Annals of Bangladesh Agriculture
Journal homepage: bsmrau.edu.bd/aba

ORIGINAL ARTICLES

Unlocking maize (*Zea mays*) potential: exploring profitability and marketing efficiency in Bangladesh's char land areas

Shakila Begum[1], Debasish Chandra Acharjee[*1], Kamal Gosh[3], Md. Ruhul Amin[1], Asif Reza Anik[2] and G M Monirul Alam[1]

[1] Department of Agribusiness, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh.
[2] Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh.
[3] Sherman Lewis School of Agriculture and Applied Science, Langston University, Oklahoma, USA.

ARTICLE INFO.

Keywords:

Char farming, input costs, benefit-cost ratio, farm size impact, economies of scale, rural infrastructure, maize value chain.

Received : 14 March 2024
Revised : 15 May 2024
Accepted : 30 June 2024
Published : 15 July 2024

Citation:

Begum, S., D. C. Acharjee, K. Gosh, M. R. Amin, A. R. Anik and G. M. M. Alam. 2024. Unlocking maize (zea mays) potential: exploring profitability and marketing efficiency in Bangladesh's char land areas. *Ann. Bangladesh Agric.* 28(1): 61-77

ABSTRACT

Maize (*Zea mays*) farming presents a promising opportunity in the char land areas of Bangladesh, characterized by shallow lands that emerge as water levels recede in rivers. However, the geographical remoteness of these regions poses challenges for char farmers in accessing fair prices for their produce. This study endeavors to delve into the determinants of maize profitability and marketing efficiency in the char area. Data were meticulously gathered through a structured survey encompassing 200 maize farmers and 40 market actors across four villages in Gangachara upazila, Rangpur district, in 2022. Employing descriptive statistics and multiple regression methods, we aim to analyze the factors affecting maize profitability, assess existing maize marketing chains and costs, and examine maize marketing efficiency in the char area. Our findings underscore the profitability of maize cultivation, with a Benefit-Cost Ratio (BCR) of 1.57. Small farms maximize returns, while medium-sized farms benefit from cost advantages despite lower yields, showing a discernible correlation between farm size, higher yields, and profits. Moreover, our investigation reveals that maize profitability is significantly influenced by farm size, seed and fertilizer costs, land preparation, and irrigation expenses. Furthermore, we shed light on the intricate maize supply chain, identifying Chain II (includes Farmers to a*ratdar* to feed mills to Processor) as the most efficient, boasting the highest producer share and the lowest marketing cost. Notably, wholesalers faced the highest marketing costs, amounting to BDT 146 per quintal, while faria (local traders) experienced the lowest costs at BDT 81 per quintal. To enhance maize production, profitability, and livelihoods of char farmers, we urge for government intervention in the form of providing subsidized hybrid seeds and fertilizers to bridge yield gaps across farm sizes, reducing irrigation costs through subsidized infrastructure or collective irrigation systems, alongside easy access to low-interest credit to manage input costs. Promoting direct farmer-to-aratdar sales (Chain II) by establishing cooperative marketing facilities could reduce costs and enhance producer shares. Additionally, improving rural road networks would minimize transportation expenses for farmers, particularly those selling through less efficient marketing chains. These targeted interventions aim to address identified inefficiencies and promote sustainable maize farming practices while enhancing the livelihoods of char communities.

[*]**Corresponding Author:** Department of Agribusiness, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh. Email: debasish.agb@bsmrau.edu.bd

https://doi.org/10.3329/aba.v28i1.81431
ISSN 1025-482X (Print)/2521-5477 (Online)

Introduction

Maize (*Zea mays*) cultivation plays a vital role in global food security and economic development, with approximately 197 million hectares under cultivation and an annual production of about 1137 million tons, surpassing rice and wheat (Adnan *et al*., 2021; Erenstein *et al.*, 2022; FAOSTAT, 2022). In Bangladesh, maize significantly impacts rural livelihoods due to its high market demand for poultry and fish feed, bakery products, and human consumption (Adnan *et al*., 2021). The country's maize production and cultivation area are steadily increasing, with around 1.8 million tons consumed annually, primarily for animal feed, underscoring its importance in the livestock sector (Roy *et al.*, 2017; Adnan *et al*., 2021; Sarker *et al*., 2021; Erenstein *et al*., 2022). Approximately 2.32 million hectares (24% of the cultivable area) are suitable for maize cultivation in Bangladesh (Hussain *et al*., 2015).

Recent government initiatives in Bangladesh have diversified crops in char[1] areas, providing new livelihood opportunities to communities affected by river erosion (Karim, 2014; Karim *et al*., 2017; Hoq *et al*., 2016; Khatun *et al*., 2017; Uddin and Dhar, 2017; Roy *et al*., 2017; Alam *et al*., 2020). These initiatives have introduced various farming systems, including livestock, poultry, fisheries, and crops, significantly benefiting thousands of farmers (Karim, 2014; Hoq *et al*., 2016; Khatun *et al*., 2017; Uddin and Dhar, 2017; Roy *et al*., 2017; Alam *et al*., 2020). The Teesta char region in Rangpur has emerged as a leading maize production area due to factors such as minimal irrigation needs, low production costs, and high yields (Shiferaw *et al*., 2011; Roy *et al*., 2017; Islam and Hoshain, 2022). However, these communities face challenges from natural hazards like riverbank erosion, floods, and low soil moisture content, which affect agricultural productivity (Al-Mamun et al., 2022; Alam *et al*., 2017; Sarker *et al*., 2022).

[1] Chars are essentially shallow lands in the river that rise when the water level decreases

Despite the potential of maize cultivation in char areas, farmers often hesitate to invest due to limited market facilities and profitability concerns. Challenges such as inadequate physical access and lack of transportation infrastructure hinder efficient marketing (Janifa *et al*., 2015; Kauser and Alam, 2016; Rana and Maharjan, 2022). Complex marketing chains, lack of timely information, and high marketing costs contribute to farmers' uncertainty and risk exposure (Janifa *et al*., 2015; Kauser and Alam, 2016; Rana and Maharjan, 2022). Consequently, many farmers sell their produce at home or at the farm gate, missing out on fair prices and timely market access.

Factors influencing maize profitability in char areas include input availability, production practices, and market access. Various studies highlight key factors such as input costs, including seeds, labor, fertilizer, and planting time (Kamruzzaman and Hasanuzzaman, 2007; Samboko, 2011), as well as education level, land allocation, and marketing strategies (Xaba and Masuku, 2013; Kanyua *et al*., 2015). Additionally, farm size, output price, and irrigation costs significantly impact profitability in Bangladesh (Alam *et al*., 2016; Hassan *et al*., 2017). Maize has demonstrated a profitability advantage over boro rice and tobacco in the Rangpur district (Roy *et al*., 2017). Establishing organized markets for maize can empower farmers to negotiate better prices with buyers.

The maize value chain in Bangladesh is complex, with wholesalers enjoying the highest net marketing margins while farmers and *aratdar* receive the lowest (Rob, 2010; Akhter and Hafiz, 2015; Hoq *et al*., 2016; Kauser and Alam, 2016). Wholesalers incur the highest marketing costs per 100 kg of maize, while farmers face significant marketing expenses that reduce their revenue (Kausar *et al*., 2015). Low output prices are a major barrier to maize development, particularly affecting smallholder farmers (Hasan *et al*., 2017). Given the significance of maize cultivation in the char areas of the Rangpur district, understanding the factors affecting profitability and marketing efficiency of Maize is essential for promoting sustainable agricultural development and improving the well-being of char communities. This study aims to investigate the followings: (i) what are the factors affecting the profitability of maize production in the char area? and (ii) assessing the maize marketing margin and efficiency. This study aims to fill this critical gap by analyzing factors affecting maize profitability, assessing existing maize marketing chains and costs, and examining maize marketing efficiency in the char area.

Methodology

Study area

This study was conducted in four selected villages within two unions in the Gangachara upazila of the Rangpur district, Bangladesh: Joydebpurbo Para, Moishasur, and Purbo Ramakanto in the Gajaghanta union, and Alaler Char in the Marnia union. These villages were purposively chosen due to their proximity to the Teesta River, making them highly susceptible to frequent floods and river erosion, yet suitable for hybrid maize cultivation. Notably, these selected villages are well-known char areas in the Rangpur district, recognized for maize production but lacking advanced marketing systems.

Sampling, questionnaire, and data collection

For this study, a complete list of char households was obtained from the Department of Agricultural Extension, and respondents were subsequently chosen using a random number technique. Household heads served as key informants, with data collected from 200 char farmers as well as from 15 *faria*, 15 wholesalers, and 10 *aratdars*, randomly selected from villages in the Gangachara upazila of Rangpur district, Bangladesh. The char farmers cultivate locally available maize varieties, such as the Local Hybrid variety (Elit) and BARI Hybrid Maize-14, because these varieties offer higher yields compared to others while having relatively lower seed costs. The sampling ensured representation from both Gajaghanta and Marnia unions, with 143 samples from Gajaghanta and 47 from Marnia.

A structured survey interview schedule was pilot tested with 10 respondents to ensure information adequacy, clarity, and to address potential ambiguities. Face-to-face interviews were conducted in two phases: Phase I from the last week of May 2022 to the first week of June 2022, and Phase II during the second to third week of June 2022, aligning with the peak maize harvest of the Rabi season (November to February). The questionnaire covered factors influencing maize profitability and overall market efficiency.

Analytical technique

Data analysis was performed using the statistical tool STATA 15. Descriptive statistics and multiple regression analysis were conducted to analyze the data. This model was applied to pinpoint the factors influencing maize profitability in the char region of Rangpur. The details of selected dependent and independent variables used in data analysis is presented in Table 1.

Estimation of cost and return

The production cost and returns/profit of the maize farmers were calculated to assess the profitability of maize farming. The following profit equation was employed in the analysis:

$$II = PF.QF - (TVC + TFC) \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Where, Π = Profit of producer per ha[2]; PF = Per unit price of maize (BDT per quintal); QF = Quantity of maize (quintal per ha); TVC = Total variable cost of maize cultivation; TFC = Total fixed cost of maize cultivation

[2] ha=hectare; 1ha=2.47acre

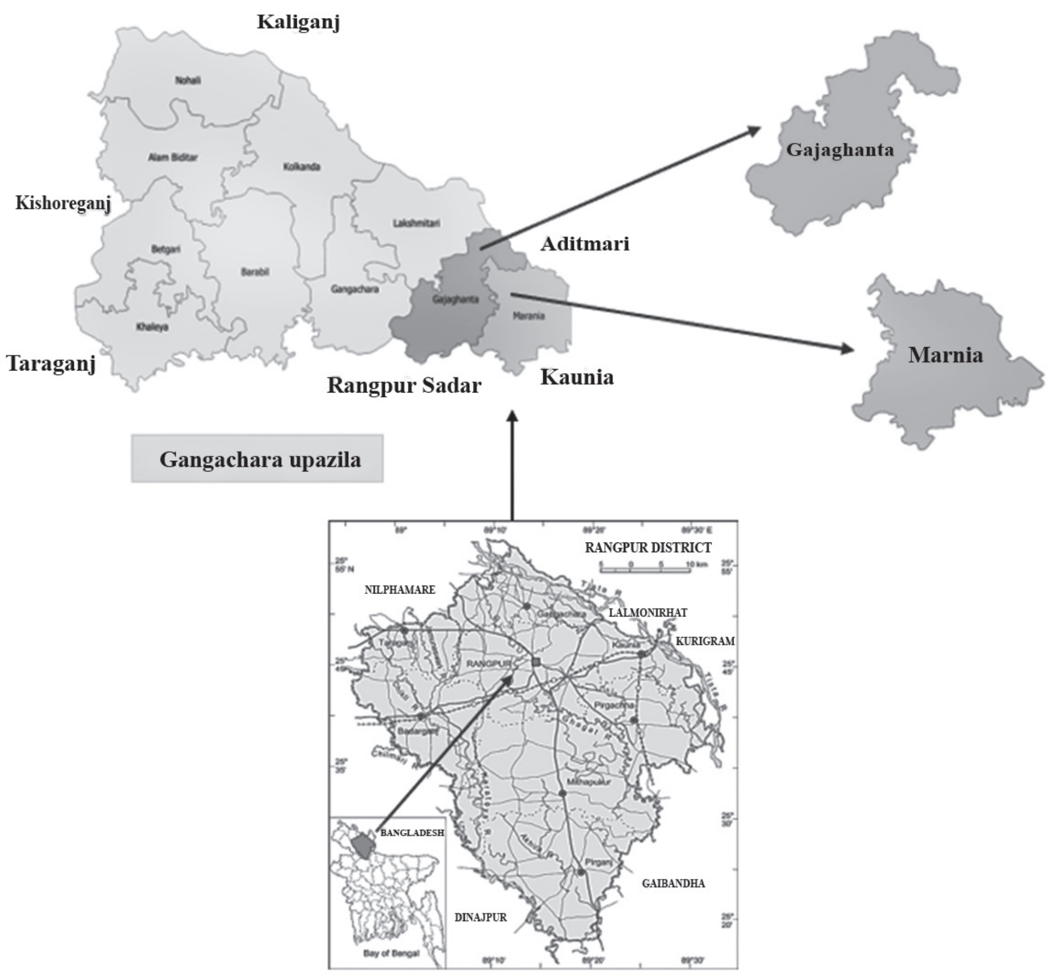

Fig. 1. Map of study area

Gross return and gross margin

Gross return

Gross return was calculated by multiplying the total volume of output by the per unit price of the commodity at the time of harvest. The following equation was used to estimate the gross return (GR).

$$GR = = P_{m*}\, Q_m \,\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; (ii)$$

Where, GR = Gross return from maize; P_m = Per unit price of maize; Q_m = Quantity of maize

Gross margin

The argument for using gross margin analysis is that maize growers were more interested to know their return over variable cost. The following equation was used to assess the gross margin.

$$GM = TR - VC \,\ldots\ldots\ldots\ldots\ldots\ldots \; (iii)$$

Where, GM = Gross margin; TR = Total return; VC = Variable cost.

Interest on operating capital

$$\text{Interest on operating capital} = \frac{\text{Amount of operating capital} \times \text{Interest rate (\%)} \times \text{Time required (in years)}}{2}$$

Interest rate during the study was 8%.

Undistributed benefit cost ration (BCR)

The average return to each taka spent on production is an important criterion for measuring profitability. Undiscounted BCR was estimated as the ratio of total return to total cost per ha.

$$BCR = \frac{\text{Total Return}}{\text{Total Cost}} \quad \text{................................(iv)}$$

Functional analysis to determine factors affecting profitability of maize cultivation

To identify the factors influencing the profitability of maize production in the char area of Rangpur, multiple regression analysis was employed, drawing on methodologies from previous studies (Xaba and Masuku, 2013; Alam et al., 2016; Hassan *et al*., 2017; Akter *et al*., 2019). This study incorporated cost-related independent variables, as various input costs directly impact the profit or net return of the product. Due to the non-linear nature of the data, a logarithmic transformation was applied to both sides of the regression model. Consequently, a double log form of the regression model was utilized, allowing for resolution via the ordinary least squares (OLS) method. The model used to estimate the effects of key factors on the profitability of maize production is specified in equation (v).

$$InYi = In\beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + \beta_5 InX_5 + \beta_6 InX_6 + \beta_7 InX_7 + \beta_8 InX_8 + \beta_9 InX_9 + u_i \text{.......... (v)}$$

Where, Y= Profit (BDT[3]/ha); β_0= Constant or intercept value; u_i = Error term; ln= Natural logarithm; and β_1……...β_9 = Coefficient of the respective explanatory variables to be estimated.

In equation (v), the observed variable, y, equals y* when y* ≥ 0, but y = 0 when y* < 0. X_i are explanatory variables. Based on review of literature the following explanatory variables were selected for the model and presented in Table 1.

Table 1. Selection of independent variables for the model

	Variables	Definition of variables	Source
	Y= Profit (BDT/ha)	Dependent variable	
	Explanatory variables		
1	Labor cost	Payment of hired labor per man-day in BDT/ha.	Field survey, 2022
2	Seed (hybrid maize seed)	The cost of hybrid maize seeds per hectare in BDT/ha.	Akter et al., 2019, Hassan et al.,2017 and Khan ,2019
3	Farm size (ha)	Taking the value of the maize cultivated land of the farmer in (ha)	Kanyua et al., 2015, Akter et al., 2019
4	Fertilizer cost (Urea, TSP, Boron, Mop) (BDT/ha)	The cost of fertilizers (including Urea, TSP, Boron, Mop) per hectare in BDT/ha.	Kanyua et al., 2015 ; Hassan et al., 2017; Akter et al., 2019
5	Insecticide cost (BDT/ha)	The expenditure on insecticides for pest control per hectare in BDT/ha.	Akter et al.,2019 and Khan,2019
6	Land preparation cost (BDT/ha)	The cost incurred for preparing the land for maize cultivation per hectare in BDT/ha.	Hassan et al.,2017
7	Land rent cost (BDT/ha)	The cost of renting land per hectare in BDT/ha.	Khan, 2019
8	Cost of irrigation (BDT/ha)	The expenditure on irrigation per hectare in BDT/ha.	Hassan et al., 2017; Akter et al., 2019
9	Use of Biofertilizer (dummy)	1= if farmers in the study area use biofertilizer, 0= if farmers does not use bio-fertilizer	Field survey, 2022

3. BDT=Bangladesh Taka (Current monetary exchange rate, 1 USD=117 BDT)

Marketing cost, marketing margin and marketing efficiency

i) The total marketing cost incurred by the farmers and actors in a chain is estimated by the following formula.

$$C = Cf + Cm1 + Cm2 + Cm3 + ... + Cmi .... (vi)$$

Where, C = Total cost of maize marketing in a chain; C_f = Cost paid by the producer when commodity moves; C_{mi}= Cost incurred by the i^{th} middlemen in the process of buying and selling of maize in a chain. (i = 1, 2, 3……………………n)

ii) Marketing margin of actors

The gross marketing margin and net marketing margin of different value chain actors was estimated by the following formula.

Gross Marketing Margin (BDT/quintal)

= Sales price (BDT/quintal) - Purchase price (BDT/quintal)

Net marketing margin (BDT/quintal)

= Gross Marketing margin (BDT/quintal) - Marketing cost (BDT/quintal)

The marketing margin of a chain is measured by using the following formula.

$$M = M_f + M_{m1} + M_{m2} + M_{m3} + ... + M_{mi} .... (vii)$$

Where, M = Total margin in a chain; M_f= Return received by the farmer; M_{mi}= Margin received by the i^{th} middlemen.

iii) Marketing efficiency

The efficiency of marketing was investigated by examining Acharya's (2004) method for estimating efficiency and compiled it later using the composite index method.

Acharya marketing efficiency

According to the Acharya (2004), an ideal measure of marketing efficiency, particularly for comparing the efficiency of alternate market/chains can be stated as:

$$ME = \frac{FP}{(MC + MM)} ....(viii)$$

Where, ME = Marketing efficiency; FP = Net price received by farmers; MC= Total marketing cost; MM= Total net marketing margin of actors.

A higher value of ME denotes a higher level of efficiency and vice versa.

Producers share to consumers' price

For the present study, the following formula are used to calculate producer's share to consumers' price.

$$\text{Producer's share} \; \frac{\text{Producer's average's price}}{\text{Weighted average price of maize}} \times 100 .....(ix)$$

In this study, the efficiency of different marketing chains was evaluated as an indicator of overall marketing performance, using four specific metrics: (i) Producers' share of the consumers' price, (ii) Marketing cost, (iii) Marketing margin, and (iv) Acharya marketing efficiency. Marketing costs were calculated, with the chain incurring the lowest costs ranked highest (1), and the chain with the highest costs ranked lowest. A similar ranking method was applied to assess the margins earned by intermediaries in each chain. Thus, a lower mean score indicates a more efficient marketing chain and vice versa (Thamizhselvan and Murugan, 2012).

The final ranking of all the four indicators of all chains were computed by using the composite index formula (Thamizhselvan and Murugan, 2012).

$$R = \frac{R_i}{N_i} ....(X)$$

Where, Ri = Total value of ranks of all indicators (I1-I5) all chains; Ni = Number of indicators.

Results and discussion

Profitability analysis of maize production

The profitability of maize production was estimated in terms of gross return, gross margin, net return or profit, and benefit-cost ratio (BCR). For calculating total production cost, variable and fixed costs were taken into consideration.

Total cost and Profitability of maize production

Table 2 reveals that maize production in the study area incurs a total variable cost of BDT 140,496 per hectare, constituting 71.29% of the total cost, while the fixed cost amounts to BDT 29,090 per hectare (14.35%). Consequently, the total cost per hectare stands at BDT 202,676. Considering an average unit price of BDT 3,095 per quintal and an average yield of approximately 103 quintals per hectare, the total return per hectare from maize cultivation is estimated at BDT 318,785, surpassing the total cost.

As a result, the gross margin and net return or profit per hectare are estimated at BDT 174,289 and BDT 116,109 respectively. This underscores the financial profitability of maize production in the study area, further supported by a favorable Benefit-Cost Ratio (BCR) of 1.57, indicative of a promising return on investment for farmers. This finding aligns with previous research by Alam *et al*. (2016) and Hassan *et al*. (2017), which also highlighted the profitability of maize production in northern districts characterized by higher returns, yields, and favorable BCRs.

Table 2. Average cost (per hectare) of maize cultivation

Cost Item	Unit (BDT/ha)	Percentage of cost
A. Variable cost		
Labor cost	30545	15.07
Seed cost	15292	7.55
Land preparation cost	15123	7.46
Transportation cost	657	0.32
Biofertilizer cost	3878	1.91
Chemical fertilizers	53276	26.29
Irrigation	16360	8.07
Insecticide cost	6367	3.14
Interest on operating capital	2998	1.48
Total Variable cost	144496	71.29
B. Fixed cost		
Land use cost	29090	14.35
Total Fixed cost	29090	14.35
Total cost (A+B)	202676	100
Returns		
Yield (quintal/ha)	103	
Price (BDT/quintal)	3095	
Total return (BDT/ha)	3,18,785	
Total cost of production (BDT/ha)	2,02,676	
Gross Margin (BDT/ha)	1,74,289	
Net Return/Profit (BDT/ha)	1,16,109	
BCR (Undiscounted)	1.57	

Profitability by different farm size

The study highlights a key socioeconomic factor affecting char farmers' maize profitability, as shown in Table 3, which compares maize yield and profitability across farm sizes. Landless farmers yielded the least and earned the lowest profits, potentially due to their lack of knowledge regarding market prices. Interestingly, medium-sized farms demonstrate lower yields (88 quintals/ha) but relatively high profits (BDT 153,226/ha), compared to small farms, which achieve the highest yields (111 quintals/ha) and profits (BDT 196,806/ha). The difference stems from contrasting economic strategies. Small farms engage in input-intensive practices, maximizing productivity on limited land. This results in higher yields but also increased variable costs per hectare. In contrast, medium-sized farms benefit from economies of scale by spreading fixed costs (e.g., land preparation, machinery) over larger areas, reducing per-unit production costs. However, their lower yields suggest less intensive cultivation practices, possibly due to resource constraints like labor availability or a focus on minimizing costs rather than output maximization. Additionally, medium farms often have better access to markets and higher bargaining power due to larger production volumes, which helps offset their lower yields and maintain profitability. These findings align with the economic principle that profit maximization does not always equate to output maximization, as optimizing cost structures can yield higher net returns despite lower productivity (Hoque & Haque, 2014; Alam *et al.*, 2016).

Table 3. Profitability by different farm size

Farm size	Yield (quintal/ ha)	Profit (BDT/ha)
Landless	76	91368
Marginal	108	104214
Small	111	196806
Medium	88	153226
Average	103.00	145199

Factors affecting the profitability of maize production

The profitability of maize production in the char area was examined using a multiple regression model to discern the factors at play (Table 5). Among the significant variables, seed cost, fertilizer cost, and farm size showed positive and noteworthy coefficients. This suggests that efficient investment in these inputs correlates with increased profitability, production, and sales volume, aligning with the principles of the neoclassical production function. The coefficient of determination (R-square) indicated that the model could explain 45% of the profit variation attributed to the explanatory variables. Furthermore, the high F value of 12.89, significant at the 1% level, underscores the model's robustness in explaining profit variations in maize production. Overall, the regression model effectively delineated the relationship between the predictors and observed maize profit.

Additionally, Table 5 presents the coefficients and related statistics derived from the regression analysis. The positive and highly significant coefficient of seed cost per hectare (ha) at 0.342 suggests that a 1% increase in seed cost would lead to a 0.342% rise in maize profitability, holding other factors constant. This unexpected outcome might be explained by the potential yield improvements associated with the use of high-quality hybrid seeds, as corroborated by previous studies (Akter *et al*., 2019; Kamruzzaman and Hasanuzzaman, 2007). However, disparities exist with findings from other regions where seed costs negatively impacted maize profitability (Samboko, 2011; Hassan et al., 2017; Khan, 2019).

Farm size exhibited a positive coefficient of 0.146 at the 5% significance level, indicating its significant influence on maize profitability. A 1% increase in farm size could potentially elevate maize profitability by 0.146%, reflecting the benefits of economies of scale. This finding is consistent with prior research suggesting that expanding land under production positively impacts profitability, although conflicting results exist in certain studies (Xaba and Masuku, 2013; Kanyua *et al*., 2015). The regression coefficient for fertilizer cost was 0.395, highly significant at the 1% level, implying a positive relationship between fertilizer application and maize profitability. This straightforward interpretation suggests that increased fertilizer application leads to higher profits. This finding aligns with previous research highlighting the positive impact of fertilizer costs on profitability, although exceptions exist in certain contexts (Kanyua *et al*., 2015; Hassan *et al*., 2017; Akter *et al*., 2019).

Conversely, land preparation cost exhibited a negative coefficient of -0.040, significant at the 10% level. This negative relationship suggests that a 1% increase in land preparation cost would decrease maize profit by 0.040%. This aligns with findings indicating that higher land preparation costs negatively affect maize profitability (Hassan et al., 2017). Similarly, irrigation cost displayed a negative coefficient of -0.166, significant at the 5% level. This implies that a 1% increase in irrigation cost would correspond to a 0.166% reduction in maize profit, holding other factors constant. High irrigation costs pose challenges to profitability, particularly for char farmers, consistent with previous research (Hassan *et al*., 2017; Kamruzzaman and Hasanuzzaman, 2007). Additionally, this result contrasts with Akter *et al*. (2019), who found a positive coefficient value for irrigation cost.

Maize marketing system

Marketing chains of maize

Marketing chains serve as the conduits through which agricultural products traverse from producers to consumers (Kohls and Uhl, 2004). The analysis of market chains endeavors to furnish insights into the profitability experienced by the diverse actors involved in the chain (Hoq *et al*., 2016). The length of these chains fluctuates, influenced by factors such as product quality, characteristics of consumers and producers, intermediary participation, and the necessary marketing services (Kauser and Alam, 2016). In the study area, the marketing chains for maize unfold as follows:

Major chains

Chain – I: Farmer ⟶ Faria ⟶ Wholesaler ⟶ Aratdar ⟶ Feed mills, Processor

Chain – II: Farmer ⟶ Aratdar ⟶ Feed mills, Processor

Chain – III: Farmer ⟶ Faria ⟶ Aratdar ⟶ Feed mills, Processor

Chain – IV: Farmer ⟶ Wholesaler ⟶ Feed mills, Processor

Chain – V: Farmer ⟶ Wholesaler ⟶ Aratdar ⟶ Feed mills, Processor

Marketing cost and margin of maize

Marketing cost

Marketing costs encompass the expenses incurred in moving products from producers to consumers, as commonly understood (Kohls and Uhl, 2004). The breakdown of these costs for farmers and other stakeholders is outlined in Table 6 below.

Total Marketing cost of maize by farmers and different market actors

Current results from Table 6 show that the total marketing costs per quintal of maize (100 kg) are borne by different stakeholders. The bulk of these costs were shouldered by wholesalers BDT 146 per quintal (42.42%), followed by *aratdars* (34.08%), and farmers (24.00%), with *faria* sharing the lowest marketing cost BDT 81 (23.45%). Farmers bear a cost of BDT 82 per quintal, with transportation expenses comprising the lion's share at 43.22%. This hefty transportation expense stems from inadequate road infrastructure, necessitating reliance on expensive transportation modes such as vans, horse carts, auto-rickshaws, and Mahendras. Additionally, wholesalers, dealing with a larger number of farmers, *faria*, and *aratdars*, bear

Table 5. Coefficients and other related statistics from the regression analysis

Explanatory variables	Value of coefficient	Standard error
Constant	4.89***	1.039
Labor cost (hired) (BDT/ha)	0.071	0.097
Seed cost (BDT/ha)	0.342***	0.989
Farm size (ha)	0.146**	0.066
Fertilizer (Urea, Tsp, Mop, Boron) cost	0.395***	0.122
Insecticide cost (BDT/ha)	0.039	0.091
Land preparation cost (BDT/ha)	-0.040*	0.021
Land rent cost (BDT/ha)	-0.009	0.016
Irrigation cost (BDT/ha)	-0.168**	0.066
Use of biofertilizer (dummy)	0.124	0.085
F-value	12.89***	
Prob> F	0.0000	
R -square	0.4531	
No. of observation	200	

(Significance level: *** for 1%, ** for 5%, * for 10%)

the brunt of the highest marketing costs among actors. Transportation expenses loom largest for all actors, underscoring the distribution of marketing costs across the maize value chain. This analysis resonates with the findings of Kauser and Alam (2016) and Hoq *et al*. (2016), highlighting the challenges faced by traders due to long distances from producers to end-users or feed mills. Moreover, expenses related to loading, unloading, packaging, tips, donations (Samiti), and market tolls/taxes are significant for all actors, albeit varying by location.

Marketing margin of market actors involved in the maize marketing

Marketing margin, as defined by Acharya and Agarwal (2004), represents the disparity between the buying and selling prices at each stage of intermediation. Typically, the total marketing margin encompasses the margins accrued at various marketing stages. Table 7 provides insight into the gross marketing margins of key actors, including *faria*, wholesalers, and *aratdar*s, amounting to BDT 90, BDT 180, and BDT 170 per quintal, respectively. Notably, wholesalers command the highest margin, constituting approximately 40.91% of the total margin, owing to their extensive trading volume. This observation aligns with prior research by Hoq *et al*. (2016) and Kauser and Alam (2016), suggesting that wholesalers leverage their market dominance to procure maize from farmers at lower prices and subsequently sell to *aratdars* and feed mills at higher rates.

Table 6. Total marketing cost of maize by different actors

(BDT/quintal)

Cost components	Farmer	*Faria*	Wholesaler	*Aratdar*	Cost	Percentage of total cost
Processing	0	0	6.03	22.44	28.47	8.30
Seed separation cost	2.50	0	0	0	0	0
Transportation	35.60	26.22	74.30	46.12	146.64	42.74
Storage	0	0	8.04	3.94	11.98	3.49
Electricity bill	0	0	3.56	3.52	7.08	2.06
Rent	0	0	3.55	3.94	7.49	2.18
Packaging (Sack)	20.45	10.15	8.12	6.25	24.52	7.15
Weighing	3.01	4.25	3.98	1.80	10.03	2.92
Labor (wages and salaries)	0	0	7.50	5.85	13.35	3.90
Market toll/tax	11.00	18.45	12.70	5.86	37.01	10.78
Load/Unload	8.02	6.48	8.05	3.20	17.73	5.17
Mobile phone cost	0.60	5.5	3.12	1.30	9.92	2.90
Personal expenses	1.00	3.04	1.50	1.50	6.04	1.76
Tips and donations (Samiti)	0	6.5	5.11	5.23	16.84	4.91
Wastage and damage/ weight loss	0	0	0	6.00	6.00	1.75
Total	82.36	80.59	145.56	116.95	343.1	100
Percentage (%)	24.00	23.45	42.42	34.08		

Conversely, *faria*, characterized by their transient business nature, incur elevated marketing expenses for smaller maize quantities, resulting in a comparatively lower marketing margin of 20.45%. Despite wholesalers boasting a higher gross margin, the net marketing margins (NMM) reveal a different picture. *Faria*, wholesaler, and *aratdar* receive BDT 9, BDT 34, and BDT 53 per quintal, respectively. Interestingly, *aratdar* enjoy the highest net market margin (NMM) at 55% in the study area, attributed to lower marketing costs stemming from their significant maize trading volume. These findings resonate with those of Jimoh et al. (2021), who reported wholesalers garnering the highest profit at BDT 17 per quintal.

Marketing cost and marketing margin distribution among the actors in the chain

Table 8 displays the marketing cost (MC) and marketing margin (MM) of various actors involved in the maize value chain. Chain-I, characterized by multiple intermediaries, had the highest marketing cost at BDT 343 per quintal and a margin of BDT 440 per quintal. Specifically, wholesalers bore the brunt of the highest marketing cost at BDT 146 per quintal, while also securing the highest marketing margin at BDT 180 per quintal.

Conversely, Chain II, which involves only one intermediary, the *aratdar*, exhibited the lowest marketing cost (BDT 117 per quintal) and marketing margin (BDT 170 per quintal). Notably, in the char areas, *aratdar* functions uniquely by directly purchasing maize from farmers and subsequently selling it to other parties, assuming ownership of the product during these transactions. This operational model contrasts with the traditional role of a commission agent who typically facilitates transactions without taking ownership. This distinction is significant in the char areas of Rangpur district, Bangladesh, where such practices by *aratdar* play a crucial role in the local agricultural economy and supply chain dynamics. This finding is also supported by Kauser and Alam (2016).

Marketing efficiency of maize

In the realm of maize marketing efficiency, the ability to transport goods from producers to consumers at minimal expense while upholding service standards is paramount (Kohls and Uhl, 2004; Kausar *et al*., 2016). Within this study, we gauge the efficiency of different marketing chains through four key performance indicators: (i) Producers' share to consumers' price, (ii) Marketing cost, (iii) Marketing margin, and (iv) Acharya marketing efficiency.

Chain wise producers' share to consumers' price

According to the estimates provided in Table 9, the proportion of producers' share to consumers' price varied across different marketing chains. Chain II exhibited the highest share at 95.19%, followed by Chain IV, Chain III, and Chain V. Conversely, Chain I displayed the lowest proportion, approximately 87.55%.

Table 7. Gross and Net marketing margin of different actors of maize

Particulars	*Faria*	Wholesaler	*Aratdar*	Total
Average Sales Price (A)	3185	3365	3535	
Average Purchase Price (B)	3095	3185	3365	
Gross Marketing Margin (A-B)	90	180	170	440
Percentage (%)	20.45	40.91	38.64	100
Marketing cost	80.59	145.56	116.95	343.10
Net Marketing margin	9.41	34.44	53.05	96.90
Percentage (%)	9.71	35.54	54.75	100

Table 8. Marketing cost (MC) and marketing margin (MR) distribution among the actors in the chain

(BDT/quintal)

Chains	Actors	Purchase Price	Sales Price	Gross Marketing Margin	Marketing Cost	Net Marketing Margin
Chain I	*Faria*	3095	3185	90	80.59	
	Wholesaler	3185	3365	180	145.56	
	Aratdar	3365	3535	170	116.95	
	Total			440	343.10	96.90
Chain II	*Faria*	0	0	0	0	0
	Wholesaler	0	0	0	0	0
	Aratdar	3365	3535	170	116.95	
	Total			170	116.95	53.05
Chain III	*Faria*	3095	3185	90	80.59	
	Wholesaler	0	0	0	0	0
	Aratdar	3185	3355	170	116.95	
	Total			260	197.54	62.46
Chain IV	*Faria*	0	0	0	0	0
	Wholesaler	3185	3365	180	145.56	
	Aratdar	0	0	0	0	0
	Total			180	145.56	34.44
Chain V	*Faria*	0	0	0	0	0
	Wholesaler	3185	3365	180	145.56	
	Aratdar	3365	3535	170	116.95	
	Total			350	262.51	87.49

Table 9. Producers' share in the final product price in different chain

(BDT/quintal)

Particulars	Chain I	Chain II	Chain III	Chain IV	Chain V
Producer price (A)	3095	3365	3095	3185	3185
Weighted average price at retail level (B)	3535	3535	3355	3365	3535
Percentage of producers' Share(A/B) *100	87.55	95.19	92.25	94.65	90.10
Rank (I_1)	5	1	3	2	4

These findings imply that selling maize through Chain II would yield the greatest benefits for farmers. It's worth noting that the selling price set by *aratdars* was considered as the consumers' price. Similar results were corroborated by Kauser and Alam (2016) and Hoq *et al*. (2016), reinforcing the significance of chain selection in maximizing farmer returns.

Marketing efficiency of different chains according to marketing cost and margin of the actors

Efficiency can be effectively gauged by examining the magnitude and composition of marketing margins. Chain II, involving the direct route from farmer to *aratdar* to feed mills and processor, emerged as the most efficient, securing the top rank due to its minimal marketing cost and margin, attributed to the involvement of fewer intermediaries. In contrast, Chain I, which encompasses farmer, *faria*, wholesaler, *aratdar*, and further intermediaries, recorded the highest cost and margin, indicating relatively lower efficiency.

Acharya's method for estimating marketing efficiency

According to Acharya's formula for determining marketing efficiency, the results indicate that Chain II achieved the highest efficiency score (19.79), followed by Chains IV, III, V, and I respectively (as shown in Table 11). A noteworthy trend across all chains was that those involving the *aratdar* demonstrated greater efficiency compared to others. This can likely be attributed to lower marketing costs and margins, leading to enhanced marketing efficiency.

Overall marketing efficiency measurement

The overall marketing efficiency of various marketing chains was evaluated using a composite index formula, considering the ranks of different performance indicators. As shown in Table 12, marketing chains I, V, and III appeared relatively inefficient in the maize-producing char region, primarily due to the low prices received by farmers, which can be attributed to the involvement of numerous actors in these chains. Conversely, the farmer's engagement in marketing chain II, involving direct sales to the *aratdar* – feed mills, emerged as the most favorable and advantageous option. This finding resonates with previous studies by Rana and Maharjan (2022), Janifa *et al*. (2015), and Islam (2014), which emphasize the efficiency of simpler market chains. Government support aimed at developing chain II and advising farmers to explore chain IV (wholesaler-feed mills) as an alternative could potentially enhance farmer benefits in the char area.

Conclusion and policy recommendation

This study delves into the determinants of profitability and marketing efficiency in the char area using a random sampling method. Given their significance

Table 10. Marketing cost, and margin of actors under different chains

(BDT/quintal)

Particulars	Chain-I	Chain-II	Chain-III	Chain-IV	Chain-V
Purchase Price	3095	3365	3095	3185	3185
Sales Price	3535	3535	3355	3365	3535
Marketing Margin	440	170	260	180	350
Rank (I_2)	5	1	3	2	4
Marketing Cost	343.10	116.95	197.54	145.56	262.51
Rank (I_3)	5	1	3	2	4

Table 11. Acharya's marketing efficiency of various chains

(BDT/quintal)

Particulars	Chain-I	Chain-II	Chain-III	Chain-IV	Chain-V
Price received by the farmer (FP)	3095	3365	3095	3185	3185
Total marketing cost (MC)	343.10	116.95	197.54	145.56	262.51
Total net marketing margin (MM)	96.9	53.05	134.46	34.44	87.49
Marketing efficiency {FP / (MC+MM)}	7.03	19.79	9.32	17.69	9.10
Rank (I_5)	5	1	3	2	4

Table 12. Marketing efficiency of maize under the composite index method

Performance Indicator	Chains				
	Chain-I	Chain-II	Chain-III	Chain-IV	Chain-V
I_1	5	1	3	2	4
I_2	5	1	3	2	4
I_3	5	1	3	2	4
I_4	5	1	3	2	4
Composite index (R_i/N_i)	4.8	1.20	2.6	2.2	4.20
Final Ranking	5	1	3	2	4

R_i = Total value of the ranks of performance indicators, N_i = Total number of performance indicators

for food security and economic growth, these findings are crucial, especially for the char communities in Bangladesh. The research underscores the challenges faced by farmers, shedding light on weaknesses in their marketing systems, which impede their ability to secure fair prices for their produce and enhance their standard of living. Nevertheless, farmers are now improving their livelihoods by cultivating maize on char lands due to substantial market demand and its contribution to poverty reduction.

The study demonstrates the profitability of maize cultivation in char lands, with a promising benefit-cost ratio (1.57) attributed to low variable costs. Descriptive analysis reveals that farmers' yield and profit vary with different farm size, indicating that small farms lead in maximizing returns, while medium farms benefit from cost advantages despite lower yields. Functional analysis highlights that maize profitability is positively influenced by farm size, seed, and fertilizer costs, while land preparation and irrigation costs have a negative impact.

On the marketing front, it's evident that the maize value chain is problematic and lengthy, involving various actors such as *faria*, wholesalers, *aratdar*, feed mills, and processors. Assessing marketing efficiency across different chains, the study emphasizes the superiority of direct farmer-to-*aratdar* sales (Chain II) in maximizing farmer benefits in the char area. The efficiency of Chain II, (includes farmers to a*ratdar* to feed mills, processor) is attributed to fewer actors, resulting in higher prices for farmers and reduced marketing costs. Additionally, the presence of redundant actors in the marketing chain increases costs for consumers and reduces profits for farmers who primarily sell to local traders (*faria*).

In conclusion, there is significant potential for enhancing maize profitability and supply chain development in the char area. Improved marketing systems could financially benefit farmers and other actors, particularly in the char area. Therefore, emphasis should be placed on factors that impact local maize profitability and marketing systems or chains, especially in the char area. To enhance maize profitability and market efficiency in the char area, it is crucial to optimize farm size to leverage economies of scale and lower production costs. Initiatives should also be undertaken to reduce input costs through subsidies or cooperative purchasing arrangements. The Department of Agricultural Extension (DAE) is likely to play a pivotal role in providing comprehensive training on advanced technologies for maize production and advising farmers on optimal input combinations to mitigate market risks and maximize returns. Simultaneously, improving rural infrastructure and transportation systems is essential to facilitate market access.

Acknowledgment

We extend our heartfelt gratitude to the villagers from the Rangpur district whose participation was invaluable to this study. Additionally, we would like to acknowledge the generous support provided by the

National Science and Technology Fellowship (NST) in 2021, which funded this research endeavor.

Conflict of Interest

All authors declare that they have no conflict of interest.

Reference

Acharya, S. S. and N. L. Agarwal. 2004. Agricultural marketing in India. *Oxford and IBH Publishing Company Pvt. Ltd.*, 4th ed. New Delhi, India.

Adnan, K. M., A. S. Sarker, R. A. Z. Tama and P. Pooja. 2021. Profit efficiency and influencing factors for the inefficiency of maize production in Bangladesh. *J. Agric. Food Res.* 5(1): 100161.

Akhter, M. and N. Hafiz. 2015. Marketing of maize products in Bangladesh: A value chain analysis. *Eur. J. Bus. Manag.* 7(3): 174-184.

Akter, T., M. T. Parvin, F. A. Mila and A. Nahar. 2019. Factors determining the profitability of rice farming in Bangladesh: Profitability analysis of rice farming in Bangladesh. *J. Bangladesh Agric. Univ.* 17(1): 86-91.

Alam, G. M. M., K. Alam, S. Mushtaq, M. N. I. Sarker and M. Hossain. 2020. Hazards, food insecurity and human displacement in rural riverine Bangladesh: Implications for policy. *Int. J. Disast. Risk Reduc.* 43: 101364.

Alam, G. M. M., K. Alam, S. Mushtaq and M. L. Clarke. 2017. Vulnerability to climatic change in riparian char and riverbank households in Bangladesh: Implication for policy, livelihoods and social development. *Ecol. Indicate.* 72(2): 23-32.

Alam, G. M. M. 2016. An assessment of the livelihood vulnerability of the riverbank erosion hazard and its impact on food security for rural households in Bangladesh. Doctoral dissertation, Southern Queensland University, Toowoomba, Australia.

Alam, S. K. M. S., M. S. Kowsari, N. Y. Chowdhury, M. M. Islam and S. Haque. 2016. Factors affecting land allocation for maize cultivars in Lalmonirhat District of Bangladesh. *Prog. Agric.* 27(3): 346-354.

Al-Mamun, A., A. R. M. Islam, G. M. M. Alam, M. N. I. Sarker, M. O. Erdiaw-Kwasie, H. Bhandari and J. Mallick. 2022. Livelihood vulnerability of char land communities to climate change and natural hazards in Bangladesh: An application of livelihood vulnerability index. *Nat. Hazards.* 1-27.

Erenstein, O., M. Jaleta, K. Sonder, K. Mottaleb and B. M. Prasanna. 2022. Global maize production, consumption and trade: Trends and R & D implications. *Food Secur.* 4(1): 1-25.

Hassan, M., I. Resmi and S. Hossain. 2017. Farmers' profitability of maize cultivation at Rangpur District in the socio-economic context of Bangladesh: An empirical analysis. *Int. J. Appl. Res.* 3(4): 794-800.

Hoq, M. S., Q. M. S. Islam, S. Khandoker and M. A. Matin. 2016. Opportunities of groundnut cultivation and marketing system in char lands of Bangladesh. *Bangladesh J. Agric. Res.* 41(4): 695-711.

Hoque, M. Z. and M. E. Haque. 2014. Socio-economic factors influencing profitability of rice seed production in selected areas of Bangladesh. *The Agriculturists.* 12(1): 33-40.

Hussain, B., K. Dawar and A. Abbas. 2015. Growth and yield response of maize to nitrogen and phosphorus rates with varying irrigation timings. *Environ. Plant Syst.* 1(2): 16-21.

Islam, M. M. 2014. Marketing efficiency and transaction cost analysis of maize in some selected areas of Dinajpur district. Doctoral dissertation, Department of Agribusiness and Marketing, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Islam, M. R. and S. Hoshain. 2022. A brief review on the present status, problems and prospects of maize production in Bangladesh. *Res. Agric. Livest. Fish.* 9(2): 89-96.

Janifa, U. A., M. I. Omar, S. A. Sabur, M. Moniruzzaman and S. Haque. 2015. Analysis of marketing function, marketing efficiency and spatial co-integration of Rohu (*Labeo rohita*) fish in some selected areas of Bangladesh. *Eur. J. Bus. Manag.* 7(1): 35-47.

Jimoh, L. O., O. K. Akintunde, A. L. Kehinde, T. O. Agboola and A. A. Alabi. 2021. Structure, conduct and performance of maize marketing in Irewole Local Government Area, Osun State. *Niger. J. Basic Appl. Sci.* 29(2): 59-66.

Kamruzzaman, M. and M. Hasanuzzaman. 2007. Factors affecting profitability of sugarcane production as monoculture and as intercrop in selected areas of Bangladesh. *Bangladesh J. Agric. Res.* 32(3): 433-444.

Kanyua, M. J., G. K. I. S. K. Waluse and W. R. Wairimu. 2015. Factors influencing profitability of diversified cash crop farming among smallholder tea farmers in Gatanga District, Kenya. *J. Econ. Sustain. Dev.* 4(3): 2222-1700.

Karim, M. A., M. A. Quayyum, S. Samsuzzaman, H. Higuchi and E. Nawata. 2017. Challenges and opportunities in crop production in different types of char lands of Bangladesh. *Trop. Agric. Dev.* 61(2): 77-93.

Karim, M. A. 2014. Upscaling mungbean—rice pattern in the charlands of Kurigram. Pilot Project Final Report. Krishi Gobeshona Foundation-World Bank, Bangladesh Agricultural Research Council Complex, Dhaka. 3(2): 1-47.

Kausar, A. K. M. G. and M. J. Alam. 2016. Marketing efficiency of maize in Bangladesh. *Asian J. Agric. Ext. Econ. Socio.* 11(2): 1-12.

Kausar, A. K. M. G., M. J. Alam and M. A. Awal. 2015. Marketing system of maize in Gaibandha District of Bangladesh. *J. Biosci. Agric. Res.* 5(1): 1-9.

Khan, N. 2019. Factors affecting maize productivity of credit owner farmers of Zarai Taraqiathi Bank Limited in rural area of District Mardan-Pakistan. *J. Econ. Sustain. Dev.* 10(5): 1700-2222.

Khatun, M., M. A. Rashid, M. A. M. Miah, S. Khandoker and M. T. Islam. 2017. Profitability of sandbar cropping method of pumpkin cultivation in char land areas of northern Bangladesh. *Bangladesh J. Agric. Res.* 42(4): 647-663.

Khols, R. L. and J. N. Uhl. 2004. *Marketing of agricultural products.* Macmillan Publishing Company, New York, USA.

Rana, M., and K. L. Maharjan. 2022. Participation of brinjal farmers in large and small wholesale markets: Factors influencing farmers' decisions and impact on producers' prices. *Sustainability.* 14(4): 2357.

Rob, A. 2010. Market system for maize – Gaibandha chars. In: CLP Market Assessment Project. Available via https://www.gov.uk/research-for-development-outputs/market-system-for-maize-gaibandha-chars. Accessed on 15 December 2024.

Roy, M., M. T. Alam and M. S. Hossain. 2017. Growing popularity of maize cultivation in Rangpur District of Bangladesh: Evidence from Gangachara Upazila. *Russ. J. Agric. Socio-Econ. Sci.* 62(2): 221-230.

Samboko, P. C. 2011. An assessment of factors influencing the profitability of bean production in Zambia. B.Sc. project dissertation, University of Zambia, Lusaka, Zambia.

Sarker, N. R., S. M. R. Rahman and M. Y. Khan. 2021. Feeds and fodder production in Bangladesh:

Present trends, availability, future requirements and challenges for dairying in 2030. *Fodder Res. Dev. Proj.* 6(2): 34-40.

Sarker, U. K., M. S. Kaysar, M. R. Uddin, M. A. Hossain, S. Hassan and M. M. Hassan. 2022. Exploring farmers' insight on cropping pattern for sustainable crop production in char areas of Bangladesh. *Sustainability.* 14(3): 1745.

Shiferaw, B., B. M. Prasanna, J. Hellin and M. Bänziger. 2011. Crops that feed the world 6: Past successes and future challenges to the role played by maize in global food security. *Food Secur.* 3(3): 307-327.

Thamizhselvan, K. and S. P. Murugan. 2012. Marketing of grapes in Theni District. *Int. J. Market. Tech.* 2(9): 96-111.

Uddin, M. T. and A. R. Dhar. 2017. Char people's production practices and livelihood status: An economic study in Mymensingh District. *J. Bangladesh Agric. Univ.* 15(1): 73-86.

Xaba, B. G. and M. B. Masuku. 2013. Factors affecting the productivity and profitability of vegetable production in Swaziland. *J. Agric. Stud.* 1(2): 37-52.