



Perception on environmental concern of pesticide use in relation to Farmers' knowledge

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Abstract

Chemical pesticides are indiscriminately used for pest management and vector control. However, many farming communities are unaware of the dangers associated with the chemicals. This study assessed vegetable farmers' perception of the environmental impact of pesticide use in Bangladesh concerning the farmers' knowledge and type. The farmers' socioeconomic characteristics and their relationship to some of the study variables, their attitude towards pesticides' environmental consequences, and their level of pesticide related knowledge were investigated. In this study, 882 farmers from nine districts participated through in-depth interviews and observations on-farm. The majority of farmers were males aged between 30 and 40 (32.44% in winter and 32.87% in summer). Moreover, 29.77% of the winter vegetable growers can sign their name only, but for the summer season's 31.02% were educated up to high school. For the winter season, the highest 74.44% of respondents belonged to focal farmers who believed pesticides could be hazardous to their health. Only 1.68% of control farmers agreed pesticide use could lead to secondary pest resurgence. For the summer season, farmers were most concerned (60.19%) about the health risks to farm-workers, while secondary pest resurgence was the least concerned. In general, the focal farmers had a high level of knowledge and concern about pesticide hazards compared to the proximal and control farmers. Comprehensive intervention measures are required to mitigate pesticide-related health and environmental risks, including pesticide safety training programs for farmers, which could promote sustainable agricultural development while minimizing the environmental and health risks of pesticide misuse.

Key words: Awareness, Bangladesh, Pesticides, Pest management, Vegetables

Introduction

Agriculture is central to economic growth and development in Bangladesh. The agriculture sector contributes about 14.23% of the country's Gross Domestic Product (GDP) and employs around 40.60% of the total labor force (Statistics, 2020). Bangladesh's primary production of Vegetables increased from 1.14 million tonnes in 1971 to 7.14 million tonnes in 2020, growing at an average annual rate of 4.03%. Pesticides have become integral to present-day farming and significantly increase agricultural productivity (Jallow *et al.*, 2017). There is an increasing concern regarding the widespread use of pesticides and their potential impacts on public health. Pesticides are of vital importance in the fight against diseases; for food production and storage, they are widely used for pest control in agriculture, gardening, homes, and soil treatment (Crespo-Corral *et al.*, 2008). Consumption of pesticides has increased in recent decades in Bangladesh to ensure food security (Bhattacharjee *et al.*, 2013).

Vegetable farmers use a variety of pesticides to prevent crop losses from pests and diseases. However, despite the contribution of pesticides to agricultural production, shreds of evidence in the last few decades have shown that they could also be detrimental to human health and the ecosystem (Taddese *et al.*, 2008). If pesticides are misused, they can cause direct human poisoning, accumulate as residues in food and the environment, and

develop pest-resistant strains. These problems can arise due to pesticide misuse or overuse, mainly if users are unaware of the risks.

These risks may be exacerbated by the lack of information on pesticide hazards (Matthews, 2008), the perception and attitude of farmers regarding risk from pesticide exposure (Atreya *et al.*, 2012), and to lack of education and poor knowledge and understanding of safe practices in pesticide use, including storage, handling, and disposal (Karunamoorthi *et al.*, 2012).

The purpose of this study is to gain a better understanding of farmers' attitudes and knowledge about pesticide use and environmental issues. This information is critical for identifying exposure situations and gaps in knowledge. However, it also provides valuable information that can be used in educational and policy recommendations to prevent or reduce pesticide-related health and environmental hazards.

Materials and Methods

In order to carry out this study, a survey was conducted in six districts (Bhola, Bogura, Chattogram, Dinajpur, Jessore, and Jhenaidah) for the summer season and five districts (Cumilla, Dinajpur, Jessore, Narshindhi, and Rajshahi) for the winter season in Bangladesh from the period of August 2019 to February 2021, based on major productivity of the selected vegetables in Bangladesh (BBS, 2017).

The study consisted of interviews with randomly selected vegetable farmers in the upazillas of selected

districts, where vegetables are mainly cultivated using pesticides. The samples comprised 882 farmers (450 for the winter season and 432 for the summer season). Three categories of farmers were targeted for investigation: focal, proximal, and control. Focal farmers received technical and logistic support from the project for practicing conservation agriculture and regular contact with extension support staff. In contrast, proximal farmers received indirect support such as technical advice and only had occasional contact with extension staff. Control farmers received no conservation agriculture training or technical assistance from any organization or project staff (Uddin *et al.*, 2017).

Data was collected using a standard, fully structured, and objectively oriented questionnaire that set the base for the interview. Data were collected on five summer vegetables (Bitter gourd, lady’s finger, pointed gourd, snake gourd, and yard long bean) and five winter vegetables (Cabbage, cauliflower, country bean, red amaranth, and tomato).

The farmers were informed of the study's purpose and consented verbally before the interview. The questionnaire was translated into Bengali and tweaked to fit the local environment. First, the interviewer gave farmers a summary of the survey goals, explained how the data would be used for research, and asked for their cooperation. At each study location, questionnaires were administered separately, with respondents being asked questions in sequential order. After that, the data sheets were gathered. The interviewer visited the farmers' vegetable fields, where the farmers were

working in most cases. After that, the data was compiled and processed

Results and Discussion

The majority of respondent vegetable growers in both winter (44%) and summer seasons (50.46%) are proximal farmers who received indirect support such as technical advice and only occasional contact with extension staff (Table 1). This information indicates that the vegetable farmers in Bangladesh are still less likely to receive technical and logical support and regular contact with extension support staff to practice safe agriculture.

There was a noticeable gender disparity among farmers, perhaps due to the fact that the distribution of agricultural activities between men and women is structured so that all activities related to pesticide use are performed exclusively by men, most of whom (32.44% in winter and 32.87% in summer) were between 30 and 40 years of age. Moreover, the majority (29.77%) of the respondents of winter season’s vegetable growers can sign their name only, but for the summer season’s majority (31.02%) of the respondent were educated up to high school (6 to 10 years of schooling) (Figure 1). There were also significant differences in years of education and agricultural experience among the three groups of farmers (Bhattacharjee *et al.*, 2013), and experience of pesticide-related adverse environmental harm in the past (Shammi *et al.*, 2020, Rahaman *et al.*, 2018).

Table 1. Socio-demographic profile of the study population

Characteristics	Winter		Summer	
	number	%	number	%
i. Farmer’s category				
Focal farmer	133	29.55	103	23.84
Proximal Farmer	198	44.00	218	50.46
Control Farmer	119	26.44	111	25.69
ii. Age				
Less than 20	9	2.00	6	1.39
20-30	81	18.00	80	18.52
30-40	146	32.44	142	32.87
40-50	85	18.88	97	22.45
More than 50	129	28.66	107	24.77
ii. Gender				
Male	430	95.55	432	100.00
Female	20	4.44	0	0.00

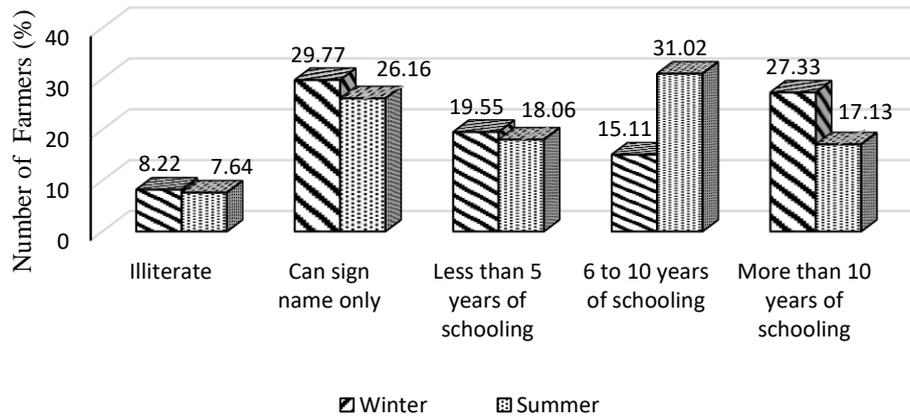


Fig. 1. Education level of the respondents

The majority of farmers in the study area were aware of pesticides' adverse effects on the environment. Knowledge of adverse effects can be found in Figures 2 and 3. The major concern of farmers was the health risk to farm workers. They are afraid of the diseases resulting from pesticide residues found in vegetables. In addition, they consider that the person engaged in spraying pesticides might suffer health risks due to inhalation of the pesticide fumes if appropriate precautions are not taken. The focal farmers are concerned with reducing beneficial insects and soil fertility due to indiscriminate pesticide application. Figure 2 shows a relationship between the type of farmers and the level of concern. In all the cases, the level of concern followed the order Focal farmer > proximal farmer > control farmers with insignificant exceptions in their opinion on the growth and reproduction of fish (Figure 2). The farmers were concerned least with the secondary pest resurgence. For the winter season, the highest respondents (74.44%) belonged to focal farmers who believed pesticides could

be a risk to the health of farmworkers, and the lowest respondents (1.68%) belonged to control farmers who agree to the fact that pesticides use can lead to secondary pest resurgence (Figure 2).

Figure 3 shows the influence of farmer's type on the perception of Pesticide application-related environmental pollution. The highest percentage of the respondents (60.19%) bears the perception that pesticides can cause a risk to the health of farmworkers. Regarding health risk of pesticide application was opined irrespective of the farmers' type. Soil fertility loss and reduction of beneficial insect population were found to be a significant concern by all three types of farmers. Unlike the summer vegetable cultivating farmers' concern, there was no clear relationship between the type of farmer and their concern on the diseases resulting from pesticide residues found in the winter vegetables, contamination of surface water, and enhancement of pest resistance (Figure 3).

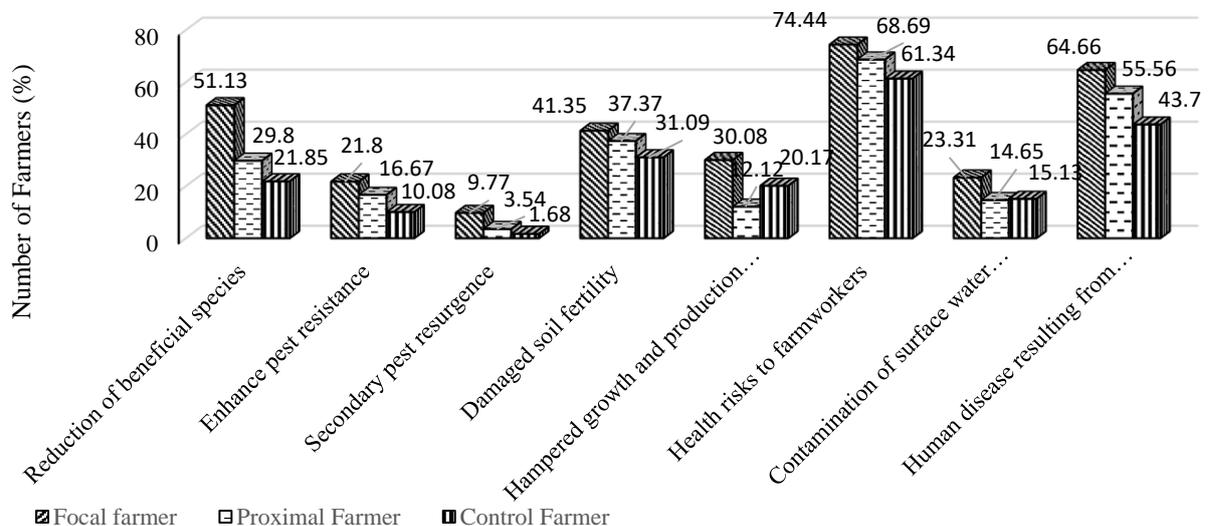


Fig. 2. Farmers' knowledge and perception of environmental pollution due to pesticide (winter season)

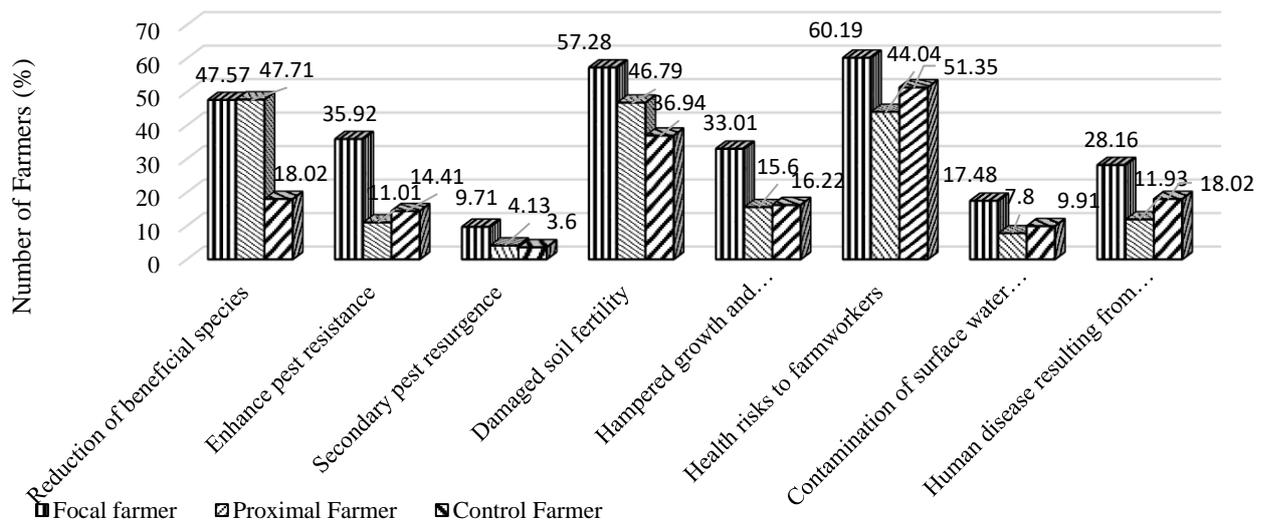


Fig. 3. Farmers' knowledge and perception of environmental pollution due to pesticide (summer)

All 882 farmers under study had direct contact with pesticides, either during the solution preparation or its application in the field. All except twenty were men, reflecting the profile of the Bangladesh rural population and similar to the results obtained in other studies conducted in the country (Shammi *et al.*, 2020; Uddin and Dhar, 2016; Dhar *et al.*, 2018; Bhattacharjee *et al.*, 2013). A different profile was revealed in some areas of China, where most pesticide applicators were women, potentially making them more susceptible to pesticides (Zhang *et al.*, 2011). In general, the education level of the farmers was low (most had incomplete high school education or less), similar to other Bangladesh regions (Rahaman *et al.*, 2018; Shammi *et al.*, 2020; Uddin and Dhar, 2016; Miah *et al.*, 2014; Bhattacharjee *et al.*, 2013; Palestine (Al-Zain and Mosalami, 2014), Iran (Abdollahzadeh *et al.*, 2015) Balochistan (Jamali *et al.*, 2016) and India (Hashemi *et al.*, 2012). In Greece, at least half of pesticide-using tobacco farmers had finished primary school (Damalas *et al.*, 2006). In New York State, USA, 55.8% of pesticide applicators had at least 12 years of education. (Stokes *et al.*, 1995).

Pesticides can harm ecosystems and the environment (Abdollahzadeh *et al.*, 2015). In previous studies, the majority of farmers reported that widespread and indiscriminate pesticide use posed a risk to farm operators' health. (Pingali and Economics, 2001, McCauley *et al.*, 2006). Farmers were aware that pesticides used in crop fields could have a detrimental effect on the population of beneficial species. Pesticides have been involved in declining natural pest predators such as earthworms, frogs, honey bees, spiders, flies, beetles, wasps, and other pollinating insects (DeBach and Rosen, 1991). Farmers were aware that pesticides could contaminate surface water, and it has been estimated that 25% of pesticides used in agricultural areas in coastal districts could end up in surface water systems as a residue during the rainy season, impairing fish growth and production, posing serious public health

risks, and resulting in long-term pest resistance (Phillips *et al.*, 1989; ESCAP, 1987.;Rahman *et al.*, 2009; Berg, 2001; Lu and Li, 2006; Paul, 2003). Farmers reported that insecticides could facilitate the resurgence of secondary pests. This understanding is consistent with previous research indicating that beneficial insects and animals are frequently killed as a result of pesticide use (Rahman *et al.*, 2003). Additionally, livestock and poultry have been poisoned or killed after consuming pesticide-contaminated grasses, straws, or grain. The decline in soil fertility reported by farmers in this study could be a result of a gradual decrease in soil nutrient replenishment caused by the destruction of beneficial microbes.

The current findings indicate that focal farmers are more aware of the negative consequences of pesticide use than proximal or control farmers. These findings support the hypothesis that focal farmers were aware of the negative environmental impact of pesticides due to the project's technical and logistical support and regular contact with extension support staff. Farmers who specialize in pesticides and their effects understand pesticides and their effects better than other types of farmers.

According to the current study's findings, most farmers are positive and concerned about the harmful effects of pesticides, mainly when applied to vegetables. So, growers should receive effective training on the proper method and timing of pesticide application, and fruit picking in vegetables should be scheduled in such a way that residual toxic effects of these pesticides are minimized.

In Bangladesh and several other developing countries in Asia, where vegetable farming is becoming more intensive and widespread, the use of pesticides on vegetables is becoming a growing environmental problem and a safety threat; however, many pesticides are not easily degradable, and they persist in soil, leach into groundwater and surface water, and contaminate

the wider environment. The above discussion clearly highlights the risks of indiscriminate pesticide use, which negatively impacts the environment and human health. Pesticide use has led to an increase in resistant pest populations, a decrease in beneficial organisms like predators, pollinators, and earthworms, a change in the soil environment, and contamination of aquatic systems. Depending on their chemical properties, pesticides can enter the organism, bioaccumulate in food chains, and thus affect human health.

Conclusions

Farmers' pesticide use behavior is a critical concept for improving environmental safety. Pesticide-related accidents could be avoided if farmers are well informed about pesticides and receive adequate pesticide training. The level of awareness and knowledge among farmers about pesticide risks is crucial for enhancing the safety in all aspects of pesticide handling. The Environmental Protection Agency's role could be improved at the farmer level by educating and motivating them about environmental issues and farmer health. Due to the extension department's inadequate advisory services, most farmers rely on neighboring farmers for advice on pesticide product selection and application methods. The extension wing should play a significant role in motivating vegetable producers, particularly regarding pesticide safety.

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