakruddin, B. et.al (2002)
	2002	Nalgonda	Fakruddin, B. et.al (2002)
	2004	Rayalaseema region	Rao, G.M.V.P et. Al (2005)
Cyhalothrin Gamma	1998	Guntur	Kranthi, K. R. et.al (2001b)
	1998	Karimnagar	Kranthi, K. R. et.al (2001b)
	1998	Warangal	Kranthi, K. R. et.al (2001b)
	1998	Guntur	Kranthi, K. R. et.al (2001b)
	1998	Karimnagar	Kranthi, K. R. et.al (2001b)
Deltamethrin	1998	Warangal	Kranthi, K. R. et.al (2001b)
	1998	Guntur	Kranthi, K. R. et.al (2001b)
	1998	Warangal	Kranthi, K. R. et.al (2001b)
Fenvelarate	2004	Rayalaseema region	Rao, G.M.V.P et. Al (2005)

Many of these pesticides available in the market and are used by the farmers against the bollworm (Helicoverpa). Based on their observations about resistance farmers use either more concentration of the chemical (higher dose) or more no. of sprays of the chemical or spray different chemicals mixed or with short intervals which is often termed as 'in discriminate' use. But what is interesting is even after the resistance is reported, the recommendations are not changed or withdrawn.

Pesticide recommendations in chillies in 2000 and 20006 against Helicoverpa

Pesticide	**First report of resistance**	**Recommendation in 2000***	**Recommendation in 2006****
Quinolphos	2001	2.5 ml/lit	2 ml/lit
Chlorpyriphos	2002	2.5 ml/lit	2 ml/lit

Source: Vyavasaya Panchangam 2000 and 2006 published by ANGRAU.

Worse, pesticides like Cypermethrin and Fenvelerate are being recommended in cotton for managing Helicoverpa. This insect is reported to have developed 946-fold resistance against cypermethrin, followed by 491-fold against fenvelarate in different locations of Andhra Pradesh (http://whalonlab.msu.edu/rpmnews/vol.15_no.1/globe/PrasadaRao_etal.htm). These resistance levels vary from region to region and there is a difference in reporting by different authors too. For example, Ramasubramanyam (2004) reported that Helicoverpa of Raichur strain developed 2489-fold resistance against Cypermethrin while Guntur strain developed a 1213-fold resistance. The same pest occurs in other crops – however, the same pesticides are recommended!

Safety of MRLs

An interesting exercise done by Centre for Science and Environment on the non-compatibility between ADI and MRLs in India brings forth the fact that even if MRLs are prescribed are followed in reality, they would be far beyond the ADI levels fixed for each pesticide. Therefore, the question to be asked is **"How Safe Are MRLs?".**

MRLs can be considered safe only if the cumulative daily intake of pesticides remains within the ADI [which is supposed to be worked out based on chronic toxicity]. Such cumulative daily intake depends on the individual [child or adult], the socio-cultural context of dietary intake and on the Theoretical Maximum Daily Intake [TMDI] of pesticides worked out on this basis.

CSE did an exercise of calculating the actual TMDI against the ADIs and MRLs of around eight pesticides for the average Indian diet. In the case of Monocrotophos, for example, they first put down the Indian MRL [in mg/kg body weight] for various food commodities like wheat, rice, pulses, vegetables, vegetable oils, milk etc. As per the diets of an average Indian, the total pesticide intake of Monocrotophos for an average adult, for an average Indian diet works out to be 0.1510 mg/day. The prescribed Average Daily Intake of Monocrotophos is 0.0360, based on chronic toxicity potential. Therefore, the total pesticide intake theoretically works out to be 419% more than the ADI.

There are other detailed total diet studies which have also reflected similar findings. This raises basic points about the way MRLs are fixed, almost cut away from the ADIs being prescribed through health impact studies.

This questions the very validity of considering MRLs as an indication of how safe our food is and the fact that almost all pesticide surveillance rests on such parameters.

4. Vegetable Cultivation around Hyderabad and Consumption in Hyderabad

The following is a picture of vegetable cultivation in Andhra Pradesh, as per the Department of Horticulture.

TOTAL Vegetable Cultivation – Area in Hectares and Production in Metric Tonnes

District	2000-01		2001-02		2002-03		2003-04		2004-05	
Srikakulam	5160	74857	5333	76260	4473	64745	5828	77091	05269	76612
VijayaNagaram	4497	63541	4087	57430	4572	62881	6345	75895	06416	84038
Vishakhapatnam	12241	138074	11324	124060	7730	91962	10232	121783	17557	200335
East Godawari	28847	516850	25718	447678	19620	339125	27329	482170	26874	486773
West Godawari	6593	78063	5412	64009	5050	60417	6304	70137	04450	57470
Krishna	7219	88682	8953	100500	6827	84429	8540	103468	03626	47781
Guntur	15021	182178	13665	166817	13020	153896	9878	112724	12687	157554
Prakasam	10955	124399	8827	101150	7729	86410	7380	84088	04916	79698
Nellore	2576	33850	1613	22923	1745	23004	2827	29982	06909	77410
Chittoor	16541	188984	16993	194308	23359	256478	19506	246739	20599	349768.5
Cuddapa	7895	96371	7676	100316	7628	102809	6720	90297	09231	154013
Anatapuram	8535	105397	7577	93674	7891	96469	10683	134088	00000	0
Kurnool	49699	352495	37712	445585	43029	489518	38571	478793	37944	634202
MehaboobNagar	11993	136328	10610	133211	11549	141338	15359	178082	17991	231735
RangaReddy	26277	305555	24392	267403	23034	258467	25581	311057	14313	228391
Hyderabad	18	207	0	2	0	0	0	0	00000	0
Medak	11473	159949	11052	136332	10653	131327	11900	147065	16791	231903
Nizamabad	5652	88832	4731	58295	4442	55042	13557	149786	05265	79007
Adilabad	4018	52184	3577	42273	4849	55728	4688	55859	30988	468134.5
KarimNagar	4993	63881	4428	50186	4408	50605	4438	55468	04732	61645
Warangal	3262	41261	3156	37242	3848	44161	4071	51646	02947	37862
Khamam	2893	30779	2277	24462	2446	26451	3490	38097	03137	49325
Nalgonda	4203	44948	3393	36072	3875	41942	5324	54334	05804	68241
A.P Total	249907	3147660	222506	2780188	221777	2717204	248551	3148649	258445	3861900

Source: Andhra Pradesh Horticulture Department's website [www.aphorticulture.com]

From this data, the largest vegetable-cultivating districts in the state are Kurnool, East Godavari, Rangareddy, Chittoor, Guntur, Mahbubnagar and Medak in that order. Cuddapah and Prakasam districts show relatively higher production even with lesser extents under vegetable cultivation as per the department's data. The area of vegetable cultivation hovered around 2.2 lakhs to 2.5 lakh hectares during the past several years, while the production ranged from 27 lakh metric tonnes to 38 lakh metric tonnes.

A compilation of data for some major vegetables [sourced from the Horticulture department's information], from the main districts surrounding Hyderabad [Rangareddy, Medak, Nalgonda and Mahboobnagar], gives the following picture.

Area & Production of vegetables in districts around Hyderabad, 2004-05

Vegetable	**RR district**		**Medak**		**Nalgonda**		**Mahboobnagar**	
	Area [ha]	**Production [m.t]**	**Area [ha]**	**Production [m.t]**	**Area [ha]**	**Production [m.t]**	**Area [ha]**	**Production [m.t]**
Beans	277	1662	2650	15900	735	4410	250	1500
Bhendi	490	6125	1023	12788	2750	34375	1036	12950
Bottle gourd	194	1940	0	0	130	1300	0	0
Brinjal	2490	49800	976	19520	270	5400	332	6640
Cabbage & Knol Khol	459	5508	500	6000	47	564	76	912
Chillies	2991	7178	8005	19212	14665	35196	13348	32035
Coriander	214	150	2985	2090	261	183	445	312
Cucumber	196	2940	300	4500	150	2250	0	0
Gourds	37	370	720	7200	455	4550	550	5500
Greens	1658	11606	1000	7000	630	4410	139	973
Onion	358	5728	3500	56000	22	352	3574	57184
Potato	190	3040	1500	24000	0	0	0	0
Tomato	2864	51552	3722	66996	560	10080	3217	57906
TOTAL VEG	14313	228391	16791	231903.5	5804	68241	17991	231735

Source: Horticulture department, GoAP [website: www.aphorticulture.com]

From the table above which reflects the trends from previous years, the largest-cultivated vegetables around Hyderabad are Chillis, Tomato, Onion, Bhindi (Okra) and Brinjal in that order.

Peri-urban vegetable cultivation is an important agricultural activity for many small and marginal farmers around Hyderabad. Such vegetable cultivation takes place in villages of neighboring districts like Rangareddy, Mahbubnagar, Medak and Nalgonda.

Vegetables produced around the city are brought to some major markets on a daily basis from the villages. These include markets like Bowenpalli market, Gaddiannaram market, Gudimalkapur market, Mozamjahi market, Rythu Bazaars etc., which are under the control of the Agriculture Market Committee of Mozamjahi market. The rythu bazaars are supposed to provide space for farmers to market their produce directly to consumers without having to go through middlemen, through transportation arrangements made directly from the villages to the markets.

In addition, vegetables like potatoes come from slightly distant production locations including from other states.

Consumption data was obtained from one large market to understand the picture of vegetable-wise consumption. The following is the information obtained from the Agricultural Market Committee [AMC] at Mozamjahi market in 2004-05 and the last column gives a picture of the average monthly consumption of vegetables from this market in kilograms.

As can be seen from the table below, the average monthly consumption of vegetables from this market ranges from around 1250 Tonnes to 1600. In addition, the following data (2005-06) shows that potatoes, tomatoes, green chillis, carrot and cabbage are some of the most consumed vegetables in the city in that order.

Vegetables	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Monthly Average
Potatoes	26453	28785	30213	29514	23655	22801	22652	24993	30739	35387	32835	26606	27886
Tomato	22313	18286	19793	25439	19593	30541	28486	33435	29741	19607	21214	21170	24135
Green Chillies	8243	8740	8220	7766	8858	9305	10866	9031	8343	12428	14794	13177	9981
Carrot	8382	5100	3517	3626	4261	5367	4934	8046	8326	7057	13065	17890	7464
Cabbage	5403	6280	9433	10357	7511	6124	7815	5675	6861	6666	6033	7674	7153
Dry Onions	0	6919	0	5370	5062	7761	0	10740	12954	12700	6688	7754	6329
Cauliflower	1479	1664	2319	3353	6980	6138	4618	10269	8080	9178	10299	4359	5728
Coccinea	5405	6365	6182	5776	5736	5952	376	5365	4853	5560	5375	6801	5312
Brinjal	4071	4118	3213	4447	4843	4418	3752	4353	4996	4270	3220	5126	4236
Cucumber	3747	3854	3808	2858	3590	2861	3231	3450	2944	3935	5583	4515	3698
Ladyfinger	4405	3651	3616	4025	3206	3221	3178	3051	2877	2906	2339	3251	3311
Green Plantain	2443	2933	3333	3750	3277	3569	3407	2966	2759	2876	2801	3545	3138
Kheera Cucumber	5664	4619	2862	1821	2151	2348	2405	3135	2377	1880	2862	4834	3080
Bottle Gourd	3328	3875	3204	3196	2392	2127	3285	3349	3530	3352	2533	2532	3059
Ribbed Gourd	3645	3175	2923	3687	5472	3347	4112	2927	1210	1175	1638	2895	3017
Lemon	4000	5000	3000	3500	3000	2500	4000	3500	3000	0	0	4000	2958
French beans	1355	538	2111	2661	2857	3362	3025	3746	4132	5075	3180	3214	2938
Cluster Bean	2473	2345	2503	1911	1406	1332	1968	2213	1008	581	1946	3553	1937
Field Beans	107	424	714	1255	1804	762	516	1390	4366	4622	3345	1278	1715
Drumsticks	4585	2334	551	792	1847	1461	473	24	127	724	2261	3268	1537
Bitter Gourd	518	530	257	3896	2865	1461	1395	1334	1210	1504	861	892	1394
Colacasia	771	919	1529	1374	1098	1171	1043	1111	1384	954	1053	1155	1130
Capsicum	1126	953	526	922	1027	1051	663	1024	1103	1033	1046	1300	981
Beetroot	1045	886	939	804	885	1024	134	597	694	919	1038	1300	855
Snake Gourd	277	188	174	900	724	414	6089	374	328	271	214	167	843
Green Mangoes	1951	1540	852	51	412	0	36	9	2	18	81	3697	721
Raddish	436	201	144	560	691	588	395	852	1242	1216	1042	348	643
Green peas	0	0	0	114	50	236	0	114	2849	2676	894	171	592
Sweet Potato	126	272	337	157	152	76	57	42	359	519	1390	2942	536
Green Onions	565	460	203	279	533	598	347	491	661	647	768	733	524
Pumpkin	352	517	371	399	503	482	775	585	350	265	521	317	453
Yam	144	145	185	301	364	361	838	446	555	452	333	313	370
Custard Apple	0	0	0	0	0	196	175	243	0	2660	403	0	306
GN Pods	0	0	0	65	0	26	74	550	1077	1004	118	14	244
Green Tamarind	0	0	0	0	0	679	158	314	422	433	43	0	171
Chow-Chow	0	0	56	68	154	226	167	106	173	128	92	62	103
Black eye beans	36	67	45	30	48	9	9	21	16	7	3	25	26
Others											162	0	162
G. TOTAL	**124848**	**125683**	**117133**	**135024**	**127007**	**133895**	**125454**	**149871**	**155648**	**154685**	**152073**	**160878**	**138666**

Source: Vegetables arrivals data from Agricultural Marketing Committee, Mozamjahi Market, Hyderabad.

5. Pesticide Use in Vegetable Cultivation around Hyderabad

Data on pesticide use in vegetable cultivation was obtained by visiting villages and holding group discussion with vegetable growers in villages Aziznagar, Pedda Mangalaram. The following was the information obtained with regard to the pesticide use at the farm level for some select crops.

Many of these pesticides are not recommended and registered with CIB for use against the particular pest in that crop. Some examples are given in the following tables (names in red font are brand names).

Pesticide usage in Tomato

Village	Pest	Pesticide	Dosage [ml/l]	Frequency of application	CIB & RC Status
Peddamangalaram, Moinabad	Fruit borer	Endosulfan	30-40 ml per tank	3 times	NR
		Chloropyriphos	30-40 ml per tank	3 times	NR
		Monocrotophos	20-30 ml per tank along with other pesticide		NR & Banned
	Fungal diseases	Dithane M45	10g per tank. 10 tanks per acre	2 times	NR
Sriramnagar, Moinabad	Fruit borer	Endosulfan	15 ml		NR
		Nuvacran	25-30 ml	4 times	NR
		Mono+endosulfan	20+15-20		NR
		Deltamethrin +triazophos + Endosulfan	5g + 15 to 20 ml /tank		NR
Aziz nagar, Moinabad Mandal	Fruit borer	Deltamethrin+triazophos	50 ml/l	5 times	NR
Allawada, Shabad	Fruit borer	Thimet	1 kg/bag of DAP		
		Endosulfan	30ml	7-8 sprays [rainy season] and 2-3 sprays [Summer]	NR
		Monocrotophos	25ml		NR & Banned
		Cypermethrin	30/40/50ml		NR
Nagireddyguda, Moinabad	Fruit & Shoot borer	Rocket	40ml	10-15 sprays	
		Deltamethrin +triazophos	50ml		NR
		Endosulfan	40ml		NR

Cabbage

Village	Pest	Pesticide	Dosage [ml/l]	Frequency of application	CIB & RC
Pedda mangalaram, moinabad mandal	Fruit borer	Methomyl	10 g per tank	3 times	NR
		Deltamethrin+ triazophos	40-50 ml per tank	2-5 times	NR
	Moth	Acephate	10 g per tank	3-4 times	NR
		Chlorpyriphos	30-40 ml per tank		Recommended
		Quinolphos			NR
Nagireddyguda, Moinabad		Indoxacarb	5 ml/tank	15 days interval	NR
Aziznagar, Moinabad		Spinosad	10ml	2-3 sprays	NR
		Emamectin Benzoate	10ml	2-3 sprays	NR
		Indoxacarb	10ml	1-2 days	NR

Other villages

Village	Crop/pest	Pesticide	Dosage [ml/l]	Frequency of application	CIB & RC status
Devarampalli, Moinabad	Beans	Monocrotophos	1 lit/acre		NR
		Ekalux+monocrotophos	0.5+0.5 l/acre	4 times	NR
Chevella, Chevella mandal	Cluster Bean	Monocrotophos +endosulfan	2 lid+3 lids/tank	5-6 sprays	NR
Mominpeta,Moinabad	Potato	Dithane M-45	1 lid/tank	3 times	NR
		Blitox			
		Pride			
		Monocrotophos	20 ml/tank		NR
Aziznagar	Palak/Spinach	Profenfos	40ml/tank	Every 15 days interval	NR
		Profenfos /cypermethrin/ Deltamethrin+triazophos			NR
Allawada, Shabad mandal	Carrot/Powdery mildew	Hexaconazole	50ml/tank		NR
	Beetroot	Cypermethrin	30 ml/tank		NR
		Endosulfan	30 ml/tank		NR

6. Discussion & Recommendations

There are serious unanswered questions related to pesticide registration processes and procedures in the country. To begin with, risk assessment of pesticides is taken up as a routine risk assessment of hazardous chemicals rather than as impact assessment vis-à-vis ecological practices in agriculture for pest management, during the registration process.

Further, the food safety assessment of pesticides is de-linked from its registration process – registration happens without ADIs or MRLs being first fixed and without MRL-fixation flowing out of chronic toxicity data. Even in cases where MRLs are fixed, they may not be fixed for all the commodities for which registration has been allowed.

The safety assessment from a long term perspective related to health impacts – whether it is related to potential endocrine disruption or teratogenecity or immune system disruption or reproductive health damage and so on.

Registration happens based on the developers' data and not independent data generated. At another level, there is an institutional conflict of interest with the Ministry of Agriculture, with a mandate of increasing agricultural production through the use of any technology, expected to regulate pesticides from an environmental and health point of view.

The ones who register pesticides have hardly monitored pesticide residues nor is there a system of periodic, automatic review of registered pesticides. It is not clear whether the AICRP on pesticide residues feeds into decision-making related to registration and licensing of pesticides. Further, the system of registering pesticides without MRLs being fixed continues.

The current research effort discovered that pesticide residue data is not pro-actively shared with the public nor does it inform regulation related to registration and use.

Most surveillance related to pesticide contamination is not shared with the public. In fact, data is presented mostly in forms that make pesticide residues look safe.

Official pesticide residue surveillance system's findings do not match with independent studies in the country. There seems to be under-reporting of the level of contamination of Indian products and this is reflected by frequent reports of Indian agricultural export consignments being rejected in other countries due to high levels of residues detected in such consignments.

The greater question of whether MRLs fixed are safe or not, from the point of chronic toxicity remains. As CSE's work on MRLs, TMDIs and ADIs has shown, the MRL-fixation itself is questionable in the country in addition to the fact that MRLs are yet to be fixed for many pesticides! Even if MRLs are fixed for all crops for all commodities they are used on and even if such MRLs are followed, there is no guarantee that the cumulative intake of such pesticide residues will be within the Acceptable Daily Intake levels!

Further, there is an additional complication allowed through law, in the form of **Provisional Registration.** Section 9 (3) (b) of the Insecticides Act allows provisional registration of some pesticides without sufficient data generated for assessing safety or efficacy. Pretty often, there are many violations witnessed in the use of such a provisional registration. A popular pesticide like Avaunt (brand name of Indoxacarb) was introduced through such a provisional registration and witnessed aggressive marketing even during that stage.

Research for the current study also revealed that there is gross mismatch between data generated and accepted during registration of pesticides and put out by the CIBRC (which pesticide to be used for what crop, with what GAPs etc.), such data put out by the agriculture/horticulture departments of the state governments and the information put out by the pesticide industry. Needless to say, all of this would not match with the actual use patterns on the ground by farmers, for a variety of reasons.

There is also the issue of too many chemicals – that too broad spectrum - being allowed for use for pest control of a specific pest on a specific crop. As CSE has pointed out in its materials, too many chemicals registered means increased costs of regulation and surveillance too. Such costs have to be met out of the tax-payers' money of course.

It is not clear how "restricted use" is actually regulated on the ground, after designated a pesticide for 'restricted use'. Though there are some regulations that the state government brings in for enforcement using its own authority of regulating marketing [like the Andhra Pradesh state government prohibiting marketing of synthetic pyrethroids for use on cotton crop before September each year], enforcement on the ground is weak of such measures too.

RECOMMENDATIONS

As the above discussion shows, there are serious shortcomings in the regulatory regime governing pesticide registration and enforcement of such regulation. It becomes increasingly clear that the best regulation to assess and reduce the impact of pesticides has to come at the time of registration itself.

Registration processes have to become transparent, broad based and open to public and scientific scrutiny. Such registration has to incorporate safer alternatives into its impact assessment processes. Further, registration should have an in-built mechanism of periodic reviews and should include comparative risk assessment methodologies before introduction of new pesticides. The systems of surveillance related to pesticide residues, resistance buildup in insects etc., have to organically feed into registration decisions. This is the system followed in several countries including some developing countries.

Accountability mechanisms on the pesticide industry and the regulators have to be stringent in case of environmental health harms. Standard setting for ADIs and MRLs has to be comprehensive. Better and adequate extension support to farmers is essential for the enforcement of standards. Serious curbing of the aggressive marketing that the pesticides industry engages in, in the pursuit of markets, is a pre-requisite for ensuring safe food for all Indians. There are more pesticides on the market than are needed for the same pest/crop in many cases, often confusing the farmers at the time of purchase. Irrational decisions are actually encouraged through such an environment.

It is also clear that the agriculture research establishment is flouting various registration clauses in its violations, almost in competition with the pesticide industry itself. Liability for violations should apply to agriculture universities and other public sector institutions too.

Finally, it is also clear that when data is generated for a pesticide, it is generated either for its efficacy or its economics or its safety. Such assessment is not done against established ecological alternatives that farmers are practicing to support the best alternative for farmers in terms of safety, affordability, sustainability and efficacy. Each individual chemical is assessed independently rather than being assessed for its very need to be registered as a pest management option vis-à-vis some ecological alternatives that are available with farmers. The

Non Pesticidal Management [NPM] experience in Andhra Pradesh and its success is enhancing farming livelihoods is appended. This experience on a large scale (of more than two lakh acres of farming being done by women farmers without the use of chemical pesticides) has more than adequately proven that pesticides are not inevitable in our farming. Any fundamental change related to pests, pesticides, pesticide residues and their regulation has to therefore begin by recasting the very pest management paradigm adopted and promoted in this country.

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Annexure 1: PESTICIDE PRODUCTION IN INDIA

INSECTICIDES and FUNGICIDES

INSECTICIDES						
1.	D.D.T.	6,344	3,638	3,786	3,513	2,937
2.	Malathion	9,500	5,894	5,900	5,597	4,248
3.	Parathion (Methyl)	4,000	1,860	1,979	2,055	1,901
4.	Dimethoate	3,210	1,477	1,436	817	758
5.	DDVP	3,900	3,495	2,648	2,832	2,426
6.	Quinalphos	5,600	2,218	2,649	2,059	1,770
7.	Monocrotophos	16,200	9,522	8,319	6,706	6,519
8.	Phospluunidon	5,700	3,234	3,470	534	832
9.	Phorate	7,500	6,140	6,101	4,717	3,156
10.	Ethion	5,100	3,383	3,456	3,838	1,246
11.	Endosulphan	10,100	8,287	8,508	4,489	3,663
12.	Fenvalarate	2,100	1,394	1,632	1,070	522
13.	Cypermethrin	4,600	3,714	4,438	5,064	5,078
14.	Anilophos	1,200	900	848	596	354
15.	Acephate	4,800	2,884	3,109	4,012	4,837
16.	Chlorpyriphos	10,300	7,513	8,033	6,621	6,313
17.	Phosalone	1,000	514	582	440	438
18.	Metasystox	@	744	583	660	513
19.	Abate	@	185	265	67	45
20.	Fenthion	@	155	189	69	352
21.	Trizaphos	@	845	847	1,512	1,151
22.	Lindane	1,300	1,107	483	266	331
23.	Temphos	200	6	176	142	122
24.	Deltamethrin	300	104	124	97	184
25.	Alphamethrin	400	361	115	303	194
	TOTAL	**103,354**	**68,571**	**69,703**	**58,106**	**49,893**
FUNGICIDES						
26.	Captain & Captafol	1,800	1,125	1,383	1,177	782
27.	Carbandazim	1,085	900	108	670	1,263
28.	Calixn	200	35	678	61	33
29.	Mancozeb	11,000	10,323	9,889	11,628	10,188
	TOTAL	**14,085**	**12,383**	**12,058**	**13,536**	**12,266**
HERBICIDES						
31.	2,4-D	2,900	1,348	1,290	202	0
32.	Butachler	900	706	224	309	244
	TOTAL	**3,800**	**2,054**	**1,514**	**511**	**244**
WEEDICIDES						
33.	Isoproturon	8,500	4,610	3,752	3,779	2,657
34.	Glyphosphate	1,950	1,676	674	409	107
35.	Paraquat	2,000	1,374	1,239	1,000	0
36.	Diuron	0	0	24	0	48
37.	Afrazin	40	128	100	203	200
38.	Fluchlorine	300	154	50	133	185
	TOTAL	**12,790**	**7,942**	**5,839**	**5,524**	**3,197**
RODENTICIDES						
39.	Zinc Phosphide	860	474	592	338	235
40.	Aluminium Phosphide	2,300	1,842	2,461	2,184	1,991
	TOTAL	**3,160**	**2,316**	**3,053**	**2,522**	**2,226**
FUMIGANTS						
41.	Methyle bromide	300	100	63	41	56.00
42.	Dicofol	150	124	106	109	90
137,63993,70992,33680,30167,400	TOTAL	**450**	**224**	**169**	**150**	**146**

GRAND TOTAL OF PESTICIDES

ANNEXURE-2
Company violations in recommending pesticides

Insecticide name/Technical name	Company name	Trade name	Company recommendations*		CIB recommendations*
			Crops	Insects	
Chlorpyriphos 20% EC	INSECTICIDES(INDIA)Ltd	Lethal	Paddy	Hispa	Recommended
				Leaf roller	Recommended
				Gall midge	Recommended
				Stem borer	Recommended
			Beans	Aphid	
				Pod borer	
				Cut worms	
			Sugarcane	Early shoot borer	Recommended only for termites by soil treatment
				Stalk borer	
				Pyrilla	
			Cotton	Aphids	Recommended
				Bollworms	Recommended
				White fly	Recommended
				Grey weevil	
				Cut worms	
			Ground nut	Aphid	
				Ropot grub	
			Mustard	Aphid	
			Brinjal	Shoot&frute borer	Recommended
			Cabbage	Demond back moth	Recommended
			Onion	Root grub	Recommended
			Apple	Aphid	Recommended
			Ber	Leaf hopper	Recommended

			Citrus	Black citrus	Recommended
				Aphid	Recommended
			Tabacco	Ground beetle	
			General	Locust hopper	
Chlorpyriphos 20%E.C.	Excel crop Care Ltd	TRICEL	Paddy	Hispa	Recommended
				Leaf roller/folder	Recommended
				Gallmidge	Recommended
				Stemborer	Recommended
			Pulses	Aphids	
				Podborer	
				Cutworms/Armyworms	
			Sugarcane	Black bug	Recommended only for termites by soil treatment
				Early shootborer&Stalk borer	
				Pyrilla	
			Cotton	Aphids	Recommended
				Bollworms	Recommended
				Whitefly	Recommended
				Grey weevil	
				Cutworms/Armyworms	
			Groundnut	Aphids	
				Rootgrub	
			Mustard	Aphids	
			Brinjal	Shoot&Fruitborer	Recommended
			Cabbage	Diamond backmoth	Recommended
			Onion	Rootgrub	Recommended
			Apple	Aphids	Recommended
			Ber	Leafhopper	Recommended

			Citrus	Black citrus	Recommended
				Aphids	Recommended
			Tobacco	Ground beetle	
			General	Locust hopper	
				Aphids	
				Jassids	
				Thrips	
				Greyweevil	
Chloropyriphos 20%EC	Hyderabad Cemical Supplies Ltd	HYBAN	Paddy	Hispa	Recommended
				Leaf roller	Recommended
				Gallmidge	Recommended
				Stemborer	Recommended
			Beans	Aphid	
				Posborer	
				Cutworms	
			Sugarceane	Black bug	Recommended only for termites by soil treatment
				Early shoot and Stalk borer	
				Pyrilla	
			Cotton	Aphid	Recommended
				Bollworms	Recommended
				Whitefly	Recommended
				Greayweevil	
				Cutworms	
			Ground nut	Aphid	
				Rootgrub	
			Mustrd	Aphid	
			Brinjal	Shoot&Fruit borer	Recommended
			Cabbage	Diamond Back moth	Recommended
			Onion	Rootgrub	Recommended

			Apple	Aphid	Recommended
			Ber	Leaf hopper	Recommended
			Ciitrus	Black Citrus	Recommended
				aphid	Recommended
			Tobacco	Ground beetle	
			Genaral	Locust hopper	
Cypermethrin 10%EC	Rallis India Ltd	RALO 10 E	Cotton	Spotted bollworm	
				American bollworm	
				Pink bollworm	
			Cabbage	Dimond back moth	Recommended
			Okra	Fruitborer	Recommended
			Brinjal	Shoot&Fruitborer	Recommended
			Sugarcane	Early Shootborer	
			Wheat	Shoot fly	Recommended
			Sunflower	Bihar Hairy [illegible]	Recommended
Cypermethrin 10% EC	INSECTICIDES(INDIA)Ltd	CYPERMIL	Cotton	Spotted bollworms	
				Amerian bollworms	
				Pink bollworms	
			Cabbage	Diamond back moth	Recommended
			Okra	Fruit borer	Recommended
			Brinjal	Fruit&shootborer	Recommended
			Sugarcane	Early shoot borer	
			Wheat	Shootfly	Recommended
			Sunflower	Bihar heary catterpillar	Recommended
Cypermethrin 25%EC	Rallis India Ltd	Tatacyper 25E	Cotton	Bollworms	
				Jassids	
				Thrips	
			Bhendi	Shoot&Fruitborer	Recommended

				Jassids	Recommended
			Brinjal	Shoot&Fruitborer	Recommended
				Jassids	Recommended
				Epilachna	Recommended
Cypermethrin 25% ec	NEW CHEMI INDUSTRIES Ltd	WHITE GOLD	Cotton	Bollworms	
			Cauliflower	Dimond back moth	
			Bhindi	Fruit borer	Recommended
			Brinjal	Fruit &shoot borer	Recommended
			Sugarcane	Early shoot borer	
			Wheat	Shoot fly	
			Sorghum	Ear head worms and Sorgham midge	
			Sunflower	Bihar hairy catterpiller	

Dichlorvos 76% EC	Syngenta india Ltd	Nuvan	Paddy	Brown plant Hopper	Recommended
				Cut	Recommended
				Leafroller	Recommended
			Wheat	Armyworm	
				Caterpillar	Recommended
				Cut worms	
				Pyrilla	
			Soyabean	Leaf eating	
				Caterpillar	
			Sugarcane	Pyrilla	
			Castor	Hairy cater pillar	
			Ground nut	Red hairy Caterpillar	
			Mustard	Painted bug	
			Sunflower	Caterpillar	
				Semilooper	
			Cucurbit	Red pumpkin beetle	Recommended

			Cashew	Apple borer	Recommended
			Apple	Gypsy moth	
Dichlorovos 76% EC	INSECTICIDES(INDIA)Ltd	BLOOM	Paddy	Brown plant hopper	Recommended
				Cutworms/ Army worms /Leaf	Recommended
			Wheat	Caterpiller	Recommended
			Soyabean	Leaf eating	
			Sugarcane	Pryilla	
			Catsor	Hairy catterpiller	
			Ground nut	Red harry	
			Mustard	Painted bug	
			Sunflower	Cabbage looper Caterpiller Semilooper	
			Cucurbit	Red pumkin beetle	Recommended
Dichlorvos 76%E.C	Hyderabad chemical Suppilies Ltd	HYVAP	Paddy	BPH	Recommended
				Cutworms/Armywor	Recommended
				Leafroller/Folder	Recommended
			Wheat	Catterpiller	Recommended
			Soyabeen	Leaf eating	
			Sugarcane	Pyrilla	
			Castor	Hairy catterpiller	
			Groundnut	Red hairy catterpiller	
			Mustard	Painted Bug	
			Sunflower	Cabbage Looper catterpiller	
				Semilooper	
			Cucurbit	Red pumpkin Beetle	Recommended
			Cashew	Apple borer	Recommended
			Apple	Gypsymoth	
Dimethoate 30%EC	Rallis india Ltd	ROG OR	Potato	Aphids	Recommended

			Onion	Thrips	Recommended
			Tomato	Wh itefly	Recommended
			Chillies	Mites	Recommended
				Thrips	Recommended
			Brinjal	Ash Weevil	
				Spotted Spider	
				Mites	
				Leaf catterpiller	
			Bhendi	Shootborer	
				Aphids	Recommended
				Leafhopper	Recommended
			Cabbage	Aphids	Recommended
			Cauliflower	Painted Bug	Recommended
				Mustard aphid	Recommended
			Paddy	Delphacid hopper	
			Banana	Milky Weed Bug	
			Maize	Stemborer	
				Shootfly	
			Sorgam	Midge	
			Redgram	Pod borer (Helicovepa armigera)	
				Thrips	
			Groundnut	Leaf minor	
			Sunflower	Aphids	
			Castor	Jassids	
				Mites	
				Whitefly	
				Semilooper	
			Mustard	Aphids	
				Saw fly	
			Ragi	Rustyplum	
				Aphids	
			RAPE	Mustard aphid	

			Coffe	Green bug	
			tea	Mites	
			Tobacco	Green peach	
				Aphids	
			Turmaric	Lace wing bug	
				Bug	
			Pepper	Pollu beetle	
			Promegranate	Coccids	
			Banana	Aphids	Recommended
			Citrus	Lace wing bug	
			Mango	Leaf miner	
			Apple	Psylla	
				Whitefly	
			Fig	Jassids	Recommended
			Custard	Mealy bug	
			Apple	Mites	
Dimethoate 30% E.C.	Insecticides INDIA Ltd	ROG ORI	Bajra	Milky Weed Bug	
			Maize	Stemborer	
				Shootfly	
			Sorgam	Midge	
			Redgram	Pod borer (Helicovepa armigera)	
				Thrips	
			Cotton	Aphids	
				Jassids	
				Thrips	
				Grey weevil	
			Castor	Jassids	
				Mites	
				Semilooper	
				Whiteflies	
			Groundnut	Leaf minor	

			Mustard	Aphids	
				Saw fly	
			Safflower	Aphids	
			Bhendi	Aphids	Recommended
				Leafhopper	Recommended
			Brinjal	Jassids	Recommended
				Leaf catterpiller	
				Shootborer	Recommended
			Cabbage	Aphids	Recommended
			Cauliflower	Painted Bug	Recommended
				Mustard aphid	Recommended
			Chillies	Mites	Recommended
				Thrips	Recommended
			Onion	Thrips	Recommended
			Potato	Aphids	Recommended
			Tomato	Whitefly	Recommended
			Apple	Stemborer	Recommended
			Apricot	Aphids	Recommended
			Banana	Aphids	Recommended
				Lace wing bug	
			Ber	Leaf hopper	
			Citrus	Black citrus aphid	Recommended
			Fig	Fig jassids	Recommended
			Mango	Mealy bug	Recommended
				Hopper	Recommended
			Lucerene	Leaf hopper	
				Weevil	
				Aphids	
			Rose	Scale insect	Recommended
				Thrips	Recommended
			Turmaric	Lace wing bug	

HEXACONAZOLE 5%EC	RALLIS Tata Enterprise	Cont af 5E	Apple	Scab	Recommended
			Rice	Blast	
				Sheath blight	
			Ground nut	Tikka leaf spot	
			Mango	Powder mildew	
			Soybean	Rust	
			Tea	Blister blight	
Indoxacarb 14.5%SL	TATA Rallis	Daks h	Cotton	Bollworms	Recommended
			Cabbage	Diamond Back Moth	
Malathion 50%EC	Insecticides INDIA Ltd	MAL AMA	Paddy	Rice hopper	Recommended
			Sorgam	Sorghum midge	Recommended
			Pea	Pod borer (Helicovepa armigera)	
			Soyabeen	Leaf weevil	
			Sugarcane	Pyrilla	
			Cotton	Aphids	
				Jassids	
				Thrips	
				Whiteflies	
			Castor	Jassids	
				Stemborer	
			Growndnut	Leaf minor	
			Mustard	Saw fly	
				Aphids	
			Sunflower	Whitefiles	
			Bendi	Aphids	Recommended
				Jassids	Recommended
				Spotted bollworm	Recommended
			Brinjal	Mites	Recommended
			Cabbage	Mustard aphid	Recommended
			Cauliflower	Head borer	Recommended
			Raddish	Stemborer	
			Turnip	Tobacco caterpiller	Recommended

			Tomato	Whitefly	Recommended
			Apple	Sanjose scale	Recommended
				wooly aphid	Recommended
			Beans	Lace wing bug	
			Mango	Mealy Scale	Recommended
				Mango hopper	Recommended
			Grapes	Beetle	Recommended
				Aphids	
				Jassids	
				Lucerne weevil	
			Lucerne	Aphids	
				Jassids	
				Lucerne weevil	
Monocrotophos 36%SL	INSECTICIDES (INDIA) Ltd	MILP HOS	Paddy	Brown plant Hopper	Recommended
				Green leaf hopper	Recommended
				Leaf roller/folder	Recommended
				Yellow stem borer	Recommended
			Maize	Shoot fly	Recommended
			Bengal gram	Pod boerer	
			Black gram	Pod boerer	
			Pea	Leaf minor	Recommended
			Red gram	Cow bug	
				Plume moth	
				Pod borer	
				Pod fly	
				Red bug	
			Sugarcane	Ear ly shoot borer	
				Mealy bug	
				Pynitta	
				Scale insect	
				Staik borer	
			Cotton	American boll worm	Recommended

				Aphids	Recommended
				Leaf hopper	Recommended
				Grey Weevil	Recommended
				Spotted boll worm	Recommended
				Pink boll worm	Recommended
				Thrips	Recommended
				White fly	Recommended
			Castor	Capsule borer	
			Mustrard	Mustrard Aphid	
			Bhindi	Leaf hopper	
				Aphids	
				Mite	
				Sootted boll worms	
			Brinjal	Mealy bug	
				Frut and shoot borer	
			Cabbage	Aphids	
				Cabbage head borer	
				Leaf webber	
			Chilli	Aphids	
				Pod borer	
				Thrips	
			Onion	Thrips	
			Citrus	Black aphid	
				Mite	
			Mango	Bud mite	
				Gsll maker	
				Hopper	
				Mealy bug	
				Shoot borer	
			Coconut	Black headeds	
				Caterpiller	
			Coffee	Green bug	

			Cardamon	Thrips	
Monocrotophos 36%SL	Hydreabad Chemicals Ltd	HYC ROP	Paddy	Brownplant hopper	Recommended
				Greenleaf hopper	Recommended
				Yellow stem borer	Recommended
				Leaf roller	Recommended
			Sugarcane	Early shoot borer	
				Stemborer	
				pyrilla	
				Mealy bug	
				Scal insects	
			Cotton	American bollworms	Recommended
				Aphid	Recommended
				Whitefly	Recommended
				Pinkbollworm	Recommended
				Spotted bollworm	Recommended
				Thrips	Recommended
				Green weevil	Recommended
			Bengal gram	Leaf hopper	
			Redgram	Podborer	
				Podborer	
				Pod fly	
				Plume moth	
			Coffee	Greenbug	
				Thrips	
Monocrotophos 36%SL	Rallis India Ltd	TAT AMO	Paddy	BPH	Recommended
				Green leaf hopper	Recommended
				Leaf roller/folder	Recommended
				Yellow stemborer	Recommended
			Maize	Shootfly	Recommended
			Bengalgram	Pod borer (Helicovepa armigera)	

			Blackgram	Pod borer (Helicovepa armigera)	
			Greengram	Pod borer (Helicovepa armigera)	
			pea	Leaf minor	
			Redgram	Cowbug	
				Pod borer (Helicovepa armigera)	
				Pod fly	
				Red bug	
			Sugarcane	Early Shootborer	
				Mealy bug	
				Pyrilla	
				Scale insect	
				Stalkborer	
			Cotton	American bollworm	Recommended
				Aphids	Recommended
				Leaf hopper	Recommended
				Grey weevil	Recommended
				Spotted bollworm	Recommended
				Pink bollworm	Recommended
				Thrips	Recommended
				Whitefly	Recommended
			Castor	Capsuleborer	
			Mustard	Mustard aphid	
			Citrus	Black aphid	
				Mites	
			Mango	Bud mite	
				Gall maker	
				Hopper	
				Mealy bug	
				Shootborer	
			Coconut	Black headed catterpiller	
			Coffe	Green bug	
			Cardamom	Thrips	

Oxydemeton Methyl 25%EC	BAYER	Meta svst	Rice	Blue leaf hopper	Recommended
				White leaf hopper	Recommended
			wheat	Brown wheat mite	
			Millets		
			Maize	Shoot fly	Recommended
			Sorgham	shootfly	Recommended
			Cotton	Aphids	
				Jassids	
				White filies	
				Mites	
				Thrips	
				Stemborer	
			Ground nut	Aphids	
				Leaf miner	
			Mustard	Aphids	
			Seasamem	Leaf hopper	
			Safflower	Aphids	
			Soyabeen	Tea stem borer	
			Chillies	Thrips	
				Aphids	
				Mites	
			Potao	Aphids	
				Jassids	
			Okra	White flies	
			Brinjal	Aphids	
				Jassids	
				Leaf beetle	
			Onion	Thrips	
			Tomato	Whitefly	
			Sugar cane	pyrilla	
			Tobacco	Aphids	

				Whitefly	
			Cit rus	Leafminer	
				Black citrus aphid	
				Ctruspyrilla	
				Whitefly	
			Apple	Wooly aphid	
				Sanjose scale	
			Mango	Mango hopper	
			Banana	Aphids	
				Trngebug	
			Guava	Scales	
			Peach	Leaf curl aphid	
			Plum	Leaf curl aphid	
			Grapes	Thrips	
				Flea beetles	
			Coffee	Leafminer	
				Greenbug	
			Tea	Aphids	
				Jassids	
PHORATE 10% C.G.	HINDUSTAN Pulverising Mills	HIT ATO	Bajra	Shootfly	Recommended
				White grub	Recommended
			Barley	Aphids	Recommended
			Maize	Shootfly	Recommended
				Stemborer	Recommended
			Paddy	Gallfly	Recommended
				Hispa	Recommended
				Leaf hopper	Recommended
				Plant Hopper	Recommended
				Stemborer	Recommended
				Root weevil	Recommended
			Sorgam	Shootfly	Recommended
				Aphids	Recommended

				White grub	Recommended
			Wheat	Shootfly	Recommended
			Blackgram	Stemfly	
				Whitefly	
			Greengram	Stemfly	
				Jassids	
			Pigeonpea	Jassids	
				Stemfly	
			Soyabeen	Stemfly	Recommended
			Sugarcane	Topborer	Recommended
				Whitegrub	Recommended
			Cotton	Aphids	
				Jassids	
				Thrips	
				Whitefly	
			Groundnut	Aphids	Recommended
				Leafminor	Recommended
				Whitegrub	Recommended
			Mustard	Mustard aphid	Recommended
				Planted Bug	Recommended
			Seasum	Jassids	Recommended
				Whitefly	Recommended
			Brinjal	Aphids	Recommended
				Jassids	Recommended
				Lace wing bug	Recommended
				Red spider mite	Recommended
				Thrips	Recommended
			Cauliflower	Aphids	Recommended
			Chillies	Aphids	Recommended
				Mites	Recommended
				Thrips	Recommended
			Potato	Aphids	Recommended
			Tomato	Whitefly	Recommended
			Apple	Wholly aphid	Recommended
			Banana	Aphids	Recommended
			Citrus	Leafminer	Recommended

			Coffee	White grub	
Quinolphos 25%EC	Cheminova INDIA Ltd	VAZ RA	Rice	BPH	Recommended
				Case worm	
				Gall fly	
				Hispa	Recommended
				Stemborer	Recommended
			Sugarcane	Shoot borer	
				Black bug	
				Leaf Hoppere	
			Cotton	Aphids	
				Jassids	
				Ash Weevil	
				White fly	
				Bollworms	
				Thrips	
			Groundnut	Leaf Hopper	
				Thrips	
				Red hairy catterpiller	
			Mustard	Saw fly	
			Bhendi	Fruit borer	
				Leaf Hoppere	
				Mites	
			Chillies	Aphids	Recommended
			Tomato	Fruit borer	
			Coffe	Hairy catterpiller	
				Mealy bug	
Quinolphos 25%EC	Insecticides INDIA Ltd	MIL UX	Paddy	BPH	Recommended
				Hisp blue beetle	Recommended
				Leaf roller/folder	Recommended
				Stemborer	Recommended

			Sorgam	Mites	
				Shoot fly	
			Wheat	Aphids	
				Ear head catterpiller	
				Mites	
			Bengalgram	Pod borer (Helicovepa armigera)	
			Blackgram	Bihar Hairy Catterpillar	
			French been	Stem fly	
			Redgram	Podborer	Recommended
				Podfly	Recommended
			Soyabeen	Leaf weevil	
			Sugarcane	Black bug	
				Leaf hopper	
				Shootborer	
			Cotton	Aphids	
				Jassids	
				Thrips	
				White fly	
			Jute	Leaf roller/folder	Recommended
				Semilooper	Recommended
				Yellow mite	Recommended
			Groundnut	Leaf hopper	
				Leaf minor	
				Thrips	
			Mustard	Saw fly	
			Sesamum	Leaf webber	
				Jassids	
			Bhendi	Fruite borer	
				Leaf hopper	
				Mites	
			Brinjal	Leafhopper	
				Shoot&Fruitborer	

			Cabbage	Aphids	
				Stemborer	
			Cauliflower	Aphids	
				Stem borer	
			Chillies	Aphids	Recommended
				Fruit borer	
				Mites	Recommended
			Onion	Thrips	
			Tomato	Fruit borer	
			Mango	Scals	
			Citrus	Citrus Beetle fly	
			Mango	Mango hopper	
			Promegranate	scals	
			Cardamon	Thrips	Recommended
			Coconut	Mites	
			Coffee	Green bug	
			Tea	Thrips	Recommended
Quinolphos 25%EC.	BAYER CROP lTD	Bayr usil	Paddy	Brown plant hopper	Recommended
				Gallmidge	
				Stemborer	Recommended
				Leafroller	Recommended
				Hispa	Recommended
			Cotton	Aphids	
				Whitefly	
				Bollworms	
			Redgram	Pod borer	Recommended
				Podfly	Recommended
			Bengalgram	Podborer	
			Sugarcane	pyrilla(Leaf hopper)	
			Ground nut	Jassids(Leafhopper)	
				Leafminer	

			Bhindi	Fruitborer	
				Leafhopper	
				Mites	
			Brinjal	Jassids(Leafhopper)	
				Fruit and shootborer	
Quinalphos 25%EC	Syngenta INDIA Ltd	Ekal ux	Maize	Cob borer	
			Paddy	Brown plant hopper	Recommended
				Case worm	
				Gall fly	
				Hispa&Blue beetle	Recommended
				Leaf roller/folder	Recommended
				Skipper	
				Stem borer	Recommended
				Whorl maggot	
			Sorgam	Mites	
				Shoot fly	
				Midge	
			Wheat	Aphids	
				Ear had catterpiller	
				Mites	
			Bengalgram	Pod borer (Helicovepa armigera)	
			Blackgram	Bihar Hairy Catterpillar	
			Fench been	Stem fly	
			Redgram	Pod borer	Recommended
				Pod fly	Recommended
			Soyabeen	Leaf weevil	
			Sugarcane	Balck bug	
				Pyrilla	
				Shoot borer	
			Cotton	Aphids	
				Ash Weevil	

				Bollworms	
				Jassids	
				Thrips	
				White fly	
			Jute	Leafroller/Folder	Recommended
				Semilooper	Recommended
				Stem weevil	
				Yellow mite	Recommended
			Groundnut	Leaf hopper	
				Leaf mite	
				Red hairy catterpiller	
				Thrips	
				White grub	
			Mustard	Saw fly	
			Sesamum	Leaf webber	
				Jassids	
			Bhendi	Fruit borer	
				Leaf hopper	
				Mites	
			Brinjal	Leaf hopper	
				Shoot &Fruit borer	
				Spotted leaf beetle	
			Cabbage	Aphids	
				Dimond back moth	
				Stem borer	
			Cauliflower	Aphids	
				Dimond back moth	
				Stem borer	
			Chillies	Aphids	Recommended
				Fruit borer	
				Mites	Recommended
			Cucrbits	Fruit fly	

			Onion	Thrips	
			Potato	Tuber moth	
			Tomato	Fruit borer	
			Apple	Wooly Aphids	
			Banana	Tingid bu g	
			Citrus	Scale insect	
				Citrus	
				Butter fly	
			Mango	Bud mite	
			Promegranate	Black leaf footedbug	
				Scale insect	
			Cardamon	Thrips	Recommended
			Coconut	Mites	
			Coffee	Hairy catterpiller	
				Green bug	
				Mealy bug	
			Pepper	Pollu beetle	
			Tea	Bunch catter piller	
				Flush worm	
				Looper catterpiller	
				Pink mite	
				Scarlet mite	
				Tea masquito	
				Thrips	Recommended
			Tobacco	Tobacco caterpiller	
Thiodicarb 75% WP	BAYER Crop Science	LAR VIN	Cabbage	Dimond back moth	
			Cotton	Bollworms	Recommended
			Brinjal	Shoot&Fruitborer	
			Pigonpea	Pod borer (Helicovepa armigera)	
			Chillies	Fruitborer(Helicovepa armigera)	

Source:

* The company brouchures, pamphlets supplied along with the pesticide bottles during 2006-07.

** Central Insecticides Board & Registration Committee’s website www.cibrc.nic.in

ANNEXURE -3

Violations in pesticide recommendations of Horticulture Department and ANGRAU

Crop: Cabbage

	Horticulture Department*	ANGRAU**	CIB***
Diamond Backmoth	malathion 0.1%		Fipronil 5% SC
	50WP carbarlyl 0.15%		Cypermethrin 10% E.C.
	40EC monocrotophos 0.04%		Chlorpyriphos 20% E.C.
	35 EC endosulfan 0.05%		Carbaryl 10% D.P.
	50 EC fenetrothion 0.05%		Flufenoxuron 10 % DC
Cabbage borer	malathion 0.1%		Carbaryl 50% W.P
	50WP carbarlyl 0.16%		
	Endosulfan 0.05%		
Saw fly	Dimethoate 0.06%		Lindane 6.5% W.P.
	Endosulfan 0.07%		
Nematode			Carbofuran 3% C.G.
Painted Bug [Bagrada cruciferarum]	Malathion 0.1%		
	30 EC Dimethoate 0.06%		
	35 EC Phosalone 0.05%		
Leaf Webber [Crocidolomia binotalis]	Monocrotophos 0.04%(		
	Malathion 0.1%		
Cabbage green semilooper [Trichopulsani]	Endosulfan 0.07%		
	Quinalphos 0.05%		
APHIDS(Brevicclvne brassicae; Lipaphis erysimi)	malathion 0.1%	Malathion	
	dimethoate 0.06%	Dimethiaote	
		Methyl demeton	
Tobacco caterpillar [Spodoptera litura] [spray before head formation]	100 EC phosphamidon 0.05%		
	100 EC phosphamidon 0.05%		
	carbaryl 0.15%		
Damping Off [Pythium]	Captan 75% WS SEED TREATMENT	COC	
Cabbage rekkal purugu	-	Endosulfan	
		Spinosad	
		BT powder	
Nalla kullu teglu	-	Sreptocyclin	
		COC	
		soil treatment Bleaching powder	
OVERALL IPM	-	captan	
		Carbendazim	

Crop: Bhendi

	Horticulture Department	ANGRAU	CIB
Aphids			Lindane 6.5% W.P.
Spider mites	Dicofol 0.036%	Wettable Supfur	Dicofol 18.5% E.C.
	Wettable sulphur 0.15%	Dicofol	
Fruit borer	quinalphous 0.05%	Carbaryl [twice in 10 days interval]	Cypermethrin 10% E.C.
	Carbaryl twice at 0.15%	Quinolphos [twice in 10 days interval]	
	Monocrotophos 0.05%		
Jasids	Malathion 0.15%	Methy demeton	Imidacloprid 70% WS SEED TREATMENT
		Dimethioate	
		Fipranil	
Thrips			Imidacloprid 70% WS SEED TREATMENT
Whiteflies		Dimethioate	
		Acephate	
Powdery Mildew		Dinocap	Dinocap 48% EC
		Hexaconazole	
		Wettable Sulfur	
Wilt		Copper Oxy Chloride	
Yellow vein mosaic		Dimethioate	
		Acephate	
when no fruit setting		Thiodicarb	

Crop: Potato

	Horticulture Department	ANGRAU	CIB
Aphids	Monocrotophos 1.5 ml/lit	Methyl demeton 2 ml/l	Lindane 6.5% W.P.
	Metasyslox 25% E.C. 2 ml/lit	Dimethioate 2 ml/l	Phorate 10% C.G
			Carbofuran 3% C.G.
			Dimethoate 30% E.C
Jassids	Monocrotophos 1.5 ml/lit	Methyl demeton 2 ml/l	Fenitrothion 50% E.C.
	Metasyslox 25% E.C. 2 ml/lit	Dimethioate 2 ml/l	
Spodoptera		Monocrotophos in Baiting	_
tuber moth (phthorimoea operculella) [10 days interval]	50% EC Sumethion 2 ml per liter of water	Phorate 10% G	
	Endosulfan 35% EC at 2 ml per liter		
CUT WORM (Agrotis ipsilon)	Endosulfan 35% E.C 0.07%		
Epilachna beetles [10 days interval]	50% Carbary WP 2 g/lit of water		
	Malathion 50% EC 2 ml/lit		
Leaf eating insects		Endosufan 2 ml/l	
Whiteflies	Monocrotophos 1.5 ml/lit		
	Metasyslox 25% E.C. 2 ml/lit		
Early & Late			Chlorothalonil-75% WP
			Aureofungin 46.15% SP
Bacterial rot		Bleaching powder 20-25g/l	_
Tuber rot [Erwinia]		Brric acid 3% seed treatment	_
Late Blight		Mancozeb 2.5g/l	Metalaxyl 8% + Mancozeb 64% WP
		COC	
Early blight	0.2% Dithane z-78	Dithane Z-78 2g/l	
	1% Bordeaux mixture	Chlorathionil 0.2%	
	Chloromatonil (0.2%)		
Ring disease	Agallol solution [tuber treatment]	Carbendazim seed treatment	
Mealy Bug		Triazophos 2.5ml/l	

Source:
* Website Depart of Horticulture, Govt. of AP http://www.aphorticulture.com,
** Vyavasaya Panchangam 2006-07, ANGRAU
*** Central Insecticides Board & Registration Committee's website www.cibrc.nic.in

Annexure 4: Information on resistance build-up in insects against insecticides in use

Resistance reported for *Spodoptera litura* (Tobacco caterpillar) against some Insecticides in Andhra Pradesh

Active Ingredient	Year of report	Location	Reported by
Chlorpyrifos	1998	Karimnagar	*C*
	1998	Khammam	*C*
	1998	Mahboobnagar	*C*
	1998	RR Dist	*C*
Cypermethrin	1998	Karimnagar	*C*
	1998	Khammam	*C*
	1998	Mahboobnagar	*C*
	1998	RR Dist	*C*
Endosulfan	1998	Karimnagar	*C*
	1998	Khammam	*C*
	1998	Mahboobnagar	*C*
Methomyl	1998	Mahboobnagar	*B*
Monocrotophos	1998	Karimnagar	*B*
	1998	Mahboobnagar	*B*
	1998	Warangal	*B*
Quinolphos	1998	Karimnagar	*B*
	1998	Mahboobnagar	*B*
	1998	Warangal	*B*

Resitance reported for *Bemesia tabaci* (Whitefly) against some Insecticides in Andhra Pradesh

Active Ingredient	Year of report	Location	Reported by
Cypermethrin	1998	Guntur	*C*
	1998	Mahboobnagar	*C*
	1998	RR Dist	*C*
Methomyl	1998	Guntur	*B*
	1998	Mahboobnagar	*B*
	1998	RR Dist	*B*
Monocrotophos	1998	RR Dist	*B*

Resitance reported for *Pectinophora gossypiella* (Pink Boll worm) against some Insecticides in Andhra Pradesh

Active Ingredient	Year of report	Location	Reported by
Chlorpyrifos	1998	Medak	*C*
Cypermethrin	1998	Medak	*C*
Methomyl	1998	Medak	*B*
	1998	Warangal	*B*
Quinolphos	1998	Medak	*B*
	1998	Warangal	*B*

Resistance reported for major insect pests against commonly used pesticides and bioagents in India.

	Bemesia tabaci	Erias vitella	Helicoverpa	Pectinophora	Plutella xylostella	Spodoptera
Bt					√	
Carbaryl			√			
Cartap					√	
Chlorfenvinphos				√		
Chlorpyriphos			√	√		√
Γ-Cyhalothrin			√			
Cypermethrin	√		√	√		√
Deltamethrin			√			
Endosulfan			√	√		√
Fenvelerate			√			
Fipronil					√	
Methomyl	√	√	√	√		√
Monocrotophos	√	√	√			√
Quinolphos			√	√		√

The consolidated table shows the resistance developed by the major insect pests in seven states i.e., Andhra Pradesh, Haryan, Karnataka, Maharashtra, Punjab, Tamil Nadu and Uttar Pradesh till the year 2004.

Compiled from Arthopd Pesticide Resistance Database from the site www.pesticideresitance.org

Annexure 5

Non Pesticidal Management in Agriculture

Introduction

Today agriculture is passing through a difficult phase. The ever increasing costs of cultivation due to excessive dependency on the external inputs, high fluctuations in market prices due to opening of up of markets, reduced public support after liberalisation coupled with the monsoon vagaries have made agriculture based livelihoods unviable. The spate of farmers suicides particularly in Andhra Pradesh and across the country are only the tip of the ice berg. The crisis needs to be understood and several long term initiations have to be made to solve it.

Agriculture chemicals especially pesticides occupy major costs in crops like cotton, chillies etc. The inevitability of pesticides in agriculture is promoted by the industry as well as the public research and extension bodies.

Shifting Paradigms in Pest Management

The dominant paradigm of pest management largely depends on chemical pesticides. Pesticide sprays can only be applied when the pest is in the most damaging stage of the its life cycle, i.e. the larvae stage. Farmers spray their fields when the number of insects per exceeds a certain threshold. However, this is often the case in monoculture. The regular use of pesticides causes the development of genetic resistance in the insects and makes the sprays more and more ineffective. Therefore the farmer has to increase the dosage more and more and therefore increase the costs of the cultivation.

On the other hand, replacing chemical products by biological products by itself may not solve the problem without a fundamental change in the perspective or thinking towards pest management. The Integrated Pest Management (IPM) initiatives which have come up as alternative though largely debates about the effects of pesticide on human health and on environment still believe that pesticides are inevitable, at least as a last resort.

Non Pesticidal Management

Non Pesticidal Management of Insect pests is a 'System that maintains the pest populations at levels below those causing economic injury, by having healthy crop and managing the population dynamics in the crop ecosystem". .

It is simply not the juxta-position or super-imposition of two or more control techniques but the integration of all suitable management techniques in a harmonious manner with natural regulating and limiting elements of the environment.

It is a paradigm shift in moving from input centric model to knowledge and skill based model. It involves making best use of natural resources locally available.

The main principles underlying the Non-Pesticidal Management:

- a natural ecological balance will ensure that pests do not reach a critical number in the field that endangers the yield
- nature can restore such a balance if it is not meddled with too much, hence no chemical pesticides/pesticide incorporated crops at all.
- understanding the behaviour and life cycle of an insect is important to manage pests – it is not enough if reactive sprays are taken up outbreak.

- Prevention rather than control/reaction is the key element to NPM
- crop diversity and soil health play an important role in pest management
- that pest management is possible with local, natural material

In the four stages of the life cycle, insects damage the crop only in one stage [larval stage in most of the cases] – atleast two of the stages are immobile [egg and pupa]. The adult stage will not be on the crop. There are several options available to control them at each of the stages mostly using local resources.

All these doesn't require the so called 'expertise' but only accepting and respecting the knowledge and skills of the farmers, supporting them to enhance their knowledge base with the demystified modern science.

The dominant paradigm which still by and large tries to find solutions in marketable technologies and commodities have to change. The public policy support which encourages such commodities has to change. The research system which has already set its agenda to work and promote on such technologies should reorient its priorities and work towards more farmer friendly methods and technologies. A shift in the mindset, a shift in the perspectives of thinking is needed.

What this calls for is a shift in the pest management paradigm currently being adopted.

Transgenic Bt crops: not a solution either

As the problems of chemical pesticides are becoming evident the industry has come out with yet another technology in the form of insect resistant genetically engineered crops like Bt cotton which are shown as a 'panacea' for controlling crop pests. The results of the last four years (2002-2005) of commercial cultivation of the Bt cotton in India, specially in Andhra Pradesh clearly shows devastating effects such technologies can have on the farming communities. This comes from the fact that the seed is four time the price of conventional seeds and BT crops often are not even completely resistant to those pests that they claim to be resistant to. In addition other pests will affect the crop and chemicals are needed again. The first three commercial Bt hybrids released in AP were withdrawn from commercial cultivation after reports of large scale failures.

It should be added that studies have assessed the variability of Bt toxin production under carefully controlled conditions, rather than the real life conditions of farmers' fields. Under real life condition toxin production of the crop is extremely uneven.

The basic principles on which transgenic Bt crops conflict with the basic principles of any rational pest management practices.

The key points of any rational pest management practices are

1. Management rather than control
2. No pesticide use till pest reaches ETL (Economic Threshold Level)
3. Judicious mixture of all the available control measures

Pest resistance: Major pest management strategies are designed to prolong the life of pest control measures, by ensuring that insects do not rapidly develop resistance to pest control chemicals. There are two key mechanisms through which insect populations develop resistance to toxins:

- *Selection for resistance*. A number of individuals within an insect population are likely to be naturally resistant to a given chemical, even if the majority are susceptible. When chemical pesticides are sprayed, susceptible insects will die, while resistant and escaped insects survive. Successive sprays amplify this effect. The resistant individuals are more likely to reproduce, and their offspring are more likely to share their parents' resistance to the chemical in question. In this way, chemical sprays and plant-produced toxins select insects for genetic resistance.

- *Selection pressure.* Even if the insect population doesn't contain any naturally resistant insects, high doses of a particular are likely to encourage genetic mutation in order to acquire resistance.

These processes are well-documented in relation to chemical pesticides. Transgenic Bt plants, which produce their own insecticidal toxins, have the similar effect. However, there is one key difference: unlike topical sprays, which become inactive after a short period of time, transgenic Bt plants are engineered to maintain constant levels of the Bt toxin for an extended period, regardless of whether the pest population is at economically damaging levels. The selection pressure with transgenic Bt crops will therefore be much more intense.

Targeted, measured doses of pesticides: In order to prevent (or at least, retard) the emergence of insect resistance, PM strategies aim to avoid the use of pesticides altogether, unless the pest population reaches the ETL. Secondly, IPM seeks to ensure that pesticides are applied in optimum doses, according to the severity of the pressure from pests.

Today the experience of Bt cotton in several areas specially dryland regions is well known. The newer questions like toxicity to smaller ruminants and soil microbes are raised by several scientists across the world and the farmers are complaining on this issue.

The experiences from several locations across the state on the non-pesticidal management show very positive results (See annexure-I and annexure-II) with out use of chemical pesticides and GM crops. These approaches have great potential in rainfed areas where most of the farmers belong to small and marginal category. Unfortunately, the current public support systems in the form of extension support, subsidies, credit etc doesn't help farmers to move towards such approaches. This is the fundamental shift which needs to happen which can change farmers scenario in the country.

Case of Punukula

This is the story of how two villages in Khammam district of Andhra Pradesh put in efforts over a five year period (1999 to 2003) to rid themselves completely of pesticides. Today, the villagers do not use chemical pesticides at all - they are inspiring other farmers in their district and elsewhere to go the same way and improve their livelihoods. The Panchayat has passed a resolution that they would remain pesticides-free.

The Punukula

5 years ago Payakari Nageswar Rao from Punukula, a small village 12 km from Kothagudem, committed suicide by drinking the very pesticides that were supposed to assure him a high and stable yield of cotton and secure his income and livelihood. His wife now leases out the land, which is still in cotton production, but cannot manage to repay her husbands debts.

For quite some time cotton has been the major crop in Punukula. It was cultivated as a monoculture and large amounts of pesticides were used to protect the crops. This caused a number of problems: there were cases of acute poisoning, which left people disabled for the rest of their life and caused enormous health service bills or ended fatal. The Registered Medical Practitioner of Punukula, Mr Madhu recollects that there used to be at least 50 to 60 poisoning cases per season earlier to 2000.

Another problem was caused by the credits that people took out to finance the pesticides. These credits caused the economics of farming to go out of control. The money seemed to have gone straight into the hands of the "single window" or "all-in-one" dealer. The dealer was indeed dealing a death blow to the farmers' dreams. He would be the one who would sell them seeds, fertilisers and pesticides – he would give these on credit to the farmers and even supply other credit. However, all of this was at high interest rates of 3-5% per month. Since the farmers were in no position to repay these

Shifting Paradigms in Pest Management

The dominant paradigm of pest management largely depends on chemical pesticides. Pesticide sprays can only be applied when the pest is in the most damaging stage of the its life cycle, i.e. the larvae stage. Farmers spray their fields when the number of insects per exceeds a certain threshold. However, nthis is often the case in monoculture. The regular use of pesticides causes the development of genetic resistance in the insects and make the sprays more and more ineffective. Therefore the farmer has to increase the dosage more and more and therefore increase the costs of the cultivation.
On the other hand, replacing chemical products by biological products by itself may not solve the problem without a fundamental change in the perspective or thinking towards pest management. The Integrated Pest Management (IPM) initiatives which have come up as alternative though largely debates about the effects of pesticide on human health and on environment still believe that pesticides are inevitable, at least as a last resort.

Non Pesticidal Management

The main principles underlying the Non-Pesticidal Management:

- a natural ecological balance will ensure that pests do not reach a critical number in the field that endangers the yield
- nature can restore such a balance if it is not meddled with too much, hence no chemical pesticides at all.
- understanding the behaviour and life cycle of an insect is important to manage pests – it is not enough if reactive sprays are taken up outbreak.
- Prevention rather than control/reaction is the key element to NPM
- crop diversity and soil health play an important role in pest management
- that pest management is possible with local, natural material

loans, the agreement would be to sell their produce to this "all-in-one" dealer. The dealer in turn would inevitably fix the price at rates lower than the market value. The farmers had no choice but to accept the rate, in the hope that next year's investments would once again be supported by the dealer. The cycle became extremely vicious with no way out. The farmers were now truly on the Pesticides Treadmill.

Most people in the village recall with horror the strong clutches of the all-in-one dealer. The social stigma of indebtedness, especially at those times when the money lender put pressure for repayment is unbearable for many.

The beginnings of the transformation:

In 1999, the local Non-Governmental Organisation, SECURE (Socio-Economic and Cultural Upliftment in Rural Environment), analyses with the villagers about their livelihoods revealed several problems related to their agriculture including lack of support for investment, higher expenditure each year, lack of marketing support, indebtedness etc. Realising that pesticides in cotton caused many of these problems, the organisation decided to work on the Non-Pesticidal Management (NPM).

The NPM project was with the technical and financial support of the Hyderabad-based Centre for World Solidarity's Sustainable Agriculture wing (now called the Centre for Sustainable Agriculture).

The initial hesitancy

When SECURE personnel approached the farmers with their non-pesticidal technology, the farmers were skeptic. This, they were doing in the face of aggressive marketing including advertising by the pesticide industry and the difficulty in the challenge is entirely understandable. 'How can I believe that the insect which cannot be killed by highly poisonous pesticides be controlled by using neem which I every day use to brush my teeth' remarks Mr. Hemla Nayak recollecting their initial hesitations. But gradually people started realizing the difference.

The sweet taste of success

At the end of the first year, the positive results were already apparent with the NPM approach:

In 2001-02, Non-Pesticidal Management work was taken up on 6.4 hectares, with eight farmers in Punukula on cotton, while in the case of pigeonpea, it was done in 7 ha with 3 farmers.

Once again, in the conventional chemical plots, farmers experienced a negative income while the NPM farmers experienced a great economic improvement leaving them with positive net incomes.

NPM in Cotton during 2001-02 (on 6.4 ha, with 8 farmers in Punukula)

Particulars	NPM	Conventional
Avg.Yield	15.62	14.72
Cost of plant protection	4301	8596
Net income	3420	-5201

By the second year, more farmers joined the effort as they had witnessed the good results first hand in the fields of the first year's participants. Farmers were also taken on exposure visits to other districts. There were more training-workshops held in the village. Slowly, word spread, and along with it, a serious conviction that getting rid of chemical pesticides is the only way out.

By 2002-03, the NPM was tried out in crops like Paddy, pigeonpea, cotton and chilli. The number of participating farmers went up to 59, with an area of 58 hectares. The increased net incomes were to the satisfaction of the farmers.

In 2003-04, the acreage under NPM cotton went up to 480 ha in Punukula and Pullaigudem villages, covering all the cotton area of Punukula. In Chilli, the discontinuation of pesticides also meant a great improvement in the quality of chilli and therefore, the produce fetched higher prices in the market.

Village	Acreage	Average Yield	Average Cost of Cultivation/ha	Average Net Income per ha
Punukula and Pullaigudem	480 ha	30 q/ha	Rs. 21408/ha	Rs. 52593/ha

Impacts

In 2004-05, for a second year in a row, nobody in the village has gone anywhere near a pesticide dealer or dabba (pesticide storage). The Village Panchayat passed a resolution to announce that it is pesticides-free and would continue to be so. From the Panchayat's side, they requested pesticides dealers not to come into their village and market their products.

Farmers of the village were able to get rid of past debts in a couple of years' time. With the debt burden off, the farmers are willing to try out more and more ecological approaches, as well as try it on more crops. Eerla Dhanamma now bought two more acres of land, after switching over to NPM, for instance. Hemla Nayak says that his debts have been repaid. Man Singh has been able to lease in 2 acres of land on which he is cultivating cotton without pesticides. Field Staff of SECURE point out the various changes – including housing - in the village after pesticides have been removed from their agriculture.

The ecological balance in the fields got restored. There are many more insects present in the fields, without any of them reaching a "pest" stage of threat. Dhanamma talks about spiders, wasps and beetles returning to their fields. Birds are returning to the village, the villagers report.

The health of the farmers improved – there are no more any cases of acute intoxication from the village. Dr Nagaraju of Kothagudem also observes that acute intoxication cases from these villages have come down.

For the agricultural labourers also, things have improved on many fronts. There was a wage increase from 25 rupees to 30 rupees during the corresponding period [when NPM was practised]. They do not have to be exposed to deadly pesticides now, nor incur medical care expenses for treatment of pesticides-related illnesses. Some point out that there is even more work for the labourers – in the collection of neem seed, in making powders and pastes of various materials and so on. Farmers are even leasing in land and putting all lands under crop cultivation these days – this implies greater employment potential for the agricultural workers in the village.

The women's groups bought a neem seed crushing unit in Punukula in 2004. This was done through the Panchayat with the help of Centre for World Solidarity, which gave a grant for the investment. Two women find full-time employment running this machine.

The rapid spread of the approach:

In Punukula, 174 farmers along with 120 farmers from Pullaigudem soon became capable of explaining to others the principles behind the new pest management approach and about how they were benefiting. Word spread both in sporadic ways and in a structured manner. Punukula farmers themselves decided to pro-actively spread the NPM message to nearby villages. Every relative that visits the village gets to hear about the transformation. Similarly, when Punukula farmers go to other places for other social purposes, they make it a point to bring up their story of NPM.

NPM scalingup with SERP

During 2005-06 NPM was initiated in 450 villages with 23000 acres in 10 districts. All over 10 districts 11766 farmers with 22581 acres in both Kharif and Rabi implemented the program. Sixty two MMS, 150 Mandal level coordinators and 450 village activists are involved in the program

Economic Advantages

Crop	Cost of Plant protection (Rs./acre)		Saving (Rs/acre)
	Conventional	NPM	
Cotton (Avg from Khammam)	5000	1000	4000
Chillies(Avg from Warangal)	15000 to 20000	2000	13000
Redgram (Avg from Nalgonda)	1500	300	1200
Groundnut (Avg from Anantapur)	1500	300	1200
Castor(Nalgonda)	2000	400	1600
Paddy(Avg.from Kurnool)	2000	225	1775

Moving to Community Managed Sustainable Agriculture

The successful grounding of NPM during 2005-06 has given importing learning on how any ecologically sound and economically benefiting technology can be scaled up by providing proper institutional support. During 2006-07 more farmers in the same villages and more villages in the same districts and few newer districts are joining the program. This year program covers 1000 villages in 17 districts. More than 80,000 farmers cultivating about 1.8 lakh acres. This year in addition to pest management initiations on soil productivity management and seed management have begun on a small scale. Agriculture credit from formal banks was mobilised in 3 districts to the tune of 15 crores. Village level procurement centres are also planned in atleast 200 villages this year.

Today we have villages like Yenabavi which is completely organic. This scalingup experience in AP has broken the myth that pesticides are inevitable in agriculture and also given important lessons on the paradigm shift in technology, institutional systems and support systems required for sustaining agriculture specially of small and marginal farmers.

For more information on NPM and problems associated with GE crops and Chemical pesticides and case studies please visit http://www.csa-india.org or write to csa@csa-india.org.

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