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IMPACT OF AGRO-CHEMICAL USES ON FARMERS' PERCEPTIONS: A STUDY OF SIRAJGANJ DISTRICT, BANGLADESH

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ABSTRACT

Talukder S, Tareq SM, Khalequzzaman KM (2024) Impact of agro-chemical uses on farmers' perceptions: a study of Sirajganj district, Bangladesh. *Int. J. Expt. Agric*. 14(1), 13-21.

Presently, the indiscriminate use of agro-chemicals in Bangladesh has been a dangerous issue for agricultural production, soil and health. The purposes of this study were to identify the farmers' perceptions of the harmful effects of using agro-chemicals and to determine their selected seven characteristics, namely age, education, farm size, cosmopolitans, organizational participation, attitude and knowledge on IPM (Integrated Pest Management) towards the use of agro-chemicals. The study also investigated the associations between farmers' specific characteristics and their awareness of the detrimental effects associated with the use of agro-chemicals in crop production. The study was conducted among the farmers of four villages, namely Raghunathpur, Bhuiyaganthi, Rayahati and Kashempur, in the Ghurka union of Rayganj Upazila under Sirajganj district. Personal interviews were conducted using a structured interview schedule during the period from September 1, 2023 to November 30, 2023. Scales tailored to measure the variables were devised. Pearson's Product Moment Correlation Coefficient (r) was employed to assess the relationships between the variables in question. Findings revealed that three-fourths (79%) of the respondents had a medium level of knowledge about their health and perceptions of the harmful effects of using agro-chemicals, as compared to 11% with low and 10% with high knowledge. Correlation analysis indicated that five characteristics of farmers, namely education, farm size, organizational participation, cosmopolitans and knowledge on IPM had significant positive relationships with their perceptions of the harmful effects of using agro-chemicals. On the contrary, attitudes towards the use of agro-chemicals exhibited a notable adverse correlation. The age of the respondents showed no association with their awareness of the detrimental effects of using agro-chemicals. Therefore, it is recommended that the government start its awareness-raising campaigns immediately.

Key words: *relationship, environment, agro-chemicals, farmers' perceptions, sirajganj district*

INTRODUCTION

In Bangladesh, to bring success in green evolution during the 1960s and subsequently meet emerging food demand for its vast population, package technologies were used to increase rice production. Promoting the adoption of agro-chemicals, such as fertilizers and pesticides, among farmers. Non-and excessive use of different agro-chemicals contributes to nitrate leaching, eutrophication, cadmium uptake by crops, as well as greenhouse gas emissions. As a result, civilized men have been surrounded by an environmental crisis. The alarming symptoms of this crisis have appeared as specific problems, namely, depletion of resources, changes in regional and global climates, reduction of biodiversity, reduction of agricultural productivity, increase in the number of insect-pests and diseases, soil pollution, air pollution, water pollution, soil erosion, deforestation etc. Drought, flood and other natural calamities were occurring more frequently. From an environmental perspective, chemically-polluted runoff from fields has contaminated surface and ground waters, damaged fisheries, destroyed freshwater ecosystems and created growing "dead zones" in ocean areas proximate to the mouths of rivers that drain agricultural regions (Pimental and Lehman, 1993; Tardiff 1992).

According to the Yearbook of Agricultural Statistics for 2022, Bangladesh utilized 58.74 lakh metric tons of chemical fertilizers in the fiscal year 2021–2022. Of which 26.63, 7.36, 16.85 and 7.90 lakh metric tons are urea, TSP (Triple Supper Phosphate), DAP (Di-ammonium Phosphate), and MOP (Muriate of Potash), respectively. Fertilizer imports cost 4,16,373 million taka for the 2021–2022 fiscal year (Foreign Trade Statistics of Bangladesh, 2021–2022). However, according to the Bangladesh Crop Protection Association's 2022 financial year report, Bangladesh utilized 39,542.75 metric tons of pesticides per kiloliter for crop production. Bangladesh receives a significant amount of its fertilizer from Russia. The remaining urea needs are satisfied by importing TSP from Morocco and Tunisia and urea from the United Arab Emirates, Saudi Arabia, and Qatar. China is currently the country of import for 90% of pesticides. Residual pesticides are imported from India, Germany and other countries. The Bangladesh Directorate of Agricultural Extension's Plant Protection Wing reports that there were 228 pesticide marketing enterprises operating in Bangladesh as of 2018. Presently, 5,500 insecticides have been registered so far. Of which, there are currently approximately 4,500 actives in the market. Thirty bio pesticides are registered (10 under progress). At present, 196 pesticides are prohibited.

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It is stated that pesticides also affect the human beings seriously sometimes directly and sometimes indirectly (Gani 1997). Most of the agro-chemicals, contain toxic compounds and their impact on health can occur through inhaling, ingesting, contact while spraying pesticides, or eating crops, vegetables and fruits with pesticide residues, some highly toxic pesticides can cause cancer, birth defects, male sterility, genetic mutations, and behavioral changes. Agro-chemicals also affect human health by causing allergies or breathing trouble or by affecting the liver, kidneys and nervous system if proper protection measures are not taken. Air driven pesticides can disperse for in the atmosphere and can result in concentration of pesticide residues in mothers' breast milk. Concentration of persistent organ-chlorine compounds like DDT (dichloro-diphenyl-trichloroethane) in the fat of mothers' milk can create health problems for future generations. If applied incorrectly, they can have an adverse effect on people, animals, other living things and the atmosphere (Yadav and Devi, 2017). Pesticides can enter the human body through the mouth through eating contaminated food or drinking tainted water, the skin through direct touch and the nose through breathing polluted air as vapor, aerosol or dust (Sacramento, 2008). Acute exposure symptoms included rashes, body aches, headaches, nausea, dizziness, reduced focus, panic episodes and in extreme situations, coma or death (Yadav and Devi, 2017).

It is apparent; therefore, that non- use of agro-chemicals is also the cause of death of birds, mammals and other wild life. Fish production in the rice field areas in South-East Asia is falling drastically due to the use of highly toxic agro-chemicals on the high-yielding rice varieties (Yudelman *et al*. 1998). As early as the 1960s and 1970s, there was suspicion that pesticides and human health were related. US epidemiologists saw an odd increase in non-Hodgkin's lymphoma in regions where pesticide use was high (Gupta 2012). Another survey report on pesticide poisoning in Dhaka Medical College Hospital from October 2005 to June 2006 showed that total pesticide poisoning cases were 10.33% and 16.7% of them died (Shadequl-Islam *et al*. 2012). The most frequently discovered toxic agent in the medicine ward of Khulna Medical College Hospital was organophosphate, which was found to be 27.64% of cases. Poisoning with an unknown substance was the second most common cause, at 16.03%, and was followed by copper sulphate at 14.03%, sedative at 13.35%, snakebite at 12.93% and so on (Chowdhury *et al*. 2011).

Pesticide agents are transferred from areas where crops are grown into the atmosphere (Bozlaker *et al*. 2009). Because of the atmospheric conditions during application, pesticide spray drift may extend beyond the application region (Bozlaker *et al*. 2009; Khan *et al*. 2022). Pesticides including soil particles are also transported by wind and wind erosion-induced droplet evaporation from plants and soil, leading to pollution of atmospheric phases, specifically gaseous aerosol particles and precipitation (Bedos *et al*. 2002). Wind direction and speed have an impact on the atmospheric gas phase level of Persistent Organic Pollutants (POPs) atmosphere, and high temperatures may cause the organic chlorine to transition via the gas phase (Bozlaker *et al*. 2009). Agricultural workers exposed to pesticides have a considerable risk of developing non-Hodgkin lymphomas and leukemia, even if the results of several epidemiological research are conflicting (Alavanja *et al*. 2004). Additional research has shown a link between pesticide use and brain tumors, sarcomas, multiple myelomas, prostate, pancreatic, lung, ovarian, breast, testicular, liver, kidney, and gut cancer (Bodeker and Dummler, 1993). Asthma, allergies and hypersensitivity are other potential health impacts. Additionally, pesticide exposure has been connected to hormone disruption, cancer, issues with reproduction and problems with fetal development (Gilbert 2012). As a result, the detrimental effects of pesticide use on human health and the ecosystem are readily apparent (Zhang *et al*. 2015).

Farmers in Bangladesh unconsciously and unmeasured used of agro-chemicals without used any safety measures. Presently, the indiscriminate use of agro-chemicals has been a dangerous issue for agricultural production, soil and health. Bangladeshi poor and untrained farmers apply the agrochemicals massively for getting rapid and huge returns from their shared lands causing incurable risks for the ecosystem and human health. So, these studies were conducted to determine and describe some selected characteristics of the farmers, to explore the relationships between the selected characteristics of the farmers with the impact of agro-chemicals uses on farmers' perceptions.

MATERIALS AND METHODS

Study area

The study was conducted among the farmers of four villages, namely Raghunathpur, Bhuiyaganthi, Rayahati and Kashempur, in the Ghurka union of Raiganj Upazila under Sirajganj district in Bangladesh (Fig. 1). Out of six unions in this Upazila, the Ghurka union was purposively selected. Four villages Raghunathpur, Bhuiyaganthi, Rayahati, and Kashempur were purposefully chosen from this union since they were within the researcher's own location and are conveniently accessible to the researcher. Both the usage of pesticides and extension initiatives are prevalent in these areas. The researcher's folks are familiar with the location, accent, and culture of these communities. The people co-operated with the study's execution as well. The researcher personally gathered data from September 1, 2023 to November 30, 2023. This involved conducting door-to-door visits to selected respondents, utilizing a structured interview schedule for the task.

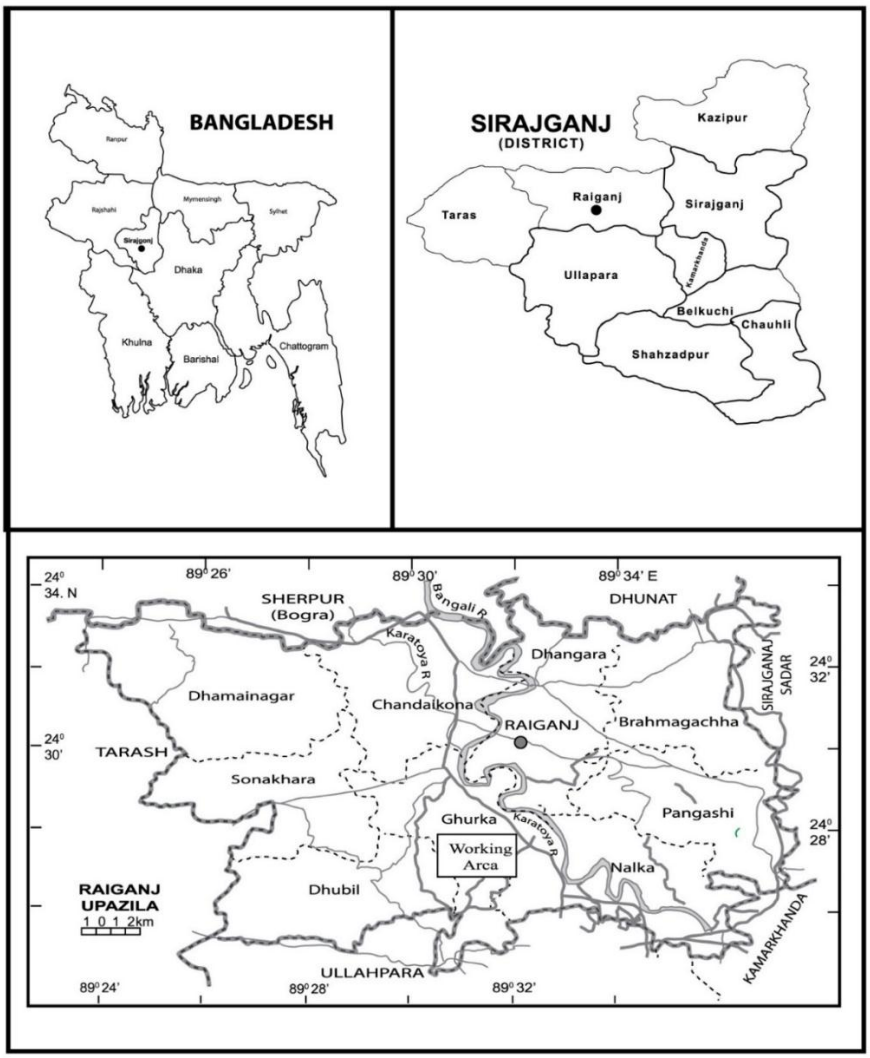

Fig. 1. Location of Study Area Map of the Rayganj Upazila, Sirajganj, Bangladesh

Populations and Sampling

The 767 families in the selected four villages in Ghurka union of Rayganj Upazila were randomly selected for this study. A list of 767 family heads was collected from the Upazila Agriculture Office at Rayganj which constituted the population for the study. Out of this population, 130 families' heads were selected by taking 20% of each village by using the Random Numbers' Table (Kerlinger 1973). Out of that population, 100 were selected for the final sample and 30 were on the reserve list. When a person in the original list may not be available, then the formers from reserve list were used. The village-wise distributions of the population, sample as well as reserve list are shown in Table 1.

Table 1. Distribution of Population and Sample of Farmers in the Study Area

Name of village	Total no. of population	Sample drawn	Reserve list
Raghunathpur	143	17	05
Bhuiyaganthi	185	18	07
Rayahati	196	31	08
Kashempur	243	34	10
Total	**767**	**100**	**30**

An interview schedule was used in order to collect relevant information from the respondents. The interview schedule was crafted with the study objectives in mind. The questions and statements within the schedule were formulated to be straightforward, clear and easily comprehensible for the farmers, minimizing the likelihood of doubt and misunderstanding. The schedule contained both opened and closed forms of questions adopting the technique for measuring selected characteristics *viz.* age, education, farm size, organizational participation, cosmopolitans, attitude towards use of agro-chemicals, and knowledge on IPM (Table 2) of the farmers and their impact of agro-chemicals uses on farmers' perceptions. Questions were set in accordance with the question

setting criteria suggested by Kerlinger (1973). Prior to finalizing the interview schedule, a pre-test was conducted in the study area under real field conditions. Pre-test was administered to 20 farmers of the selected area Name out of sample list. Modifications and adjustments to the final interview schedule were implemented based on the insights gained from the pre-test experience.

Analysis of the Data

Following the interviews, the questionnaire survey was examined, and each question's responses were coded and entered into SPSS. A software programme called SPSS is utilised for both non-batched and logical batched statistical analysis. IBM SPSS Statistics is the official name of the version 2015. One popular programme for statistical analysis in social science is called SPSS.

Table 2. Distribution of the Farmers According to their Characteristics

Variables	Measuring unit	Range		Categories	Number and percent (N=100)		Mean	SD
		Possible	Observed		N	%		
Age	Years	-	15-70	Young (up to 30)	36	36	35.93	12.51
				Middle-aged (31-50)	51	51		
				Old (>50)	13	13		
Education	Year of schooling	-	00-17	Illiterate (0)	16	16	6.27	4.07
				Primary (1-5)	21	21		
				Secondary (6-10)	47	47		
				Above secondary (>10)	16	16		
Farm size	Hectare	-	0.20-4.00	Small (0.20-2.00)	61	61	1.10	0.90
				Medium (> 2.00-3.00)	23	23		
				Large (> 3.00)	16	16		
Cosmo politeness	Scale score	00-32	06-16	Low (up to-05)	18	18	9.47	2.14
				Medium (05-11)	72	72		
				High (>11)	10	10		
Organizational participation	Scale score	-	00-21	No participation (0)	23	23	13.93	14.49
				Low (1-6)	15	15		
				Medium (7-21)	37	37		
				High (>21)	25	25		
Attitude	Scale score	00-80	26-77	Unfavorable (<35)	08	08	52.89	8.67
				Neutral (35- 50)	20	20		
				Moderately favorable (51-65)	54	54		
				Highly favorable (>65)	18	18		
Knowledge on IPM	Scale score	00-50	08-38	Low (<13)	29	29	19.52	7.46
				Medium (13-26)	51	51		
				High (> 26)	20	20		

Meaning of Correlation Co-efficient is presented in Table 3.

Table 3. Meaning of Correlation Co-efficient

'r' value	Meaning
± 0.00- 0.19	Very low correlation
± 0.20- 0.39	Low correlation
± 0.40 -0.69	Medium correlation
± 0.70 - 0.89	High correlation
± 0.90 - 1.00	Very high correlation

Source: Cohen and Holliday, 1982:

RESULTS AND DISCUSSION

Man possesses various interrelated and constitutional characteristics and those form his/her personality. It is expressed behavior or the sum totality of individual characteristics and ways of behaving, which determines his unique adjustment to his environment. It includes the individual behavior, appearance, beliefs, attitude, values, motives, emotional reactivity, expressing capacity, experience and individual modes of adjustment. The selected characteristics included age, education, farm size, cosmopolitans, organizational participation, attitude, and knowledge on IPM. These characteristics of respondents have been presented in Fig. 2 and Fig. 3.

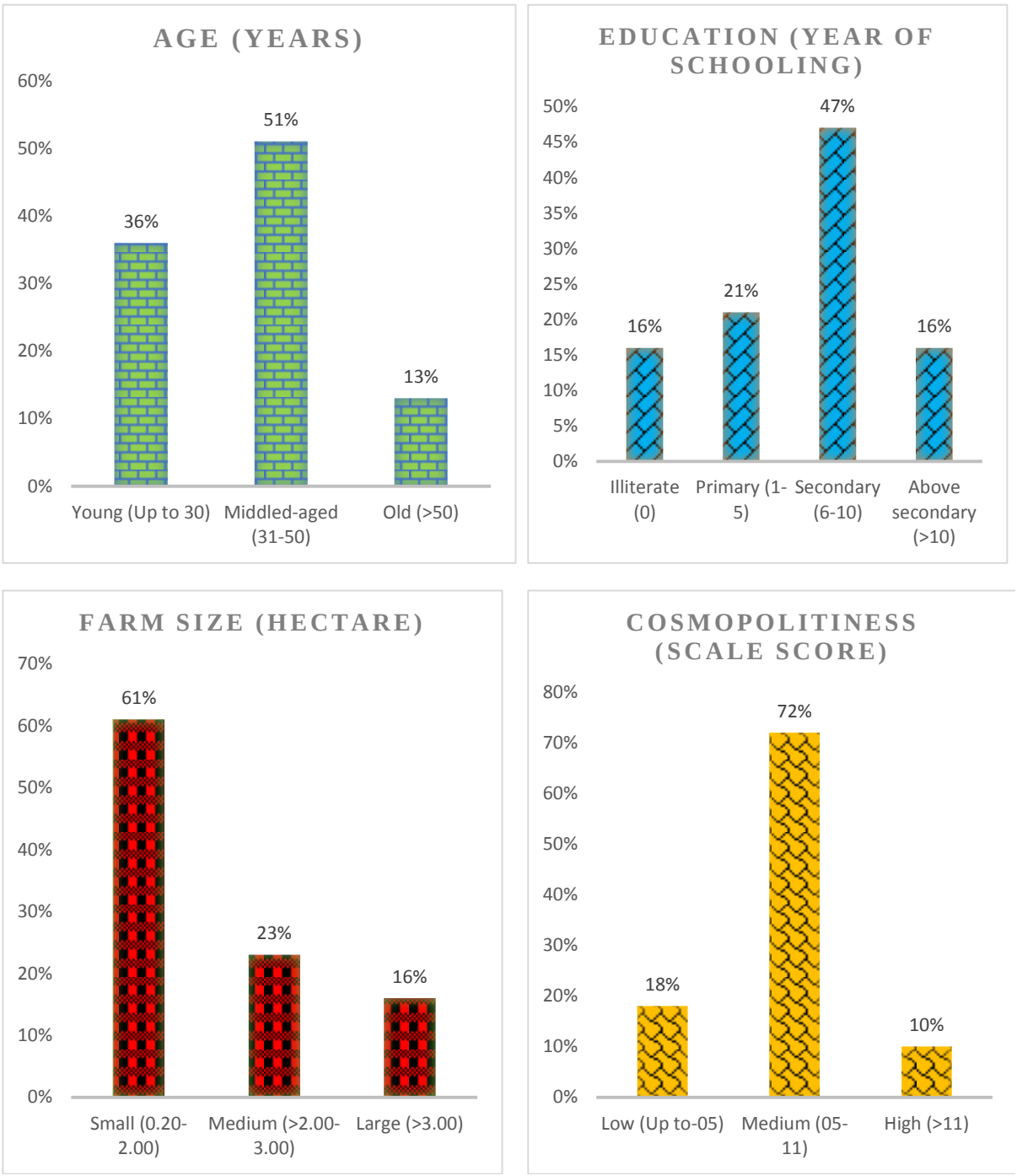

Fig. 2. Farmers characteristics (age, education, farm size & cosmopolitans) according to their distribution

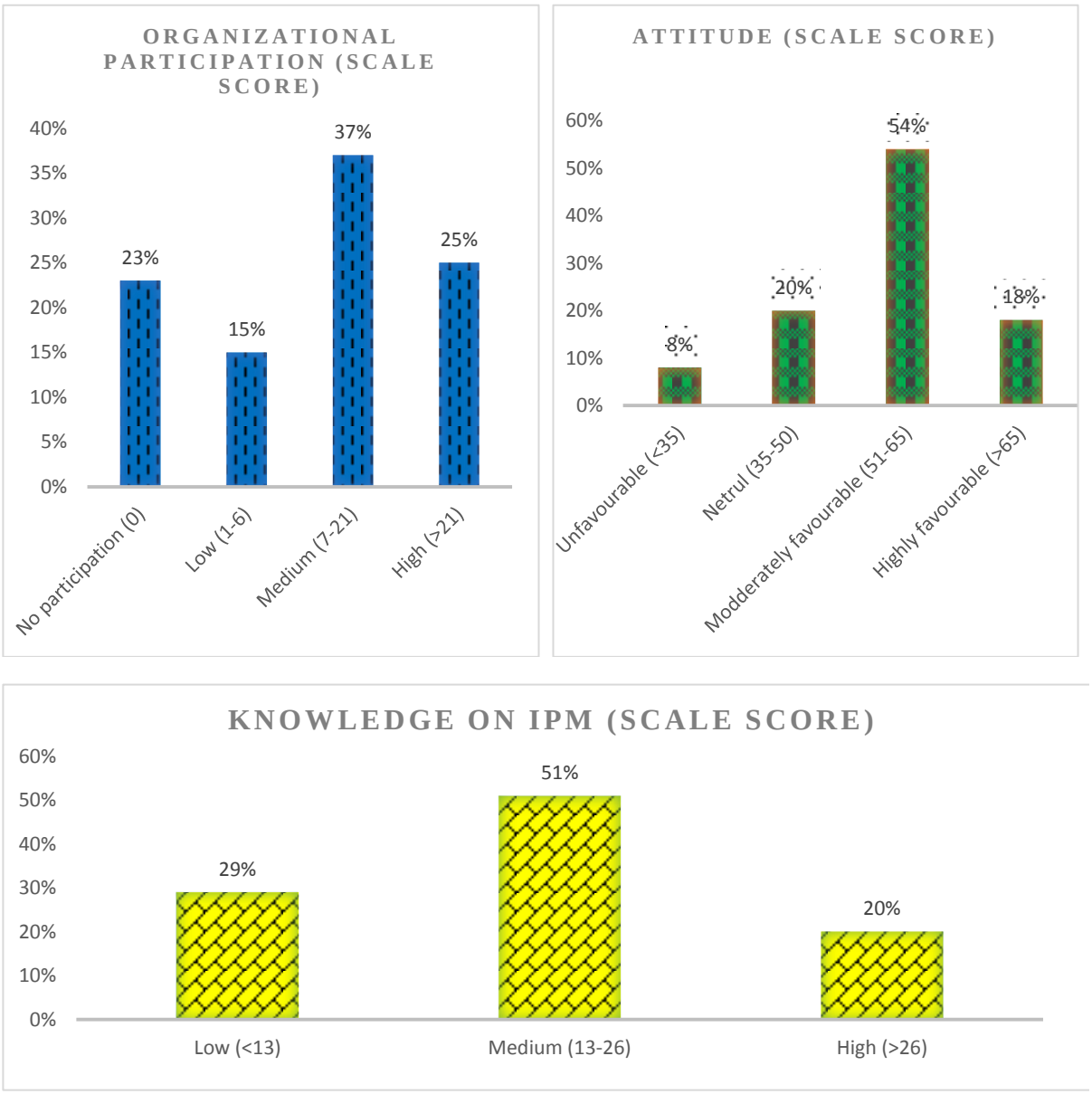

Fig. 3. Farmers characteristics (organizational participation, attitude & knowledge on IPM) according to their distribution

Impact of Agro-chemical Uses on Farmers' Perception

The computing perceptions of the harmful effects of using agro-chemicals the scores of the farmers of the study area ranged from 14 to 25 against the possible score of zero (0) to 25. Based on the farmers' understanding, they were categorized into three groups, as illustrated in Table 4. Analysis of the data contained in Table 4 indicated that the three-fourth (79%) of the respondent had medium level of knowledge on the harmful effects of using agro-chemicals as compared to 11% low and 10 percent high knowledge on the harmful effects of using agro-chemicals. The majority (90%) had either low or medium knowledge on the harmful effects of using agro-chemicals.

Table 4. Distributions of the Farmers According to their Perception of the Harmful Effects of Using Agro-chemicals

Categories (Scores)	Farmers Number and Percent (n = 100)	Mean	SD
Low knowledge (<16)	11		
Medium knowledge (16-20)	79	17.97	1.59
High knowledge (>20)	10		

Relationship between Selected Characteristics of the Farmers' and their Perceptions on the Harmful Effects of Using Agro-chemicals

To explore the relationships between the selected characteristics of farmers' perceptions on the harmful effects of using agro-chemicals, Pearson's Product-Moment Correlation Co-efficient, 'r' has been used. Table 5 is placed below with directions and interpretations of the meaning of 'r' (Cohen and Holliday, 1982).

In the following sections, based on the coefficient of correlation, the following findings were made on the relationship between selected variables of the farmers and their perceptions of the harmful effects of using agro-chemicals:

The computed value of co-efficient of correlation between the age of the respondents' and their perceptions of the harmful effects of using agro-chemicals was found to be 0.059, as shown in Table 5. The relationship showed a positive trend and relationship between the concerned two variables was very low. The computed value of 'r' (0.059) was found to be less than the tabulated value ('r'=0.196) with 98 degrees of freedom at the 0.05 level of probability. Hence, an insignificant relationship was found between the two variables. Therefore, the null hypothesis was accepted and it may be concluded that there was no relationship between ages of the respondents with their perception of the harmful effects of using agro-chemicals. Miah and Rahman (1995) also found that the age of the farmers had insignificant relationship with their perceptions on harmful effects of using agro-chemicals.

The study of co-efficient of correlation between the education and farmers' perceptions of the harmful effects of using agro-chemicals was found to be 0.495, as shown in Table 5. The relationship showed a positive trend and the degree of relationship was medium. The computed value of 'r'(0.495) was found to be greater than the tabulated value ('r'=0.256) with 98 degrees of freedom even at the 0.01 level of probability. Hence, the relationship was highly significant. From the above observations, the formulated null hypothesis was rejected, which implied that the educations of the respondents were related to their perceptions of the harmful effects of using agro-chemicals. The positive trend indicated that the perceptions of the harmful effects of using agro-chemicals increased with the increase of education of the farmers. This indicates that education helps individuals gain knowledge and skill in different cognitive contents and develop positive attitudes. The education levels of farmers ultimately increase their power of observation and decision-making. Also educated farmers are more likely to come in contact with mass media, especially printing materials. Thus, they gain knowledge and develop favorable perceptions. The study made by Hossain (1999) also demonstrates a significant positive relationship of education of the respondents with their perception of effects pesticide on crop production.

Table 5. Computed Correlation Coefficient between Independent and Dependent Variables (N=100)

Characteristics of the farmers	Correlation of co-efficient (r) with knowledge	Tabulated value significant at	
		0.05 level	0.01 level
Age	0.059		
Education	0.495**		
Farm size	0.275**	0.196	0.256
Organizational participation	0.707**		
Cosmo politeness	0.786**		
Attitude	-0.498**		
Knowledge on IPM	0.750**		

**Significant at P<0.01; *Significant at P<0.05

The hypothesis was rejected when the observed value of 'r' was the greater than the tabulated value of 'r' at the 0.05 level of probability.

In this study, the co-efficient of correlation between the farm size and farmers' perceptions of the harmful effects of using agro-chemicals was found to be 0.275, as shown in Table 5. The relationship showed a positive trend and the relationship between the concerned variables was low. The computed value of 'r'(0.275) was found to be larger than the tabulated value ('r'=0.256) with 98 degrees of freedom at the 0.01 level of probability. The relationship was statistically significant. Therefore, the null hypothesis was rejected and it may be concluded that there is a positive perception of the harmful effects of using agro-chemicals. It means that the higher the farm size, the more favorable farmers' attitude towards the use of agro-chemicals and vice-versa. It is quite logical that high farm size category people are bound to use agro-chemicals as they cannot use non-chemical pesticides with their large farm because chemical pest control is easier and less time consuming than non-chemical pesticides.

The computed value of co-efficient of correlation between the organizational participation and farmers' perceptions of the harmful effects of using agro-chemicals was found to be 0.707, as shown in table 5. The relationship showed a positive trend. The degree of relationship was high and the computed value of 'r'(0.707) was found to be greater than the tabulated value ('r'=0.256) with 98 degrees of freedom at the 0.01 level of

probability. Hence, the relationship was highly significant. From the above observations, the formulated null hypothesis was rejected, which implied that the organizational participation of the respondents had a positive significant relationship to their knowledge on environmental degradation due to the use of agro-chemicals. This indicates that organizational participation provides an opportunity to increase their environmental degradation knowledge experience through mutual interactions and sharing of ideas and opinions among them.

The co-efficient of correlation between the cosmopolitans and farmers' perceptions of the harmful effects of using agro-chemicals was found to be 0.786, as shown in Table 5. The relationship showed a positive trend. The degree of relationship was high and the computed value of 'r'(0.786) was found to be greater than the tabulated value ('r'=0.256) with 98 degrees of freedom at the 0.01 level of probability. Hence, the relationship was highly significant. Following the discoveries outlined above, the null hypothesis was dismissed, leading the researcher to infer that the respondents' cosmopolitanism exhibited a notably positive correlation with their awareness of environmental degradation caused by the use of agro-chemicals. It means that cosmopolitans of the farmer's help to acquire various information and knowledge related to farm operations.

In this study, the co-efficient of correlation between the attitude and farmers' perceptions of the harmful effects of using agro-chemicals was found to be (-0.498), as shown in Table 5. The relationship showed a negative trend and the degree of the relationship was medium. The computed value of 'r' (-0.498) was found to be greater than the tabulated value ('r'=0.256) with 98 degrees of freedom even at the 0.0l level of probability. Hence, the relationship was highly negative significant. According to observations, the null hypothesis was rejected, which implied that the attitude towards the use of agro-chemicals was related with farmer's perceptions of the harmful effects of using agro-chemicals. The negative trend indicated that the perceptions of the harmful effects of using agro-chemicals increased with the decrease of attitude towards the use of agro-chemicals and vice-versa. It means that the farmers with lower attitude towards use of agro-chemicals had possessed higher knowledge on harmful effect of using agro-chemicals. It was quite logical.

The study of co-efficient of correlation between the knowledge on IPM and farmers' perceptions of the harmful effects of using agro-chemicals was found to be 0.750, as shown in Table 5. The relationship showed a positive trend and the relationship between the concerned variables was high. The computed value of 'r'(0.750) was found to be larger than the tabulated value ('r'=0.256) with 98 degrees of freedom at the 0.0l level of probability. Hence, the relationship was highly significant. So, the above findings, the null hypothesis was, therefore, rejected. Thus, it may be concluded that knowledge on IPM among the farmers had a positive significant relationship with farmer's perception of the harmful effects of using agro-chemicals. The findings indicate that the farmers having more knowledge on IPM had more environmental awareness. In fact, the farmers were supposed to get enough information regarding the negative impact of agro-chemicals used in their crop field. Knowledge on IPM helps the farmers to grow crops by using environment friendly cultivation practices.

CONCLUSION

The findings of the study revealed that an overwhelming majority (79%) of the respondents had medium awareness concerning the harmful effects of using agro-chemicals on the environment. Socio-economic variables like education, farm size, organizational participation, cosmopolitans and knowledge on IPM have a positive correlation with the farmers' perceptions about the harmful effects of using agro-chemicals. Attitude was found to have a negative correlation with the farmers' perceptions. On the other hand, there was no significant relationship between the age of the farmers' perceptions about the harmful effects of using agro-chemicals. The farmers of this country are increasingly using agro-chemicals in their farming without considering their long run effects, either knowingly or unknowingly. But land and water resources are not like the machines that could be replaced. So, it could be said that an ecological balanced agro-environment is a must to attain a sustainable agricultural system. The Department of Agricultural Extension (DAE), Bangladesh Rural Development Board (BRDB), Bangladesh Agriculture Research Council (BARC), Ministry of Forest and Environment and Non-Government Organizations (NGOs) need to take proper steps to delivery adequate knowledge on environmental degradation due to the use of agro-chemicals among the farmers.

CONSENT

The author(s) obtained and maintained the respondents' written consent in accordance with international or university standards.

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