Determinants of Farmers' Level Awareness on Pesticide Use in a Selected Region in Bangladesh

ABSTRACT

The study aimed to investigate farmers' awareness level of pesticide use in the study area and to pursue the relationship between the selected characteristics of the respondents and their awareness level of pesticide use. A mixed-method approach wasused in which qualitative and quantitative analyses were blended rationally to have in-depthKnowledge and understandingof research problems.The area of DumkiUpazila underPatuakhali district in Bangladesh was selected for conducting this study successfully.The simple random sampling technique was used to select 110 farmers engaged in various types of crop production using multiple pesticides.Data was collected through face-to-face interviews using a pretested interview schedule from April 15 to June 30, 2020.Descriptive statistical measurement and the software SPSS were used to analyze collected data.The results of the Pearson's Product Moment correlation coefficient identified that, among the independent variables, only six variables such as training received, percentages of land ownership, communication exposure, yearly household income, risk orientation, and Knowledge of pesticide use had a positive and significant relationship on farmers' level of awareness of pesticide use.At the same time, the stepwise multiple regression analysis demonstrated that four variables, such as Knowledge of pesticide use, communication exposure, risk orientation, and training received, had a positive and significant contribution to the farmers' awareness of pesticide use. These four variables also explained 54.55% of the farmers' total variation in awareness level.

KEYWORDS: Awareness, Pesticide, Crop productivity, Food security, sustainable agriculture,Environment

INTRODUCTION:

Bangladesh is mainly an agricultural country where agriculture plays the agriculturalsectors playthe most importantrole in increasing overall economic growth. About 13.31% of Gross Domestic Product and around 40%(LFS 16-17) of the country's total labor force comes fromthe agriculture sector**[1]**.So, the contribution of this sector is very important for achievinga profitable, sustainable, and environment-friendly agricultural system to ensure the long-term food security for its large and ever-growing population **[2]**.Although productivity in the farming sectors is very important fromBangladeshperspectives,various social, economic, and psychological factors hinder productivity. Among the factors, scarcity of cultivable land is very crucial.In Bangladesh,the total cultivable landis countedas 8.52 million hectares and the average cropping intensity of one ninety-one **[3].**So, very low performance was observed, which affects all economic growth. According to Food and Agriculture Organization (FAO) projections, the global agricultural land area is awaited to extend from 5.1 to 5.4 billion ha within 2030 **[4]**.Due to the scarcity of cultivable land, farmers have to use asmall piece of land repeatedly for increased production using excessive agrochemicals. Without awareness, most farmers handle a wide range of agrochemicals to prevent production loss from the attack of various types of pests and diseases.In a study on rice, potato, mango, and sugarcane farmers conducted in Bangladesh, the authors mentioned that 47 percent of farmers were overusing pesticides, and about 13 percent of the farmers use protective measures when applying pesticides **[5].**

Most farmers suffer more through contact with pesticide residues due to the lack of proper protective equipment, management of instruments for spraying, poor storage, andadequate handling knowledge **[6,7].**A study by Recena et al. (2006) predicted that more than ninety percent of pesticides were considered harmful to human health. Still, less than 20% used masks, impermeable clothes, or gloves while applyingpesticides **[8].**There are many rules and regulations for pesticide handling. Still, most of the farmers in our country use pesticides inappropriately, which in the long run creates numerous hazards for human health and the Environment.

For example,several researchers mentioned that pesticides have some beneficial effects on agriculture and human wellbeing; on the other hand, their use harms human health, non-target organisms, or the Environment **[9,10].**About five billion kg of pesticides are applied annually worldwide, which can seriously affect non-target organisms, the food chain and biodiversity, and human health and the Environment

[11,12,13]. According to the World Health Organization (WHO) report, about 3,000,000 cases of pesticide poisoning and about 220,000 deaths are observed in developing countries **[14].**It is estimated that about 1,000 people die yearlyin Tanzania from pesticide poisoning **[15].**Several acute effects of pesticide poisoning include blurred vision, vomiting, muscle weakness, numbness, and so on.**[16,17].**

Nowadays, many countries consider the importance of farmers' level of awareness of pesticide use in agricultural sectors. Yang et al. (2014) concluded that the levels of knowledge and risk awareness,as well as the practices of farmers and retailers, are very important factors for enhancing the efficiency of devising to protect these stakeholders **[18].**Another study indicated thatfarmers' knowledge and awareness level about pesticide risk plays an important role in determining the use of personal protection equipment (PPE) **[19].**The pesticide residue is considered a major threat, and it depends on the quality and specificity of pesticides and farmers' awareness and behavior patterns.**[20,21,22].** Also, a study showed that the agricultural production system has to face many serious problems due to the lack of farmers' awareness and the misuse of pesticides **[23].**

The present study has been undertaken given the importance of farmers' level of awareness of pesticide use.Today, many farmers in the Patuakhali district are engaged in agricultural activities and use a huge amount of pesticides to increase productivity. So this study wasinvestigated in this area to determine and describe the level of awarenessof thefarmers of pesticide use.
The major objectives of this study are given below:

1. To determine and describe the level of awareness of farmers on pesticide usein the study area
2. T identify the socioeconomic characteristics of the farmers
3. To find out the correlation between farmer's characteristics and their awareness level of pesticide use
4. To describe thecontribution of factors to the level of awareness of farmers,

The change in climate and its adverse effect on agriculture is consideredthe worst, resulting in temperature rise, abnormal rainfall, sea-level rise, cyclones, and storm surges in high frequency and covering more areas by salinity, further aggravating drought. As a result,sometimes productivity loss occurs due to weather and pests. Thegrowing of unfamiliar crops or varieties involves more uncertainty. Farmers use uncontrolled amounts of pesticides to minimize losses without considering their long-term impact. Proper farming practices and awareness about various crop productions can save lives and resources. So, farmers'awareness level of pesticide use is crucial for achieving a safe and better environment.

MATERIALS AND METHODS:

The study area was selected purposively atDumkiUpazilainthe Patuakhali district. The farmers in those areas engaged in agricultural activities, using more or fewer pesticides considered for the population in this research purpose. An up-to-date list of the farmers was compiled with the assistance of respective union Parishad personnel, sub-assistant agricultural officers,local leaders, and a dealer or retailer. About 1102 farmers were found in this area engaged in agricultural crop production, using various pesticides, which constituted the population.A sample population was prepared by obtaining 10% population from the total of 1102 population.This sample population was considered from two villages under the sreerampur union. One hundred and ten farmers were estimated for the total sample population for study purposes. Ten percent of farmers were taken into consideration for making a reserve list. This reserve list helped us fulfill the total respondents because some farmers were not available during interviewing—a pretest wasdone on a small scale of representative samples to finalize the structured interview schedule.

Socioeconomic characteristics: The socioeconomic factors included variablessuch as age, educational qualification, training received, farming experience in a year, totalfarmlandarea, percentageof land

ownership, annual family income, communication exposure, Knowledge ofpesticide use, and risk orientation of the farmers, etc.

All the data was properly recorded, edited, carefully compiled,tabulated, and computerized. The data were analyzed using statistical software SPSS 16,following the study's objectives. Descriptive statistics (mean percentage, range, frequency, standard deviation, and categories) were used to describe the general characteristics of the farmers.

Farmers' level of awareness of pesticide use was the dependent variable, which was measured by the awareness level score for 16 selected statements related to awareness level of pesticide use. Pearson's product-moment correlation was applied to determine the relationship between socioeconomic characteristics and farmers' level of awareness of pesticide use. Also,a regression analysis was done to find out the determinants and contribution of factors to the level of awareness of farmers.

A multiple regression equation was followed to measure the awareness level of farmers on pesticide use, which was given below:

$$Y_i=\alpha + \beta X_i+\varepsilon_i$$

Where,
Y = Farmers' level of awareness of pesticide use (obtained score)
X1= Respondents' age in a year
X2= Educational qualification (Year of Schooling)\
X3= Duration of farming from birth (year)
X4= Training received (days)
X5= Total farmland area (ha.)
X6= Percentages of land ownership
X7= Yearly income (tk.)
X8= Communication exposure (Frequency of contact)
X9= Knowledge ofpesticide use (total calculated score)
X10= Risk orientation of the farmers (total observed score)

ε are random components independently and normally distributed with mean zero and variance σ^2. For accepting and rejecting the null hypothesis,a five percent (5%) level of significance was considered.

Table 1: Description of variables and their unit of measurement:

Variables Name	**Variables description and unit of measurement**
i.Dependent variable Farmers' level of awareness of pesticide	A 5-point Likert scale was used for a total of 16 statements (8 positive and eight negative),

use	scored as 5,4,3,2,1 for strongly agree, agree, neutral, disagree, and strongly disagree, respectively. Reverse scoring was done for negative statements **[24, 25].**
(ii) Independent variables (Socioeconomic characteristics):	
1. Age of the respondents	How much older the respondents were (in the year)
2. Educational qualification	The extent of formal schooling in year
3. Experience of farming	The total number of years from the farmer's farming activities.
4. Training received	A total number of days the farmers received training.
5. Total farmland area	Total farmland area the farmers used. They expressed in a hectare.
6. Percent land ownership	The total percentage of land in a hectare is inherited from the entire farm area.
7. Yearly income	Total annual income ("000" taka/year)
8. Communication exposure	The total extent of contact from various sources.
9. Pesticide using Knowledge	Scores were obtained when asked related questions.
10. Risk orientation	The total risk orientation score was obtained from 10 selected statements.

3. RESULTS AND DISCUSSION:

3.1 Socioeconomic Characteristics of the Respondents:

The observed age score of the farmers ranged from 25 to 75, with a mean was 52.22 and a standard deviation of 11.68. It also observed that most farmers (52.72%) in this area were old-aged, and 34.55% were middle-aged. This could happen due to the household head position for income-generating activities being old to middle-aged people. Besides this, 84.55% of the respondents had educational qualificationsto various extents. Such as, 44.55% of the farmers had a primary level of education, 38.18% had a secondary level, 4.54% had above secondary, and 4.54% were illiterate. So, it can be said that the maximum number of farmers involved in agricultural activities wasthe primary level. Medium farming experienced people made up 65.45 percent of the total because of medium Knowledge and skill in farming sectors. The highest proportion (65.45%) of the respondents received training at a lower rate on pesticide use and management because of fewer opportunities and a lack of available experts for training. But, training is an essential component that enhances Knowledge and improves skills on awareness level of pesticide use for agricultural farm management. In the farmland area, the data revealed that 65.45% of the respondents possessed small farms, and 32.73% possessed medium farmland areas. The most important factor, for this reason, was a lower tendency of the respondents to hire or lease land for agricultural practices.

The majority (55.45%) of the respondents had 76–100% land ownership.Early household incomes of the farmers were eighty-nine percent. One factor of low income could be due toowning a few lands, having limited training experience and Knowledge, and so on. The data on communication exposure reflected that about one-half (47.27%) of the respondents were exposed at a lower rate to different communication sources.The poor exposure to additional information sources is the root cause of inadequate Knowledge and skills of pesticide use. Contact with various extension information sources is crucial for improving the farmers' awareness level. The Knowledge of pesticide use and management was moderate, at about 41.82%. Lower chance of training and less concern could be the reason for goodKnowledge of pesticide use. A

moderate-risk orientation was held by 41.82 percent of farmers. The farmers should be able to take a certain degree of risk for innovative ideas.

The data presented in Table 3 expressed that the level of awareness of pesticide use-value ranged from 24 to 76, and the average value was 50.89 with a standard deviation of 12.73.The respondents were categorized into three sectors based ontheir level of awareness scores. Such as, "Low (24.00- 41.00)", "Medium (42.00-59.00)", and High (60.00-76.00)". The result showed that nearly half of the proportions (45.45%) of the respondents were aware at a medium level. Besides this, about 28.19% of farmers were low awareness, and 26.36% were highly aware of pesticide use.
In a study conducted by Damalas CA, Koutroubas SD (2018) mentioned that, during pesticide handling, proper Knowledge and awareness are very important for the farmers to enhance their safety **[26].**
All the authorities related to agriculture and agrochemicals management should take necessary steps to buildawareness among the farmerson pesticide use for crop production.As for example, Fan et al. (2015) concluded that to get over the gap between stakeholders and farmers, various activities such as training, supervising, educating, and enhancing information clearness are very important for multiple staff, retailers, and also for the farmers **[27].**

3.2 Correlation Analysis among Farmers' Level Awareness of Pesticide use and Socioeconomic variables:

The result of the correlation analysis among the farmer's socioeconomic characteristics and awareness of pesticide use is shown in table 4. The result demonstrated that, among the variables, only six variables as training received (.543$^{**)}$, percentages of land ownership (.233$^{*)}$, use of communication sources (.606), pesticide using Knowledge (.598$^{**)}$, yearly household income (.514), and risk orientation (.578$^{**)}$ hada significant relationship with awareness of pesticide use among the farmers. It can be explained that if we want to increase the awareness of pesticide use among the farmers, we must focus on and improve the above significant characteristics.
The result also demonstrated that among the socioeconomic characteristics or variables, four variables had a positive but non-significant relationship with the awareness of farmers on pesticide use.These variables were age (.012), education (.164), duration of farming (.046), and farmland area (.143).
A study guide by Dessart et al. (2019) mentioned that decision-making analysis for the economic purpose of the farmers and behavioral factors is noteworthy, and also those factors are important for agro-environmental policies [**28**].

3.3Contribution of Factors to the Level of Awareness of the Farmers:

To explain the contribution of factors to farmers' awareness of pesticide use, a Stepwise Multiple Regression Analysis was run accordingly. All variables that showed a positive and significant relationship with awareness of pesticide use in correlation analysis were considered for stepwise multiple regressions. Our main criterion variable was awareness of pesticide use, and its total score was calculated from sixteen statementsobtained from a five-point Likert-type scale entered into this model.After entering all of the considered variables into this model, the result demonstrated that only four variables had a significant contribution or influence on the awareness of pesticide use at a five percent level of significance. Those four variables were communication exposure, pesticide using Knowledge, training received, and farmers' risk orientation, which is mentioned in table **5**. The result also showed that R^2=0.545 and F=31.491 were very significant at the 0.00 level.These four variables could explain 54.5% of the total variation infarmers' awareness of pesticide use. Also, from the table 5, we found that β1=0.263, β2=0.701, β3=0.690, and β4=0.545. From these values, we can explain that when communication exposure, Knowledge of pesticide use, risk orientation, and training received by the farmers increased by a unit, then their awareness of pesticide use increased by 0.263, 0.701, 0.690, and 0.545 units, respectively.

Lastly, from the summary of table 6, we concluded that communication exposure along could explain 36.7 percent variation in awareness of pesticide use by farmers. At the same time, pesticide using Knowledge, risk orientation, and training received could explain 8.1%, 6.1%, and 3.5% of variation respectively for awareness of pesticide use for farmers.

Table 2: Socioeconomic characteristics of the respondents

Socioeconomic characteristics of the respondents	Ranges	Categories of the respondents	Respondents		Mean value	Standard deviation
	Observed ranges		Numbers	Percentages		
Age	25-75	Young aged (up to 35years)	14	12.73		
		Middle aged (36-50 years)	38	34.55	52.22	11.68
		Old aged (above 50 years)	58	52.72		
Educational qualification	0-12	Illiterate (0)	5	4.54		
		Can sign only (.5)	12	10.91		
		Primary level education (1-5)	49	44.55		
		Secondary level of education (6-10)	42	38.18	5.06	2.87
		Above secondary level education (above 10)	2	1.82		
Farming experience in year	10 to 65	Lower farming experience (10-28)	30	27.27		
		Medium farming experience (29-47)	72	65.45	34.20	11.24
		High farming experience (above 48)	8	7.28		
Training received	0 to 22	No training received (0)	9	8.18		
		Lower training received (1-7)	72	65.45		
		Mediumtraining received (8-15)	23	20.91	5.69	4.87
		High training received(above 16)	6	5.46		
Farmland area	0.28 to 3.02	Landless Farmers (below 0.02ha)	00	00		
		Marginal farmers (.02-0.20 ha)	00	00	0.99	0.59
		Small farmers (.21-1.00 ha)	72	65.45		
		Medium farmers (1.01-3.00 ha)	36	32.73		
		Large (above 3.00 ha)	2	1.82		
Percentage land ownership	21.56-100	>25% ownership	2	1.82		
		26-50% ownership	17	15.46	76.73	24.08

		51-75% ownership	30	27.27		
		76-100% ownership	61	55.45		
Yearly household income	52.0 to 363.85	Lower level income (52-156)	89	80.91		
		Medium level income (156.01-261)	19	17.27	114.33	54.22
		High level income (above 261)	2	1.82		

Socioeconomic characteristics of the respondents	**Ranges**	**Categories of the respondents**	**Respondent**		**Mean value**	**Standard deviation**
	Observed ranges		**Numbers**	**Percentages**		
Communication exposure	17 to 52	Lower exposure (17-28)	52	47.27		
		Medium exposure (29-40)	47	42.73	29.81	7.73
		High exposure (above 40) (above 10)	11	10.00		
Knowledge ofpesticide use	14 to 37	LittleKnowledge (14-21)	28	25.45		
		Medium Knowledge (22-29)	46	41.82	25.90	5.43
		Highly knowledgeable (above 29)	36	32.73		
Risk orientation	23 to 45	Low (23-30)	27	24.54		
		Medium (31-38)	46	41.82	34.80	5.60
		High (39-450	37	33.64		

Table 3.Respondents' categories according to their awareness level of pesticide use

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
The lower level of awareness	31	28.19	50.89	12.73
Medium level of awareness	50	45.45		
High level of awareness	29	26.36		

Table 4. Correlation Analysis among Farmers Level Awareness on pesticide use and socioeconomic characteristics:

Criterion or dependent variable	Independent variables (Socioeconomic factors)	Correlation coefficient (r)
	1. Respondent's age	.012^{NS}
	2. Educational qualification	.164^{NS}
	3. Farming experience in year	.046^{NS}
	4. Training received	.453**
Awareness level of farmers on pesticide use	5. Total farm land area	.143^{NS}
	6. Percentages of land ownership	.233*
	7. Yearly household income	.514**
	8. Communication exposure	.606**
	9. Knowledge ofpesticide use	.598**
	10. Risk orientation level of the farmers	.578**

****= significant at a .01 level of probability**
NS= Not significant
***= significant at a .05 level of probability**

Table 5: Multiple regression analysis:

Predictor variables	B	Std. error	Standardized coefficient (β)	T	Significance (p)
CONSTANT	-2.218	5.697		-.389	.698
Communication exposure	.263	.158	.160	1.664	.099
Knowledge on pesticide use	.701	.198	.229	3.537	.001
Risk orientation	.690	.183	.304	3.762	.000
Training experience	.545	.191	.209	2.855	.005

R^2=0.545, F=31.49 and P=0.000

Table 6: Changes in multiple R^2 for entry of the variables into the stepwise multiple regression model for awareness of farmers on pesticide use:

Model	Variables	R^2	Adjusted R^2	Standard error of the estimate	R^2 Changes	Variances explained	Significance F changes
1	Communication Exposure	.367	.362	10.17	.367	36.7	.000
2	Knowledge on Pesticide Use	.449	.439	9.53	.081	8.1	.000
3	Risk Orientation	.510	.496	9.03	.061	6.1	.000
4	Training Experience	.545	.528	8.74	.035	3.5	.005

4. CONCLUSIONS AND RECOMMENDATIONS

Raising the farmers" level of awareness of pesticide use is a very effective strategy for obtaining food security and achieving a safe and sustainable environment for the future generation. Results of the study expressed that nearly two-thirds (73.64%) of the respondents were little to moderate level aware of the use of various types of pesticides. As a result, the awareness of pesticide use by the farmers is not anticipative. Farmers should be well trained in up timely for pesticide use and handling. Besides this, by increasing regular contact with various extension information sources, providing proper Knowledge for the handling of pesticides, and making capable of takingthe risk of using innovative ideas, the awareness of pesticide use by the farmers can be increased. Because the multiple regression resultsdisplayed that communication exposure, training received, risk orientation, and pesticide using Knowledge positively contributed to the farmers' level of awareness of pesticide use. The government and all the concerned authorities should come forward to draw up various policies and take necessary steps to make the farmers aware of pesticide use. So, in developing countries, like Bangladesh, all of us need to concentrate on this issue with the widespread awareness building and regulations for pesticide use.If proper policies are not implemented, safe health and a balanced or sustainable environment will continue to suffer seriously.

CONSENT

As per international or university standards, the author(s) collected and preserved farmers' written consent.

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