OPEN ACCESS

South Asian J. Agric.

Research Article	Vol. 11, No. 2, Dec., 2025: 14-27

Title:	Problems of Dark Green Bulrush [*Scirpus atrovirens* (Wild.)] Cultivation at Tala Upazila of Satkhira District

Authors:	Johora Sardar, Emamul Hossen Bappi, Md. Yasin Ali* and Md. Matiul Islam
	Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh

*Corresponding Author:	Md. Yasin Ali	Email: drmdyasinali@at.ku.ac.bd

Article Info:	**ABSTRACT**

The cultivation of Dark Green Bulrush (*Scirpus atrovirens* [Willd.]) has emerged as a promising avenue for socioeconomic development in Tala Upazila, Satkhira District, Bangladesh. This study explored the major challenges faced by local farmers engaged in its production. Using a descriptive and diagnostic research approach, data were collected from 41 participants selected through snowball sampling. The findings revealed waterlogging (95.6%) as the most pressing issue, followed by unsuitable land (85.6%), drought and pest problems (84.4%), salinity (83.1%), and limited access to improved technologies (70%). Moderate constraints included market access, information deficiencies, and fertilizer availability. In contrast, issues related to seeds, training, transportation, and storage were considered less significant, with the lowest concern being a lack of agricultural habituation (36.3%). The study also examined how farmers' socioeconomic traits influenced their challenges. Variables such as age, education, family size, experience, organizational participation, and media exposure had minimal or statistically insignificant impacts. However, farm size and annual household income showed notable associations. Farmers with larger landholdings faced more difficulties, likely due to greater management demands, whereas higher household incomes corresponded with fewer constraints, possibly due to better access to resources. The challenges associated with Bulrush cultivation in the mentioned area need to be identified thoroughly. The research highlights the urgent need for targeted policy support, affordable financing options, and access to modern agricultural technologies to promote sustainable Dark Green Bulrush cultivation. These interventions are essential to strengthen regional and national economic resilience.

INTRODUCTION

In the southwestern coastal belt of Bangladesh, particularly in the Satkhira District, a native sedge plant locally known as "Mele" (মেলে) is being cultivated by the local population. The scientifically accurate name for this plant is *Scirpus atrovirens* (Willd.), and it is commonly referred to in English as Dark Green Bulrush. It has soft triangular stem (Edwards, 2020). This plant's cultivation has become an important agricultural activity in Bangladesh, especially within wetland ecosystems (Umkhulzum et al., 2019). Known locally as "Mele," this perennial sedge species holds both ecological and economic significance. Its cultivation is increasingly acknowledged as a strategic approach within various agroecological zones, not only for climate change adaptation but also to promote sustainable agricultural development (Rahman et al., 2018). Tala Upazila in the Satkhira District of Bangladesh offers a suitable climatic and hydrological environment for cultivating Dark Green Bulrush, presenting considerable opportunities for enhancing livelihoods and promoting ecological resilience.

Local farmers often employ integrated practices alongside bulrush cultivation—such as digging ponds for irrigation and harvesting rainwater—which serve the dual purpose of intensifying agricultural output and improving access to clean water (Halder, 2009). Nevertheless, several serious obstacles continue to impede the sustainable expansion of this cultivation practice in the southwestern coastal region. During the monsoon season, farmland in Tala Upazila frequently suffers from extended periods of flooding, sometimes lasting over a month. Although Dark Green Bulrush prefers moist and marshy conditions, it is highly sensitive to stagnant water and cannot endure prolonged waterlogging. For example, around 80% of the cultivated land in Bathuadanga Village was reported to have been destroyed due to excessive water retention.

The encroachment of saline water into agricultural fields significantly diminishes crop productivity and degrades soil fertility. Factors such as rising sea levels and reduced freshwater inflow aggravate salinity issues, prompting many farmers to switch to salt-tolerant crops (Hossain et al., 2004). In the case of bulrush, saline water causes physiological drought, severely impacting the plant's growth and yield. Tala Upazila remains highly vulnerable to various climate-related hazards including cyclones, salinity, and flooding. These environmental stressors not only harm crop yields but also damage infrastructure, thereby undermining the economic viability of agricultural ventures in the area.

Moreover, agricultural extension services, which play a crucial role in spreading agricultural knowledge and innovation, are notably limited in this region. Inadequate engagement by extension workers leads to information gaps, low adoption of modern practices, and inefficiencies in market participation. Farmers often struggle to receive fair prices due to unethical trading practices and lack of adequate market information.

Farmers involved in the cultivation of Dark Green Bulrush in Tala Upazila face a complex array of challenges, including financial limitations, environmental stresses, and policy-related constraints. Addressing these issues through coordinated and integrated solutions is vital to ensure the sustainable cultivation and broader expansion of this ecologically and economically valuable crop.

Despite the crop's promising potential as a sustainable livelihood option in the climate-sensitive coastal areas, there remains a notable lack of empirical data regarding its

current cultivation status, farmers' perspectives, and the nature and severity of the challenges encountered during production. This gap in detailed understanding has hindered the formulation of effective policy responses and the development of tailored support mechanisms for farmers. It is within this context that the current study, titled *"Problems of Dark Green Bulrush [Scirpus atrovirens (Willd.)] Cultivation at Tala Upazila of Satkhira District,"* was initiated. The study aims to close this critical knowledge gap by examining existing cultivation methods, identifying major production constraints, and analyzing the socio-economic factors that influence the success of Dark Green Bulrush cultivation.

The objective of the study is to identify the problems and challenges faced by farmers in Tala Upazila, Satkhira District. The following specific objectives were designed to provide clear direction for the research.

   i.   To identify the problems of Green Bulrush cultivation
   ii. To explore the relationship of the socioeconomic conditions of farmers with the problems of Green Bulrush cultivation

MATERIALS AND METHODS

Locale of the study
A descriptive survey design was employed in this research to collect comprehensive and systematic data from respondents across multiple villages within Tala Upazila, specifically Krishnonagar, Bathuyadanga, Horinkhola, and Sonabadhal. This design was chosen because it allows for the collection of diverse opinions and experiences from a targeted population, making it particularly effective in exploring the challenges related to the cultivation of Dark Green Bulrush (*Scirpus atrovirens*). These villages were purposefully selected based on several factors. First, they are geographically adjacent to the main areas of interest within Tala Upazila, ensuring

accessibility and logistical feasibility for field data collection. Second, preliminary observations and field visits indicated that these locations contain low-lying, waterlogged, or seasonally flooded lands—conditions naturally suitable for Dark Green Bulrush growth. Third, anecdotal evidence and local reports suggested that a few farmers and community members had either experimented with or shown interest in cultivating this plant, making these areas relevant for the study. Furthermore, these villages represent a cross-section of the broader agroecological and socio-economic characteristics of the southwest coastal region, allowing for a more holistic understanding of the constraints and opportunities involved in introducing or expanding the cultivation of this native wetland species. The location and layout of these villages are depicted in Figure 1 to provide a visual representation of the study area.

Population and sampling
The target population of this study included farmers and individuals engaged in the cultivation and processing of Dark Green Bulrush in the selected areas of Tala Upazila, Satkhira district. A purposive sampling technique was employed to ensure that participants had direct involvement and experience with Dark Green Bulrush, thereby providing relevant and meaningful data for the study. To maintain objectivity and minimize selection bias, respondents were identified through a systematic approach. Initial identification was carried out in collaboration with the local office of the Mukti Foundation, which has a longstanding presence and working knowledge of the community. The organization assisted in generating a preliminary list of eligible individuals based on their active engagement with Dark Green Bulrush cultivation or processing activities.

Efforts were made to ensure that the sample represented a diverse cross-section of the community in terms of age, gender, and farming practices. A total of 41 respondents

were selected from multiple villages within the research area. This approach ensured the inclusion of knowledgeable participants while upholding the integrity and credibility of the data collection process.
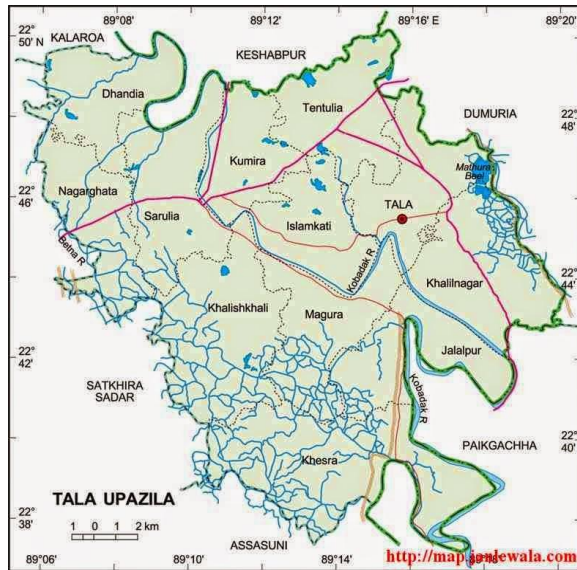

Figure 1. Map of Tala upazila of Satkhira district.

Selection of variables

The objective of this research was to assess the field-level challenges associated with the cultivation of Dark Green Bulrush. To support this investigation, a few specific characteristics of the respondents were carefully considered and documented. These characteristics were selected to facilitate a comprehensive understanding of the socio-economic and demographic profiles of the individuals involved in the cultivation process.

Independent variables	Dependent variable
a. Age b. Educational qualification c. Family type d. Family size e. Gender f. Occupation g. Organization participation h. Annual family income	Challenges/ Problems faced

i. Extension media contact
j. Cosmopolitanism
k. Attitude

This study seeks to systematically explore the key problems and challenges related to the cultivation of Dark Green Bulrush [*Scirpus atrovirens* (Wild.)] in Tala Upazila of Satkhira District. Additionally, it aims to critically examine these issues through a proactive and solution-driven lens, offering sustainable, locally adapted strategies to address the constraints encountered by farmers. Ultimately, the goal is to improve productivity, strengthen resilience, and enhance the socioeconomic conditions of the local farming community.

Measurement of variables

The selected characteristics of the respondents were considered as the key variables of this study. The procedures followed for measuring these variables are described below.

The study collected data on eleven socio-demographic and behavioral characteristics of respondents through an interview schedule. Age was calculated from birth date and categorized as young ($\leq$35), middle-aged (36–55), and old (>55). Educational qualification was measured by years of completed schooling, grouped from illiterate to post-graduate levels. Family type was categorized as nuclear, joint, or extended, while family size was based on the number of household members, grouped into small ($\leq$4), medium (5–6), and large (>6). Gender was recorded as Male, Female, or Other using a nominal scale. Occupation was identified as either Farmer or Agricultural Laborer. Organizational participation was scored based on involvement in local organizations and classified into no, low (<6), medium (7–12), or high (>12) participation. Annual family income in BDT was grouped into minimum (<30,000), medium (30,000–60,000), and maximum (>60,000). Extension media contact was measured using a 5-point scale across six sources, with total scores categorized as low

(≤8), medium (9–16), or high (>16). Cosmopolitanism reflected travel frequency outside the village and was scored up to 12, with respondents grouped into low (≤4), medium (5–8), and high (>8) levels. Finally, attitude toward Dark Green Bulrush cultivation was assessed through a 10-item Likert scale (positive and negative statements), with total scores (10–50) categorized as high positive (<18), moderately positive (18–34), and low positive (>34) attitudes (Farabi et al., 2024; Sarkar et al., 2024).

Problems/ Challenges Faced (score)

The primary objective of this research was to identify the challenges associated with Dark Green Bulrush cultivation. To quantify these challenges, a five-point rating scale was employed. Respondents were asked to express the severity of problems they experienced across 15 specific issues, all grouped under a broad category of cultivation challenges. The severity levels were rated as: highly severe, severe, moderately severe, less severe, and no problem, with corresponding scores of 4, 3, 2, 1, and 0 respectively. The overall challenge score for each respondent was calculated using the following formula (Salam et al., 2024):

$$CS = N_{hs} \times 4 + N_s \times 3 + N_{ms} \times 3 + N_{ls} \times 1 + N_{np} \times 0$$

Where,

CS= Score of challenges faced by the respondents

N_{hs}= Number of respondents who said highly severe with the issue

N_s= Number of respondents who said severe with the issue

N_{ms} = Number of respondents who said medium severe with the issue

N_{ls}= Number of respondents who told less severe with the issue

N_{np} = Number of respondents who told no problem with the issue

After calculating the challenge score (CS), the index (%) for the issue was computed using the following formula (Mim et al., 2022). The index represents the normalized score as a percentage, allowing for a comparative measure across different items.

$$Index\ (\%) = \frac{Actual\ Observed\ Score}{Possible\ Highest\ Score} \times 100$$

Here, the maximum possible score is calculated as the total number of responses multiplied by 4, assuming that all respondents selected "highly severe."

Ranks were assigned based on the index (%) of the issues, with the issue having the highest index (%) receiving the 1st rank. In cases where two or more issues had the same score, they were assigned the same rank.

The respondents were categorized based on the challenge scores they faced in Dark Green Bulrush cultivation. Those with a challenge score of 20 or below were classified as having a low level of challenges. Respondents with a challenge score ranging from 21 to 40 were categorized as facing a medium level of challenges, while those with a challenge score above 40 were considered to be experiencing a high level of challenges.

The interview schedule for this study was meticulously developed based on the research objectives, incorporating input from farmers, organizations, and the research supervisor through preliminary interviews and revisions. Data collection was conducted via face-to-face interviews from October 5 to December 7, 2024, using the finalized schedule. To ensure data reliability and respondent comfort, rapport-building measures were taken, and supplementary methods such as Key Informant Interviews (KII) and Focus Group Discussions (FGD) were employed. The collected data were systematically processed, compiled, and tabulated according to pre-defined categories for clarity and ease of interpretation. Quantitative analysis involved descriptive statistics (frequency, mean, standard deviation) and correlation analysis, with SPSS software used to manage and analyze the data. Specifically, Spearman's Rank Correlation Coefficient (ρ) was applied to assess monotonic relationships among variables, offering insights into how different respondent characteristics were associated with the challenges they faced.

RESULTS AND DISCUSSION

The objective of this chapter is to present and interpret the key findings derived from the study. The results are systematically organized and discussed in alignment with the specific objectives of the research. Accordingly, the section is divided into two major sections: (1) identification of the major challenges encountered in its cultivation, and (2) an exploration of the relationship between the socio-economic characteristics of the farmers and the challenges they face in cultivating Dark Green Bulrush.

Problems of Dark Green Bulrush cultivation

The Table 1 presents the distribution of problem severity levels experienced by farmers, based on a scoring system ranging from 16 to 55. The data show that the majority of respondents (48.8%) fall into the severe problem category, while 46.3% are categorized under a moderate level of problems, and only 4.9% experience low levels of difficulty. The mean problem score is 36.92, with a standard deviation of 11.42,

indicating a moderate to high level of variability in the challenges faced by the farming population. The findings reveal that a significant portion of the farmers are facing substantial challenges, with nearly half experiencing severe problems. The mean score being closer to the higher end of the range further supports this observation. The relatively high standard deviation suggests that while many farmers are struggling, the intensity of those struggles varies across individuals, possibly due to differences in resources, access to support, or local conditions.

The data indicate a concerning level of hardship among the majority of farmers, with severe challenges affecting nearly half of the respondents. These findings underscore the need for targeted interventions, such as improved agricultural support services, access to resources, and capacity-building initiatives, to alleviate the burden on farmers and promote more sustainable agricultural livelihoods.

Table 1. Distribution of the respondents according to their cultivation challenges (farmers' problem category)

Characteristics	Categories	Score	N=41		Range		Mean±SD
			F.	%	Min.	Max.	
Problem Level (score)	Low	≤20	2	4.9	16.00	55.00	36.92±11.42
	Medium	21-40	19	46.3			
	Severe	>40	20	48.8			

Data from Table 2 present an in-depth analysis of individual problems faced by farmers cultivating Dark Green Bulrush, highlighting their severity through problem indices and corresponding rankings. The findings reveal that farmers encounter a wide range of challenges, with waterlogging emerging as the most critical issue, reported by 95.6% of respondents, and ranked first. This underscores the significant impact of poor drainage and excessive moisture on cultivation.

The second most severe issue is the lack of suitable land for Bulrush cultivation, affecting 85.6% of farmers. Both drought conditions and infestations from insect pests and diseases were each reported by 84.4% of respondents, placing them jointly in the third rank, indicating that farmers are simultaneously vulnerable to both excessive moisture and water scarcity, as well as biological threats.

Salinity was also recognized as a significant constraint, with 83.1% of farmers identifying it as a problem. High salt content in the soil

renders it less favorable for successful cultivation. A lack of improved technology for planting and harvesting, reported by 70%, ranked sixth, highlighting farmers' reliance on traditional methods due to the absence of mechanized or modern solutions.

Other moderately severe issues included limited market access (69.4%), unavailability of information (66.9%), and inconsistent access to quality fertilizers (60%)—although fertilizers were generally considered moderately available. Lack of quality seeds or propagules (58.1%) was not perceived as a major concern, as these planting materials are relatively accessible and perennially available.

Table 2. Distribution of the respondents according to their cultivation challenges (individual problem severity)

Serial No.	Problem description	Score	Index (%)	Rank
1.	Lack of suitable land for Dark Green Bulrush Cultivation	137	85.6	2nd
2.	Lack of quality seeds/ propagules	93	58.1	10th
3.	Lack of sufficient quantity of fertilizer	96	60	9th
4.	Lack of storage facility	70	43.8	14th
5.	Lack of training, skill and experience	83	51.9	12th
6.	Lack of improved technology for planting and harvesting	112	70	6th
7.	Insect- pest and disease infestation	135	84.4	3rd=
8.	Lack of marketing facilities	111	69.4	7th
9.	Transportation problem	71	44.4	13th
10.	Lack of internal motivation	91	56.9	11th
11.	Unavailability of information	106	66.3	8th
12.	Drought	135	84.4	3rd=
13.	Water logging	153	95.6	1st
14.	Salinity	133	83.1	5th
15.	Not habituated	58	36.3	15th

Additional concerns such as lack of internal motivation (56.9%), insufficient training or experience (51.9%), and transportation issues (44.4%) were seen as less severe. In particular, improved infrastructure has made transportation less problematic than in the past. Lack of storage facilities (43.8%) was also viewed as a minor issue, as most farmers' process or sell their harvests immediately. The least concerning issue, reported by 36.3%, was the factor of not being habituated to the cultivation of Bulrush, ranking last among all identified problems.

The data indicate that farmers are contending with a mix of environmental, technological, and institutional constraints. Water-related issues—both excess (waterlogging) and scarcity (drought)—along with pest infestations, rank as the most critical barriers to Bulrush cultivation. The lack of suitable land and modern technologies further complicates efforts to enhance productivity. On the other hand, lower-ranked issues such as storage, transport, and internal motivation suggest some areas where significant progress has been made or where the challenges are less impactful. The findings highlight that the cultivation of Dark Green Bulrush   is challenged primarily by environmental and infrastructural constraints, especially water management, land suitability, and pest control. While moderate issues such as limited market facilities and

lack of technological support persist, they are not as severe as the top-ranked problems. To support sustainable expansion of Bulrush cultivation, priority should be given to addressing water management, promoting resilient farming practices, and enhancing access to technology and training.

During the fieldwork phase of the study, several challenges were encountered that affected the overall efficiency and execution of the research. One of the primary difficulties was the limited availability of resources and logistical support. Constraints in transportation, equipment, and manpower often hindered smooth operations, making it difficult to cover all planned survey locations within the desired timeframe. These limitations occasionally forced adjustments to the original fieldwork schedule and methodology.

Another significant challenge was the scheduling mismatch between enumerators and participants. Due to the respondents' involvement in daily agricultural and household activities, aligning suitable timings for interviews proved difficult. As a result, enumerators had to revisit certain areas multiple times to ensure full participation, leading to delays and increased resource consumption.

Furthermore, the fieldwork was severely impacted by intense waterlogging and erosion issues, particularly in low-lying and river-adjacent areas. These environmental disruptions not only made many areas physically inaccessible but also interrupted the survey process, resulting in delays and rescheduling. In some locations, ongoing erosion and stagnant water made it nearly impossible to complete data collection according to the original timeline.

Additionally, the condition of the Dark Green Bulrush crop itself was significantly affected by late-season climatic events. While the crop showed promising growth during its early stages, heavy rainfall toward the end of the season, coupled with a riverbank slide of the Betna River in a neighboring Upazila, led to prolonged inundation of cultivated fields. This excessive water exposure caused serious physiological damage to the plants, impacting both their health and yield potential. These unforeseen climatic challenges not only influenced the crop outcomes but also affected farmers' responses during data collection, as many were dealing with the aftermath of crop loss.

Exploration of the relationship of the socioeconomic conditions of farmers with the problems of Dark Green Bulrush cultivation

To examine the relationship between the socioeconomic conditions of farmers and the problems associated with Dark Green Bulrush cultivation, a range of socioeconomic variables were systematically measured using standard procedures. These variables included age, educational qualification, family type, family size, and gender, which provide insights into the demographic background of the respondents. Additionally, key livelihood and social indicators such as occupation, organizational participation, and annual family income were assessed to understand the farmers' economic status and social engagement. Variables related to information access and worldview—extension media contact, cosmopolitanism, and attitude—were also evaluated to determine the farmers' exposure to agricultural innovations and their openness to change. Together, these variables formed the basis for analyzing how different socioeconomic factors influence the challenges faced in the cultivation of Dark Green Bulrush.

Table 3. Distribution of the respondents according to their socioeconomic characteristics

Serial	Characteristics	Categories	Score	N=41 F.	%	Range Min.	Max.	Mean±SD
1.	Age (years)	Young	≤35	18	43.9	22.00	70.00	40.14±12.66
		Middle-Aged	36-55	17	41.5			
		Old	>55	6	14.6			
2.	Educational Qualification (schooling years)	Illiterate	0	8	19.5	0.00	16.00	6.73±4.26
		Primary	1-5	6	14.6			
		Secondary	6-10	23	56.1			
		Higher Secondary	11-12	3	7.3			
		Undergraduate	13-16	1	2.4			
		Above	>16		0			
3.	Family Type (category)	Nuclear	-	22	53.7	-	-	1.46±0.50
		Joint		19	46.3			
		Extended		0	0			
4.	Family Size (member number)	Small	≤4	16	39.0	1.00	10.00	5.00±1.81
		Medium	5-6	20	48.8			
		Large	>6	5	12.2			
5.	Gender (category)	Male	-	8	19.5	-	-	-
		Female		33	80.5			
6.	Occupation (category)	Farmer	-	34	82.9	-	-	1.31±0.72
		Agricultural Laborer		1	2.4			
		Farmer & Agricultural Laborer		6	14.6			
7.	Organizational Participation (score)	Low	≤6	41	100	0.00	1.00	0.85±0.35
		Medium	7-12	0	0			
		High	>12	0	0			
8.	Annual Income (BDT)	-	-	-	-	20,000	95,000	59537.8± 20009.32
9.	Extension Media Contact (score)	Low	≤8	41	100	0.00	4.00	2.41±1.04
		Medium	9-16	0	0			
		High	>16	0	0			
10.	Cosmopolitanism (score)	Low	≤4	41	100	0.00	1.00	0.75±0.43
		Medium	5-8	0	0			
		High	>8	0	0			
11.	Attitude (score)	Less Favorable Attitude	≤17	0	0	28.00	46.00	38.09±4.15
		Moderately Favorable Attitude	18-34	7	17.1			
		Highly Favorable Attitude	>34	34	82.9			

Table 3 provides a comprehensive overview of the socioeconomic characteristics of Dark Green Bulrush farmers. The data reveal that a significant proportion of the farmers are young, accounting for 43.9% of the total, followed closely by middle-aged farmers at 41.5%.

Older farmers constitute only 14.6% of the population. The age range spans from 22 to 70 years, with a mean age of 40.14 and a standard deviation of 12.66, indicating that the majority of participants are relatively young, which

reflects strong youth involvement in bulrush cultivation.

Regarding educational qualifications, the majority of farmers (56.1%) have attained secondary education. A smaller proportion (14.6%) have completed primary education, while only 7.3% have reached the higher secondary level. Notably, 19.5% of respondents are uneducated, and a mere 2.4% have pursued undergraduate studies, the lowest among all education categories. The mean education level is 6.73, with a standard deviation of 4.26, and ranges from 0 to above 16 years of schooling.

In terms of family structure, the majority (53.7%) of farmers belong to nuclear families, whereas 46.3% are from joint families. There were no respondents from extended families. The mean family type score is 1.46 with a standard deviation of 0.50, reflecting a predominance of simpler family units.

Family size among respondents ranges from 1 to 10 members, with a mean of 5.00 and a standard deviation of 1.81. Medium-sized families (4–6 members) are most common, representing 48.8%, followed by small families (1–3 members) at 39.0%, and large families (more than 6 members) at 12.2%.

Gender-wise, female participation in bulrush cultivation is notably high, making up 80.5% of respondents, whereas male participation stands at only 19.5%, indicating a strong role of women in this agricultural activity.

In terms of occupation, a large majority (82.9%) of respondents identify as farmers. A smaller segment (14.6%) engage in both farming and agricultural labor, while only 2.4% work solely as agricultural laborers. The mean occupational score is 1.31, with a standard deviation of 0.72, reinforcing the dominance of farming as the primary livelihood.

Organizational participation among farmers is notably low, with 100% of respondents reporting limited involvement in formal or informal organizations. The participation score ranges from 0 to 1, with a mean of 0.85 and a standard deviation of 0.35, highlighting a general lack of institutional engagement.

The annual income data obtained from 41 cultivators of Dark Green Bulrush (*Scirpus atrovirens*) reveals important insights into the economic viability of this wetland crop. The average income was found to be 59,537.80 BDT, with a standard deviation of 20,009.32 BDT, indicating considerable variability in earnings among the cultivators. Income ranged from a minimum of 20,000 BDT to a maximum of 95,000 BDT, highlighting a wide disparity in economic returns. This variation may be attributed to several factors, including differences in environmental conditions such as soil type, water availability, and exposure to flooding, as well as socio-economic factors like landholding size, cultivation practices, and market access. The relatively high standard deviation suggests that while some farmers benefit significantly from bulrush cultivation, others may face challenges that limit profitability. Scientifically, this points to a need for targeted interventions—such as improved production technologies, access to quality planting materials, and extension services—to enhance income uniformity and support the sustainable expansion of *Scirpus atrovirens* cultivation in wetland areas.

Extension media contact is also minimal. The contact scores range from 0 to 4, but all respondents (100%) fall under the low contact category, with a mean of 2.41 and a standard deviation of 1.04. This indicates limited access to agricultural information and advisory services.

Similarly, cosmopolitanism, which reflects the extent of a farmer's exposure beyond the local context, is very low among respondents. All (100%) fall within the low cosmopolitanism category, with a score range of 0 to 1, a mean of 0.75, and a standard deviation of 0.43, suggesting that

most farmers have limited external interactions or experiences.

Despite these constraints, the attitude of farmers towards Bulrush cultivation remains overwhelmingly positive. A large majority (82.9%) exhibit a highly favorable attitude, while the remaining 17.1% demonstrate a moderately favorable stance. The attitude scores range from 28 to 46, with a mean of 38.09 and a standard deviation of 4.15, indicating strong enthusiasm and commitment among farmers towards cultivating Dark Green Bulrush.

Relationship of the socioeconomic conditions of farmers with the problems of Dark Green Bulrush cultivation

To assess the relationship between the socioeconomic conditions of farmers and the challenges associated with Dark Green Bulrush cultivation, Spearman's rho (ρ) coefficient of correlation was employed. This non-parametric method was chosen to analyze scored and ranked data measured on interval and ratio scales, ensuring accurate interpretation of the associations. The results of the correlation analysis are presented in Table 4, which illustrates the nature and strength of the relationships between various socioeconomic

variables and the problems faced by farmers in cultivating Dark Green Bulrush.

The relationship between the problems faced in Dark Green Bulrush cultivation and a set of selected socio-economic and psychological variables was systematically analyzed to understand the underlying factors influencing cultivation outcomes. These variables included personal characteristics such as age, educational qualification, and family size; farming-related factors like farm size, actual area ownership, cultivation experience, and annual family income; and institutional and communication variables such as organizational participation, extension media contact, and cosmopolitanism. Additionally, factors directly linked to the crop's management and economics—such as cultivation cost, possible benefit, average yield, selling price, and knowledge level—were also considered. The inclusion of attitude as a psychological variable helped assess the growers' mental disposition toward bulrush cultivation. Exploring the relationships among these variables provided valuable insights into the multidimensional challenges of cultivating Dark Green Bulrush and identified potential leverage points for improving productivity and farmer satisfaction.

Table 4. Relationship of the socioeconomic conditions of the respondents with the problems of Dark Green Bulrush cultivation

Serial	Characteristics	Correlation coefficient (ρ) with Cultivation challenges
1.	Age	0.055[NS]
2.	Educational qualification	-0.083[NS]
3.	Family size	0.021[NS]
4.	Farm size	0.313*
5.	Actual area ownership	0.017[NS]
6.	Experience	0.167[NS]
7.	Organizational participation	-0.120[NS]
8.	Annual family income	-0.360*
9.	Cultivation cost	0.044[NS]
10.	Possible benefit	0.085[NS]
11.	Extension media contact	-0.264[NS]
12.	Cosmopolitanism	-0.034[NS]
13.	Dark green bulrush knowledge	0.192[NS]
14.	Average yield	0.131[NS]
15.	Selling price	0.121[NS]
16.	Attitude	-0.047[NS]

NS =Non-Significant; **Correlation is significant at the 0.01 level (2-trailed); *Correlation is significant at the 0.05 level (2-trailed)

Table 4 presents the correlation between various farmer characteristics and the challenges encountered in Dark Green Bulrush cultivation, distinguishing between statistically significant and non-significant associations. In the table, asterisks (*) represent significant correlations, while "NS" denotes non-significant relationships.

The analysis reveals that the majority of socioeconomic variables—such as age, educational level, family size, actual land ownership, farming experience, organizational participation, cultivation cost, anticipated benefits, extension media contact, knowledge, and attitude—are not significantly correlated with the cultivation challenges. This suggests that these variables have limited influence on the difficulties faced by farmers.

However, two variables exhibit statistically significant relationships with the challenges of bulrush cultivation: Farm size demonstrates a positive and significant correlation ($\rho = 0.313$, $p < 0.01$), indicating that as the size of a farm increases, the challenges in bulrush cultivation tend to increase as well. This may be attributed to the greater complexity, management requirements, and resource allocation issues typically associated with larger landholdings. Annual family income shows a negative and significant correlation ($\rho = -0.360$), suggesting that farmers with higher incomes tend to experience fewer cultivation-related challenges. This could be due to better access to resources, improved infrastructure, or the ability to invest in adaptive strategies and technologies.

Conversely, variables such as age, education, and family size show weak, non-significant correlations, indicating that these demographic characteristics do not significantly influence the cultivation difficulties. Experience, organizational participation, and ownership of land also have minimal associations, further supporting the notion that structural or resource-based factors may play a larger role in determining cultivation outcomes than personal attributes or background.

Likewise, cultivation cost, expected benefits, extension media contact, cosmopolitanism, average yield, selling price, purpose of cultivation, and attitude all exhibit very weak and non-significant correlations, implying that they do not play a major role in affecting cultivation challenges.

The findings underscore that farm size and annual income are the most influential socioeconomic variables in determining the level of difficulty farmers' face in cultivating Dark Green Bulrush. Larger farms are likely to face increased logistical and management challenges, while higher-income farmers may benefit from better access to resources, knowledge, and support systems that help them overcome or mitigate such challenges. In contrast, other personal, demographic, or attitudinal factors appear to have minimal or no significant impact on cultivation difficulties. This highlights the importance of focusing interventions on supporting small-scale and low-income farmers through resource access, infrastructure development, and targeted support to reduce the barriers to successful cultivation.

CONCLUSION

This study in Tala Upazila of Satkhira District, southwestern Bangladesh, revealed several key constraints in Green Bulrush (*Scirpus atrovirens*) cultivation. The most critical problems included waterlogging, unsuitable land, drought, and pest and disease infestations. Additional challenges such as soil salinity, lack of improved cultivation technologies, and limited market access further hinder productivity. Climate-related risks, particularly flooding and riverbank erosion, were also identified as major aggravating factors.

Spearman's rank-order correlation analysis indicated that age, education, experience, and family size had weak or statistically

insignificant associations with cultivation challenges. However, farm size exhibited a significant positive correlation, showing that larger farms tend to face more complex problems. Conversely, annual household income was negatively correlated with challenges, suggesting that wealthier farmers are more capable of coping with these issues. Although levels of organizational involvement, extension contact, and cosmopolitanism were generally low, farmers demonstrated highly favorable attitudes toward Green Bulrush cultivation, reflecting its perceived potential.

The study highlights the need for targeted interventions, particularly improved water management, adoption of modern farming practices, stronger market linkages, and enhanced extension services. These initiatives, when aligned with farmers' socioeconomic realities, can help address current constraints and enhance the role of Green Bulrush cultivation as a sustainable, climate-resilient livelihood in coastal Bangladesh.

Conflict of Interests
The authors declare that there is no conflict of interest regarding the conduct, authorship, or publication of this research. No financial, institutional, or personal relationships have influenced the work presented in this study. All aspects of the research, including the design, data collection, analysis, and interpretation, were carried out independently and objectively. This declaration is made in the interest of full transparency and to uphold the integrity of the research process.

REFERENCES

Edwards, M. E., Brinkmann, K. C., & Watson, J. T. (2020). Growth of soft-stem bulrush (*Scirpus validus*) plants in a gravel-based subsurface flow constructed wetlands. In *Constructed wetlands for water quality improvement* (pp. 415–425). CRC Press.

Farabi, T., Islam, M. M., & Ahmed, M. B. (2024). Prospects and problems of YouTube and virtual video channels in agricultural content dissemination. *International Journal of Agricultural Research, Innovation and Technology, 13*(2), 31–40. https://doi.org/10.3329/ijarit.v13i2.70851

Halder, A. K. (2009). Causes of early childhood deaths in urban Dhaka, Bangladesh. *PLoS ONE, 4*(12), e8145. https://doi.org/10.1371/journal.pone.0008145

Hossain, S. H., Alam, S. M. N., Lin, C. K., Demaine, H., Khan, Y. S., Das, N. G., & Rouf, M. A. (2004). Integrated management approach for shrimp culture development in the coastal environment of Bangladesh. *World Aquaculture, 35*(1), 35–45.

Mim, M. K., Katha, J. F., Islam, M. M., & Kabir, M. Y. (2022). Present status and problems of underutilized vegetables as perceived by the retailers and consumers of Khulna City of Bangladesh. *Food & Agribusiness Management (FABM), 3*(2), 34–39. http://doi.org/10.26480/fabm.02.2022.34.39

Rahman, M. M., Jiang, Y., & Irvine, K. (2018). Assessing wetland services for improved development decision-making: A case study of mangroves in coastal Bangladesh. *Wetlands Ecology and Management, 26*(4), 563–580.

https://doi.org/10.1007/s11273-018-9592-0

Salam, M. D., Oyshy, J. M., Ahmed, M. B., & Islam, M. M. (2024). Present status and problem confrontation of farm mechanization in Bangladesh. *Acta Mechanica Malaysia, 7*(2), 122–129. http://doi.org/10.26480/amm.02.2024.122.129

Sarkar, S., Khan, M. A., Islam, M. M., Biswas, C., & Ahmed, M. B. (2024). Divergence in the utilization and adoption magnitude of different Indigenous Technical Knowledges (ITKs) in different upazilas of Bangladesh. *Malaysian Journal of Sustainable Agriculture, 8*(1), 53–65. http://doi.org/10.26480/mjsa.01.2024.53.65

Umkhulzum, S. F., Ameena, M., & Pillai, P. S. (2019). Biology of rock bulrush (*Schoenoplectus juncoides*) in the wetland rice fields of south Kerala. *Journal of Tropical Agriculture, 57*(2), 150–157.