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Assessment of Farmers on Their Knowledge of Pesticide Use, Biosafety and Occupational Health Hazards in Bangladesh

[1]Tasnova Tasin, [2]Minara Hafiza Ferdous, [2]Mahmudunnabi Mithu and [3]Mohibul Hasan

[1]Department of Agriculture, Noakhali Science and Technology University,
Noakhali-3814, Bangladesh
[2]Department of Fisheries, Matshya Bhaban, Ramna, Dhaka-1000, Bangladesh
[3]Department of Fisheries Management,
Bangladesh Agriculture University Mymensingh-2202, Bangladesh

Abstract: The use of pesticides to protect various crops has increased last few decades and indiscriminate application is quite common in Bangladesh. The objectives of the current study were to know the knowledge, attitude and occupational hazards posed by the application of pesticides in Bangladesh. The survey was conducted in Gafargaon (Mymensingh district) and Bagherpara Upazila (Jessore district) in Bangladesh. Data were collected using a cluster sampling technique by conducting face-to-face interviews. The most commonly used pesticide was found Virtako 40 WG (Thiamethoxam +Chlorantraniliprole), used by 45% of the interviewed farmer, followed by ETI gold 40 WG, Carbotaf 5G, Darsban 20 EC, Amistar top, Nitro 505 EC, Trooper 75 WP, Vertimec, Kumulus DF, Asataf 75 SP. Most (58%) of the farmers owned that pesticides harm their health. However, farmers' knowledge regarding hazardous pesticide safety was insufficient. Over 89% of the farmers did not follow pesticide-labeled instructions and 95% of farmers used a towel to protect against the smell of pesticides. It was observed that full personal protective equipment (PPE) was completely absent. A large portion of the interviewed farmers described negative health symptoms after pesticide applications, including headaches (64%), skin irritation (51%), nausea (39%), dizziness (37%), stomach ache (31%), itchy eyes (29%), poor vision (11%) and shortness of breath (9%) (multiple responses were allowed from respondents). The majority (79%) of the farmers discard empty pesticide bottles in open agricultural fields, which could be harmful to the environment. Factors like education level, land ownership and training on safety significantly influence the knowledge level of farmers on the safe use of pesticides. Most of the farmers are reluctant to follow instructions from agricultural extension officers; they rely on other farmer's opinions. The effective training program is necessary for their safety as well as protect the environment from these hazardous compounds.

Key words: Pesticide Knowledge · Biosafety · Health Hazards · Environmental Pollution

INTRODUCTION

Pesticides are hazardous by designs that are manufactured to control pests that destroy crops [1]. These compounds are also used in public health activities to prevent vector-borne diseases and unwanted plants [1]. In a country like Bangladesh, applying pesticides has become inevitable in the agricultural sector to improve the current stage of harvest production [2, 3]. Bangladesh's climate as a subtropical [4] observes varying temperatures and humidity profiles throughout the year, which brings a vast array of harmful organisms to be tackled [5].

Agricultural pesticides are classified based on chemical classes, functional groups, mode of action and toxicity [6]. Active ingredients are either organic (complex and less water soluble) or inorganic (contain metal, e.g., copper). Organic pesticides are subdivided into two groups: natural and synthetic. Sometimes, pesticides are classified by the target of the pest for which they are applied, such as insecticide, herbicide, fungicide, rodenticide, etc.

However, unrevised exposure to pesticides can be highly hazardous to humans [6] and other non-target living organisms [7, 22] as they are designed to be

Corresponding Author: Mohibul Hasan, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Tel: +880183074804.

poisonous. Human exposure to pesticides is mainly through air, food [19, 20, 21, 23], flora and fauna [6]. After exposure, these hazardous compounds are distributed through the bloodstream and excreted through urine and skin. Exposure to pesticides in the human body can occur directly from occupational exposure in four typical ways dermal, oral, eye and respiratory. The previous study revealed that pesticide exposure is linked with various diseases, including cancer[8], hormone disruption, asthma [9], allergies and hypersensitivity. In addition, evidence also exists for the negative impacts of pesticide exposure leading to congenital disability; reduced birth weight, fetal death [10], leukemia [11], diabetes [12] and ' 'Parkinson's disease [13].

In developed countries, many studies have assessed farmers' level of knowledge about the safe use of pesticides [14, 15]; However, no scientific research on the subject has been conducted in Gafargaon (Mymensingh district) and Bagherpara Upazila (Jessore district) in Bangladesh. Therefore, the present study was carried out. It is expected that this study, through its research-based findings, will help examine the level of knowledge among farmers and identify the issues they face concerning the safe use of pesticides. In addition, the results of the study will help develop policy tools and farmer extension programs related to the safe use of pesticides that reduce health risks

MATERIALS AND METHODS

Questionnaire Development and Delivery: The study was conducted in the district of Mymensingh (Gafargaon Upazila) and Jessore (Bagherpara Upazila) in Bangladesh. This research work used a cluster sampling technique to obtain cross cross-sectional data. One village is selected randomly from the rural union and five members are interviewed from each village. The studies included 100 farmers who were interviewed to collect data for research purposes. A pre-designed questionnaire with the objective of the study comprised both open and close-ended questions. The questionnaires were reviewed by the Department of Agricultural extension officer. English questionnaires were translated into Bengali to avoid misunderstanding during the interview. The questionnaire was composed of two sections. The first section included questions related to basic information about the interviewee and farmer's knowledge, behavior and experience towards pesticides were included in the second part. After receiving feedback, further rectifications were done. In order to check reliability, Cronbach's alpha was calculated.

Data Analysis: Most of the data analysis were performed using RStudio (version 4) and SPSS (version 20). Data visualization package "'ggplot2' and "'agricole' for were used for creating graphics.

RESULTS

Profile of the Interviewee and Pesticides Used in Bangladesh: In this study, all farmers surveyed were men, as farming activities, especially those related to pesticide use, are performed exclusively by men in Bangladesh. The majority of the farmers (72%) interviewed were between 20 and 50 years old, with the average age being 33. A considerable number of the farmers 23.2% were illiterate and the rest of them was educated to a tertiary level.

However, commonly used pesticides are listed in Figure 1. A total of 12 active pesticide ingredients were found to be in use during the survey period (Fig. 1). About 75% (12 out of 9) of the agro-pesticides used belonged to the World Health Organization (WHO) toxicity class II (moderately hazardous), followed by toxicity class III slightly unsafe 25%, toxicity class IV non-toxic 8.3%, toxicity class U (unlikely to present acute hazard in regular use) 8.3% and a few (8.3%) under toxicity class Ib (highly hazardous) in Table 1. And insecticides were used by 95% of the farmers, followed by fungicides and herbicides.

Respondents' Knowledge, Attitude and Understanding of Pesticides: In Table 2 and Table 3, 'respondents' knowledge of pests and pesticides, including human health, their effects on the environment and their awareness of pesticides were analyzed. The majority (88%) of the farmers had not received any training for the safe handling of pesticides, while 12% were partially trained. Most of the farmers agreed that indiscriminate use of pesticides poses a risk to human health (58%), but they lack knowledge regarding non-target toxic effects. The majority (82%) of them strongly believe that pesticides are not harmful to other organisms. They also indicated that pesticides were inevitable for high crop yield (95%). On the other hand, 89% of the farmers did not follow instructions on pesticide labels because they were reluctant to read and understand the meaning of the labels. Some pesticides are banned due to high toxicity, but 56% of the respondents reported that those pesticides were forbidden because they were not adequate to control the pest. Moreover, different types of available pests were noted based on 'respondents' information in Table 3.

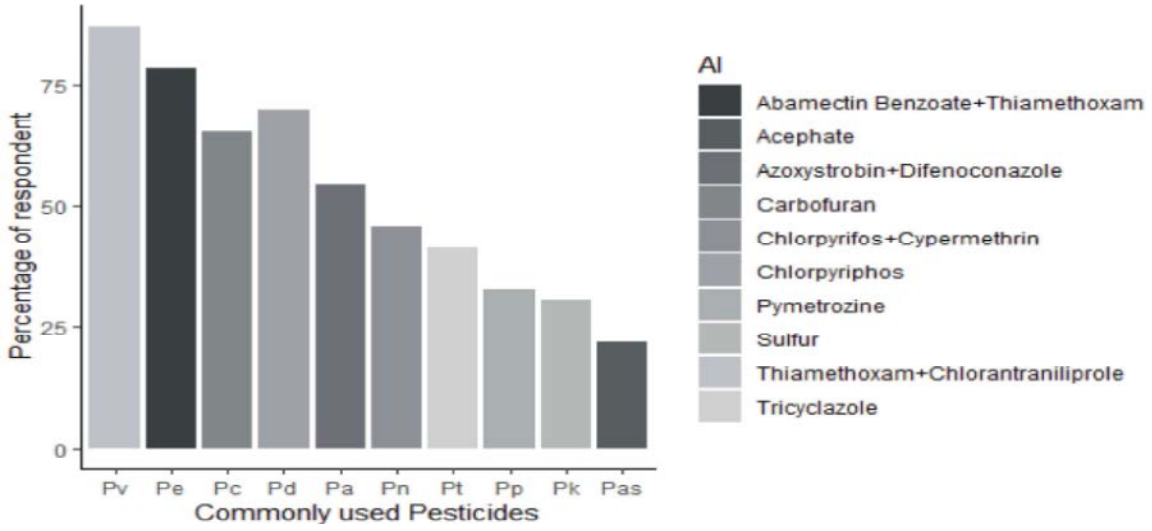

Fig. 1: Commonly used pesticides were Pv (Virtako 40 WG), Pe (ETI gold 40 WG), Pc (Carbotaf 5G), Pd (Darsban 20 EC), Pa (Amistar top), Pn (Nitro 505 EC), Pt (Trooper 75 WP), Pv (Vertimec), Pk (Kumulus DF), Pas (Asataf 75 SP) in Bangladesh

Table 1: Commonly used pesticides in Bangladesh (Gafargaon Upazila and), active ingredients (AI), hazard category (WHO 2009) and their use

Trade Name	AI	Hazard Category	Use Rate in Rice
Virtako 40 WG	Thiamethoxam +Chlorantraniliprole	Class III, Class IV	1.5 gm. in 10 Liter water for 5 decimal land
Tropper 75 WP	Tricyclazole	Class II	8 gm. in 10 Liter water for 5 decimal land
Darsban 20 EC	Chlorpyriphos	Class II	2 cap in 10 Liter water for 5 decimal land (1 cap = 10 ml)
Nitro 505 EC	Chlorpyrifos +Cypermethrin	Class II, Class II	1 cap in 10 Liter water for 5 decimal land
Carbotaf 5G	Carbofuran	Class Ib	200 gm. for 5 decimal land
Kumulus DF	Sulfur	Class III	50 gm. in 10 Liter water for 5 decimal land
Esataf 75 SP	Acephate	Class II	15 gm. in 10 Liter water for 5 decimal land
Cap 50 EC	Phenthoate	Class II	4 cap in 10 Liter water for 5 decimal land (1 cap = 5 ml)
Riva 2.5 EC	Lambda Cyhalothrin	Class II	1.5 cap in 10 Liter water for 5 decimal land (1 cap = 5 ml)
Contaf 5 EC	Hexaconazole	Class III	1 cap in 10 Liter water for 5 decimal land (1 cap = 5 ml)
ETI gold 40 WG	Emamectin benzoate + Thiamethoxam	n.f	1.5 gm. in 10 Liter water for 5 decimal land
Amistar top	Azoxystrobin +Difenoconazole	U, Class II	15 gm. in 10 Liter water for 5 decimal land

Ia = Extremely hazardous; Ib = Highly hazardous; II = Moderately hazardous; III = slightly hazardous; U = Unlikely to present acute hazard in normal use; FM = Fumigant, not classified; O = Obsolete as a pesticide, not classified, AI= Active ingredients

Occupational Health Hazards: The most frequently reported symptoms were headaches (64%), skin irritation (51%), nausea (39%), dizziness (37%), stomach ache (31%), itchy eyes (29%), poor vision (11%), shortness of breath (9%); multiple responses were allowed from respondents(Table 4). The majority of the respondents (90%) reported that they used to take self-medication to solve minor health problems. Health problems were categorized based on the different age groups of farmers. It was noticed that not only older farmers (50-80 years old) faced these types of problems but also younger farmers (20-35 years old) have similar health problems.

Farmer's Safety Practices Against Pesticides: During pesticide application, protective measures are and essential to reduce exposure to the pesticide. The majority (95%) of the farmers use a towel to protect against the pesticide smell (Table 5). Personal protecting equipment (PPE) is completely missing, whereas 5% of the respondent uses partial cover to protect themselves from pesticides. The majority of farmers (91%) reported that they avoid eating or drinking during pesticide spraying, whereas 57% informed that they sometimes smoke during spraying pesticides. Take showers and washing clothes are essential tasks for the farmer after spraying pesticides. A considerable number of respondents reported that 22% never take a shower after pesticide use in the field, whereas 41% of the farmer sometimes take a shower after spraying pesticide in the agricultural area.

Table 2: Farmer's knowledge, understanding and attitude toward pesticide use (n=100)

Question	Variable	n[a]	%
Do you think that agro-pesticides affect human health during work?	Strongly agree	26	26%
	Agree	58	58%
	Disagree	10	10%
	Strongly disagree	6	6%
Do you think that pesticides can affect non-target aquatic and terrestrial organisms?	Strongly agree	0	0%
	Agree	3	3%
	Disagree	15	15%
	Strongly disagree	82	82%
Do you think pesticides are inevitable for high crop yield?	Strongly agree	95	95%
	Agree	5	5%
	Disagree	0	0
	Strongly disagree	0	0
Do you read, understand and follow pesticide labels before applying in field?	Yes	11	11%
	No	89	89%
What you think, how do pesticides can enter the human body?	Dermal	56	56%
	Inhalation	9	9%
	Oral	7	7%
	Eye contact	2	2%
	'Don't know	26	26%
Do you know some pesticides are recently banned or restricted for use?	Yes	44	44%
	No	56	56%
What are the reasons for banning or restricting pesticides?	Highly toxic	2	2%
	Not effective	73	73%
	Expensive	1	1%
	Do not know	24	24%

a Multiple responses allowed

Table 3: Major pests in Bangladesh (according to farmers' knowledge)

Local Name	English Name	Scientific Name	Type of damage
Majra puka (in rice)	Yellow stem borer	*Scirpophaga incertulas*	Bore the sheath and tiller of the plant
Pamri Puka (in rice)	Rice hispa	*Dicladispa armigera*	Scrapping the upper surface of the leaf blade leaves only the lower epidermis as white streaks parallel to the midrib
Thrips (in rice)	Rice thrips	*Stenchaetothrips biformis* (Bagnall)	Damage the leaf, suck the sap of the leaf
Sobuj Ghasphoring (in rice)	Green leafhopper	*Nephotettix virescens* (Distant) *Nephotettix nigropictus* (Stal) *Nephotettix cincticeps* (Uhler)	Suck the leaf sap
Gandi puka (in rice)	Rice bug	*Leptocorisa oratorius* (Fabricius) *Leptocorisa chinensis* (Dallas)	Attack the grain of rice and form empty grain
Shiskata ledapuka (in rice)	Army worm	*Spodoptera mauritia*	Feed the leaves of paddy seedlings at a large scale
Dhaner patamuranu puka	Rice leaf folder	*Cnaphalocrocis medinalis*	They feed inside the folded leaf creating longitudinal white and transparent streaks on the blades
Cutworm of eggplant	Cutworm of eggplant	*Agrotis ipsilon* (Rottenburg)	Cut the base of eggplant seedlings at the bottom of their stem
Thrips of potato	Thrips of potato	*Caliothrips indicus*	They damage the undersides of leaves by scraping the epidermis and also damage young and soft part of plants
Fruit borer of tomato	Fruit borer of tomato	*Helicoverpa armigera* (Hubner)	The advanced-stage larvae bore circular holes and eat the inner contents. A single caterpillar may eat and destroy 2-8 fruits

Table 4: Health problems reported by farmers

Health problems	Number of the respondent (n[a])	Percentage (%)
Headaches	64	64
Skin irritation	51	51
Nausea	39	39
Dizziness	37	37
Stomach ache	31	31
Itchy eyes	29	29
Poor vision	11	11
Shortness of breath	9	9

a Multiple responses were allowed ; respondents were asked if, within the past years of the interview, they had experienced at least one health problem after handling pesticides.

Table 5: Farmers' safety practices in Bangladesh to prevent occupational pesticide exposure (n = 100).

Protective Equipment	Variable	n	%
	Full cover (PPE)	0	0
Use personal protective equipment (PPE)	Partial cover (gloves/mask)	5	5%
	Use a towel to protect smell	95	95%
	Always	0	0%
Eating/drinking while mixing or spraying	Sometimes	9	9%
	Never	91	91%
	Always	0	0%
Smoking while mixing or spraying pesticide	Sometimes	57	57%
	Never	43	43%
	Always	98	98%
Spray pesticide with the wind direction	Sometimes	2	2%
	Never	0	0
	Always	37	37%
Showering immediately after pesticide spray	Sometimes	41	41%
	Never	22	22%
	Always	2	2%
Wash work clothes immediately and separately	Sometimes	3	3%
	Never	95	95%

a Multiple responses allowed

Table 6: Farmers' practices on storage and disposal of pesticides (n = 100)

Question	Variable	n	%
Where do you store pesticides?	Refrigerator	0	0%
	In the open field	73	73%
	Chemical store room	4	4%
	Living area	23	23%
	Animal house		
What do you do with the unused leftover (mixed, diluted) pesticides?	Dispose of in the field	8	8%
	Mix only needed pesticides	68	68%
	Apply on other crops	21	21%
	Dispose of in the drain	3	3%
	Hazardous waste collection sites	0	0%
What do you do with old pesticide stocks?	Return to retailer	0	0%
	Hazardous waste collection sites	0	0%
	Dispose of in the field	22	22%
	Buy only the amount needed	78	78%
	Dispose of in the drain	0	0%
What do you do with empty pesticide containers?	Discard on-farm (field)	79	79%
	Place in trash	9	9%
	Hazardous waste collection sites	7	7%
	Reuse for other purposes	5	5%

a Multiple responses are allowed

DISCUSSION

Twelve active ingredients of pesticides were recorded after the interview. The majority of the respondent reported that 'virtako' (Thiamethoxam +Chlorantraniliprole) is a widely used insecticide compared to other pesticides available in the market. A similar study was conducted in another region (Noakhali) in Bangladesh and it was also found that "'virtako' is a commonly used pesticide for controlling pests [14].

To reduce occupational exposure, the use of appropriate personal protective equipment (PPE), showering after pesticide use and not smoking while handling pesticides are needed. Increasing the use of protective measures while working with pesticides can decrease the probability of poisoning, whereas lack of using PPE can increase health problems [16]. In this study, the majority (95%) of the farmers were reluctant to use any PPE, whereas only 5% of the respondent used masks/hand gloves (partially covered). Sometimes, 'farmer's like to smoke (57%) during spraying pesticides which could increase the danger of poisoning. However, there are some reasons not to use PPE, such as lack of education, weather and financial condition. Proper education and training can assist aware farmers in protecting themselves from these hazardous compounds.

Pesticides have short and long-term impacts on human health. In this study, the most common negative symptoms experienced by respondents after pesticide application were headaches (64%), skin irritation (51%), nausea (39%), dizziness (37%), stomach ache (31%), itchy eyes (29%), poor vision (11%), shortness of breath(9%). This could be explained by the fact that 95% of the interviewed farmers only used towels to cover their noses to prevent smell, whereas other equipment such as gloves, appropriate masks or glasses was rarely used. According to Miah *et al.* [17] some short-term diseases such as skin diseases, eye diseases, gastrointestinal diseases and urinary and reproduction impairments were reported among vegetable farmers in Bangladesh [17]. Another study was conducted among eleven districts in Bangladesh, including 821 farmers, which sowed health problems such as headache (27%), dizziness (8%), eye irritation (26%), skin disease (13%), vomiting (9%) and other multiple conditions [18, 14].

CONCLUSION

The adverse effects of pesticides during occupational exposure are widely discussed in this study. It is noticed that, awareness among farmers of protecting themselves from pesticides is still lacking. The finding of this research will warn policymakers in Bangladesh about the safe handling of this hazardous compound to protect ' 'farmers' health and the environment. In addition, highly hazardous pesticides should be restricted from selling.

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