Environment and Ecology 40 (3D) : 1873—1879, July—September 2022
ISSN 0970-0420

Villager's Perception about the Impact of Chemical Pesticides on the Environment

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Received 15 May 2022, Accepted 28 June 2022, Published on 17 September 2022

ABSTRACT

The green revolution is a milestone associated with the development of independent India in terms of food grain production. This self-sufficiency in food grain production was achieved through using high-yielding crop varieties. These high-yielding varieties are highly responsive to chemical fertilizers and some extent amenable to pests and diseases. The objective of the study is to find out the level of adoption of modernized agricultural technologies with particular reference to pesticides, to collect the information regarding farmers' knowhow about the application of chemical pesticides; and to study the effects of these inputs on the health of human beings as a whole. The study was carried out in two different highly vegetable growing villages i.e. Ghoragacha and Bhawanipur in the Nadia district of West Bengal, India. Data has been collected by personal interview methods. In both the villages, the majority of the farmers are in the middle age group (36-45 years) and have education from middle to high school, most of the respondents have marginal landholding (<1 ha) and are vegetable cultivators, and vegetable cultivation is followed by cereals and fruit crops. Villagers' decision-making behavior, source of information for timely application of pesticides, and use of appropriate pesticides were mainly obtained from agri-input dealers. The majority of the respondents were unaware of health hazards associated with pesticides (at the time of spraying, storage of pesticides and disposal of pesticide containers). Lack of knowledge coupled with the traditional method of pesticide use was considered the main reason behind this malpractice. The major crop like tomato, brinjal, chili, cabbage, cauliflower and potato is cultivated in the *rabi* season, pumpkin, okra, cucumber and sesame are cultivated in the pre-*kharif* season in two villages. Thus pesticides are indispensable to attain our targeted food production standards if used judiciously and appropriately.

Keywords Pesticides, Pesticide effect on environment, Environmental impact indicators, Toxicity.

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INTRODUCTION

A chemical pesticide is known to have played a significant role in the improvement of crop yields all over the World during the last four to five decades. Insect pests are a major source of crop damage and yield reduction. Jassid, whitefly, thrips, bollworms,

aphids, and spider mites are posing a serious threat to several high-value cash crops. About 70 % of insect pests are reported to attack paddy crops and cause 20-25% losses on a recurrent basis. Insects, in many instances, practically reduced the food availability by over 50%. To overcome the insect pest problems pesticides worth more than a billion rupees are imported every year in India. Despite all these, pest problems still exist, and even the enormous increase in pesticide composition has not led necessarily to an increase in the yields of crops (Gibbs *et al*. 2009). However, as a result of excessive, unplanned and indiscriminate use of pesticides use and their mishandling; many other problems such as pesticides residues in the agro-ecosystem, development of insect resistance to pesticides and resurgence of target pests, an outbreak of secondary pests, destruction of bio-control agents, environmental pollution (soil, water, air), accumulation of pesticides in the food chain, health-related issues such as human and domestic animal poisoning; damage of wildlife and loss of biodiversity have emerged severely (Parsons 2009). Their indiscriminate use is also showing signs of several serious human ailments, the most common being cancer, liver diseases, and hypertension. Boatman *et al*. (2007) stated that agricultural pesticides could reduce the abundance of weeds and insects, which are important food sources for many species. Donald *et al*. (2002) in their study reveal that in Europe, the population decline among farmland birds was far greater in countries with more intensive agriculture, and in a statistical analysis 'cereal yield' explained over 30% of the trend in population change. Bandyopadhyay *et al*. (2000) stated that farmers broadly used plant protection chemicals. They apply either below normal or normal doses but hardly resort to overdoses. Larson *et al*. (2010) reported that pesticide residues recently pose a great threat to biological communities, including humans. Aubertot and Barbier (2005) discussed that advances in plant protection have contributed considerably to increasing yields and ensuring regular production. However, today, the systematic use of pesticides is being called into question, with the increasing awareness of their negative impacts, the demonstration of undesirable adverse effects on ecosystems, on non-targeted useful or domestic species, and on human health (FAO, 2017). Keeping all these thoughts in the background, assessing the impact of chemical pesticides, on the water, soil and air vis-à-vis human beings and local biodiversity, in brief, the environment as a whole. The objective of the present study is to find out the level of adoption of modernized agricultural technologies with particular reference to pesticides, to collect the information regarding farmers' knowhow about the application of chemical pesticides and to study the effects of these inputs on the health of human beings as a whole.

MATERIALS AND METHODS

The study was conducted in Ghoragacha village of Chakdah Block and Bhabanipur village of Haringhata Block under the Nadia district of West Bengal. Indiscriminate use of chemical pesticides is rampant in the study area over the years and adoption of proper, judicious agricultural practices are lacking for a long time. All these things are detrimental to the overall ecosystem. As the area was ideal concerning the problem and convenient for the researcher, purposive, as well as simple random sampling techniques were adopted for the study. The district, blocks, panchayats, and villages were selected purposively, and the respondents were selected by simple random sampling without replacement (SRSWOR). From both the selected villages, 100 respondent farmers from each of the villages' i.e. 200 respondents in total were selected for the generation of data in two consecutive years. Data were collected personally from the respondents with the help of a structured interview scheduled. The first part dealt with the background information of the respondent, i.e. his name, age, and religion. It was followed by the socio-economic status scale by Pareek and Trivedi (1965) and the question of exposure to mass media communication of the farmers. Different measures of validity were also reported by them (Pareek and Trivedi 1964). The components are caste, occupation, education, land, house, farm power, material possession, family size, family type and mass-media exposure. Some open-ended questions were asked to the farmers to collect information related to the topic to justify the objectives. The questions were mainly linked to the crops: Their varieties, seed rate, spacing, irrigation, used fertilizers, proper plant protection chemicals, and their dosages and sources of different agricultural inputs and others. Some other questions associated

with environmental issues regarding flora and fauna were also interrogated. Statistical techniques and tools used in the present study are frequency, percentage, mean and standard deviation.

RESULTS AND DISCUSSION

This chapter deals with the result derived by statistical analysis after the interpretation of raw field data and discussion of each result in a systematic manner. From the results, it was found that in both the villages majority of the farmers are in the middle age group (36-45 yrs), based on caste are schedule caste; the pattern of occupation is cultivation; educational qualification middle to high school. Cultivators have marginal landholding (<1 ha) and have two rooms for their house type; maximum has no farm animal. The majority have a TV, cycle, motorcycle, radio and wristwatch. The majority of them have a reading habit of the newspaper. The pointed gourd is the most dominated crop in the pre-*kharif* season sharing 42% and 46% in Ghoragacha and Bhawanipur villages respectively; tomato, brinjal, chili, cabbage, cauliflower and potato are the major crops cultivated in *rabi* season in two villages; Pumpkin, Okra, Cucumber, Sesame are the primary summer season crops cultivated in two villages. Rice is the main crop cultivated in the *kharif* season along with jute and onion in two villages. In both villages, farmers used an excessive amount of nitrogenous fertilizers above the recommended dose (Mohiuddin *et al*. 2011).

Table 1 shows that the crop cultivation pattern of both the villages is an important criterion to determine the agricultural practices of those villages. In the case of Ghoragacha village, the ratio of distributions of the agronomic crop, vegetables, and fruits has followed the ratio 30:59:11 or 3:5.9:1.1 ratios. It indicates the domination of vegetable crops as farm enterprises over field crops or fruits. In the case of the other village, Bhabanipur the ratio runs as follows11:75:14 or 1.1:7.5:1.4 ratios. This indicates the more dominating role of vegetables over the other two crop enterprises. In our study area, multi-tier cropping (i.e. guava – brinjal – pointed gourd) was also prevalent. It is considered that vegetables are important crops and share a good amount of vitamins and necessary minerals in regular diets. Bangladesh the neighboring country, just 55 KM away from the study area, offers a huge similarity in agriculture, climate, language, and culture but remains internationally divided by a narrow fence only. The change and ripples of agriculture are homogenously shared amongst and between the farmers and living agro-ecosystems. Generally, vegetables grown in Bangladesh turn vulnerable to damage by insect pests. The role of pesticide use in Bangladesh has become decisively important in boosting productivity and making agriculture an intensive practice. If we think of modern agriculture today, it comprises chemical fertilizers, new generation pesticides and new varieties along with proper irrigation scheduling. But these techniques in modern agriculture are in turn, to some extent amenable to pests and diseases. In a vast area in the new alluvial zone in West Bengal, mostly some part of Nadia district intensive cultivation had been generating a crucial role of agri-chemicals towards high commercialization of agriculture. Mostly older farmers are traditional and not aware of the indiscriminate use of pesticides (Jallow *et al*. 2017). The respondent's decision-making regarding the selection of time in case of pesticide application is an important criterion to determine the accuracy of the timely application of pesticide (Table 2). In the case of Ghoragacha village, 66 % rely on an agri-input distributor, 8%

Table 1. Percentage distribution of respondents of the two villages on crop cultivation pattern.

Crops	Village	
	Ghoragacha (Percentage)	Bhabanipur (Percentage)
Agronomic	30	11
Vegetables	59	75
Fruits/Orchards	11	14

Table 2. Percentage distribution of respondents of the two villages on the basis of decision making regarding timely application of pesticides.

Decision making	Village	
	Ghoragacha (Percentage)	Bhabanipur (Percentage)
Economic threshold level	8	6
Agri-input distributor	66	60
KVK Scientist/agri-professionals recommended	4	8
Others	22	26

Table 3. Percentage distribution of respondents of the two villages on the basis of source of information regarding pesticide application.

Source of information	Village	
	Ghoragacha (Percentage)	Bhabanipur (Percentage)
Own experience	10	6
Other farmers practices	44	38
Agri-input dealer recommended	46	56
Other sources	0	0

are judged by the economic threshold level of a crop, 4% by KVK scientists and the rest 22% by others' recommendation. Whereas in the case of Bhabanipur village most of the respondents (60%) rely on an agri-input distributor, 6% judged by the economic threshold level of a crop, 8 % by KVK scientists and the rest 26% by others' recommendation. Therefore, a substantial influence is seen in respondents of both of the villages by the agri-input distributor in case of timely application of pesticides.

The source of information regarding pesticide application is an important criterion to determine the reliable sources used by the respondents and their preferability towards acceptance (Table 3). In the case of Ghoragacha village 46% rely on agri-input dealer recommendation, other farmers' practices come next just after agri-input dealer with a share of 44%, rest 10%t use their own experience as a source of information regarding pesticide application. Whereas in the case of Bhabanipur village 56% relies on agri-input dealer recommendation, other farmers practices come next just after agri-input dealer with a share of 38% but show a significant difference than Ghoragacha, rest only 6% significantly uses their own experience as a source of information regarding pesticide application. Table 4 shows that the selection of appropriate pesticides is an important criterion to determine the effective and judicious use of pesticides by respondents either crop-specific or/ farming situation-specific. In the case of Ghoragacha village based on the selection of appropriate pesticide, 56% rely on agri-input dealer recommendation; own perception of the respondent comes next just after agri-input dealer with a share of 28%, rest 16% uses other farmers' practices for the selection of appropriate pesticides. Whereas in the case of Bhabanipur village 60% relies on agri-input

Table 4. Percentage distribution of respondents of the two villages on the basis of appropriate selection of pesticides by the respondents.

Selection of pesticide	Village	
	Ghoragacha (Percentage)	Bhabanipur (Percentage)
Own perception	28	24
Help of KVK Scientist/ Agricultural professionals	0	2
Agri-input dealer recommendation	56	60
Other farmers practices	16	14
Others	0	0

dealer recommendation, the own perception of the respondent comes next just after agri-input dealer with a share of 24%, rest 14% uses other farmers' practices for the selection of appropriate pesticides. Therefore, in the case of selecting appropriate pesticides, farmers at large mass depend on the agri-input dealer (Damalas and Hashemi, 2010). In both Ghoragachha and Bhabanipur both of the villages respectively 29% and 32%, of respondents possess knowledge about Integrated Pest Management (IPM), and the rest 71% and 68% do not know IPM (Table 5). It indicates that in both the villages, the majority of the farmers were not aware of the Integrated Pest Management techniques; they are using insecticides non-judiciously which causes environmental pollution. Therefore, a significant influence of agri-input dealers over the own experience of respondents and other farmers' practices is seen (Mohiuddin *et al*. 2009). Input dealers here play a pivotal role in modernizing and commercializing agriculture, as well as opinion leaders. That's why their role and contribution have been so apparent. Table 6 is devoted to assessing the degree of use of a proper dose of PPC by the sample farmers. It is noted that in Ghoragacha village 32% of farmers use recommended dose but 60% use more than the recommended dose and in the

Table 5. Percentage distribution of respondents of the two villages on the basis of their knowledge about integrated pest management (IPM).

Knowledge about IPM	Village	
	Ghoragacha (%)	Bhabanipur (%)
Yes	29	32
No	71	68

Table 6. Percentage distribution of respondents of the two villages on the basis of proper doses of plant protection chemicals.

Dose of PPC	Village	
	Ghoragacha (%)	Bhabanipur (%)
Less than normal	8	0
Normal	32	36
More than normal	60	64

Bhabanipur village 36% of farmers use recommended dose and 64% use more than the recommended dose. A few percentages (8%) in the case of Ghoragacha and none in the case of Bhabanipur use lower doses than the recommended dose. Indiscriminate use and application of improper doses are mainly due to wrong advice gathered from unauthorized sources. They get advice from the PPC dealer/retail shop. The present superfluous uses of insecticides or pesticides are causing different consequences like the development of resistance power in pests, and the killing of natural enemies. It is observed from (Table 7) that the hindrances in the socialization of Integrated Pest Management are an important criterion to determine the respondent's perception of the use of pesticides or non-IPM methods (Damalas and Eleftherohorinos 2011). Most of the respondents in Ghoragacha and Bhabanipur rely on traditional beliefs about pesticides with 84% and 78% respectively. Just next to traditional belief comes enhancing productivity with 70% in Ghoragacha and 74% in Bhabanipur.

Table 7. Percentage distribution of respondents of the two villages on the basis of hindrance in adoption of Integrated Pest Management (IPM).

Hindrance in adoption of IPM	Village	
	Ghoragacha (%)	Bhabanipur (%)
Traditional belief on pesticide	84	78
Enhancing productivity (rupee to rupee concept)	70	74
Risk & Uncertainty	50	58
Primary stage potential yield reduction by massive pest attack	44	42
Low acceptability of final products	42	46
Lack of reliable applicable source regarding IPM	34	38
Meteorological constraints in respondents farming situation	42	40
Poor no. of innovative category, in case of IPM adoption in local area	72	66

The general concept among respondents is to invest in crop protection chemicals as much as possible as it helps in increasing productivity and ultimately increases profit for respondents (Rupee to Rupee concept). The next major finding developed by the respondents is poor no. of innovative category, in the case of IPM adoption in the local area with a percentage of 72% in Ghoragacha and 66% in Bhabanipur. Next are some other factors like risk and uncertainty, low acceptability of final products, and meteorological constraints. Lastly, they are a lack of reliable sources regarding IPM in both villages with 34% in Ghoragacha and 38% in Bhabanipur (Hussain *et al*. 2009). It is evident from (Table 8) that most of the respondents in both villages are suffering from either vomiting (58% or 66%), excessive salivation occurs (56%, 60% of respondents) from Ghoragacha and Bhabanipur villages. Nausea comes next vomiting and excessive salivation with a relative frequency of 32% in Ghoragacha and 24% in Bhabanipur. Headache and Laziness symptoms are present in the case of Ghoragacha 26% and 24% and Bhabanipur 24% and 30% of respondents respectively. Lastly, there are some symptoms or health hazards associated with spraying are blurred vision with a 4% relative frequency only in Ghoragacha, and disturbance in consciousness is also with a relative frequency of 10% and 6% in respective villages (Atreya *et al*. 2012). Indiscriminate use and application of improper doses of pesticides along with various non-judicious natures of respondents (like dozes application, noncompliance with spray schedule, wrong time of application, not maintaining safe distances) at the time of spraying or storage or disposal of pesticides may be an important cause behind their symptoms.

Table 8. Percentage distribution of respondents of the two villages on the basis of health hazards associated after spraying application.

Health hazards	Village	
	Ghoragacha (%)	Bhabanipur (%)
Nausea	32	24
Vomiting	58	66
Excessive salivation	56	60
Headache	26	24
Blurred vision	4	0
Disturbances in consciousness	10	6
Laziness	24	30

Table 9. Distribution of respondents of the two villages on the basis of Pesticides/Fungicides used in different crops.

Village					
Ghoragacha			Bhabanipur		
Season	Crop	Pesticide/ Fungicides used	Season	Crop	Pesticide/ Fungicides used
Kharif	Rice	Chlorpyrifos, Cartap Hydrochloride	*Kharif*	Rice	Chlorpyrifos, Cartap Hydrochloride
	Jute (*Olitorious*)	Chlorpyrifos		Jute (*Olitorious*)	Chlorpyrifos
	Onion	Metalaxyl + Mancozeb		Sesame	Dimethoate, Triazophos
Pre *kharif*	Pointed Gourd	Azoxystorbin, COC		Pointed Gourd	Azoxystorbin, Carbenzime+ mancozeb
	Okra	Cypermethrin		Okra	Cypermethrin
	Blackgram	Carbendazim , Acephate		Blackgram	Carbendazim, Acephate
	Maize	Imidachloprid, Metalaxyl + Mancozeb		Maize	Imidachloprid
Rabi	Mustard	Metalaxyl- mancozeb, Dimethoate	Rabi	Mustard	Metalaxyl- mancozeb, Dimethoate
	Cauliflower	Acephate, Carbendazim		Groundnut	Imidachlorprid, Triazophos
	Chilli	Imidachlorprid		Cabbage	Trifloxystrobin, Tebuconazole
	Brinjal	Carbendazim + Mancozeb		Brinjal	Carbendazim + Mancozeb
	Tomato	Metalaxyl- mancozeb, Cypermethrin		Capsicum	Carbendazim
	Potato	Metalaxyl- mancozeb, Cymoxanil-mancozeb		Potato	Metalaxyl- mancozeb, Cymoxanil-mancozeb
Orchard	Mango	Mancozeb, Acetamiprid	Orchard	Banana	Aldrin
Crops	Banana	Aldrin	Crops	Guava	Triazophos, Carbendazim
	Guava	Triazophos, Carbendazim			

Their knowledge, perception of unconsciousness, and reluctance regarding general precaution, storage, or disposal of pesticides are important factors that help to determine the relationship between their unscientific and improper application of pesticides and the frequency of associated health hazards. Pesticides used in different crops the farmers from both villages used many pesticides to protect their crops from different insect pests (Table 9). Amongst the different pesticides, organophosphate compounds are the most popular in both villages. Farmers generally used Chlorpyriphos in rice and jute. During the *rabi* season, farmers used several systemic and contact fungicides to protect their crops from fungal attacks (Maxwell-Lefroy 2009). The most popular fungicide used in the villages is carbendazim, mancozeb, metalaxyl, dimethoate. The arsenic problem is one of the significant threats to the locality as perceived by the farmers. Crop damage from pest infestations often results in such severe consequences that it necessitates applying pesticides. However, despite their benefits, pesticides pose potential hazards to human health and the environment when inappropriately handled.

CONCLUSION

With the ever-growing population, increased production of food grains is a must. It is a well-known fact that pesticide use cannot be stopped overnight. However, till the time pesticides are being used, good stewardship practices can help to reduce their harmful implications for health and the environment. Good practice begins at the point of analyzing the pest problem and identifying the right approach for the problem. In many cases, chemical pesticides are a favored option, but consideration should be given to alternative strategies. If pesticide use is unavoidable, it is also essential that the end-users should be well trained in safe use practices (Pesticide Action Network the Asia and the Pacific by Mourin (1998). The gap between total yield and actual yield can be bridged by the judicious, timely agrochemicals with proper training knowledge, label specifications, and application guidelines of the Department and manufacturer. The use of insecticides over a long period has resulted in the development of cross-resistance in insect pests. When an insect develops resistance to a particular insecticide, it automatically becomes resistant to all the other insecticides having the same target or activity. Science helps to evolve new-fangled ideas and technologies however misuse; overuse and underuse can lead to negative consequences. Thus hue and cry about pesticide pollution can be abated through proper training and technological know-

how transfer between end-user and manufacturer. More pollution in the environment can be attributed to emissions from industries and automobiles than pesticides alone. Thus pesticides are indispensable to attain our targeted food production standards if used judiciously and appropriately. Defective spraying and over-dosages coupled with the spraying of spurious insecticides have also aggravated the problem of pest resistance. To overcome this problem, farmers apply more than the optimum dose and also resort to unscientific combinations of pesticides. Sequential application of pesticides from different chemical groups and also adoption integrated pest management (IPM) practices are some viable techniques for managing the problem of resistance.

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