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MODERN AGRICULTURE, PESTICIDES AND HUMAN HEALTH : A CASE OF AGRICULTURAL LABOURERS IN WESTERN MAHARASHTRA

Dhanraj A. Patil and*
*Ravasaheb J. Katti***

ABSTRACT

Modern agriculture practices have been great promise for economic development of nation. Farm productivity is directly proportional to use of agrochemicals as observed from the first green revolution. Improper and unsafe use of these agrochemicals, especially pesticides is not only harmful to environment but also human health. Pesticides cause 14 per cent of all known occupational injuries in agriculture and 10 per cent of all fatal injuries. The relationship between the extent of pesticide-use and signs and symptoms of illnesses due to exposure among agricultural labourers of one of the high cash crop zones of Maharashtra State (Western Maharashtra) was assessed. Total 100 agricultural labourers were interviewed with pre-tested interview schedules by using accidental sampling procedure. It is found that more than 75 per cent of labourers used either "moderately hazardous" or "highly hazardous" pesticides as classified by World Health Organisation (WHO). However, 88 per cent did not use any form of protection, while handling pesticides. Poverty and Illiteracy are greatly responsible for improper handling of pesticides.The study also found that there is ample scope for reducing pesticide exposure through training, agricultural extension and community mobilisation.

Introduction

Agriculture is the mainstay of Indian economy. Agriculture and agriculture allied sectors contribute nearly 22 per cent of Gross Domestic Product (GDP) of India, while about 65 -70 per cent of population depends on agriculture for livelihood (Sachdeva, 2007).The scenario of Indian agriculture has changed drastically after first green revolution in 1960. A vast majority of the population in India are engaged in agriculture and are therefore, exposed to the pesticides used in agriculture. Indian farmer is using wide ranges of chemical pesticides to limit the losses from pests and diseases, in which insecticides account for 73 per cent, herbicides14 per cent, fungicides 11 per cent and others 2 per cent (Grace, et al., 2007). Chemical pesticide use is associated with risk and health hazards if not handled properly. Improper handling and unsafe spraying of the agrochemicals cause high risk of health hazards reported in the past studies (Bag, 2000, Gupta, 2004). Centre for Science and Environment (CSE) reported that pesticide exposure causes acute poisoning, cancer and

* Head, Department of Sociology, Walchand College of Arts & Science, Walchand Hirachand Marg, Ashok Chowk, Solapur-413006(Maharashtra). dr.dhanraj9@gmail.com

** Head, Department of Sociology, Government First Grade College, Khanapur, Belgaum (Karnataka).

neurological impairment, reproductive and developmental problems (Arora, 2007, Takagi, et al., 1997). Thus, considering the importance of the subject an empirical investigation has been carried out purposively in Western Maharashtra, which is one of the high cash crop zones of Maharashtra State.[1]

Background and Rationale of the Study

Post-Independence, population was growing at a much faster rate than food production. This called for drastic action to increase yield. Action came in the form of Green Revolution involving expansion of farming areas, double cropping, existing farmland using irrigation and using High-Yielding Variety (HYV) seeds. The 'Green Revolution' of the 1960s was confined to the Northern States of Punjab, Haryana and parts of Uttar Pradesh, and to strategic crops, mainly wheat and rice. Over 70 per cent of the country's farmland remains rain-fed, whilst a significant proportion of agricultural land (150 million hectares) is now classified as 'wasteland'. The liberalisation of Indian agricultural economy started in 1991. The major impact has been the shift from "lower value" or subsistence food crops to higher value cash crops (like cotton or oilseeds). This shift had created massive impact especially on the use of pesticides in Indian agriculture.

Pesticides in Indian Agriculture

The promotion of High Yielding Varieties that marked the green revolution has led to large scale use of chemicals as pesticides. Increase in the use of chemicals as pesticides can result in various health and environmental problems like pesticides poisoning of farmers and farm workers, cardiopulmonary, neurological and skin disorders, fetal deformities, miscarriages, lowering the sperm count of applicators, etc. (Bag, 2000). Indian pesticide industry is the fourth largest in the world. Of the total market, around 75 per cent is accounted by insecticides. At present, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides with an annual production of 90,000 tonnes (Government of India, 2007). According to Mr.Pradeep Dave, President, PMFAI, and Chairman and Managing Director, Aimco Pesticides Ltd., "Pesticides consumption in India is low, less than 800gm per acre against 16 kg per acre in the U.S. We want the government machinery to educate farmers about the use of pesticides through scientific programmes. All over the world better crop protection is used and here the government discourages the use of pesticides" (Subbu, 2001). Over the past decade, high prices of HYV cotton crops encouraged tens of thousands of small and marginal farmers in the region to shift from traditional food crops to cotton. Shift to the cotton meant costly investments in seeds, fertilisers and pesticides which were possible for the small peasants of Telangana only through loans typically secured with their land or the gold ornaments of their wives. Now, in thousands of homes, dreams lie shattered amidst the ruin of thousands of families. A pall of despair and shock lies over the region today, where at least 180 debt-ridden cotton farmers committed suicide in a short spell of just three months, recently (Kanekar, 1999). The food we eat today contains a concoction of banned and restricted chemicals like DDT, benzene hex chloride (BHC), aldrin, dieldrin, lindane and many others that result in functional disorder and disease. It all began with the Green Revolution, which saw indiscriminate use of chemical fertilisers and pesticides. It left behind enormous toxic loads of contaminants in the environment, which eventually found their way into humans through the food chain (Rangarajan, 2001).

India had adopted the environment-friendly integrated pest management (IPM) approach for combating pests and diseases as a cardinal principle of its plant protection

strategy way back in 1985. By adopting the IPM technology on rice, they have not only saved on pesticides but also improved conditions for restoring ecological balance in rich agricultural belt. However, in most cases, farmers gave up this practice and reverted to pesticide use soon after the projects under which they took to it were over. Besides lack of necessary follow-up action on the part of the promoters, there are other reasons as well for the failure of interest in this technology to endure without official patronage (Business Standard, 1999).

Agricultural Modernisation and Liberalisation

Historically, modernisation of agriculture was to lead to changes in relations of production from a feudal system to capitalist mode. In India, factors such as caste, colonial influence and uneven development meant that complex relations developed. The debate on mode of production in the 60s and 70s indicated that the relations were characterised variously viz., semi-feudal, semi-colonial, early capitalist, to semi-colonial systems (Patnaik Utsa, 1990 and Habib, 1984). The new seed-fertiliser technology especially, those arising from the Green Revolution resulted in the increase in land rents and lower labour wages (in real terms). Only big farmers, mainly those who are producing for the market, could make use of Government support. Marginal farmers have in fact been further marginalised under the new regime of modern agriculture and green revolution. In fact most farmer suicides have been connected to pauperisation and indebtedness which so called government support in the form of part subsidies for seeds, credit, fertilisers have brought in.[2]

Agricultural Labourer

Agricultural labour households (ALH) are defined according to Rural Labour Enquiries as those that derive over 50 per cent of their total household income from wage earned manual labour in agricultural activities. Overall, there was a significant increase in the proportion of such households over the two decades "73-74 to '93-94 in 11 major States[3]. Less than half of the rural labour households have land, and of those who do, only 13 per cent own above one hectare. In States like Punjab and Haryana where the green revolution has taken place and the areas most likely to go global, the proportion of rural labour owning land is as low as 6 and 12 per cent, respectively, as compared to so called backward States of Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh, where over 50 per cent own land (Shivakumar, 2001). This clearly shows that modernisation has resulted in alienation of land from the marginal rural labour households. Among the 1 billion of the world's poorest people, 75 per cent live in rural areas and 50 per cent of all working people worldwide are farmers and agricultural workers —most of whom live in the South. Thus, the present study has been carried out in this context to examine the relationship between pesticide use and its impact on agricultural labourers in Shirol region of Western Maharashtra purposively.

Methodology

The main aim of the study was to analyse the nature, pattern and health effects of pesticide use among the agricultural labourers in one of the cash crop zones of Maharashtra State. The specific objectives were to:

1. study the factors associated with pesticide use and its impact on agricultural labourers.
2. suggest policy implications for reducing pesticide induced health problems.

A total of 100 agricultural labourers were selected by using accidental sampling procedure from Shirol region of Kolhapur

district. Information was collected through structured and pilot tested questionnaire during January-February 2010. It was decided that for the convenience of farmers, interviews should be conducted in field, in the forenoon hours. Interviews were conducted in the local language, namely Marathi, however some of the interviews were also conducted in Kannada language.

Socio-economic Characteristics of Agricultural Labourers

The primary exposure status to pesticides was ascertained based on whether or not the agricultural labourers were involved with spraying pestisides.It was noted that majority of male respondents (73.00 per cent) were closely linked with pesticide spraying than (05.00 per cent) of female respondents (Table1. S.No.5). The average age of male respondents was in between 31-50.

The level of education and illiteracy has contributed to poor awareness on use of agrochemicals especially pesticides. However, 50 per cent respondents received no formal schooling while 36 per cent were able to read and write Marathi and Kannada language. Shirol region is situated on Karnataka-Maharashtra border, majority of agricultural labourers are migrated from Karnataka State. Due to the fertile soil and irrigation resources, most of the landless labourers prefer to work in this region.

However ₹1500-3000 is the average monthly income of both male and female respondents (Table. 1. S.No. 4). Number of respondents under the category of ₹1500-2000 are 29 and ₹ 2000-2500 are 28 and ₹ 2500- 3000 are 24.

Pesticide Use Pattern

The most commonly used pesticides according to the labourers were Dimethoate/ Roger (70.51 per cent), Endosulfan (62.82 per cent) and Qunalphos / Ekalux (52.56 per cent). Likewise 6.41 per cent of the labourers used pesticides which are extremely hazardous i.e. Phorate. Furthermore, Roger, Ekalux and Endosulfan are classified as moderately hazardous by WHO, while Monocrotophos is classified as highly hazardous.[4] Only very few labourers (12 i.e.15.28 per cent) used pesticides in the class III (slightly hazardous) and unlikely to present acute hazard in normal use. Due to the fertile soil and modern agricultural tools and techniques, farmers use maximum pesticides on crop and especially on vegetables in the study area.[5] However, apart from WHO classified pesticides, labourers were also using few other popular pesticides in their fields such as Methoxychlor, Lindane and Dicofol from Organochlorine category. Organochlorine group pesticides used widely in the U.S. in 1960's to 1970's, are acutely toxic and very persistent pollutants in the environment. Many pesticides in this category are proven carcinogens, reproductive toxicants or both (CEPA, 1998).

Few Organophosphates group pesticides were also found in the study area, these are Malathion, Methyl parathion, Chlorpyrifos and Diazinon. The pesticide contains chemical formulations Aldicarb and Carbaryl, along with this synthetic Pyrethroid is also being used popularly in the study area. Pyrethroid includes Permethrin and Cypermethrin formulation. Herbicides used for the control of weeds have different chemicals such as Alachlor, Atrazine and Simazine. Herbicide is designed to kill plants rather than animals and is less acutely toxic to human than insecticides. But many of them are classified as probable or possible carcinogens by US and EPA (EPA-US, 1999). Fumigants are also used as agrochemicals but its use is very rare in the study area and used only for sterilising soil and in structural pest control. Fumigants have ability to diffuse organic matters in the soil. Fumigants tend to be rapidly absorbed across the pulmonary

Table 1 : Socio-economic Background of Respondents

N-100

S.No.	Socio–Economic Characteristics	Male	Female	Total
1	Marital Status			
	Unmarried	21	09	30
	Married	58	12	70
2	Age			
	21-30	07	02	09
	31-40	22	06	28
	41-50	28	07	35
	51-60	13	06	19
	Above 60	09	00	09
3	Education			
	Illiterate	39	11	50
	Merely Read and Write Marathi/Kannada	19	07	26
	Fluently Read and Write Marathi/Kannada	16	03	19
	Fluently Read and Write Marathi and English	05	00	05
4	Monthly income			
	1500-2000	21	08	29
	2000-2500	25	03	28
	2500-3000	18	06	24
	3000-3500	15	04	19
5	Involvement in pesticide spraying			
	Yes	73	05	78
	No	06	16	22
	Total	79	21	100

Source : Field Survey, 2010.

membrane and through skin (Arora, 2007). Fumigants are classified under the deadly poisonous and it acts as a carcinogen and found in use in the study region especially in the green house agriculture commodities (Takagi, et al., 1997).

Table 2 : Pesticide Use Pattern by Agricultural Labourers

S.No.	Pesticide : Common name (WHO Classification)	Chemical Category	No. of agricultural labourers	% (N = 78)
1	a. Extremely hazardous			
	1. Phorateb.	Organophosphate	05	6.41
	Highly hazardous*			
	2. Monocrotophos	Organophosphate	36	46.15
	3.Profenofos & Cypermethrin	Combination pesticide	17	21.79
	4. Carbofuran	Carbamate	03	3.84
2	*Moderately hazardous**			
	5. Dimethoate/ Roger	Organophosphate	55	70.51
	6. Qunalphos/Ekalux	Organophosphate	41	52.56
	7. Endosulfan	Organochlorine	49	62.82
	8. Carbaryl	Carbamate	11	14.10
	9. Chlorpyrifos	Organophosphate	08	10.25
	10. Cypermethrin	Pyrethroid	04	5.12
	11. Fenthion	Organophosphate	09	11.53
	12. DDT	Organochlorine	06	7.69
3	Slightly hazardous*			
	13. Malathion	Organophosphate	04	5.12
	Unlikely to present acute hazard in normal use*			
	14. Carbendazim	Carbamate	06	7.60
	15. Atrazine	Triazine	02	2.56

* WHO classification of pesticides, 2004.

Source : Field Survey, 2010.

Information Sources, Precaution and Handling of Pesticides

It was observed that retail shop owners/ agricultural marketing agents were the key source of information regarding usage of pesticides (55 per cent). However, 43 per cent of labourers consulted with fellow labourers about the use of pesticide and only 21 per cent of labourers considered government officials (agricultural extension workers) as their source of information. This highlights the need for redesigning and refocusing the training and extension programme targeting the agricultural labourers.

Table 3 : Information Sources About Proper Pesticide Usage

N = 100

S.No.	Sources of Information	Yes	No	Total
1.	The retail shop owners/ agricultural marketing agents	55 (55%)	45 (45%)	100 (100%)
2.	Fellow labourers	43 (43%)	57 (57%)	100 (100%)
3.	Govt./agricultural officials	21 (21%)	79 (79%)	100 (100%)
4.	Land owner	09 (9%)	81 (81%)	100 (100%)

Source: Field Survey, 2010.

It is interesting to note that mere 9 per cent of agricultural labourers know proper usage of pesticide from their respective land owners, in fact they are educated and well aware about the scientific and proper utilisation of the pesticide. But they did not think that it is their moral responsibility. The agricultural labourers are uneducated, poor, they work hard in their land, take maximum risk during pesticide use, but they were not able to get proper information from the land owner. It was found that the land owners have a traditional belief that, "Maximum Pesticide gives - More-Quick and Safe Product". Hence they keep silent and influence the labourers to use maximum pesticides and the capitalistic relations of production do not allow them to do in favour of the labourers. However, because of their illiteracy labourers are very often unable to read information written on the labels.

In Pesticide Action Network, PAN's (2001) own research, plantation workers have noted that the labels are often removed from pesticide containers, thus making it very difficult to know about the scientific application of pesticide. Many farm workers cannot read warning labels about careful use, because they do not know how to read or because the label is in a foreign language (Rengum, 2006).

Precaution and Handling of Pesticides

Handling of concentrated pesticide formulation and application of diluted formulation requires use of appropriate personal protection equipment as a precaution

against pesticide exposure. This would include the use of gloves, masks, protective clothes, personal hygiene, appropriate footwear, head gear etc., as indicated in the respective pesticide labels (FAO, 1990).

Table 4 : Protective Measures During Pesticides Use

N-78

S.No.	Protective measures	Yes	No	Total
1	Did you take any personal protective precautions while using pesticides?	09 (12%)	69 (88%)	78 (100%)
2	Did you cocktail of different kinds of pesticides?	45 (58%)	33 (42%)	78 (100%)
3	Did you use scarf/mask during pesticide spraying?	23 (30%)	55 (70%)	78 (100%)
4	Did you use bare hands to mix pesticides?	21 (27%)	57 (73%)	78 (100%)
5	Did you use gloves while using pesticides?	02 (0.3%)	76 (97%)	78 (100%)
6	Did you chew tobacco /gutkha or smoke while spraying pesticides?	47 (60%)	31 (40%)	78 (100%)
7	Did you consume wine while spraying pesticides?	03 (0.4%)	75 (96%)	78 (100%)

Source : Field Survey, 2010.

The labourers in the study were not much keen to take necessary personal protective measures while handling pesticides. In all 88 per cent of agricultural labourers reported that they took no precaution while handling and spraying pesticides. Furthermore, 58 per cent of labourers prefer to make a cocktail of different kinds of pesticides before spraying. It was found that maximum amount of pesticides were sprayed on fruits, vegetables, leafy vegetables and vegetables grown in green house. Labourers used to mix different pesticides in a plastic or metal drum with water or sometimes they use pesticides later. Around 27 per cent labourers mix pesticide directly using bare hands and 70 per cent did not use scarf/mask during pesticide spraying. The condition is much worse especially regarding use of gloves by the agricultural labourers (i.e. only 3 per cent) during spraying and mixing of pesticides in the field, while some of them use plastic carry bags as an alternative to gloves. It is pertinent to note that due to bad smell, eye irritation, throat infection and many other reasons majority of the labourers (60 per cent) chewed either tobacco/gutkha or smoke while spraying.[6-7] However, very few (4 per cent) labourers expressed the fact that they consume country liquor/wine during spraying to avoid adverse effects of pesticides.[8] Alcoholism is not only a serious health problem

but also one of the emerging social problems in agrarian society. It has been observed that this process further aggravates various social problems such as child abuse, violence against women, indebtedness and family disruption etc. The findings of other studies done in developing countries also support this observation (London, et al., 1998; Julaine, 2007; Wang, et al., 2010).

Pesticides and Health Impacts

The signs and symptoms related to pesticide exposure were included in the interview schedule. The labourers who are actually involved in pesticide using were asked whether they experienced these signs and symptoms during or immediately after pesticide spraying days and non-spraying days. These symptoms and signs were reported by a large number of labourers.

Skin problems are the most common health problem linked to pesticide use in Shirol region, itching (97.43 per cent), eye-irritation

Table 5 : Signs and Symptoms Among the Study Population

N-78

S.No.	Signs and symptoms	Pesticide during applying day	Pesticide during non-applying days	Total
1	Eye irritation	64 (82.05%)	14(17.94%)	78 (100%)
2	Nausea	50 (64.10%)	28 (35.89%)	78 (100%)
3	Giddiness	41 (52.56%)	37 (47.43%)	78 (100%)
4	Breathing problems	55 (70.51%)	23 (29.48%)	78 (100%)
5	Fever	28 (35.89%)	55 (70.51%)	78 (100%)
6	Vomiting/ dehydration	31 (39.74%)	47 (60.25%)	78 (100%)
7	Cramps	24 (30.76%)	54 (69.24%)	78 (100%)
8	Itching	76 (97.43%)	24 (30.76%)	78 (100%)
9	Convulsions	12 (15.38%)	66 (84.61%)	78 (100%)
10	Burning sensation	10 (12.82%)	68 (87.17%)	78 (100%)
11	Hives	58 (74.35%)	20 (25.64%)	78 (100%)
12	Diarrhoea	10 (12.82%)	68 (87.17%)	78 (100%)
13	Tremor	09 (11.53%)	69 (88.46%)	78 (100%)

Source : Field Survey, 2010.

(82.05 per cent), and vision problems were also very common among the respondents. These are regarded as minor ailments and are often managed by the labourers themselves using home remedies or traditional ayurvedic/ hakim treatment. A number of more severe

symptoms are also reported, for which agricultural labourers either go to a doctor or hospital. These include breathing problems (70.51 per cent), dehydration/ vomiting (39.74 per cent), cramps and diarrhoea (43.58 per cent). There were nine cases of hospitalisation among the 62 cases of sickness reported in the survey. It was found that agricultural labourers are relatively free from illness during non-pesticide applying days. However, during the informal interview it was observed that among men there is a higher frequency of signs and symptoms, but some of the female labourers were also facing stomach problems sometimes during or after spraying.

This is also important in the context that females are major part of a family and when a woman gets sick or dies due to sickness, the family is left behind in crisis and chances of social disintegration increase.[9]

Policy Implications and Conclusions

Present study found that illiteracy, poverty, capitalistic relationship of production, lack of awareness and training often force agricultural labourers to use heavy doses of pesticides in agriculture. It was also found that labourers are not only using pesticides for agricultural purposes but for suicides too. According to government data, over 5,000 farmers committed suicide in 2005-2009 in Maharashtra, while 1,313 cases were reported by Andhra Pradesh between 2005 and 2007. The situation is more or less same in other parts of India (Crime Records, 2007). Due to the easiness, and quick availability, farmers and farm workers prefer to consume pesticide for suicide. There were five cases of suicides in the study region in the last three years.

However, use of pesticide in agriculture is more harmful for women. Agricultural women labourers in our study reported that they continue to work while pesticides are being sprayed. This exposure to pesticides could cause a variety of reproductive health problems in women of reproductive age group. This unexpected, though "direct" exposure to pesticides due to their proximity to source of exposure needs to be studied further. This aspect of women being prone to various ways of exposure to pesticides has been highlighted in the study done among the cotton growers of India by Maxicni, et al. 2005.The study therefore, recommends that the quantity of pesticide be used as per the recommended dosage. This can be achieved either through restricting the quantity of formulation or by increasing the dilution of the spray fluid by using water at recommended volumes. Less than 5 per cent of the applicators know the toxicity levels of the pesticides they use. Thus, there is ample scope for reducing pesticide exposure through training. A participatory extension strategy focusing on this aspect alone would result in an improvement in the health of pesticide applicators. Support could be provided by subsidising the supply of protective gear, and by setting up general awareness-creation programmes.

Policy Implications

On the basis of the present study and discussions with agricultural scientists, doctors and comments received from agricultural community, the following suggestions have been made to reduce pesticide induced health problems.

1) Strengthening Existing Regulatory Mechanism : It includes the Insecticide Act 1964. To incorporate ADI (Acceptable Daily Intake) in addition to MRL (Maximum Residue Limit), strengthening the registering and re-registering procedures for agrochemical manufacturers. Modifying the existing laws including deterrent punishment of violation, as the exposure leads to death or damage to innocent people. In this context Dr. M.S. Swaminathan appeals for effective legislations and laws for agrochemicals with special reference to sale of spurious chemicals (Jayraj, 2007).

2) Support and Sensitisation on Biopesticides : A wide range of biopesticides and natural agrochemicals are available in Indian market. Encourage the research and extension of natural agrochemicals.

3) Establish Single Independent Nodal Agency : It includes adequate testing laboratories, which follows the guidelines of USEPA (United States Environment Protection Agency) for technical evaluation, enforcement, licensing of all chemical use in agriculture / public health / allied sectors.

4) Strict Regulations on Pesticides : Banning of Class I (a) agrochemicals like arsenic acid, arsenic pentaoxide, chromic acid and complete phase out of pesticides especially I (b) category, which has carcinogenic impacts over human health.

5) Health Monitoring : Health monitoring is very sporadic and almost non-existent in least developed countries. They have no resources or sometimes the capacity to undertake systematic monitoring of pesticides and even to enforce regulations. Hence it is recommended that frequent health monitoring of agricultural labourers, mainly women, will be conducted by local Primary Health Centres with the help of local NGOs/ SHGs and Medical Colleges.

6) Mobile Health Van : Due to poverty, remote area and non-availability of transport facilities, agricultural labourers often neglect to visit health centres.Therefore, mobile health van will be helpful to minimise the existing gap.

7) Use of Low Profile Channels : Compared to big media channels like TV and cinema, community media channels such as community radio, local newspapers, magazines, video and traditional folk media channels can be effective to disseminate desired developmental messages and create awareness among rural masses. These channels are easy, cheap, and mobile and most importantly they use local language and deal with local problems.

8) Ecological Agriculture Movement : This movement looks at agriculture as a holistic system, where other key concerns besides yield increases are considered in making decisions about development. Most emphasis is placed on food sovereignty and security in a framework encompassing production, environment, women's participation and democracy. Such ecological agriculture systems tend to learn from, and build on, traditional farming using local farmers' tools and technology. Today 200,000 farmers in Bangladesh are practising ecological agriculture within the *Nayakrishi Andolan* (New Agricultural) movement. More than 20,000 farmers in India are practising low external input agriculture without the use of pesticides, while in one NGO programme in Indonesia; more than 10,000 farmers have been reducing pesticide use by 60-80 per cent through community integrated pest management (Jayraj, 2007).

Notes

1 Pesticide use is high in regions with good irrigation facilities and in areas where commercial crops are grown (Shetty, 2004). Karnataka, Andhra Pradesh, Maharashtra and Punjab account for 38.14 per cent of the total amount of pesticides used in the country (Agnihotri, 2000).

2 The World Trade Agreement of 1994 brought agriculture for the first time in world trade history within its policy framework. The four major elements of the World Trade Agreement in the field of agriculture are: Market access, Domestic support, Export subsidies, Trade-Related Intellectual Property Rights. Under WTO: relaxation of quantitative restrictions

non-tariff/phyto/sanitary by importing countries will expose Indian farmers to world market prices. This view feels that the Indian farmer will be jolted out of their "reverie" under the shadow of the protective cocoon of Government Support (Barua, 1999).

3 The workers have been classified by the type of economic activity into nine broad categories as per National Industrial Classification, 1998. The dependence on agriculture (2001) is brought out by the fact that of the 313 million main workers in the country, 166 million (56.6 per cent) have been engaged in 'Agricultural and allied activities' (13.4 per cent). (http://censusindia.gov.in/Census_And_You/economic_activity.aspx).

4 Food and Agriculture Organisation recommends that WHO Ia (extremely hazardous) and Ib (Highly hazardous) pesticides should not be used in developing countries. It also suggests that class II (Moderately hazardous) pesticides be avoided. But the practice of spraying these "powerful" pesticides continues. Preliminary results of environmental sampling tests done in the study area support this statement. Large chemical industries reinforce the myth by adopting aggressive marketing strategies that more potent pesticides are necessary to prevent crop loss. This scenario has been reported from other countries also (Grace, et al., 2007:8).

5 The pesticide residues in food in India, especially vegetables, are the highest in the world. Chemical pesticide residues have often been detected in foodgrains, vegetables, fruits, oils, cattle feed and fodder in most parts of the country. About 72 per cent of food samples in India have shown the presence of pesticide residues within tolerance levels while in 28 per cent of samples they are above the tolerance level. As a consequence, India accounts for one-third of all pesticide poisoning cases in the world (Indira Devi, 2007).

6 The practice of chewing or smoking while spraying "to reduce the nauseating feeling" is also hazardous to health. This may also indicate that the farmers were symptomatic enough to self-medicate during a pesticide spraying session. But many are unwilling to follow the necessary precautions attributing non-availability and high cost of personal protection products, and the prevailing hot and humid weather conditions.

7 Gutka (also spelled gutkha, guttkha, guthka) is a preparation of crushed betel nut, tobacco, catechu, lime and sweet or savory flavorings, it is considered responsible for oral cancer and other severe negative health effects. In 2008, about 5 million children under 15 are addicted to gutkha. A survey in Uttar Pradesh and Madhya Pradesh yielded precursor of mouth cancers in 16 per cent of the children. (http://timesofindia.indiatimes.com/Lucknow/Kids_getting_addicted_to_tobacco/articleshow/2706674.cms).

8 Country liquor is a distilled alcoholic beverage made from locally available cheap raw material such as sugarcane, rice, palm, coconut and cheap grains, with alcohol content between 25 and 45 per cent. Common varieties of country liquor are arrack (from paddy or wheat), desi sharab and tari. In many parts of India, illicit production of liquor and its marketing is a cottage industry with each village having one or two units operating illegally (Mohan, 2001).

9 A recent study has found that women with potential exposure to pesticides at work or at home took longer to get pregnant than women without pesticide connections. The study, conducted by researchers at the University of California, Berkeley, found that women, who worked in agriculture, lived within 200 feet of agriculture fields or used pesticides in their home took significantly longer to conceive when compared to those that did not. The effect that pesticides may have on fertility raises considerable concern, especially among women with significant exposure. While a number of studies have been conducted on pesticides and sperm quality, less is known about the possible effects on female fertility (Harley, 2008).

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