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# Assessing farmers' awareness towards climate change in the middle part of Bangladesh

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## Abstract

Climate change is known to have a severe influence on agriculture, posing a serious danger to the food security and livelihoods of rural people, hence, public understanding about climate change must be encouraged in order to facilitate mitigation and adaptation strategies. Therefore, the main purpose of this study was to determine farmers' awareness towards climate change. The study was conducted in three villages of Sadar upazila of Gazipur district (middle part) of Bangladesh. A total number of 110 farmers were selected as sample following proportionate random sampling technique. The findings of the study revealed that about 65% farmers were in between 30 to 50 years with secondary to SSC level of education (72%) and had '5 to 6' members of family size. For acquiring extension information, the farmers mainly communicated with SAAOs and seed dealers. Out of all the respondent farmers, 83% had their own land for cultivating different types of crops, and 86% of them received 1 to 6 no. of agriculture related training, although 98% of them did not involve themselves to receive any website help for conducting better agricultural activities. Moreover, 83% farmers had moderately to highly favorable awareness to climate change (both causes and effects). In addition, out of the selected attributes, three attributes, namely, age, agricultural training received, and knowledge on climate change had significant contribution on the awareness to climate change. The study provided new empirical evidence on the awareness level of farmers to climate change on agriculture, in general. The findings of the study can be utilized by the policy makers of the country to formulate proper mitigation and adaptation options to future climate change and its' impact on agriculture.

**Keywords:** Assessment, climate change causes, climate change effects, farmers' awareness, middle part of Bangladesh, socio-demographic factors.

## Introduction

Bangladesh is an unpredictable country due to climate risks (Khan & Elahi, 2015). The country is regularly stricken by extreme weather and calamities, like, monsoon flooding, drought or shortage of water during dry seasons; suffers from cyclones and storms, also with changing groundwater depletion (Hossain et al., 2020a; Hossain et al., 2020b). Presence of floodplains is the dominant land mass of the country and 60% of the whole country is susceptible to extreme flooding (Shahen, 2020). As an agrarian as well as highly populous country of the world (Hasan et al., 2015; Hasan et al., 2017a; Hasan et al., 2017b; Hossain and Hasan, 2018; Hasan and Sultana, 2011), in Bangladesh agriculture shares 13.35% of the GDP and 40.6% of the labor force. Although, the agriculture sector, mostly the crops yield of the country is highly affected by extreme climate change like, flooding, drought and cyclones (Hossain et al., 2020b; MOEF, 2005) and also in future the extreme climatic events (like, drought) will also influence on crop yields (Prodhan et al., 2022).

Bangladesh is trying to become self-sufficient in food security and especially after natural disasters, sufficient climate change adaption measures must be implemented within the agricultural sector (Ayers et al., 2014). Findings from different researchers (like, Manoj, 2017; Alam et al., 2017) indicated that implementation of different adaptation practices into the farmers field produced positive results for farms and income of the farmers. In this connection, smallholder farmers are currently experiencing the effects of climate change which help them to think to adapt diverse strategies. Meanwhile, Somda et al., (2017) indicated that adaptation planning was interconnected to farmers' awareness about climate change and a good understanding of climate change is essential for the farmers to implement appropriate adaptation strategies.

Few previous studies have indicated that most of the farmers perceive the climate as changing, and correspondingly adapt to reduce the negative impacts of climate change (Thomas et al., 2007; Ishava & Abaje, 2008; Mertz et al., 2009). Some other studies further showed that awareness to cause and effect of climate change (Semenza et al., 2008; Sampei & Aoyagi-Usui, 2009; Akter & Bennett, 2011) and the adoption of adaptive measures (David, 2007; Hassan & Nhemachena, 2008) are influenced by different socio-economic factors. Findings of Ricart et al., (2019) exhibited that factors like personal experience, local knowledge, familiarity, and social-learning exchanges between farmers and the public may help to boost mutual understanding and to reduce agricultural systems vulnerability. However, farmers awareness and sustainable development within the Bangladeshi agricultural sector hinges upon farmer's belief, awareness, and knowledge regarding climate change, and their resulting present and future planning in view of our changing climate.

We conducted the current study in Gazipur district (the middle part of the country) of Bangladesh. The agriculture of Bangladesh is affected badly by extreme climatic events, like, extreme temperature, droughts, floods and cyclones and which ultimately affected the food security of the country (Miah et al., 2016; Rahman et al., 2016). Nonetheless, most parts of the country are more or less affected due to climate change and the middle part of the country is not different from that and this part is sensitive due to both geo-climatic (mainly floods) and anthropogenic pressure (Rahman et al., 2016; Abdullah et al., 2015). Rice production into this area is greatly hampered due to climatic variability, mainly by flash floods. The selected areas of Gazipur are susceptible to facing adverse climate conditions in recent years, demanding that measures are taken to better understand and address this issue although they don't have enough carefulness on its' deeper consequences. In these moments of crisis, farmers have utilized locally acquired knowledge to engage in small scale awareness, adaptation practices and production

diversification as strategies to mitigate the impact of existing climate conditions. To address this critical issue properly, we took the local farming communities' recognition and awareness of climate change and evaluated the socioeconomic factors that affected on climate change awareness of those farmers. We achieved these targets by conducting survey research comprising of 110 farmers in Gazipur Sadar upazila (lower administrative unit of Bangladesh) of Gazipur district.

## Method and study area

### *Research design and sample*

We followed descriptive survey research design to undertake this research. That means we designed the study to examine the awareness of the farmers towards climate change and also to ascertain several sociodemographic characteristics of the farmers which affected on their awareness of climate change. We then administered face to face interview through interview schedule to collect relevant data from the farmers. The study was undertaken in three purposively selected villages, namely Bikebari, East Dogori and Taltoli of Mirzapur union of Sadar upazila of Gazipur district in Bangladesh due to its relevance of climate change mainly flooding. Total number of farmers of the three villages were 611 which were considered as the population of the study. Out of which we took 110 (19%) respondents as sample following proportionate random sampling technique.

### *Selection of variables and their measurement*

Based on previous review (like, Chakma et al., 2021; Ghosh & Hasan, 2013; Hasan et al., 2021; Ibrahim et al., 2015; Raghuvanshi et al., 2017; Saha et al., 2021; Suza et al., 2021) we took nine (09) variables as independent variable of this study. The variables were the farmers age, family size, farmer type, educational attainment, family annual income, extension media communication, training received on agriculture, knowledge on climate change, and taking website help.

### *Measurement of independent variables*

Age of the respondent was meant here as the time from birth to the time of interview and we assigned a score of one (1) to each year of age. Educational attainment was judged in terms of formal education obtained by a respondent and we allocated a score of one (1) for each year of passing of the respondent in any formal educational institution. Moreover, the respondents who could not read and write was assigned a score of zero (0). We measured family size by putting a score of one (1) for each member of the family who jointly live and ate together. We classified the farmer type variable by taking the land as a basic unit and allotted a score of one (1), two (2) and three (3) to who had own land, tenant and both type of farmers, respectively. We computed the extension media communication by assigning different scores against different extension communication sources by the respondents, like, communication with Sub Assistant Agriculture Officers (SAAOs), contact with seed dealers, contact with others of agricultural offices and contact with others like NGO workers, visit to research station, visit to demonstration plot, visit to agriculture related exhibition etc. Family annual income of the respondents was computed on the basis of total earnings from various sources, like, agriculture, service, business and others and these were expressed in BDT (Bangladeshi Taka). We computed the agricultural training receive variable of the respondents by giving score of one (1) for each day of agriculture related training

received of a respondent from different agriculture related organizations. Respondents' knowledge on causes and effects of climate change as an independent variable was calculated after giving scores against 17 questions (08 for climate change causes and 09 for climate change effects) asked to the respondents. We assigned a score of '2' for correct answer, '1' for partially correct answer and '0' for incorrect answer for each question. We wanted to recognized whether the respondents were taking help from website/internet for agricultural information and provided a of one (1) for 'no' and two (2) for 'yes' response.

*Measurement of dependent variable*

We considered farmers' awareness towards climate change as the dependent variable of this research. Accordingly, the respondents were asked to give their responses on awareness regarding 27 statements related to climate change (both 12 statement on causes and 15 statements on effects). Moreover, out of these 27 statements 16 statements were positive and the rest 11 statements were negative which we arranged randomly. For measuring the level of agreement, we took a five-point Likert-type scale, as, strongly agree, agree, undecided, disagree, and strongly disagree for positive statements and the reverse score was assigned for negative statements (Salawat et al., 2013; Ghosh & Hasan 2013; Chouichom & Yamao, 2010; Saha et al., 2021; Hasan et al., 2018; Hasan et al., 2017a; Hasan et al., 2015).

*Measuring the respondent's climate change awareness*

We constructed the climate change awareness index (CCAI) through a simple two step procedures considering the following formula 1:

$$CCAI=\sum_{j=1}^{7},\ \sum_{m=0}^{5},\ \sum_{q=0}^{1} E_j R_m W_q \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

A total number of 27 climate change causes and effects were read to sample respondents and were asked their opinion (Ej). These 27 statements were selected on the basis of prior discussion and pretesting of the interview schedule. We then assigned a value of 1 for each recognized causes and effect, and if not assigned 0. In the second step, the respondents were asked to expose their opinion on a five-point scale (Rm), hence, they were assigned a score of 5 for each strongly agree opinion and 1 was assigned for each strongly disagree opinion. After that, we converted these ranks into weighted score (Wg). We assigned 02 to the lowest rank of 1 and 1 was assigned to the highest rank of 5. While, the CCAI for each of the respondents was calculated by summing up the weighted score of the climate change indicators. This formulation and equation were also followed by Rahman (2005) and Ibrahim et al., (2015).

*Multiple linear regression procedure*

To determine the attributes influencing the respondents' awareness towards climate change (both causes and effects), we administered a total number of six independent variables (age, family size, educational attainment, family annual income, agricultural training received and knowledge on climate change) to full-model regression analysis. We administered the linear regression model due to the nature of the dependent variable as because, the respondents were still unaware of the

climate change although it was changing. Therefore, the latent equation (equation 2) which was utilized in this study were:

$$y=\beta_o+\beta_1 x_1+ \beta_2 x_2+\ldots\ldots\ldots\ldots+ \beta_6 x_6+\varepsilon\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where, $y$ was the dependent variable, $\beta_0$ was the intercept, $\beta_{1\text{-}6}$ was the coefficient, and $x_{1\text{-}6}$ was the independent variables.

The independent variables that influenced on the respondents' awareness to climate change were as follows:

$X_1$ = Age of the respondents in years;

$X_2$ = Family size of the respondents in numbers;

$X_3$ = Educational attainment of the respondents in years;

$X_4$ = Family annual income of the respondents in BDT;

$X_5$ = Respondents agricultural training received;

$X_6$ = Respondents knowledge score on climate change.

After collecting all necessary data from the respondents, we categorized and classified the data according to the objectives of study in view. We also performed the multiple regression analysis (based on equation 1) with 0.05 and 0.01 level of significance to determine the attributes influencing the respondents' awareness towards climate change. We took 06 independent variables (like, respondents' age, family size, educational attainment, family annual income, agricultural training received and knowledge on climate change) to full-model regression analysis.

## Results and discussion

### *Demographic characteristics of the respondents*

Data displayed in the Table 1 indicated that about 67% respondents constituted 30 to more than 50 years aged category. The findings in this table also revealed that the average age of the respondents was about 47 years. Through a study conducted by Ibrahim et al., (2015) in Nigeria found similar types of results as average age of the respondents of 48 years. Meanwhile, in Bangladesh Saha et al., (2021) also found similar findings that the average age of the respondents was 46.22 years. Moreover, Hasan et al., (2017a) concluded that younger respondents generally had broader viewpoint as well as had more social and mass media contact than that of the older people. It was interesting to notice that cent percent respondents of the study area were literate and about 72% of them had secondary to above SSC level of education which provided a good improvement of education sector of Bangladesh. Findings from Table 1 exhibited that about 98% of the respondents' family size were with 06 members although the average family size was 4.75. The average family size was higher than the national average of 4.06 (BBS, 2016). In Nigeria, Adekunle et al., (2012) concluded that large family size means more mouths to feed which required more exploitation of different types of resources and services.

**Table1.** Socio-demographic characteristics of the respondents

| Variable | Category | Frequency | Percentage | Mean |
|---|---|---|---|---|
| Age | Less than 30 | 2 | 2.20 | |
| | 30 to 40 | 26 | 23.30 | |
| | 41 to 50 | 45 | 41.20 | 46.64 |
| | More than 50 | 37 | 33.30 | |
| Educational attainment | Illiterate | 0 | 0 | |
| | Primary (class 1 to 5) | 16 | 14.5 | |
| | Secondary (class 6 to 8) | 43 | 38.9 | |
| | SSC (class 9 to 11) | 37 | 33.3 | |
| | Above SSC (> class 11) | 14 | 13.3 | |
| Family size | Less than 4 | 44 | 40.00 | |
| | 5 to 6 | 64 | 57.80 | 4.75 |
| | More than 6 | 2 | 2.20 | |
| Occupation | Agriculture | 77 | 70 | |
| | Business | 24 | 22.2 | -- |
| | Job | 9 | 7.8 | |
| Land ownership | Own land | 92 | 83.3 | |
| | Tenant | 18 | 16.7 | |
| | Both | 0 | 0 | |
| Family annual income (BDT) | Less than 200000 | 4 | 3.3 | |
| | 200000.01 to 300000.0 | 24 | 22.2 | |
| | 300000.01 to 400000.0 | 49 | 44.5 | 377888.89 (BDT) |
| | More than 400000.01 | 33 | 30 | |
| Website help | Yes | 2 | 2.2 | |
| | No | 108 | 97.8 | |
| Extension media Communication | SAAOs | 58 | 52.8 | |
| | Seed dealer | 48 | 43.7 | |
| | Agril. Office others | 3 | 2.2 | |
| | NGO workers | 1 | 1.3 | |
| Training on agriculture | No training (0) | 14 | 12.2 | |
| | Training 1 to 3 | 49 | 44.5 | |
| | Training 4 to 6 | 45 | 41.1 | 2.90 |
| | Training more than 6 | 2 | 2.2 | |
| Knowledge on climate change | 90% and above correct knowledge (>34) | 0 | 0.0 | |
| | 80% and above correct knowledge (30-33) | 4 | 3.7 | 25.78 |
| | 70% and above correct knowledge (26-29) | 59 | 53.7 | |
| | 60% and above correct knowledge (22-25) | 41 | 37.0 | |
| | Less than 60% correct knowledge (<22) | 6 | 5.6 | |

We observed that in the study area agriculture (70%) was the main occupation of the respondents and about 83% of them performed agricultural operation in their own land. Also, about 17% respondents were tenant. Although in Bangladesh, the percentages of owner, owner cum tenant and tenant farmers are 65%, 22% and 13%, respectively (BBS, 2011). The family annual income of the respondents ranged from BDT 180000 to 660000 and the average was BDT 377888. According to Economic Census 2020, the per capita income is more than BDT 165200. Hence, two-third (75%) of the respondents were in between BDT 300000 to more than BDT 400000 family annual income categories which indicated heterogeneous nature of family annual income. We observed in the study area that most of the respondents (97.8%) didn't take any website help for conducting farming activities/agricultural activities. The findings were not uncommon like many farmers of the country where the internet infrastructure is not so upgraded as same as the developed countries. The Sub Assistant Agriculture Officers (SAAOs) and the seed dealers were the main media of communication of the respondents and more than 96% of the respondents communicated with these two types sources to get agricultural extension related help. We observed that about 85% of the respondents received at least one to six training on different agriculture related issues. It is observed that training related to agriculture makes people more concerned about environment-related issues like climate change, adverse effects of human activities on the environment, etc. (Islam et al., 2019). Thus, farmers with a higher number of agriculture-related training perceive environmental awareness and climate change better than others. Knowledge and belief are two important factors in the adoption of climate change adaptation practices (Al-Mutairi et al., 2019). We asked a total number of 17 questions (as observed knowledge score was 17-30) to judge the knowledge of the respondents on climate change causes and effects. We then classified the respondents' knowledge into five categories on the basis of their correct answer on those 17 questions. We observed in the table that 90% respondents had 60% to 80% correct knowledge climate change issues. In a Bangladeshi study conducted by Ghosh et al., (2020) appealed that knowledge helped to increase individual's awareness, and mental alertness.

*Respondent's awareness index of causes and effects of climate change*

We calculated the mean of the individual climate change causes and effects awareness statements and ordered them in ranking (Table 2). From the data showing in the Table 2 revealed that the highest mean (1) was found in the statement, "increasing deforestation". This was followed by another three statements, like, "increasing agricultural land", "increasing use of polythene" and "increasing industrialization" ranked second. While, the other two statements, "increase use of chemical fertilizer" and "increasing brick kiln factories" took the third rank. Data portrayed in Table 2 also indicated that the overall index of climate causes was 0.88 that means most of the sampled respondents were aware of the causes of climate change. This validated the findings of Ibrahim *et al*., (2015) in Nigeria that deforestation was the main cause of climate change. Similarly, through his study on the public knowledge of climate change causes Henry De-Graft (2011) also found bush burning and deforestation as one of the major causes of climate change.

**Table 2.** Respondents awareness index of climate change (both causes and effects)

| | Mean | Rank |
|---|---|---|
| ***Indicators of climate change causes*** | | |
| Increasing deforestation | 1 | 1 |
| Increasing agricultural land | 0.99 | 2 |
| Increasing use of polythene | 0.99 | 2 |
| Increasing industrialization | 0.99 | 2 |
| Increase use of chemical fertilizer | 0.98 | 3 |
| Increasing brick kiln factories | 0.98 | 3 |
| Rapid growth of urbanization | 0.92 | 4 |
| Increasing heat emission | 0.88 | 5 |
| Increase use of nitrogen fertilizer | 0.84 | 6 |
| Increasing sedimentation on river bed | 0.84 | 7 |
| Increasing stubble burning | 0.66 | 8 |
| Increasing evaporation | 0.60 | 9 |
| *Overall index of causes of climate change* | 0.88 | |
| | | |
| ***Indicators of climate change effects*** | | |
| Increasing temperature | 0.99 | 1 |
| Decreasing wildlife | 0.99 | 1 |
| Destroying environmental balance | 0.97 | 2 |
| Frequently changing of daily temperature | 0.96 | 3 |
| Changing rainy season | 0.95 | 4 |
| Decreasing fertility and productivity of agril. land | 0.94 | 5 |
| Prolong droughts | 0.93 | 6 |
| Increasing flooding | 0.85 | 7 |
| Increasing duration of rainfall | 0.85 | 8 |
| Increasing desertification | 0.84 | 9 |
| Increasing rain density | 0.81 | 10 |
| Increasing sand content on soil | 0.79 | 11 |
| Gradually increase of relative humidity | 0.77 | 12 |
| Decreasing agricultural productivity | 0.38 | 13 |
| Decreasing parks and tourist spots | 0.32 | 14 |
| *Overall index of causes of climate effects* | 0.82 | |

When we calculated the mean of the respondents' individual climate change effects and arranged in rank order, we observed that, out of 15 statements, two statements, namely, "increasing temperature" and "decreasing wildlife" ranked 1st. These were followed by the statement, "destroying environmental balance" and "frequently changing of daily temperature" received the 2nd and 3rd rank, respectively. Meanwhile, overall index of climate change effects of the respondents was 0.82 again indicated an improved percentage of the sampled respondents' awareness of climate change effects. This was in line with the findings of Deressa et al., (2011) who conducted their study in the Nile basin, Ethiopia and the respondent farmers identified increasing temperature as one of the main climate change effects.

*Respondents overall awareness towards climate change*

We calculated the respondent's overall climate change awareness when both climate change causes and effects of the respondents were taken into consideration and categorized into three (Figure 1). The overall score was ranged from 109 to 120, with an average was 115.77. The findings in Figure 1 indicated that about 83% of the respondents possessed moderately to highly favorable awareness

towards climate change.

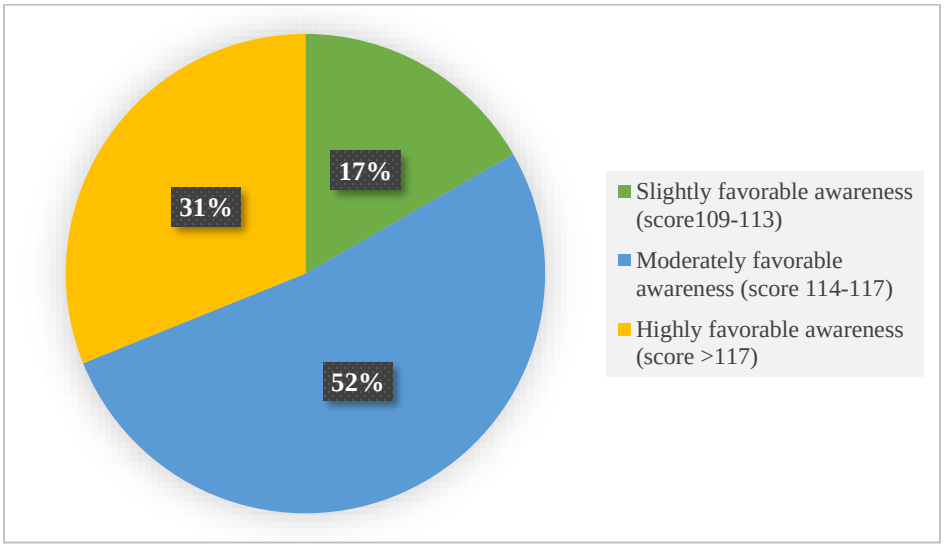


**Figure 1.** Distribution of the respondents according to overall awareness to climate change

Awareness of any man may be increased by his education, knowledge and awareness. Most of the respondents of the study area knew the cause and effects of climate change as we can observe from their awareness scores. Alotaibi et al., (2020) in Saudi Arabia also found similar types of findings, that was about 65% farmers had moderately belief about climate change. In another context of Saudi Arabia, Al-Mutairi et al., (2019) concluded that 74% of respondents had moderate levels of concern regarding the impacts of climate change. Meanwhile, in USA, Grimberg et al., (2018) found that 48.3% of farmers were concerned about climate change, while 86.7% reported being somewhat to very concerned about the impacts of climate change on agricultural production.

*Contribution of the selected characteristics of the respondents on their awareness towards climate change*

In the full-model regression analysis (Table 3), it was revealed that age, agricultural training received and knowledge of the respondents on climate change were found to have significant influence which meant higher the above-mentioned characteristic of the respondents distinguished climate change better than the other members. The $R^2$ value was 0.302, which revealed that 30.2% of the variation in the awareness towards climate change.

**Table 3.** Contribution of selected characteristics of the respondents on their overall awareness towards climate change

| Sl. No. | Variables | β | SE | t- value | *P* |
|---|---|---|---|---|---|
| 01. | Age | 0.093* | 0.055 | 1.683 | 0.099 |
| 02. | Family size | -0.046 | 0.475 | -0.097 | 0.923 |
| 03. | Educational Attainment | 0.313 | 0.247 | 1.267 | 0.212 |
| 04. | Family annual income | 0.488 | 0.591 | -0.880 | 0.549 |
| 05. | Agril. training received | 0.631** | 0.218 | 2.891 | 0.006 |
| 06. | Knowledge on climate change | 0.429** | 0.152 | 2.828 | 0.007 |

$R^2$=0.302, Adjusted $R^2$=0.224, F= 2.439 ** 1% LOS, * 10% LOS

We observed in Table 3 that age of the respondents showed a significant and positive influence on respondents' awareness towards climate change as the value of regression co-efficient (0.093) was significant at 10% level. Through a study, Mudombi et al. (2014) also found similar significant and positive influence of age on climate change awareness of the respondents in Zimbabwe. Similarly, through a study in Bangladesh, Ghosh et al. (2020) observed that age of the respondents had significant influence on sustainable agricultural practices. Meanwhile, the value of regression coefficient (β) of agricultural training received of the respondents was 0.631 which had significant influence on the awareness towards climate change. That means if the agricultural training could be increased among the local farmers then their awareness towards climate changes would be positively changed. Similar significant and positive relationship between agricultural training received and awareness of the respondents were also obtained by Saha et al. (2021). Consequently, in this study, we observed significant and positive influence of the respondents' climate change knowledge on their awareness as the 'β' value was 0.429. Similar type of significant contribution of knowledge on the attitude of the farmers towards using agrochemicals was also found by Hasan et al. (2015).

## Conclusion and recommendation

The finding of the study revealed that the respondents of the study area maintained moderately to highly favorable (83%) awareness towards climate change which indicated that they had good concern about climate change (both causes and effects). The respondents had good alertness on different climate change causes issues like increasing trends of deforestation, agricultural lands, use of polythene, industrialization etc. At the same time, they had good awareness about climate change effects like, increasing temperature, decreasing wildlife, destroying environmental balance etc. issues.

Among the selected characteristics of the respondents, age, agricultural training received, and knowledge on climate change had significant contribution on the farmers' awareness towards causes and effects of climate change. To increase more and more awareness of the respondents towards climate change, it is imperative to increase more age, arranging more agricultural training and more knowledge on climate change.

Training activities on agriculture and climate change can improve the awareness of the farmers. Hence, more agriculture and climate change related training programs as well as motivational program may be carried out for better output. The Department of Agricultural Extension (DAE), Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), and agricultural universities also can play a vital role on this issue. The findings of the study will be useful for planning and execution of climate change and agriculture policy of Bangladesh.

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