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Understanding the challenges to paddy production and marketing in Bangladesh: A relative importance index approach

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ABSTRACT

Bangladesh is self-sufficient in rice production; however, paddy farmers continue to face substantial challenges in both production and marketing. This study investigated the key constraints affecting farmers using primary data collected from 500 respondents across four districts through a multistage random sampling technique. The Relative Importance Index (RII) was employed to assess the severity of the challenges, while correlation analysis examined their associations with farmers' characteristics. The results showed that the high cost of inputs was the most severe production challenge, followed by pest and disease infestations, climate change effects, labor shortages, and limited access to credit. Major marketing challenges included low paddy prices during harvest, inadequate government procurement, price instability, limited storage facilities, and weak market monitoring. Six of the twenty identified challenges were rated as highly severe, with the remainder being moderately to highly severe, indicating persistent structural issues in the paddy sector. Correlation analysis revealed significant associations between the severity of challenges and farmers' age, farm size, credit access, and distance to markets. Given rice's central role in Bangladesh's food security strategy, this study recommends improving access to affordable inputs, strengthening extension services, promoting climate-resilient technologies, and enhancing government procurement and market-monitoring systems to support farmers' incomes and livelihoods.

Contribution/ Originality: This study contributes to the existing literature by exploring the challenges faced by paddy farmers in Bangladesh using the Relative Importance Index (RII). By addressing both production and marketing issues, it offers policymakers practical guidance to formulate comprehensive interventions that support farmers and enhance market access.

1. INTRODUCTION

Over the last 50 years, both rice production and consumption have grown vastly worldwide. Rice is the primary staple crop for more than 50% of the world's population (Hashim et al., 2024; Jamal, Kristiansen, Kabir, & De Bruyn, 2023; Mottaleb & Mishra, 2016; Muthayya, Sugimoto, Montgomery, & Maberly, 2014) and is the third most cultivated crop in the world, after maize and wheat (USDA, 2025b). Approximately 90% of the global rice production

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is grown in Asia, 5% in Africa, and 3% in Latin America, while 86% of the entire rice is consumed in Asia, followed by 8% in Africa, and 3% in Latin America (USDA, 2025a). Over two billion people in Asia alone account for 50% of their total daily calorie intake from rice (Hashim et al., 2024; Muthayya et al., 2014). Rice is considered a vital crop for global food security, economic development, and poverty alleviation. It is mainly consumed in large quantities by the poor (Hashim et al., 2024; Muthayya et al., 2014). In addition, paddy farming is the backbone of Asia's food security, with Bangladesh being one of the leading producers despite having limited fertile land. However, currently, Bangladesh is ranked third in global rice production and consumption after China and India (USDA, 2025b).

The agricultural landscape of Bangladesh is primarily centered around paddy cultivation, with rice serving as the main staple food. It plays a vital role in ensuring food security, supporting rural livelihoods, and contributing significantly to the national economy. Paddy farming accounts for nearly 75% of the total cropped area and irrigated land, involving approximately 13 million family farms engaged in the industry (BBS, 2024). The paddy industry comprises 70% of the nation's agricultural GDP and is the primary source of livelihood for 48% of the rural population (BBS, 2024). Accordingly, paddy cultivation and marketing are key to reducing poverty and ensuring food security, as almost 50% of the population is involved in this process (Bairagi & Mottaleb, 2021). In Bangladesh, rice accounts for over 67% of the population's caloric intake and 50% of the population's protein needs (Sayeed & Yunus, 2018). Furthermore, paddy is a strategic crop for Bangladesh in terms of food security, economic growth, and socio-political stability, and is usually viewed as a political crop (Jamal et al., 2023; Roy, Chan, & Rainis, 2014; Sayeed & Yunus, 2018). During the last few decades, due to technological innovations, such as the introduction of new varieties and improved management practices, Bangladesh's paddy production (FAO, 2021; World Bank, 2020) has increased manifold, and it is now self-sufficient in rice production (Bairagi & Mottaleb, 2021; Mottaleb & Mishra, 2016; World Bank, 2020). Despite achieving self-sufficiency in rice production, the sector suffers from numerous structural and functional problems; therefore, the country's agricultural sector remains in a precarious state.

Studies in developing countries indicate that productivity bottlenecks are likely to originate from a combination of input constraints, institutional weaknesses, and climatic exposure. Jayne, Mather, and Mghenyi (2010) noted that small farm holdings, lack of mechanization, and informal input-output markets constrain growth in smallholder-dominated agricultural systems. Pingali (2007) highlighted the issues of intensification and sustainability in the Asian rice systems. Hashim et al. (2024) noted that conventional paddy farming practices and the use of low-quality paddy varieties are the main challenges, which negatively affect paddy production. From the marketing perspective, Fafchamps and Hill (2005) described how market failures, including imperfect information, high transaction costs, and limited access to organized markets, affect smallholder price realization. In addition, the profitability of paddy cultivation is hindered by fluctuating input and output prices, as well as low access to credit facilities and resources for small-scale farmers (Hashim et al., 2024). These challenges are exacerbated in Bangladesh, where rural infrastructure has not yet improved, and minimum support prices are weakly enforced (Islam et al., 2023).

Several studies have consistently reported production and marketing barriers to paddy cultivation in Bangladesh. For instance, Bell, Bryan, Ringler, and Ahmed (2015) noted that although rice production has increased due to technological advances, farmers face challenges in increasing productivity and income due to a lack of effective utilization of recent technologies and poor access to quality inputs. Jamal et al. (2023) and Bell et al. (2015) highlight the vulnerability of paddy farmers to climate-related shocks, including floods, droughts, rising temperatures, increasing salinity, and extreme weather events, which occur frequently due to climate change. Quddus and Kropp (2020) documented that farm machinery shortages, low productivity, a lack of irrigation facilities, and poor access to farm inputs exacerbate the challenges farmers faced in producing paddy. Minten, Murshid, and Reardon (2013) noted that even in intensively cultivated zones, inefficiencies in infrastructure and input delivery persist. Jamal et al. (2023) also revealed that the growth of paddy production is further constrained by decreasing arable land, lack of labor, low profitability, and diversification of crops. Ahmed et al. (2025) reported that the incorporation of inadequate access to resources such as irrigation facilities, fertilizers, and quality seeds, along with high labor costs, pest infestations, flash

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floods during the initial stages, and low paddy prices during the harvesting season, are the key challenges faced by farmers in wetland areas. At the marketing stage, inefficiencies in the paddy marketing chain, such as unstructured procurement systems and informal traders, are likely to result in low prices for farmers (Alam et al., 2016; Deb, Lee, & Lee, 2020; Islam et al., 2023). Marketing channels in developing countries are often characterized by their length and multiple intermediaries (Alam et al., 2016), and Bangladesh is no exception. Specifically, the marketing channel for paddy in Bangladesh has traditionally been broad, highly fragmented, and dominated by small-scale actors, resulting in inefficiency (Alam et al., 2016; Reardon, Minten, Chen, & Adriano, 2013). The presence of these intermediaries results in a broad price difference between farm and retail prices (Alam et al., 2016; Rahman et al., 2021), thereby generating low farmer income. Poor rural infrastructure, particularly road and market facilities, and poor producer organizations are other problems that contribute to intensifying the issue, in addition to low returns to farmers and low market participation (Hoq, Uddin, Raha, & Hossain, 2021; Quddus & Kropp, 2020). In addition, effective and productive farmers' organizations and agricultural extension services remain poor in Bangladesh (Afrad, Wadud, & Babu, 2019; Bairagi & Mottaleb, 2021; Quddus & Kropp, 2020). Institutional lending is also highly limited for small and marginal farmers. Usually, farmers obtain loans from paddy traders, relatives, and friends (Alam & Begum, 2021; Quddus & Kropp, 2020), and the interest rates levied by them are incredibly high (Siddique, 2015). Moreover, when farmers receive tied credit from local intermediaries, they are obligated to sell their paddy to lenders, which creates opportunities for the exploitation of paddy farmers. Asymmetric market information, a common constraint for most farmers, hampers their ability to make informed decisions regarding the sale of their paddy at fair prices. Additionally, when farmers do sell their paddy, they are unlikely to receive a premium price. Farmers are often denied adequate price information and lack awareness of post-harvest management techniques, such as paddy grading, standards, and moisture content. Due to limited knowledge about pricing and post-harvest practices, farmers are unable to determine the appropriate quantity to produce and sell, identify suitable buyers and markets, or negotiate effectively with traders. Consequently, traders often benefit unfairly by offering lower prices, which diminishes farmers' earnings and hampers their economic well-being (Hoq et al., 2021; Quddus & Kropp, 2020; Segal & Le Nguyet, 2019). Low prices during the harvest season also worsen the financial conditions of paddy farmers (Bell et al., 2015; Islam et al., 2023). Additionally, Barrett (2008) discussed more universal problems of entry into agricultural markets in developing countries, which also apply to the case of Bangladesh's smallholder farmers' environment.

The Government of Kenya (2018) recognizes these challenges and emphasizes the need for strategic interventions in input supply, research-extension linkages, and rural market development. Despite these efforts, a significant research gap persists in the form of a comprehensive, farmer-centered quantitative assessment of the challenges faced by farmers. This assessment should integrate both production and marketing dimensions across various agro-ecological zones to provide a holistic understanding of the issues. While numerous studies have individually examined some of these issues for example, (Ahmed et al., 2025) for productivity and profitability, Minten et al. (2013) for market behavior, Quddus and Kropp (2020) for production and marketing in lagging areas, and Jamal et al. (2023) for resilient production, few have quantitatively measured farmers' experiences across regions with comparable measures and direct field-level observations. The present study addresses this gap by utilizing a structured survey to quantitatively compare the challenges faced by farmers, thereby providing evidence-based justification for specific policy interventions. The study aims to examine the underlying reasons for the challenges in farmers' paddy production and marketing in Bangladesh and to offer policy recommendations for the development of the paddy sector.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

Bangladesh has three seasons for paddy harvesting: Aus, Aman, and Boro. Among these, Aman and Boro are the principal paddy harvesting seasons because they produce higher yields, whereas the yield of Aus is comparatively

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lower. This study focuses on the Aman season, specifically because it accounts for the largest share (48.91%) of the total land used for paddy cultivation (BBS, 2024). The study area comprises four districts renowned for producing large quantities of Aman paddy: Dinajpur, Jashore, Naogaon, and Chattogram. These districts are situated within Bangladesh's extensive agro-ecological zone and feature rich alluvial plains that are highly suitable for rice cultivation.

2.2. Sampling Technique and Sample Size Determination

This study employed a cross-sectional research design to investigate the challenges faced by farmers in producing and marketing paddy in selected districts of Bangladesh. Data were collected from April 2024 to June 2024 using a structured questionnaire and a multistage random sampling technique. Initially, four districts Dinajpur, Jashore, Naogaon, and Chattogram were randomly selected from Bangladesh's top ten Aman paddy-producing districts. In the second stage, two sub-districts were randomly chosen from each district. The final sampling units, namely the farmers, were randomly selected from the eight sub-districts in the final stage of data collection. According to the local agriculture office, there are 288,969 paddy-growing farmers in these eight sub-districts. The sample size was calculated using the formula proposed by Yamane (1967), as it is considered the most effective method for calculating sample size when the population size is known.

$$n = \frac{N}{1 + N(e^2)} = \frac{288969}{1 + 288969(0.05^2)} = 399.73 \cong 400$$

Where n is the sample size, N is the total number of paddy farmers in the study area, and e is the acceptable margin of error (5%). Although the formula produced an optimal sample size of 400 farmers, we added 25% to better represent the population, which yielded a final sample size of 500 farmers. The sample distribution is presented in Table 1.

Table 1. Sample distribution.

District	Sub-district	Total paddy farmers	Sample size for each sub-district	Final sample size
Chattogram	Fatikchari	42200	58	73
	Mirsharai	35505	49	61
Naogaon	Niyamatpur	41276	57	71
	Sadar	37154	51	64
Jashore	Chaugacha	34367	48	60
	Jhikorgacha	39360	55	68
Dinajpur	Chririrbandar	37382	52	65
	Bochaganj	21725	30	38
	Total	288969	400	500

2.3. Statistical Analyses

Descriptive statistics, such as means, frequencies, and percentages, were used to summarize the data. The Relative Importance Index (RII) was employed to analyze the challenges faced by farmers in producing and selling their paddy. This method was utilized to determine the relative importance of the identified challenges and to rank them according to their RII values. RII is recognized as one of the most consistent techniques for ranking multiple factors based on a Likert scale questionnaire (Antwi-Agyei, Abalo, Dougill, & Baffour-Ata, 2021; Das, 2025; Kassem, Khoiry, & Hamzah, 2020; Tholibon et al., 2021; Yeleliere, Yeboah, Antwi-Agyei, & Peprah, 2022). It identifies key factors and highlights a relatively more significant one (Mensah, 2025; Prodhan et al., 2024; Quarshie, Abdulai, & Fraser, 2023). The mathematical representation of the RII is as follows:

$$RII = \frac{\Sigma w}{AN} = \frac{(5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1)}{5N}$$

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In this context, w represents the weight assigned to an individual statement provided by respondents, with values ranging from 1 to 5. A indicates the highest score given by respondents; in this case, it is 5. N denotes the total number of respondents.

The relative importance index ranges from 0 to 1, with the maximum value indicating the most severe challenge for farmers. RII has also been categorized into five levels to assess the significance of various challenges. This classification was suggested by Akadiri (2011) and has recently been used in several studies (Boakye & Adanu, 2022; Oluwole, 2022; Rooshdi, Abd Majid, Sahamir, & Ismail, 2018; Tholibon et al., 2021). The five levels are stated as follows: High (H) (0.8≤ RII≤1), High-Medium (H-M) (0.6≤ RII<0.8), Medium (M) (0.4≤ RII<0.6), Medium-Low (M-L) (0.2≤ RII<0.4), and Low (L) (0≤ RII<0.2).

3. RESULTS AND DISCUSSION

3.1. Socio-Demographic Characteristics of the Respondents

Table 2 presents the socio-demographic characteristics of the respondents. The findings indicate that nearly 60% of the farmers were between the ages of 31 and 50 years, suggesting that an active workforce was engaged in paddy farming. The age group 51-60 comprised 19.80% of the farmers, and 11.80% of the total farmers were over 60 years old. The age group between 21 and 30 years consisted of only 8.40% of farmers, which suggests that the youth were not particularly keen on agricultural professions, consistent with the findings of Quddus and Kropp (2020). The average age of the farmers was 46.1 years, which is nearly identical to the finding reported by Hoq et al. (2021).

Table 2. Sociodemographic Characteristics of the Respondents (n=500)

Characteristics	Category	Frequency	Percent	Mean
Age of respondents	21 - 30	42	8.40	46.1
	31 - 40	150	30.00	
	41 - 50	150	30.00	
	51 - 60	99	19.80	
	≥61	59	11.80	
Level of education	No formal education	113	22.60	6.23
	Primary	167	33.40	
	Secondary	140	28.00	
	Higher secondary	56	11.20	
	Bachelor's degree and above	24	4.80	
Family size	≤5	202	40.40	5.11
	≥6	298	59.60	
Farming experience	1 - 10	105	21.00	22.72
	11 - 20	164	32.80	
	21 - 30	118	23.60	
	≥31	113	22.60	
Main source of income	Non-Agriculture	57	11.40	-
	Agriculture	443	88.60	
Access to off-farm income	No	306	61.20	-
	Yes	194	38.80	

According to Table 2, most farmers (33.40%) had a primary education, 28% had a secondary education, 11.20% had a higher secondary education, and only 4.80% had a bachelor's degree or higher. Moreover, 22.60% of the farmers had no formal education. The average number of years of schooling for farmers was 6.23, which was marginally higher than the 4.98 years reported by Hoq et al. (2021).

Almost three-fifths of the farmers had larger family sizes, consisting of more than six members, while 40.40% of farmers' families had between 1 and 5 members. The average family size was 5.11 members, which is slightly higher

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than the national average family size in rural areas, recorded at 4.30 (BBS, 2023). Most farmers (32.80%) had 11-20 years of experience in paddy cultivation, while 23.60% had 21-30 years of experience. However, 21% were relatively new farmers with expertise ranging from one to ten years, and the remaining 22.6% had over 31 years of farming experience. Nearly 89% of the farmers' primary source of income was agriculture. Additionally, approximately 39% of farmers (194 individuals) had access to off-farm income.

3.2. Farm Characteristics of the Respondents

Table 3 presents the farm characteristics of the respondents in the study area. In the study area, the average farm size of the farmers was 0.87 hectares, indicating that most of the sampled paddy farmers were smallholders. Approximately two-thirds of the farmers (75.60%) in the studied area owned small farms with an area of less than 1.01 hectares. About 20.60% owned medium farms ranging from 1.01 to 3.03 hectares, and only 3.60% of farmers had large farms exceeding 3.04 hectares. This finding is similar to that of Quddus and Kropp (2020).

Table 3. Farm characteristics of the respondents (n=500).

Characteristics	Category	Frequency	Percent	Mean
Farm Size	Small (Less than 1.01 ha)	379	75.80	
	Medium (1.01 to 3.03 ha)	103	20.60	0.87
	Large (3.04 ha and above)	18	3.60	
Cultivated varieties	Local	245	35.10	
	High-yielding (HYV)	340	48.71	
	Hybrid	113	16.19	-
Yield (Tonne/Hectare)	<= 3.86	35	7.00	
	3.87 - 5.17	62	12.40	
	5.18 - 6.47	311	62.20	5.71
	6.48+	92	18.40	

Regarding seed varieties, approximately 48.71% of farmers used high-yielding varieties (HYV), 35.10% used local varieties, and 16.19% used hybrid varieties. On average, farmers in the study area experienced a yield rate of 5.71 tonnes per hectare, which was slightly higher than the national average yield rate of 4.59 tonnes per hectare for HYV and nearly equivalent to the national yield rate of 5.79 tonnes per hectare for hybrid varieties (BBS, 2024). Additionally, the majority of farmers experienced a yield rate between 5.18 and 6.47 tonnes per hectare, while 12.4% of farmers reported yields ranging from 3.87 to 5.17 tonnes per hectare. Furthermore, 18.4% of farmers achieved yields exceeding 6.48 tonnes per hectare, and approximately 7% reported yields less than or equal to 3.86 tonnes per hectare.

3.3. Respondents' Institutional Access

It outlines descriptive information on institutional factors such as access to credit, sources of credit, access to extension services, access to marketing services, access to price information, and access to farm organizations. Table 4 summarizes the respondents' institutional factors.

The findings reveal that approximately 63.20% of farmers did not have access to formal credit, whereas only 36.80% did. Farmers may avoid obtaining formal loans due to high interest rates, uncertainty regarding loan repayment, excessive borrowing costs, challenges with loan applications and documentation, and a lack of knowledge about the borrowing process. Addressing these barriers is essential to improve access to formal credit and support agricultural development (Quddus & Kropp, 2020). Table 4 also indicates that extension services were accessible to nearly two-thirds (376) of the farmers in the study area, while the rest did not receive any services. Furthermore, the findings indicate that only half of the farmers (254) had access to marketing extension services. The majority of farmers (87%) in the study area received price information for paddy before selling it. Approximately half of the

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farmers (47.40%) were involved in at least one of the following farm organizations: farmers' marketing groups, farmers' groups, cooperatives, and farmers' field schools.

Table 4. Access to institutional factors by the respondents (n=500).

Characteristics	Category	Frequency	Percent
Access to credit	No	316	63.20
	Yes	184	36.80
Access to extension services	No	124	24.80
	Yes	376	75.20
Access to marketing services	No	246	49.20
	Yes	254	50.80
Access to price information	No	65	13.00
	Yes	435	87.00
Access to farm organizations	No	263	52.60
	Yes	237	47.40

3.4. Challenges Faced by Farmers in Paddy Production and Marketing

The challenges farmers encountered in producing and marketing paddy are outlined in Table 5. The literature review identified 20 statements related to challenges in paddy production and marketing. Respondents were asked to rank the severity of these challenges using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The severity of the challenges was assessed using the Relative Importance Index (RII), which was ranked from highest to lowest. These challenges can be classified into production-oriented and marketing-oriented categories.

Table 5. Challenges Faced by Farmers in the Production and Marketing of Paddy

Item	RII	Rank	Dimensions of challenges	Importance level
High price of material inputs (seeds, fertilizer, pesticides, and diesel)	0.862	1	Production	H
Low price of paddy during the harvesting period	0.858	2	Marketing	H
Insufficient government procurement	0.844	3	Marketing	H
Pest and disease incidence	0.830	4	Production	H
Unstable price, specifically for fresh paddy	0.828	5	Marketing	H
Climate change effects (Salinity, Flood, Drought, heavy rain, etc.)	0.824	6	Production	H
Shortage of labor	0.786	7	Production	H-M
Limited storage facilities	0.784	8	Marketing	H-M
Limited access to low-cost credit	0.761	9	Production	H-M
Poor market monitoring system by the government authority	0.757	10	Marketing	H-M
Lack of access to modern harvesting technology	0.745	11	Marketing	H-M
High transportation cost	0.744	12	Marketing	H-M
Limited drying facilities	0.713	13	Marketing	H-M
Low adoption of new crop management technologies	0.705	14	Production	H-M
Poor extension service	0.697	15	Production	H-M
Poor market infrastructure	0.689	16	Marketing	H-M
Mismatch of available high-quality varieties with farmers' preferences	0.688	17	Production	H-M
Limited market information	0.688	17	Marketing	H-M
Malpractices in the scaling of paddy in the market	0.676	19	Marketing	H-M
Inadequate irrigation system	0.672	20	Production	H-M

Farmers in the study area faced several challenges in the production and marketing of paddy. The findings revealed that the high price of input materials was the most severe challenge faced by farmers in the study area. Rana and Rahaman (2021) and Quddus and Kropp (2020) also noted that the high price of inputs is a significant constraint

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for vegetable farmers. A similar result was reported by Okoma et al. (2025), who found that the high cost of agrochemicals and fertilizers was the most severe production constraint in Kenya and Uganda. The second most severe challenge faced by farmers was the low price of paddy during the harvesting period. This finding is similar to that of Rana and Rahaman (2021). Insufficient government procurement was the third most severe challenge faced by farmers in the study area. This finding is also supported by Islam et al. (2023) who opined that every year, the government of Bangladesh buys paddy from farmers at a fixed price, often known as the support price, but the buying amount of paddy is minimal, and the irony is that middlemen take this opportunity by providing the paddy to the government; hence, farmers are deprived of getting a remunerative price. The fourth most severe challenge was the infestation of pests and diseases, which is similar to the findings reported by Rana and Rahaman (2021) and Ahmed et al. (2025). Okoma et al. (2025) also reported that insect pests were one of the major challenges in Uganda; however, they were less severe in Kenya. The unstable price of fresh paddy during the harvesting season is a common scenario in Bangladesh (Islam et al., 2023), which was identified as the fifth most severe challenge faced by farmers in the study area. Due to price fluctuations, farmers often struggle to make decisions on producing and marketing paddy (Alam et al., 2016). In addition, the effects of climate change were one of the significant challenges faced by farmers in producing paddy. Similarly, Okoma et al. (2025) found that climate change effects, such as drought and poor rainfall, are severe challenges to vegetable production in Uganda. Similarly, in Iraq, salinity was ranked as one of the top challenges to vegetable production (Kshash, 2019). Climate change is regarded as a significant challenge to crop production, as it substantially threatens paddy cultivation and adversely impacts the livelihoods of farmers in food-insecure regions worldwide (Habib-Ur-Rahman et al., 2022; Islam et al., 2025). Regarding production-oriented challenges, the study identified that the high cost of input materials is the most significant constraint. Pest and disease infestations were the second most severe challenge, followed by the impacts of climate change on paddy production. Additional challenges include labor shortages during cultivation and harvesting, as well as limited access to low-cost credit. Other issues encompass the low adoption of new crop management technologies, insufficient extension services, a lack of high-quality paddy varieties, and inadequate irrigation systems.

The low paddy prices during the harvesting period represented the most severe marketing-oriented challenge faced by farmers, followed by insufficient government procurement, unstable prices of fresh paddy, limited storage facilities, and inadequate market monitoring systems implemented by government agencies. Other significant marketing challenges included limited access to modern harvesting technology, high transportation costs, insufficient drying facilities, poor market infrastructure, lack of market information, and malpractices in weighing paddy. Out of 20 identified challenges, six were classified as the most severe, while the remaining 14 posed medium to high-range difficulties. This distribution indicates that these challenges are highly persistent in the paddy production areas of Bangladesh, affecting the overall efficiency and sustainability of the rice supply chain.

3.5. Relationship Between Respondents' Different Characteristics and Challenges Faced

This section examines the relationship between respondents' specified characteristics and the challenges faced in the production and marketing of paddy. The relationship between the challenges encountered by farmers and their various characteristics was determined using Pearson's Correlation Coefficient (r). Table 6 presents the results of the correlation analysis.

The results demonstrated that age, farm size, access to credit, and distance to market were significantly associated with the problems encountered by farmers in the study area. The correlation coefficient between age and the challenges faced by farmers showed a significant negative association, indicating that as farmers' age increases, they are less likely to encounter severe challenges in paddy production and marketing. One possible explanation for this result is that, as farmers age, they may adapt to challenges by employing different strategies to mitigate them. Similarly, years of education and farming experience showed a negative correlation with farmers' confrontation with challenges.

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Table 6. Output of correlation analysis between challenges faced by farmers and various selected characteristics.

Characteristics	Pearson correlation
Age of respondents	-0.111*
Years of education	-0.016
Farming experience	-0.063
Access to off-farm income	0.056
Family size	-0.035
Paddy farm size	-0.198**
Access to credit	0.156**
Access to farm org.	0.061
Access to extension services	-0.004
Access to marketing services	0.008
Access to price information	0.050
Distance to market	0.134**

Note: **, and * represent significance at the 1% and 5% level.

However, the results were not statistically significant, but they suggest that the more education and experience farmers acquire, the better they are at mitigating challenges. Paddy farm size was significantly negatively associated with farmers' confrontation with challenges. This finding implies that larger farm sizes are associated with fewer difficulties in producing and marketing paddy, highlighting the importance of resource endowment in agricultural success. However, Rana and Rahaman (2021) and Kshash (2019) found contradictory results, suggesting that farmers with larger farm sizes often face greater difficulties in production and sales. Contrary to our expectation, access to credit was significantly and positively associated with farmers' challenge confrontation, indicating that farmers with greater access to credit faced more challenges in producing and marketing paddy in the study area. One plausible explanation for this result is that farmers with access to credit may invest their money in activities other than paddy farming, thereby confronting additional challenges in paddy farming and marketing (Alene et al., 2008). However, our findings contradict those of Rana and Rahaman (2021), who argued that farmers with access to credit tend to invest more in adopting and implementing new technologies, thereby reducing challenges in vegetable production and marketing. The correlation coefficient indicates that the farther the distance to the market, the more difficulties farmers face in producing and marketing paddy. This may be because farmers face difficulties in accessing input and output markets due to the long distance to the market (Hoq et al., 2021).

4. CONCLUSION

A sustainable rice-based food system is a top priority in Bangladesh's national policy, aimed at achieving self-sufficiency and ensuring food security. However, paddy farmers encounter numerous challenges in both production and marketing. This study assessed the challenges faced by farmers in these areas. Empirical evidence indicates that farmers face challenges ranging from input supply to market inefficiencies. The Relative Importance Index (RII) found that all identified challenges from the literature review were highly persistent in the study area. Notably, six out of twenty challenges were highly severe, while the remaining fourteen were of medium to high severity. The RII also revealed that the high price of material inputs (seeds, fertilizer, pesticides, and diesel), low price of paddy during the harvesting period, insufficient government procurement, pest and disease incidence, unstable price of fresh paddy, climate change effects (salinity, flood, drought, heavy rain, etc.), shortage of labor, limited storage facilities, limited access to low-cost credit, and poor market monitoring system by government authorities were the top ten severe challenges. Furthermore, the results of the correlation coefficient analysis indicated that age, paddy farm size, access to credit, and distance to the market were significantly associated with the challenges faced by farmers. Based on the findings of this study, the government and policymakers should consider the following recommendations to address the issues faced by farmers. First, strengthening the input supply chain to ensure a timely and adequate supply of input materials, including seeds, fertilizers, pesticides, and diesel, must be guaranteed. Additionally, government

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agencies should prioritize the supply of affordable inputs for farmers. Second, government procurement processes should be reformed to enable the direct and timely acquisition of paddy from farmers, particularly during harvest, to prevent distress sales and ensure fair prices. This can be achieved by introducing a dynamic minimum support price, considering the cost of production, marketing costs, and inflation, which would act as a crucial social safety net for farmers. Third, while several salinity-, drought-, and flood-tolerant paddy varieties have been introduced in the country, investment in climate-resilient agricultural research should be strengthened to develop more such varieties. Moreover, measures should be taken to control pest and disease infestations. Finally, priority should be given to developing an agricultural marketing policy aimed at improving farmers' market access, featuring adequate physical market infrastructure, quality extension services, and effective market monitoring.

This study was limited in several ways despite its significant policy implications. First, it relied on a cross-sectional design that captured the challenges faced by farmers at a specific point in time. Future research should include longitudinal studies to monitor changes over time. Second, only the Aman paddy season was analyzed. To develop a more comprehensive understanding, future research must consider other production seasons, such as Boro.

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Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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