



Research Article

Crop Interventions and Farmers Livelihood Outcomes: A Case of Specific Wetland Areas in Bangladesh

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Abstract | Bangladesh Agricultural University Research System (BAURES) projects provide crop interventions such as training, suitable cropping patterns, and input provisions for the wetland farmers. This study was conducted to assess the extent to which the practice of those crop intervention influences farmers' livelihoods in Netrokona district of Bangladesh. It also identified the factors that impacted the livelihoods changes, and the challenges faced by the farmers when implementing crop interventions. The study was conducted in two villages under Mohanganj upazila (sub-district) of Netrokona district where 100 farmers were interviewed from April to May 2022 using a structured interview schedule. The primary focus variable i.e., the extent of changes in the livelihood of wetland farmers was assessed using a 3-point Likert scale. Multiple linear regression analysis was used to identify factors that made significant impacts on the livelihood changes of wetland farmers. The findings indicated that 64% of the farmers had a moderate change in their livelihood while about 36% had high changes. None of the farmers reported low changes in their livelihoods due to the practice of crop interventions. Among the selected characteristics of the farmers, level of education, annual family income, organizational participation, and media contact were identified as the influential factors affecting the livelihood change of the wetland farmers and these factors accounted for 65.8% of the observed variation in the study's focal issue. In terms of problems faced during the implementation of the crop interventions, 53% of the respondents reported facing medium-level problems. The most prominent problem reported by the respondents was 'lack of technical knowledge'. It is recommended that necessary steps, such as providing credit and training, to resolve these problems should be taken to ensure an improved quality of life for wetland farmers.

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Introduction

The human population on Earth is expected to escalate to over 9.2 billion by the year 2050

(Silva, 2020). Consequently, this will increase the demand for food production (Helin and Weikard, 2019). According to estimates, 13% of people in developing countries are undernourished, thus

making global food supply a burgeoning challenge (Pawlak and Kolodziejczak, 2020). In Bangladesh, agriculture supports the livelihoods of 61% of its 169.3 million people inhabiting rural areas (World Bank, 2020). As a result, the agriculture sector can significantly contribute to reducing poverty and guaranteeing food security (Dhahri and Omri, 2020) since for the rural population, it serves as their main source of employment (Gimenes and Lorin, 2020; Gidey, 2020).

Bangladesh has witnessed notable improvement in rice production, vegetables, livestock, and fish (Roy *et al.*, 2019). The introduction of High Yielding Varieties (HYVs) of rice, using the latest inputs like chemical fertilizers, pesticides, irrigation, and the use of subsidies and microcredit supports are only a few examples of the extensive investment made in agricultural policy and infrastructure (Uddin *et al.*, 2019). The agricultural sub-sectors are being improved by a number of governmental, non-governmental organizations (NGOs), and research institutions (Mahmud and Ntuli, 2021). These activities generally include lending monetary support, providing the rural poor with seeds and fertilizers, and involving them in horticulture and timber plantations.

Since its founding in 1984, the Bangladesh Agricultural University Research System (BAURES) has played a crucial role in advancing agricultural practices through a variety of research projects. These projects have sparked the creation of technology and interventions like enhanced crop varieties, seed treatment methods, and training activities. To evaluate the effect of these interventions on farmers' livelihoods, however, there is no formal evaluation framework in place. This study will focus on evaluating specific interventions from a BAURES project that have been adopted by farmers at the field level, including training, suitable cropping patterns, and input provisions. Thus, this study aims to assess the extent to which the practice of crop intervention influences wetland farmers' livelihoods.

Livelihood perspectives have been widely used by scholars to address a range of issues affecting diverse populations (Ha, 2012). The term livelihood refers to the means through which one makes a living in the world (Bebbington, 1999). First, the concept focuses on how a society's resources (such as land and property, knowledge, crops, money, food, and social ties) relate to its characteristics (such as political, economic, and

socio-cultural). Second, in order to effectively target development strategies aimed at improving livelihood outcomes, it is crucial to understand the resources of the impoverished (in terms of their human, natural, financial, physical, and social capitals), their coping mechanisms (in incidents of calamities, shocks, climate change impacts, etc.), and contextual factors that shape their vulnerability (Ashley and Carney, 1999).

Between urban and rural inhabitants in Bangladesh, there is a considerable disparity in the pattern of livelihood, which is mostly caused by poverty (Imam *et al.*, 2018). Khatun (2015) observed that a lack of access to sources of income, education, credit, and infrastructure is what causes poverty. Rahman (2015) studied those natural resources such as land, forests, water, livestock, and human capital are essential for rural livelihoods. With 45.33% of the people of the country still employed in agriculture, agriculture remains the main source of employment (Byron, 2023).

It is worth noting that wetland areas have quite different ecosystems, agricultural production methods, and general farmer lifestyles than other sections of the country (Ali *et al.*, 2018). Large floodplain depressions known as wetlands can be found in Bangladesh's Northeastern region (Kamal *et al.*, 2018). Due to its position and frequent severe rains, floods are a serious threat in this region (Haque *et al.*, 2021; Rahaman *et al.*, 2021). The wetland basin covers an estimated area of 80,000 square kilometers (Kamruzzaman and Shaw, 2018). Climate change has exacerbated the challenges faced by the wetland inhabitants (Haque, 2016). It poses a serious threat to their livelihoods due to frequent natural hazards and changes in upstream river discharge (Jakariya and Islam, 2017; Hoq *et al.*, 2021). Crop cultivation, fisheries, livestock, and poultry are the key sources of income for wetland people (Uddin *et al.*, 2019).

Wetland areas' cultivable landscape is primarily low-lying in nature (Hoq *et al.*, 2021). The single farming season is Rabi, which runs from mid-October until mid-March in the wetland areas. Due to the buildup of high floodwater during Kharif-1 (mid-March to mid-July) and Kharif-2 (mid-July to mid-October), the land is left uncultivated (Chowdhury and Hassan, 2013). Boro rice, which is sown in December or January and grown with additional irrigation, is the

main crop during the Rabi season (Alamgir *et al.*, 2021) which is commonly affected by flash floods. This adversely impacts the wetland population since they are dependent on agriculture and aquaculture (Parvez *et al.*, 2022). Consequently, this leads to food insecurity and vulnerability (FAO, 2017). Even after this, the wetland area still contributes about 20% of the nation's overall rice production (Kamruzzaman and Shaw, 2018). In climate-ridden regions where the population is dependent on the agriculture sector, crop interventions are used as a strategy to bring a change in livelihoods to improve their income and well-being (Hoque *et al.*, 2019). Crop interventions (necessary inputs for farming, suitable cropping pattern and training) are the various techniques and processes that farmers undertake to enhance the growth, productivity, and health of their crops. Though such interventions are commonplace in wetland areas (Ferdushi *et al.*, 2019), yet, there is a gap in understanding the changes in farmers livelihoods due to crop interventions. As a result, this study's goal was to thoroughly examine how the practice of crop interventions provided by the BAURES project named Designing and Developing Climate Change Resilient Cropping Systems for the Haor Area of Bangladesh has altered the livelihoods of the wetland farmers.

Materials and Methods

The Boyra and Noljhuri villages in the Netrokona district served as the study's locations (Figure 1) as the project was implemented in those two villages. The study population consisted of 200 farmers (128 farmers from Boyra and 72 farmers from Noljuri village) who were beneficiaries of BAURES project. Through the use of simple random sampling procedure and Slovin's formula for sample size determination, 100 farmers (64 farmers from Boyra and 36 farmers from Noljuri village) were chosen proportionately (50%) from each village as the sample. Fieldwork was undertaken from April to May 2022. In the first week of April, exploratory research was initiated at the village level to gain insight into the activities of farmers involved in the BAURES project, and to identify the changes in the livelihood outcomes resulting from their engagement in the project. This preliminary phase included Focus Group Discussions (FGDs) with selected farmers in order to develop appropriate questions and information to be collected from the sampled farmers.

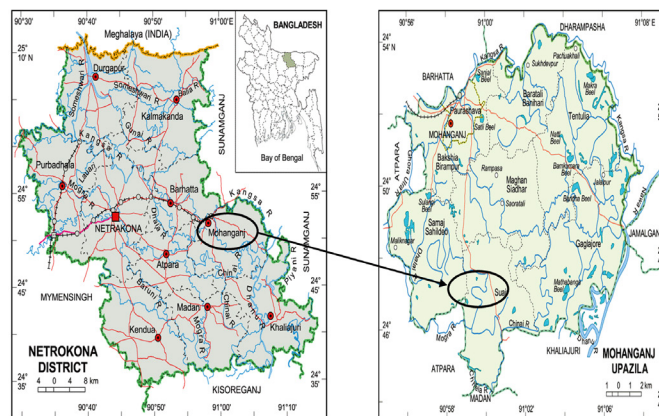


Figure 1: Map of Netrokona district and Mohanganj upazila (sub-district) showing the study area.

Eleven independent variables described the characteristics of farmers. These variables included age, level of education, family size, farm size, annual family income, farming experience, training received, organizational participation, credit received, media contact, and social mobility. The study's main goal was to determine at what extent the livelihoods had changed. Drawing from Mondol (2008), a livelihood change score was established to measure the extent of changes in farmers livelihoods resulting from crop interventions. To measure the changes in livelihoods, three key indicators such as food security, income, and well-being were selected based on the framework for sustainable livelihoods put forth by the Department of International Development (DFID) in 1999 (Figure 2). Several features and components of this framework are included, including the vulnerability setting, livelihood assets, livelihood approaches, and livelihood outcomes. However, in order to comprehend the changes in farmers livelihoods brought on by crop interventions, the current study focuses especially on analyzing livelihood outcomes linked to income, well-being, and food security.

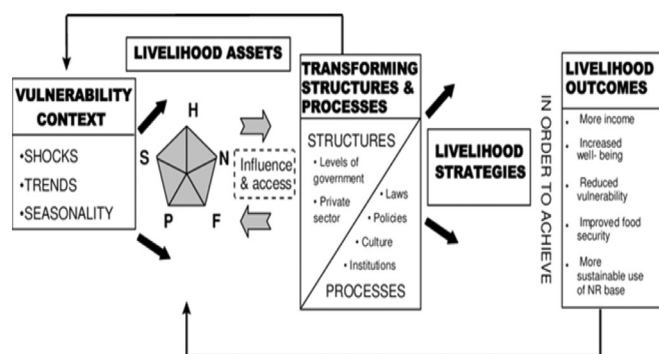


Figure 2: Sustainable livelihood framework (DFID, 1999).

The livelihood outcomes that appear in the generic framework served as broad categories. Depending on

the particular context under investigation, which can only be determined through participatory inquiry, the relevance of each outcome may change. Increased income, enhanced well-being, decrease vulnerability, better food security, and more sustainably using natural resources are among the outcomes taken into account in this study. Additionally, this study also considers a number of wetland farmers' socioeconomic and demographic characteristics, which are classified as independent variables whereas the dependent variable is the change in farmers' livelihoods as a result of practice of crop interventions.

Food security assessment among respondents was based on the year-round availability of the essential foods. Each component of food security was assessed using a three-point Likert-type scale, with the responses like decreased, unchanged, and improved equating to scores of 0, 1, and 2, respectively. As a result, the score for food security might range from 0 to 24, with 0 denoting the lowest and 24 denoting the highest level of food security, respectively. Income evaluation was based on a total of six income sources. A three-point scale was used to evaluate each source, with the responses like decreased, unchanged, and improved equating to scores of 0, 1, and 2, respectively. Well-being assessment considered six aspects. Each element was scored on a three-point scale with decreased, unchanged, and improved receiving ratings of 0, 1, and 2, respectively. The well-being score could vary from 0 to 12. For both income and well-being, 0 denoted the lowest, and 12 denoted the highest level. By adding the results of the three indicators used to measure changes in livelihoods, the total livelihood change score was determined. The overall livelihood change score can range from 0 to 48, with 0 denoting no livelihood change and 48 denoting a significant livelihood change.

The study's second objective was to pinpoint the factors affecting the livelihood changes of wetland farmers. For this purpose, a multiple regression analysis was conducted (Izzah *et al.*, 2020) for which the statistical package for social science (SPSS) version 22 was used to carefully input, code, and examine the data.

Nine problems were identified through the FGDs. To assess the extent of the problem encountered by wetland farmers, a four-point rating system was implemented. Scores of 3, 2, 1, and 0 were assigned correspondingly for each of the four potential answers

serious problem, medium problem, minor problem, and not at all. Each respondent's total problem scores were calculated by adding the scores for each problem. For nine problem statements, the possible range of problem scores ranged from $(9 \times 0) = 0$ to $(9 \times 3) = 27$, where 0 denoted no problem and 27 denoted highest-level of problems. An index called the problem-facing index (PFI) was developed to rank the problems that had been found. PFI assists in identifying the most significant problems and ranking them (Hamid *et al.*, 2020) as given in Equation 1.

$$PFI = (P_h \times 3) + (P_m \times 2) + (P_l \times 1) + (P_n \times 0) \dots (1)$$

Where PFI = Problem Facing Index, P_h = frequency of farmers with serious problems, P_m = frequency of farmers with medium problems, P_l = frequency of farmers with minor problems, and P_n = frequency of farmers with no problems. A single issue's PFI might range from 0 to 300, with 0 signifying a not significant problem and 300 signifying a significant problem that wetland farmers were dealing with.

Salient feature of the personal characteristics of the wetland farmers

Table 1 summarizes the socioeconomic attributes of the sampled wetland farmers. Age was ranged from 20 to 70, and their average age and standard deviation were 42.28 and 11.25, respectively. Middle-aged respondents made up the majority of the sample (55%), while the remaining (45%) were comprised of young and old respondents. The respondents' education scores ranged from 0 to 14, with a mean value of 5.58 years of schooling and a standard deviation of 3.93 years. According to Table 1, the largest proportion of participants (39%) had achieved primary-level education, while 15% remained illiterate.

Table 1 also reports that compared to the national average of 4.30, the mean family size among farmers was 5.92 which is greater than the national average (BBS, 2022). More than half of the farmers (56%) were included to the medium-sized family category. The surveyed farmers farms were 0.49 hectares in size on average, which is slightly less than the 0.6 hectares that constitute the national average (Uddin *et al.*, 2019). The annual household income of the interviewees ranged from 90,000 to 190,000 Bangladesh Taka (BDT), with a mean of 95,550 BDT and a standard deviation of 28,230 BDT. The majority of farmers (97%) fell into the low-income category,

Table 1: Socio-economic characteristics of the wetland farmers involved with the BAURES project.

Characteristics (Measuring unit)	Score range		Respondents		Mean	SD*
	Possible	Observed	Categories	Percent (n=100)		
Age (Years)	Unknown	20-70	Young (18-35)	34	42.28	11.25
			Middle-aged (36-55)	55		
			Old (>55)	11		
Level of education (Years of schooling)	Unknown	0-14	Illiterate (0)	15	5.58	3.93
			Primary (1-5)	39		
			Secondary (6-10)	38		
			Above secondary (>11)	8		
Family size (No. of members)	Unknown	2-10	Small (2-4)	22	5.92	1.94
			Medium (5-7)	56		
			Larger (>7)	22		
Farm size (Hectare)	Unknown	0.11-1.01	Landless and marginal (0.02-0.2)	8	0.49	0.19
			Small (0.21-0.99)	90		
			Medium (1.0-3.0)	2		
			Large (>3.0)	0		
Annual family income (BDT '000')	Unknown	90-190	Low (up to 150)	97	95.55	28.23
			Medium (151-300)	3		
			High (>300)	0		
Farming experience (Years)	Unknown	2-55	Up to 10 years	23	23.85	12.81
			Up to 20 years	26		
			Above 20 years	51		
Training received from the BAURES project (No. of days)	0-1	0-1	Yes	95	0.95	0.21
			No	5		
Organizational participation (Scale score)	0-12	0-4	No participation (0)	52	0.84	1.01
			Low (1-4)	48		
			Medium (5-8)	0		
			High (> 8)	0		
Credit received (BDT '000')	Unknown	0-250	No (0)	55	28.36	46.64
			Up to 50	28		
			51-100	13		
			Above 100	4		
Media contact (Scale score)	0-48	8-36	Low (1-16)	28	19.20	5.409
			Medium (17-32)	71		
			High (>32)	1		
Social Mobility (Scale score)	0-18	0-13	Low (1-6)	31	7.41	2.97
			Medium (7-12)	62		
			High (>12)	7		

while 3% were in the medium-income category. None of the farmers reported at the high-income level. These results indicate that the average annual family income in the study area is lower than the national average of BDT 137,748 (World Bank, 2019). Farmers' farming experience varied from 2 to 55 years. Farmers with a high level of experience

in farming made up the majority (51%) of the population. In terms of training received, 95% of the farmers had received a one-day training session, while 5% had not received any training from the BAURES project. This finding aligns with the notion that training equips farmers with skills to cope with various uncertainties (Uddin *et al.*, 2019). Results

indicate that the highest proportion of farmers (52%) had no participation in any organizations, while 48% had low levels of participation. The organizational participation score varied from 0 to 6, with a mean of 0.84 and a standard deviation of 1.22. Regarding credit received, the mean credit amount obtained by farmers involved in the BAURES project was 28,360 BDT, with a standard deviation of 46,640 BDT. Table 1 shows that the majority of farmers (55%) did not receive any credit facility. Out of a possible range of 0 to 48, the respondents' computed media contact scores varied from 8 to 36. The average score was 19, while the standard deviation was 5.40. Results indicate that the highest proportion of farmers (71%) had medium media contact, while one 1% had high media contact. Finally, social mobility had an average score of 7.41 and a standard deviation of 2.97. The majority of farmers (62%) exhibited medium social mobility. Studies carried out by Ahmed *et al.* (2017) and Rahman and Akter (2020) show a similar pattern on social mobility among farmers.

Extent of livelihood change of wetland farmers due to the practice of crop intervention

Figure 3 provides an overview of the extent of livelihood change among wetland farmers as a result of practicing crop interventions. Findings reveal that a majority of the respondents (64%) experienced a medium-level change in their livelihood outcomes. Additionally, 36% of the respondents reported a high level of change, while none fell into the category of low-level change. This suggests that the practice of crop interventions does improve the livelihood status of wetland farmers.

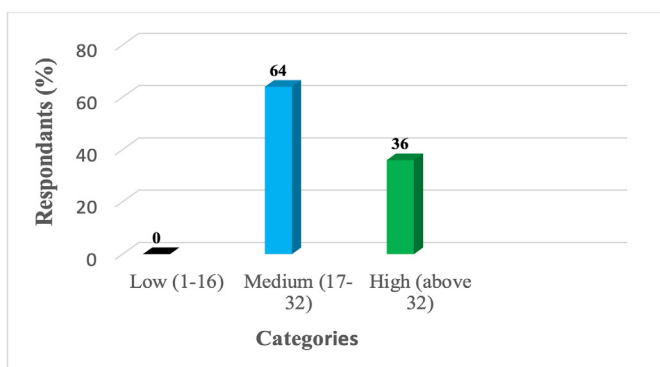


Figure 3: The extent of livelihood changes of wetland farmers.

However, it is important to note that the income generated from these interventions may still be insufficient for farmers to afford food, clothing, medicine, education, and other basic necessities of

life. In order to further enhance their standard of living, farmers must, therefore boost their income. This finding is compatible with the research of Abdul *et al.* (2015) who likewise found that participants in a livelihood program had a medium change in their livelihoods.

Rank order of the issues of livelihood change of the wetland farmers

Results presented in Table 2 show the livelihood changes experienced by wetland farmers from the practice of crop interventions (necessary inputs for farming, suitable cropping pattern and training). A major change in livelihood was observed in the aspect of food security during the months of “Jaistha” (mid-May to mid-June). This can be attributed to the abundance of food availability in the wetland area during this particular farming season. The harvesting of Boro crops, which takes place in the Bengali month of Jaistha (Jahan *et al.*, 2010), leads to increased income for farmers due to higher production (Uddin *et al.*, 2013). Consequently, this improves their food security. It is worth noting that the aspect crops obtained a score of 185, indicating a high level of livelihood change. Income generated from crop farming-related activities significantly impacts farmers livelihood outcomes. Similar findings reported by Kumar *et al.* (2015) revealed how the livelihood of farmers improved through crop cultivation and participation in cooperative societies.

The aspect of better food and clothing was the highest element that brought a change in farmers livelihoods. Better quality of food and clothing ensures an improved livelihood status and promotes the well-being of people. Furthermore, the findings highlight that, concerning the livelihood changes related to well-being outcomes, wetland farmers experienced significant improvements in their access to better-quality meals. This was followed by improvements in their clothing and a positive change in household assets resulting from the practice of crop interventions. These findings are consistent with a study by Bagroy *et al.* (2017) which similarly highlighted the beneficial effects of crop interventions on farmers wellbeing.

Comparison of different aspects of livelihood change

The study also sought to investigate the variations among the three dimensions of livelihood changes among farmers who are actively engaged in the BAURES project, as depicted in Figure 4.

Table 2: Ranking of the aspects of livelihood change of the farmers.

Aspects	Score	Rank
Food security		
Jaishthya (Mid-May to Mid-June)	148	1
Bhadra (Mid-August to Mid-September)	140	2
Ashar (Mid-June to Mid-July)	137	3
Sraban (Mid-July to Mid-August)	136	4
Augrahasan (Mid-November to Mid-December)	133	5
Poush (Mid-December to Mid-January)	127	6
Ashwin (Mid-September to Mid-October)	121	7
Maagh (Mid-January to Mid-February)	119	8
Kartik (Mid-October to Mid-November)	118	9
Falgun (Mid-February to Mid-March)	103	10
Chaitra (Mid-March to Mid-April)	96	11
Baishakh (Mid-April to Mid-May)	47	12
Income		
Crops (Red Amarnath, Spinach, Tomato, Cabbage, Cauliflower, all of these with Boro rice)	185	1
Livestock	165	2
Fish	148	3
Business mainly small business	119	4
Remittance	146	5
Services (GOs and NGOs)	126	6
Well-being		
Better food and clothing	180	1
The capacity of providing better education to children	172	2
Better health facilities	163	3
Change in physical assets	162	4
Better nutrition and sanitation facilities	160	5
Improved housing condition	143	6

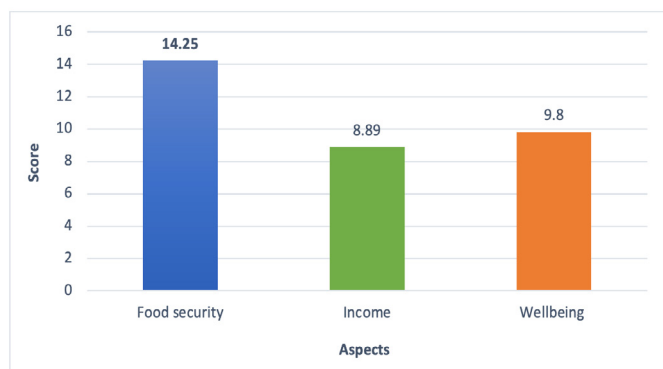


Figure 4: Comparison of different aspects of livelihood change.

The highest degree of change was observed in the food security dimension (14.25) for wetland farmers, followed by changes in well-being (9.8) and income (8.89). In most instances, the improvement in food security can be attributed to farmers livelihood changes, which enable them to fulfill their basic needs. The enhanced food security has allowed farmers to

concentrate on their work, subsequently leading to increased income and improved well-being.

Factors affecting the livelihood change of the wetland farmers

Below is the discussion of the findings of the statistical techniques used to analyze how the practice of crop interventions provided by the BAURES project has impacted the factors affecting wetland farmers' livelihood status.

Multiple linear regression analysis

To identify the variables and their relevance in foretelling the focal variable, multiple linear regression analysis was employed. The explanatory variables considered for regression analysis were age (X_1), level of education, (X_2), family size (X_3), farm size (X_4), annual family income (X_5), experience in farming (X_6), training received (X_7), organizational

participation (X_8), credit received (X_9), media contact (X_{10}) and social mobility (X_{11}). Table 3 outlines the findings of the regression analysis of the changes in wetland farmers' livelihoods due to the practice of crop interventions provided by the BAURES project.

The Variance Inflation Factor (VIF), which is displayed in Table 3, was used to investigate the multicollinearity among the model's variables. The greatest VIF value of 3.742 meant that multicollinearity was not a concern (considered threshold value for VIF is 4), and the variables also had high tolerance levels. The regression analysis result shown in Table 3 reveals that the value of R^2 found in the multiple regressions was 0.658, while the corresponding F-value of 12.702 was also significant at 0.001 level. According to the findings of multiple regression analysis, the factors that most strongly predicted changes in wetland farmers' livelihoods due to the practice of crop interventions provided by the BAURES project were education level, annual family income, organizational participation, and media contact.

According to the regression coefficient (Table 3), if the education level varies by one unit (one number), then the livelihood changes by 0.345. This implies that the wetland farmers having greater levels of education have a significant change of livelihood due to the practice of crop interventions. This finding has similarities with the study of Sarker (2017) who found that the years of schooling act as an important factor for farmers' attitudes toward using agricultural machinery.

The regression coefficient indicates that if annual

family income changes by 1 unit (one number) then the livelihood changes by 0.035. This means that wetland farmers having high annual family income have a high change of livelihood due to the practice of crop interventions. This result is supported by the study of Mustafa *et al.* (2016) that shows the importance of a family's annual income in enhancing the quality of life for family members by enabling them to pay for basic needs such as food, clothing, shelter, healthcare, and education.

The regression coefficient from Table 3 indicates that if the organizational participation of the wetland farmers changes by 1 unit (one number) then the livelihood changes by 2.976. This means that wetland farmers having high organizational participation have a high change of livelihood due to the practice of crop interventions. Rahman and Akter (2014) conducted a study on the effectiveness of Village-Based Organizations (VBOs) in enhancing the livelihood of the rural householders in Bangladesh. They found organizational participation as a key factor in the livelihood changes of rural communities. Lastly, the regression coefficient from Table 3 also indicates that if media contact of wetland farmers changes by 1 unit (one number) then the livelihood changes by 0.210. This means that the wetland farmers having high media contact have a high change of livelihood due to the practice of crop interventions. Rana *et al.* (2018) carried research on how Common Interest Group (CIG) members' livelihood had changed. They found that initiatives of the national agricultural technology program having media contacts as a dominant factor contributed towards the livelihood change of the CIG members.

Table 3: Summaries of the linear multiple regression analysis.

Explanatory variables	Unstandardized coefficients		t	Sig.	Collinearity statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	20.352	3.464	5.875	0.000		
Age (X_1)	0.065	0.066	0.976	0.332	0.297	3.371
Level of education (X_2)	0.345	0.128	2.696	0.008	0.630	1.587
Family size (X_3)	0.122	0.224	0.548	0.585	0.867	1.153
Farm size (X_4)	-0.774	2.339	-0.331	0.741	0.907	1.103
Annual family income (X_5)	0.035	0.015	2.295	0.024	0.846	1.181
Experience in farming (X_6)	-0.006	0.062	-0.099	0.922	0.267	3.742
Training received (X_7)	0.038	0.380	0.099	0.921	0.869	1.150
Organizational participation (X_8)	2.976	0.465	6.395	0.000	0.700	1.429
Credit received (X_9)	-0.019	0.010	-1.895	0.061	0.765	1.308
Media contact (X_{10})	0.210	0.088	2.371	0.020	0.904	1.107
Social mobility (X_{11})	0.132	0.145	0.908	0.366	0.875	1.143

$N=100$, $R^2 = 0.658$, $Adjusted R^2 = 0.606$, $F value = 12.702$

Table 4: Rank order of the problems faced by the wetland farmers.

S. No.	Problems	Extent of problems				Score	Rank
		High (3)	Moderate (2)	Low (1)	Not at all (0)		
1.	Lack of technical knowledge	48	28	14	10	214	1
2.	Lack of irrigation facilities	45	27	17	11	206	2
3.	Lack of quality seeds	28	55	10	7	204	3
4.	Lack of ongoing training	41	31	18	10	203	4
5.	Lack of inputs (fertilizers, pesticides, etc.)	33	30	18	18	180	5
6.	Poor extension service	28	27	40	5	178	6
7.	Lack of credit	30	33	21	16	177	7
8.	Lack of neighbor cooperation	24	14	50	12	150	8

Source: Field survey, 2022.

Problems faced by wetland farmers while practicing crop interventions

Extent of problems faced by wetland farmers: Problems faced by wetland farmers while practicing crop intervention for maintaining livelihood were measured through 8 selected items of problems with a three-point grading scale. The observed score of the problems faced by them varied from 9 to 20 against a probable range of 0 to 24 with the mean and standard deviation of 15.90 and 4.41, correspondingly. Results indicated in Figure 5 show that the majority (53%) of respondents in the surveyed area reported a medium level of problems in relation to the practice of crop interventions provided by the BAURES project. Huq et al. (2021) carried out research with the rice farmers from wetlands of Bangladesh where they highlighted different issues encountered by the farmers during market participation and access with their cultivated crops.

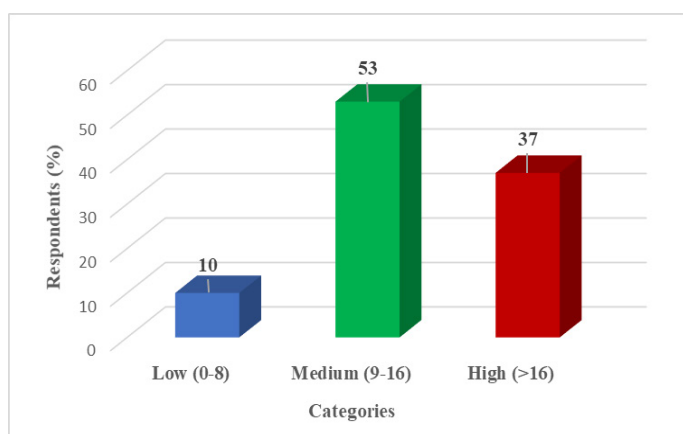


Figure 5: Categorization of selected wetland farmers based on their problems faced.

Rank order of the problems faced by the wetland farmers

The extent of problems faced by wetland farmers while practicing crop interventions provided by the BAURES project with their rank order values is

presented in Table 4.

As shown in Table 4, the most prominent issue identified was a lack of technical knowledge. Consequently, this restricted farmers from generating higher income since they were unable to use various tools and techniques and adopt interventions effectively. Islam et al. (2018) studied the knowledge disparity of the wetland farmers in Boro rice farming and they came to identical conclusions. The second-ranked problem was the lack of irrigation facilities. Farmers encountered difficulties in accessing water supply pipes for irrigation purposes, particularly in drought seasons. The scarcity of resources, including funds and opportunities, prevented them from acquiring the necessary equipment, such as machinery and wells, which are crucial for drawing water from depths of up to 350 feet. Consequently, their agricultural activities suffered due to insufficient irrigation systems during drought periods. Chakraborty et al. (2021) also identified the lack of irrigation facilities during the drought period in the wetlands of Bangladesh. Another significant issue ranked third, is the lack of quality seeds that adversely impacts overall crop production. Sheheli et al. (2014) also found unavailability of quality seed and species as one of the major problems that prevails in the wetland region. Farmers faced the risk of crop damage caused by pests and diseases. Several other challenges confronting wetland farmers while working on the BAURES project included a lack of ongoing training opportunities, insufficient availability of fertilizers and pesticides, limited access to credit facilities, and a lack of cooperation from the neighboring farms.

Conclusions and Recommendations

The current study provides a summary of the changes in wetland farmers livelihoods through the practice

of crop interventions facilitated by the BAURES project. These interventions have played a positive role in improving the farmers' livelihood status. The study identified several significant factors, namely education level, annual family income, organizational participation, and media contact, which influenced the livelihood changes of farmers because of practicing crop interventions. The research also showed that most farmers experienced medium-to-high levels of problems while practicing crop interventions provided by the BUARES project. Given the leading role of the BAURES project in improving the living standards of farmers, it is strongly recommended to maintain and continue these efforts to accelerate development activities. Furthermore, it is advisable for the concerned authority to conduct regular monitoring even after project completion to ensure that farmers can effectively implement the interventions in their respective fields.

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Novelty Statement

This paper is based on the crop interventions that lead to the change in farmers' livelihood outcomes in wetland areas in Bangladesh. This paper will help the policymakers in the formulation of strategies so that necessary steps are to be taken to include a greater number of wetland farmers in future projects to ensure sustainable livelihood change.

Author's Contribution

Mohammed Nasir Uddin: Conceptualization, methodology development, and conduction of data collection, data analysis, and initial draft preparation.

Maimona Monir Jhilam: Data collection, formal analysis, and initial draft preparation.

Most Zannatun Nahar Mukta: Methodology development and conduction of data collection.

Zujaja Wahaj: Review and final version preparation.

Mohammad Maruf Hasan: Data analysis, initial draft preparation, review, and preparation of final version.

Samiha Khan: Review and final version preparation.

Conflict of interest

The authors have declared no conflicts of interest.

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