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Use of Agro-Pesticides in Agriculture and Farmer's Perception Towards Risk from Pesticides in Noakhali, Bangladesh

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Abstract: The current study aimed to determine the use agro-pesticides and the occupational health hazards posed by the application of pesticides in Noakhali (Noakhali sadar and Subarnachar upazila). Bangladesh. Information of agro-pesticide use and farmer's awareness towards pesticides were collected through structured interview with 100 farmers held between August 2019 to February 2020. Most commonly reported pesticide was Virtako 40 WG (Thiomethoxam + Chlorantraniliprole) used by 35% of the interviewed farmers, followed by Sumithion 50 EC (Fenitrothion), Nitro 505 EC(Chlorpyrifos), Ripcord 10 EC (Cypermethrin), Diathon M 45 (Mancozeb) and Trooper 75 WP (Tricyclazole). However, 45% of interviewed farmers reported that, other farmers are primary source of information about pesticide use followed by dealers (35%) and agricultural extension officer (15%). It was also observed that, personal protective equipment (PPE) were absent. Farmers of Noakhali used partial cover 66% where 31% farmers reported no covering. In contrast, a large number of interviewed farmers after pesticide applications, suffer from health risks including Headache (38%), Skin problem (21%), Stomach ache (13%), Vomiting (11%), Weakness (7%), Unconsciousness (6%) and Eye problem (4%). In addition, 57% of farmers reported that empty bottle of pesticides are thrown in nearby area or water body. Farmers have knowledge about pesticide use to protect crops but they do not have enough knowledge to protect themself and ecology from side effects of this hazardous compound.

Key word: Agro-Pesticide · Health Problem · Personal Protective Equipment (PPE) · Environmental Pollution

INTRODUCTION

Pesticides are hazardous by design; they are manufactured with the unique aim of controlling insects, weeds, fungi and other pests that destroy crop [1]. They are biologically active compounds with component specific-inherent toxicity [2]. Prudent use of pesticides is considered by controlling agricultural pests in order to enhance adequate food supply for the increasing world population. In a country like Bangladesh, the application of pesticides has become inevitable to improve the existing stage of harvest production [3]. The climate of Bangladesh as being a subtropical, observes varying temperatures and humidity profile throughout the year, which brings a vast array of pests to be tackled. Therefore, to meet the demand, it is essential to apply pesticides to protect the crops during development [4]. Moreover, government of Bangladesh

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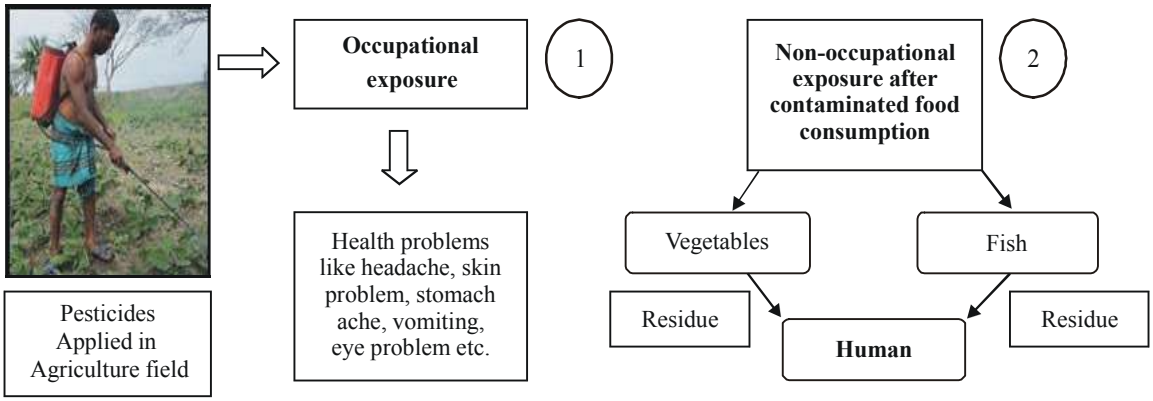

Fig. 1: A scheme showing that how pesticides transfer from agricultural land to aquatic system and exposure on Human during handling and consumption of pesticide contaminated foods.

also promotes the use of pesticides to expand its agricultural frontiers and increase output per acre of land. For this reason, pesticide use in general is increasing. In 2017, Bangladesh imported more than 15,106 tonnes of active ingredients to made 37,187 tonnes of pesticide products, almost 6 % rise in supply compared to last year [5]. In comparison to developed countries, people in Bangladesh are not concerned about harmful effects of pesticides during handling due to lack of toxicological knowledge [6].

Under chemical classification, pesticides are categorized based on chemical nature of the active ingredients. This kind of classification that gives the clue of the physical and chemical properties (Table 4) of the respective pesticides, the knowledge of which is very important in the mode of application, precautions that need to be taken during application. Based on chemical classification, organic pesticides are classified into four main groups called; organochlorines, organophosphorous, carbamates and pyrethrin and pyrethroids [6]. Organochlorines pesticides are organic compounds with five or more chlorine atoms. Organochlorines were the first synthetic organic pesticides to be used in agriculture. Some of the commonly used representative examples of organochlorine pesticides are DDT, lindane, endosulfan, aldrin, dieldrin and chlordane. Organophosphorous insecticides include parathion, malathion, diaznon and glyphosate. Carbamates are organic pesticides derived from carbamic acid and pyrethroids are synthetic analogues of the naturally occurring pyrethrins; a product of flowers from pyrethrum plant (*Chrysanthemum cinerariaefolium*). When pesticides are used in the agricultural field, it becomes distributed among four major compartments like soil water and biota [7]. And distribution processes in environment are sedimentation and volatilization.

However, pesticides are applied in agricultural field and then released into the aquatic food chain. These chemicals are distributed through rain water and dry particles (Fig. 1). Fishes are directly or indirectly impacted by pesticides. Some long-term exposures cause abnormalities or mutations in developing fish larvae, while acute exposure can cause immediate fish die-offs. The liver, kidney, brain and gills of exposed fish are extremely vulnerable to this toxic chemical exposure [7, 8]. In addition, aquatic zooplankton (eg. Daphnia) plays an extremely important part of aquatic food chains. They eat primary producers such as algae, yeast and bacteria. Researchers are still concerned with the relationship between the concentration of this harmful chemicals present in aquatic system and the potential effects after receiving aquatic organisms. In particular, infochemical interactions among phytoplankton, zooplankton, small invertebrates (bottom of food chain) and fish to pesticide exposure is still remain unknown. Therefore, it is necessary to evaluate the response of aquatic organisms to pesticides in community to understand the hazardous impacts of pesticides on aquatic ecosystem [9]. The toxic response of an organism to a chemical is measured in a number of ways including death, reduction in growth, reproductive inhibition, chemical and molecular changes and alteration in behavior.

On the contrary, pesticides are serious threats upon human health. In developing country like Bangladesh it is very difficult to find out the impact on human health due to lack of awareness, training and adequate knowledge

for using agrochemicals. Agrochemicals users in Bangladesh are vulnerable due to inadequate regulatory and preventive mechanisms. On the other hand, pesticide contaminated fish consumers are also affected. The current study aimed to determine the use of agro-pesticides and the occupational health hazards posed by the application of pesticides in Noakhali.

MATERIALS AND METHODS

Site Selection and Questionnaire Survey: This survey was conducted in sonapur, Maijdee (Noakhali sadar) and khaser hat (Subarnachar upazila) during August 2019 to February 2020. The farmers and dealers related to agriculture were the main source of data. Furthermore, agriculture officers, agro-based medical representatives and local people were considered as data source. Survey data were collected from all the respondents using pre-designed questionnaire with the objective of the study comprised both open and close ended question. The questionnaires were composed of two sections. The first section included questions related to basic information about interviewee. On the other hand second part included farmer's knowledge, behavior and experience towards pesticides. To ensure data collection, questionnaires were translated in Bengali (local language) and local dialects were used where necessary. One hundred questionnaires were surveyed from those selected arrears.

Fig. 2: Geographical location of study areas of greater Noakhali, Bangladesh (dae.gov.bd)

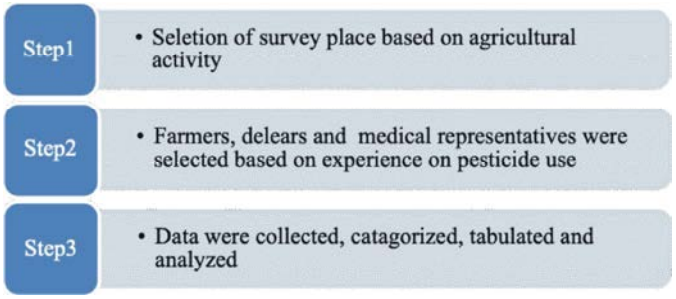

Fig. 3: Sampling scheme of the farmers for interview

Table 1: A questionnaire regarding farmer's background, knowledge and experience

Basic information
1. Name, gender, age, education
2. Number of family members, farm ownership and monthly income
3. Training experience, health condition, smoking habits
Farmer's knowledge and experience towards pesticides
1. Name of pesticides used in agriculture
2. Source and types of pesticides
3. Method of storing, preparing and spraying pesticide in field
4. Use of PPE during application
5. Precautions just after spraying pesticide in agriculture field
6. Discarding empty bottles
7. Health problems of using pesticides, visit health doctor
8. Ecological risk due to access use of pesticides
9. Positive use of pesticides

Data Analysis: The raw data from questionnaire survey were reviewed after interviews and data were analyzed using Microsoft Excel 2010.

RESULTS

In this study, a total of 100 farmer's from Noakhali Sadar and Subarnachar upazila were interviewed. Majorities of the individuals were male and belonging to the age group 40-50. Most of them were "semi-illiterate" having primary education with poor reading skill. According to their information, there are twelve pesticides which are commonly used in their agricultural activity (Table 2). Among them, 35% farmers reported that the commonly used pesticide was "Virtako 40 WG" (Thiomethoxam + Chlorantraniliprole) (Fig. 4). On the other hand, found percentages were 20, 15, 11, 10 and 9% followed by Sumithion 50 EC (Fenitrothion), Nitro 505 EC (Chlorpyrifos), Ripcord 10 EC (Cypermethrin), Diathon M 45 (Mancozeb) and Trooper 75 WP (Tricyclazole) respectively (Fig. 4). Moreover, 45% of interviewed farmers reported that, they collect information about pesticides use from dealers (35%), agricultural extension officer (15%) and label (5%). Personal protective equipment (PPE) are important for farmers to protect themself from these toxic chemicals but it was observed that farmers of Noakhali used fully PPE 3%, partial cover 66% and 31% farmers reported no covering (Table 3). On the other hand, a large number of interviewed farmers had health problems, including Headache (38%), Skin problem (21%), Stomach ache (13%), Vomiting (11%), Weakness (7%), Unconsciousness (6%) and Eye problem (4%) (Fig. 5). It was also noticed that, 57% of the farmers throw empty pots near agricultural area or water body, 38% farmer re-use used bottle and 5% burn. (Table 3). As a precaution measure, 46% of farmers washed their hand, 39% changed cloths and 15% took bath after pesticide application (Table 3).

Table 2: List of commonly used pesticides in the study areas during interview with the farmers including their hazard category, chemical composition and application

Active ingredients	Tread name	Hazard category (WHO 2009)	Type	Applications
Thiamethoxam	Virtako 40 WG	Class III	Neonicotinoids	Insecticide
Cypermethrin	Ripcord 10 EC	Class II	Pyrethroid	Insecticide
Chlorpyrifos	Nitro 505 EC	Class II	Organophosphate	Insecticide
Mancozeb	Diathon M 45	Class II	Carbamate	Fungicide
Fenitrothion	Sumithion 50 EC	Class II	Organophosphate	Insecticide
Diazinon	McZinex 60 EC	Class II	Organophosphate	Insecticide
Abamectin	Vertimec Pro	Class II	n.f	Insecticide
Imidacloprid	Capture 75 WDG	Class II	Neonicotinoids	Insecticide
Carbofuran	Krisan 5 G	Class Ib	Carbamate	Insecticide
Malathion	Syfanon 57 EC	Class III	Organophosphate	Insecticide
Tricyclazole	Trooper 75 WP	Class II	n.f	Fungicide
Paraquat	Usched 20 SL	Class II	n.f	Herbicide

* Class Ia=Extremely hazardous, Ib=Highly hazardous, II=Moderately hazardous, III=Slightly hazardous, n.f=not found

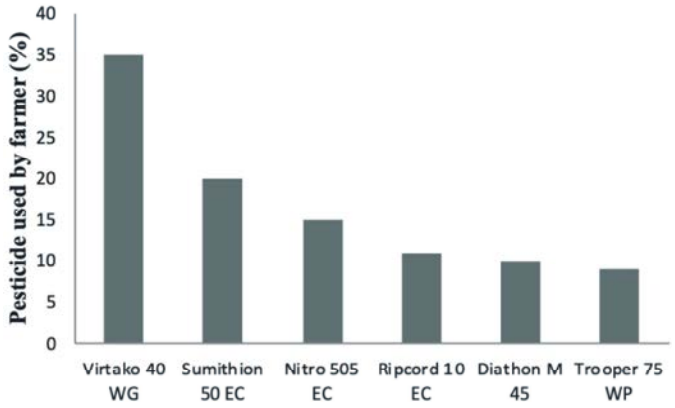

Fig. 4: Commonly used pesticides were Virtako 40 WG (Thiomethoxam + Chlorantraniliprole), Sumithion 50 EC (Fenitrothion), Nitro 505 EC(Chlorpyrifos), Ripcord 10 EC (Cypermethrin), Diathon M 45 (Mancozeb) and Trooper 75 WP (Tricyclazole) in Noakhali region

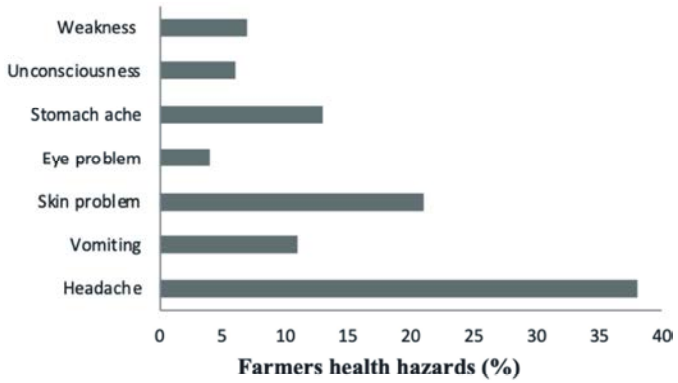

Fig. 5: Farmers health hazards including Headache (38%), Skin problem (21%), Stomach ache (13%), Vomiting (11%), Weakness (7%), Unconsciousness (6%) and Eye problem (4%).

Table 3: Farmers perceptions about pesticide application on agriculture field

Questions	Variables	Noakhali,N=100	Percentage (%)
1.Source of pesticide	Dealer	35	35
	Label	5	5
	Extension officer	15	15
	Other farmers	45	45
2.Method of application	Liquid	33	33
	Spray	64	64
	Granular	3	3
	Other	0	0
3.Use of PPE	No cover	31	31
	Partially cover	66	66
	Fully cover	3	3
4.Precautions after application	Wash hand	46	46
	Change cloths	39	39
	Take Bath	15	15
5.Discarding empty bottles	Re-use	38	38
	Burn pot	5	5
	Throw into water body or nearby area	57	57

DISCUSSION

This study evaluated the pesticides use and risks on farmers health. We have found that 35% of farmers used insecticides Virtako 40 WG in their fields and 38% farmers have headache problem. This study also revealed the trade way of pesticides to farmers and found that 35% pesticides they have got from local dealers. In additions only 3% farmers in total surveyed use full cover PPE when they use pesticides in their fields. In our studied area most people had poor reading skill similar to farmers in conducted study [10, 11] and said that most farmers in Bangladesh rely on their own experiences and on pesticide sellers to help select the appropriate pesticide as they have no knowledge on reading [12, 13]. In many cases, the inability to understand the information displayed led to the adoption of practices which increased exposure, risks to human health and environmental contamination in consistence with our study that found that 38% farmers have headache problem and there were other health problems also including Skin problem (21%), Stomach ache (13%), Vomiting (11%), Weakness (7%), Unconsciousness (6%) and Eye problem (4%) [14-16]. Some studies in (SU) Savar Upazilla (sub-city) and (MU) Mehedigonj Upazilla in Bangladesh found that a substantial portion of the farmers (35% in SU and 32% in MU) suffered from headache problem [17-19]. In previous studies [20, 21] authors reported that personal protective equipment (PPE) such as nose mask, overall and eye goggles were hardly used during pesticide application in Asia including Bangladesh, in regard to this study we found only 3% farmers used PPE in our study area.

CONCLUSIONS

Pesticide pollution and occupational health hazards of farmers are not only a serious problem for Bangladesh but also for other developing countries. This study indicated that, farmers are in a threat due to lack of toxicological knowledge, reluctant to wear PPE during pesticide application, semi-illiterate, economically undeveloped, lack of agriculture extension officer to communicate and smoking habit during pesticide application. Findings of this research will help agro-pesticide policy makers in Bangladesh.

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APPENDIX:

Table 4: Physio co-chemical properties of some pesticides available in Bangladesh

Pesticide	M[a]	SOL (Tref)[b]	Kow[c]	VP (Tref)[d]	DT 50 water	Koc[f]	1/n[g]
Name	(g/mol)	(mg/L)		(Pa)	hydrolysis[e] (d)		
Thiamethoxam	291.71	4100	0.741	$6.60 \cdot 10^{-09}$	1000 (stable)	56.2	0.90
Cypermethrin	416.30	0.009	200000	$2.30 \cdot 10^{-7}$	179	156250	0.90
Chlorpyrifos	350.89	1.05	50100	$1.43 \cdot 10^{-3}$	25.5	8151	0.90
Chlorantraniliprole	483.15	0.88	724	$6.30 \cdot 10^{-12}$	1000 (stable)	362	0.95
Chlorpyrifos	350.89	1.05	50100	$1.43 \cdot 10^{-3}$	25.5	8151	0.90
Cypermethrin	416.30	0.009	200000	$2.30 \cdot 10^{-7}$	179	156250	0.90
Imidacloprid	255.66	610	3.72	$4.00 \cdot 10^{-10}$	1000 (stable)	6719	0.80
Carbofuran	221.26	322	631	$8.00 \cdot 10^{-5}$	37	70.8	0.89
Malathion	330.36	148	562	$3.10 \cdot 10^{-3}$	6.2	1800	0.94

M[a]- Molecular mass; SOL (Tref)[b] - Solubility in water at reference temperature (20°C); Kow[c]- Octanol-water partition coefficient; VP (Tref)[d]- *Vapour pressure at reference temperature (25°C); DT50 water hydrolysis*[e]*- Half-life in water at pH = 7 and* 20°C, assuming 1000 days when the compound is regarded as "stable" in the data base. The data for cartap, isoprocarb, and phenthoate were collected [22]; Koc[f]- Sorption coefficient on organic carbon; 1/n[g]- Freudlich exponent. It is assumed to be 0.9 when the value is not available in the databases.