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*Original Article*

# Rice Farmers' Perception on Occupational Risk Exposure to Pesticides in Bangladesh

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**A B S T R A C T**

Rice is a staple food and pesticides have become a dominant input for production of rice in Bangladesh. To protect the farmers' health and environment, farmers' understanding about risk on occupational risk exposure to pesticides is a crucial matter. Accordingly, a study was carried out in Khagdohor *union* of Mymensingh *Sadar upazila* (sub-district) under Mymensingh district in Bangladesh to assess the rice farmers' perception on occupational risk exposure to pesticides. An interview schedule was used to collect data during March-April, 2018 from 100 rice farmers. Data were analyzed using descriptive statistics, rank order and coefficient of correlation. Majority of the rice farmers (73%) had medium to high level of perception on occupational risk exposure to pesticides in the study area. Among twenty (20) statements on four (4) dimensions: 'eating, drinking or smoking could be done during mixing and loading'; 'after applying pesticides more time should be taken to change clothes or to take bath'; 'pesticide store house can be also used for storing food, fire wood, farming equipment and kitchen utensils'; and 'pesticides do not kill target or non-target organisms (snakes, worms, insects, mud skippers etc.)' were the first ranked perceived risks by the rice farmers on occupational risk exposure to pesticides regarding handling; application; storage and disposal; and human health and biodiversity stages, respectively. It was revealed that the influential factors such as education, household size, farm size, annual income, organizational participation, training received, extension media contact, ownership of pesticide applicators, and perception on the use of pesticides of the rice farmers were significantly associated with the rice farmers' perception on occupational risk exposure to pesticides. The study specified some recommendations for the policymakers to address the aforesaid influential factors of the rice farmers on occupational risk exposure to pesticides in the study area. Moreover, awareness raising programmes, credit facilities, proper training on safety measures and suitable extension services could play a significant role in lessening the risks of the rice farmers on occupational exposure to pesticides.



## Introduction

Bangladesh is predominantly an agrarian country and a varieties of crop grow abundantly in this country due to its very fertile land and favorable weather (BBS, 2019). Rice is a globally significant staple cereal crop for which cultivation is concentrated in developing countries (Wong and Brown, 2020) and there is no alternative of rice cultivation for feeding increasing population in Bangladesh (Rasha *et al.*, 2018). Rice farmers often rely heavily on the use of pesticides to control a range insects and pests, to ensure high yield of rice and thus high income, and to save costs associated with labour and time (Abdollahzadeh *et al.*, 2015; Mohamed *et al.*, 2016; Wang *et al.*, 2018).

Pesticide poisoning is a major global health problem, and it is more prevalent in developing countries like Bangladesh. Depending on toxicity, frequency and duration of exposure, and the susceptibility of exposure to individuals, pesticides cause a range of human health hazards (WHO, 2018). Due to exposure of pesticides, the rice farmers suffer from acute poisoning and chronic diseases including skin and eye

irritation, headaches, coughing, nausea, blurred vision, fatigue, respiratory disorders, abnormal semen, and chronic kidney disease (Sankoh *et al.*, 2016; Elahi *et al.*, 2019). The farmers who are well aware of the harmful effects of pesticides are sometimes unable to translate this awareness into practices (Damalas *et al.*, 2006; Zyoud *et al.*, 2010).

Occupational exposures to pesticides occur during handling, transportation, preparation and application of pesticides in the workplace (Damalas and Eleftherohorinos, 2011). The farmers face great risks of exposure to pesticides due to wrong application techniques, inappropriate spraying equipment, inadequate storage practices, and often the reuse of old pesticide containers for food and water storage (Asogwa and Dongo, 2009). As rice is our staple food, most of the farmers in our country produce rice in their field. If the farmers are not aware of the pesticides exposure, they will be remaining in high risks as most of them apply pesticides in their rice field by themselves. If they have a good perception and sufficient knowledge about risks of occupational exposure to pesticides, they will try to save themselves and their family members from the risks of pesticides. Therefore, the study was conducted to assess the rice farmers' perception on occupational risk exposure to pesticides in Bangladesh. The specific objectives were to identify socio-economic characteristics of the rice farmers; assess the extent of rice farmers' perception on occupational risk exposure to pesticides; and determine the factors associated with rice farmers' perception on occupational risk exposure to pesticides.

## Methodology

### Study area

The study was carried out in Khagdohor *union* of Mymensingh *Sadar upazila* (sub-district) under Mymensingh district in Bangladesh (Figure 1). The *upazila* occupies an area of 388.45 km$^2$ and located between 24°38' and 24°54' north latitudes and between 90°11' and 90°30' east longitudes. Mymensingh district is very prominent area for rice production and consisted of 13 sub-districts. According to *upazila* agriculture office, among these sub-districts, Mymensingh *Sadar upazila* has been selected purposively for investigation as rice cultivation is more in this sub-district than the others along with utilization of pesticides at a maximum rate.

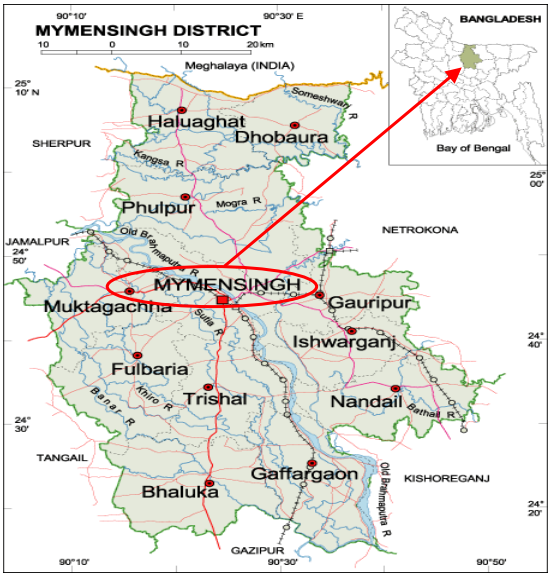


Figure 1: Map showing the study area

### Population, sampling, data collection and analysis

According to the list collected from agriculture office of the Mymensingh *Sadar upazila*, there were a total of 1000 rice farmers in Khagdohor *union*, constituted the population of the study. However, 100 rice farmers (10% of total population) were selected randomly for the survey. Data were collected during March-April, 2018 through face to face interviews by using a structured interview schedule. Alongside, two focus group discussions (FGDs) with 20 rice farmers (10 in each session) were conducted using an open-ended questionnaire. The outputs of the FGDs were used to refine the interview schedule as well as to interpret the results. The survey instrument was pre-tested with 15 respondents (who did not participate in the final survey) to identify the inconsistencies, and modified accordingly. The first section of the interview schedule consisted of socio-economic characteristics of the rice farmers, and the second section consisted of farmers' perception on occupational risk exposure to pesticides in the study area.

The rice farmers' perception on occupational risk exposure to pesticides was measured by using a five-point Likert scale (Rensis, 1932). There were total twenty (20) statements as identified from FGDs and available literature which were divided into four dimensions such as handling (transportation, mixing), application, storage and disposal, and human health and biodiversity. The positive and negative statements were arranged randomly in the schedule in order to obtain the real picture of risks of pesticides. The respondents were asked to indicate for each of the statements, whether they strongly agree, agree, undecided, disagree and strongly disagree with a corresponding score of 4, 3, 2, 1 and 0, respectively for the positive statements and vice versa for the negative statements. Hence, the scale score ranged from 0 to 80, where 0 indicates high level of perception by the rice farmers and 80 indicates no perception on occupational risk exposure to pesticides. Extent of rice farmers' perception on occupational risk exposure to pesticides was measured by computing total score of the twenty individual statements (Equation 1 for positive statements and Equation 2 for negative statements).

$$\text{Total score} = (R_{sa}\times 0) + (R_a\times 1) + (R_u\times 2) + (R_d\times 3) + (R_{sd}\times 4) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{Total score} = (R_{sa}\times 4) + (R_a\times 3) + (R_u\times 2) + (R_d\times 1) + (R_{sd}\times 0) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, $R_{sa}$ = number of responses strongly agree with risk perception, $R_a$ = number of responses agree with risk perception, $R_u$ = number of responses undecided with risk perception, $R_d$ = number of responses disagree with risk perception, and $R_{sd}$ = number of responses strongly disagree with risk perception

Therefore, the total score of individual statement could range from 0 to 400, where 0 indicates high level of perception by the rice farmers and 400 indicates no perception on occupational risk exposure to pesticides.

The Statistical Package for Social Sciences (SPSS) version 20 and Microsoft Excel version 13 was used for data management. The socio-economic characteristics of the respondents were measured with descriptive statistics: mean, standard deviation (SD), and percentage. Descriptive statistics help to explain the characteristics and basic features of the respondents in a study (Fraenkel *et al.*, 2012). Pearson's Product Moment Correlation coefficient (r)

(Pearson, 1895) was used for testing the relationship between the socio-economic characteristics and rice farmers' perception on occupational risk exposure to pesticides (Equation 3).

$$r_{xy} = \frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum(x_i-\bar{x})^2 \sum(y_i-\bar{y})^2}} \quad \ldots\ldots (3)$$

Where,

$r_{xy}$ = Pearson's product-moment correlation coefficient

$\bar{x}$ and $\bar{y}$ = Means of the variables x and y, respectively

## Results and Discussion

### Socio-economic characteristics of the rice farmers

Table 1 represents the socio-economic characteristics of the respondents. Among 100 rice farmers, majority of the respondents (44%) were middle aged followed by old (34%). The highest proportion of the rice farmers (52%) was illiterate compared to 14% primary and 27% secondary level of education. According to Ogunmefun and Achike (2017), the educational level of the farmers influences farm management ability and adoption of any technology. About half of the respondents (50%) had medium sized household compared to large (41%). The large household size eases labor constraints leading to increase in production (Onyenweaku and Nwaru, 2005). The majority of the rice farmers (75%) belonged to small sized farm in the study area. Approximately more than half of the respondents (55%) had medium annual income followed by high income category (25%). The findings indicate that the highest proportion of the rice farmers (79%) had medium to high farming experience (Table 1). Farmers with high experience can predict farm production and market situation (Olaoye *et al.*, 2013). About half of the respondents (50%) had low organizational participation followed by no participation (34%). Majority of the rice farmers (59%) had received no training and about 50% of them had medium extension media contact followed by low contact (43%). More than four-fifths of the respondents (84%) used their own pesticide applicator to apply pesticides in the rice field. The majority of the rice farmers (77%) had medium to high perception on the use of pesticides in the study area.

**Table 1. Socio-economic characteristics of the rice farmers (n= 100)**

| Socio-economic characteristics | Percentage | Mean | SD* |
|---|---|---|---|
| **Age (years)** | | | |
| Young (18 to 35) | 22 | 48.94 | 14.62 |
| Middle aged (36-55) | 44 | | |
| Old (above 55) | 34 | | |
| **Level of education (years)** | | | |
| No schooling (0) | 52 | 3.98 | 4.76 |
| Primary (1-5) | 14 | | |
| Secondary (6-10) | 27 | | |
| Higher secondary (above 10) | 7 | | |
| **Household size (number)** | | | |
| Small (up to 4) | 9 | 6.25 | 1.89 |
| Medium (5-6) | 50 | | |
| Large (above 6) | 41 | | |
| **Farm size (hectares)** | | | |
| Marginal (0.05-0.20) | 9 | 0.70 | 0.61 |
| Small (0.21-1) | 75 | | |
| Medium (1.1-3.0) | 13 | | |
| Large (above 3.0) | 3 | | |
| **Annual income (000 tk.)** | | | |
| Low (up to 60) | 20 | 135.33 | 95.34 |
| Medium (61-170) | 55 | | |
| Large ( above 170) | 25 | | |
| **Farming experience (years)** | | | |
| Low (0-15) | 21 | 28.05 | 13.11 |
| Medium (15-35) | 50 | | |
| High (above 36) | 29 | | |
| **Organizational participation (score)** | | | |
| No participation (0) | 34 | 2.55 | 2.16 |
| Low (1-4) | 50 | | |
| Medium (5-8) | | | |
| High (above 8) | 16 | | |
| **Training received (days)** | | | |
| No (0) | 59 | 3.31 | 6.17 |
| Medium (1-7days) | 21 | | |
| Long (above 7days) | 20 | | |
| **Extension media contact (score)** | | | |
| Low (up to 10) | 43 | 12.27 | 4.63 |
| Medium (11-20) | 50 | | |
| High (above 20) | 7 | | |
| **Ownership of pesticide applicators (score)** | | | |
| Hired (0) | 16 | 0.83 | 0.38 |
| Self (1) | 84 | | |
| **Perception on the use of pesticides (score)** | | | |
| Low (0-10) | 23 | 15.66 | 5.21 |
| Medium (11-20) | 56 | | |
| High (above 20) | 21 | | |

SD* Standard Deviation

### Extent of rice farmers' perception on occupational risk exposure to pesticides

The extent of rice farmers' perception on occupational risk exposure to pesticides has been presented in the Table 2. More than half of the respondents (57%) had medium level of perception, while 27% had low and 16% had high level of perception on occupational risk exposure to pesticides. The findings reveal that majority of the rice farmers (73%) had medium to high level of perception on occupational risk exposure to pesticides in the study area.

**Table 2. Extent of rice farmers' perception on occupational risk exposure to pesticides (n=100)**

| Category | Respondents (%) | Mean | Standard deviation |
|---|---|---|---|
| High (up to 27) | 16 | 45.47 | 13.58 |
| Medium (28 to 54) | 57 | | |
| Low (above 54) | 27 | | |

**Table 3. Extent of rice farmers' perception on occupational risk exposure to pesticides according to their opinions on four dimensions of pesticides utilization**

| Occupational exposure | Categories | Respondents (%) | Mean | SD* |
|---|---|---|---|---|
| **Handling (transportation, mixing)** | High risk (up to 7) | 5 | 12.90 | 3.65 |
| | Medium risk (8-14) | 54 | | |
| | Low risk (above 14) | 41 | | |
| **Application** | High risk (up to 7) | 11 | 12.45 | 4.01 |
| | Medium risk (8-14) | 56 | | |
| | Low risk (above 14) | 33 | | |
| **Storage and disposal** | High risk (up to 7) | 55 | 7.51 | 4.89 |
| | Medium risk (8-14) | 34 | | |
| | Low risk (above 14) | 11 | | |
| **Human health and biodiversity** | High risk (up to 7) | 5 | 12.55 | 2.82 |
| | Medium risk (8-14) | 64 | | |
| | Low risk (above 14) | 31 | | |

SD* Standard Deviation

The extent of rice farmers' perception on occupational risk exposure to pesticides according to their opinions on four dimensions of pesticides utilization (handling, application, storage and disposal, and human health and biodiversity) has been presented in the Table 3.

**Handling (transportation, mixing) stage**

The results indicate that the highest proportion of the rice farmers (54%) had medium level of perception compared to 41% low and 5% high level of perception on occupational risk exposure to pesticides in handling stage (transportation, mixing) (Table 3). This may occur due to lack of knowledge and experience on handling (transportation, mixing) of pesticides of the rice farmers.

**Application stage**

The findings imply that more than half of the respondents (56%) had medium level of perception followed by 33% low and 11% high level of perception on occupational risk exposure to pesticides in application stage in the study area (Table 3). Lack of interest of the rice farmers to contact with different information sources and follow the right way of application of pesticides may lead to the aforesaid results.

**Storage and disposal stage**

The results show that majority of the rice farmers (55%) had high level of perception compared to 11% low and 34% medium level of perception on occupational risk exposure to pesticides in storage and disposal stage (Table 3). Lack of knowledge and experiences about proper way of storage and disposal of pesticides may be the possible reasons of the above findings.

**Human health and biodiversity stage**

The findings indicate that the highest proportion of the respondents (64%) had medium level of perception followed by 31% low and 5% high level of perception on occupational risk exposure to pesticides in human health and biodiversity stage (Table 3). That may happen due to lack of courage to know about risks of pesticides on human health and biodiversity.

**Rank order of the dimensions of pesticides utilization (handling, application, storage and disposal, and human health and biodiversity)**

Table 4 represents the rank order of the dimensions (20 statements) of pesticides utilization (handling, application, storage and disposal, and human health and biodiversity) by the rice farmers. A total score was computed and denoted in rank order (Table 4).

**Rank order of handling (transportation, mixing) stage**

The findings show that eating, drinking or smoking could be done during mixing and loading, with a total score of 318, was the first ranked perceived risk by the rice farmers on occupational exposure to pesticides (Table 4) and 57% of the farmers were disagreed with the statement. This may be due to the fact that the rice farmers get necessary information and other services related to their farming activities which help to increase their perception on occupational risk exposure to pesticides. Handling of pesticides could be carried out without gloves or masks or any other forms of personal protective equipment (total score = 187) was the last ranked perceived risk by the rice farmers on occupational exposure to pesticides (Table 4). The results indicate that there is lack of knowledge about protective measures during handling of pesticides among the rice farmers in the study area.

**Table 4. Rank order of the dimensions of pesticides utilization (handling, application, storage and disposal, and human health and biodiversity)**

| Statements | Extent of responses | | | | | Total score | Rank order |
|---|---|---|---|---|---|---|---|
| | SA | A | UD | D | SD | | |
| **Handling (transportation, mixing)** | | | | | | | |
| Eating, drinking or smoking could be done during mixing and loading (-) | 0 | 7 | 2 | 57 | 34 | 318 | 1 |
| Loading of pesticides is done with other materials especially with food (-) | 0 | 8 | 7 | 57 | 28 | 305 | 2 |
| Mixing is not done in enclosed place or where there is lack of sufficient ventilation (+) | 14 | 61 | 17 | 8 | 0 | 281 | 3 |
| During transportation pesticides could be directly contacted with the hand or the body (+) | 0 | 49 | 9 | 34 | 8 | 199 | 4 |
| Handling of pesticides could be carried out without gloves or masks or any other forms of personal protective equipment (-) | 26 | 23 | 0 | 40 | 11 | 187 | 5 |

| Statements | Extent of responses | | | | | Total score | Rank order |
|---|---|---|---|---|---|---|---|
| | SA | A | UD | D | SD | | |
| **Application** | | | | | | | |
| After applying pesticides more time should be taken to change clothes or to take bath (-) | 0 | 4 | 2 | 82 | 12 | 302 | 1 |
| Eating on the field or anywhere just after the application of pesticides can be done (-) | 1 | 21 | 10 | 37 | 31 | 276 | 2 |
| Personal protection equipment (mask, glove, cloth etc.) are used during pesticide application (+) | 9 | 52 | 2 | 28 | 9 | 224 | 3 |
| Application of pesticides are done through label instruction or knowledge gained from extension officers (+) | 17 | 39 | 3 | 31 | 10 | 222 | 4 |
| During application wind direction need not to be followed to avoid inhalation of pesticides (-) | 1 | 34 | 10 | 52 | 3 | 222 | 5 |
| **Storage and disposal** | | | | | | | |
| Pesticide store house can be also used for storing food, fire wood, farming equipment and kitchen utensils (-) | 0 | 30 | 13 | 46 | 11 | 238 | 1 |
| Empty containers or remaining pesticides must be buried or burnt away from the locality (+) | 17 | 28 | 1 | 38 | 16 | 192 | 2 |
| Empty containers of pesticides or remaining pesticides can be disposed in open place or near the field (-) | 35 | 25 | 0 | 24 | 16 | 161 | 3 |
| Unused pesticides and sprayers are stored in separate store house (+) | 0 | 16 | 7 | 38 | 39 | 100 | 4 |
| Clothes and pesticides equipment after spraying can be washed in river or irrigation canal (-) | 62 | 27 | 2 | 6 | 3 | 61 | 5 |
| **Human health and biodiversity** | | | | | | | |
| Pesticides do not kill target or non-target organisms (snakes, worms, insects, mud skippers etc.) (-) | 0 | 1 | 0 | 60 | 39 | 337 | 1 |
| During performing any activity related to pesticides it is common that pesticides are entered into the body by inhalation (+) | 13 | 69 | 13 | 5 | 0 | 290 | 2 |
| Different health problems are faced during spraying of pesticides(+) | 5 | 54 | 18 | 23 | 0 | 241 | 3 |
| Skin absorption could be the most common route of poisoning than inhalation among the applicators (-) | 10 | 32 | 8 | 50 | 0 | 198 | 4 |
| Body discomfort conditions include nausea and vomiting, weakness, blindness, irritation etc. could not be faced by the applicator after application of pesticides (-) | 1 | 49 | 6 | 44 | 0 | 193 | 5 |

SA=Strongly Agree; A=Agree; UD=Undecided; D=Disagree; SD=Strongly Disagree

**Rank order of application stage**

It is evident from the Table 4 that after applying pesticides more time should be taken to change clothes or to take bath, with a total score of 302, was the first ranked perceived risk by the rice farmers on occupational exposure to pesticides and 82% of the farmers were disagreed with the statement. Therefore, farmers of the study area had low risks of occupational exposure to pesticides during this type of activities. During application wind direction need not to be followed to avoid inhalation of pesticides (total score = 222) was the last ranked perceived risk by the rice farmers on occupational exposure to pesticides (Table 4). This may be due to lack of knowledge about wind direction during application of pesticides.

**Rank order of storage and disposal stage**

The results reveal that pesticide store house can be also used for storing food, fire wood, farming equipment and kitchen utensils (total score = 238) was the first ranked perceived risk by the rice farmers on occupational exposure to pesticides (Table 4) and 46% of the farmers were disagreed with the statement. The findings may be due to that the rice farmers were conscious about contamination of food and other materials with pesticides. Clothes and pesticides equipment after pesticide spraying can be washed in river or irrigation canal, with a total score of 61, was last ranked perceived risk by the rice farmers on occupational exposure to pesticides (Table 4). Lack of knowledge about the cleaning or washing the pesticide equipment and less concerned about the pollution of river or irrigation water may lead the farmers to perform above mentioned activities.

**Rank order of human health and biodiversity stage**

It is evident from the Table 4 that pesticides do not kill target or non-target organisms such as snakes, worms, insects, mud skippers etc., with a total score of 337, was the first ranked perceived risk by the rice farmers on occupational exposure to pesticides and 60% of the farmers were disagreed with the statement. The findings may be due to that the rice farmers had seen to die different useful insects. Body discomfort conditions include nausea and vomiting, weakness, blindness, irritation etc. could not be faced by the applicator after application of pesticide (total score = 193) was the last ranked perceived risk by the rice farmers on occupational exposure to pesticides (Table 4). The findings indicate that the rice farmers had least knowledge about the specific health problems in the study area.

**Relationships between socio-economic characteristics and rice farmers' perception on occupational risk exposure to pesticides**

Table 5 represents the summary of relationships between focus and explanatory variables. The findings demonstrate that nine (9) out of eleven (11) explanatory variables such as education, household size, farm size, annual income, organizational participation, training received, extension media contact, type of pesticide applicators, and perception on the use of pesticides were found significantly associated with the focus variable i.e. rice farmers' perception on occupational risk exposure to pesticides.

**Table 5. Summary of the correlation analysis (n=100)**

| Focus variable | Explanatory variables | Correlation Coefficients (r) |
|---|---|---|
| Rice farmers' perception on occupational risk exposure to pesticides | Age | -0.113 |
| | Level of education | 0.667** |
| | Household size | -0.229* |
| | Farm size | 0.543** |
| | Annual income | 0.470** |
| | Farming experience | -0.123 |
| | Organizational participation | 0.564** |
| | Training received | 0.631** |
| | Extension media contact | 0.718** |
| | Ownership of pesticide applicators | -0.473** |
| | Perception on the use of pesticides | 0.811** |

df = degrees of freedom (98), * Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed)

Level of education shows a positive and significant relationship (r = 0.667) with the rice farmers' perception on occupational risk exposure to pesticides (Table 5). The findings indicate that educated farmers have more perception on occupational risks exposure to pesticides because they know various adverse effects of pesticides application in rice cultivation. Ali (2012), Jahan *et al.* (2017) and Shanto (2011) found similar findings in their respective studies. The negative and significant correlation between household size and farmers' perception (r = -0.229) clearly indicates that when the household size of rice farmers are large, the perception on occupational risk exposure to pesticides becomes poor as they are busy with their family maintenance and have less time to think about the risks of pesticides. Table 5 shows a positive and significant relationship (r = 0.543) between farm size and rice farmers' perception on occupational risk exposure to pesticides. Jahan *et al.* (2017) and Shanto (2011) found similar relationship between the concerned variables.

The positive and significant relationship (r = 0.470) between annual income and rice farmers' perception reveal that with the increase of income, the rice farmers' perception on occupational risk exposure to pesticides also increases due to their improved socio-economic condition and standard of living (Table 5). The findings show a positive and significant correlation between organizational participation and rice farmers' perception (r = 0.564), obviously suggest that high organizational participation rises the rice farmers' perception on occupational risk exposure to pesticides as they learn new idea and gain positive thinking from different organizations. Our findings are supported by Shanto (2011). Table 5 shows a positive and significant relationship (r = 0.631) between training received and rice farmers' perception on occupational risk exposure to pesticides. Ali (2012) found that farmers had significant relationship between training exposure and their knowledge on health and environmental perspectives of pesticide exposure.

Extension media contact reveals a positive and significant relationship (r = 0.718) with the rice farmers' perception which may mean that with the increase of extension media contact, rice farmers' perception on occupational risk exposure to pesticides also increases as they gain necessary knowledge and information about harmful effect of pesticide from different extension media (Table 5). Ali (2012) and Shanto (2011) found similar relationships in their respective studies. The negative and significant correlation between ownership of pesticide applicators and rice farmers' perception (r = -0.473) clearly indicates that the rice farmers without pesticide applicators are likely to have least level of perception on occupational risk exposure to pesticides in the study area. Table 5 shows a positive and significant relationship (r = 0.811) between perception on the use of pesticides and rice farmers' perception on occupational risk exposure to pesticides, suggests that the rice farmers had clear perception on the use of pesticides and they also possess a strong idea on occupational risk exposure to pesticides in the study area. Jahan *et al.* (2017) found similar results in her study.

## Conclusions

From the study, it is evident that the rice farmers in the study area assess a number of occupational risks exposure to pesticides, of which, 'eating, drinking or smoking could be done during mixing and loading'; 'after applying pesticides more time should be taken to change clothes or to take bath'; 'pesticide store house can be also used for storing food, fire wood, farming equipment and kitchen utensils'; and 'pesticides do not kill target or non-target organisms (snakes, worms, insects, mud skippers etc.)' were significant. The degree of perception is further determined by the socio-economic characteristics of the rice farmers. Lack of training and low access to extension services are likely to be vital determinants that the farmers addressed during the survey. However, proper attempts by the extension personnel could limit this weakness. Several factors such as education, household size, farm size, annual income, organizational participation, training received, extension media contact, ownership of pesticide applicators, and perception on the use of pesticides of the rice farmers were found to be associated with the rice farmers' perception on occupational risk exposure to pesticides. This indicates an opportunity to work on those features to the risks of the farmers. Therefore, it is highly recommended that there is a need for continuous pesticide safety education along with training to the farmers regarding the use of personal protective devices, personal hygiene and sanitation practices during and after application of pesticides. In addition, the supervisory mechanism and environmental monitoring systems for pesticides need to be strengthened on safety use of pesticide regarding environment and human health.

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