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Economic Analysis of Sugarcane Production: An Empirical Study on Smallholder Farmers in the North Bengal Sugar Mills Area

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Abstract

Sugarcane is one of the most important cash crops, which plays vital role in augmenting income and employment of farmers in the northern area of Bangladesh. However, there is a shortage of sugarcane production in the local market of the country. Farmers often lose their encouragement in sugarcane production because of its less profitability and long duration features compared to other cash crops. As a result, the economic viability of the crop is critical to the farmers for continuing the production of sugarcane. Very few studies have paid attention in examining the economic feasibility of sugarcane production in Bangladesh. Therefore, this study aims to perform an economic analysis of sugarcane production focusing on the profitability, factor productivity, and resource use efficiency among the smallholder farmers in the North Bengal Sugar Mills area. A sample of 90 farmers has been taken randomly to conduct this study. Comprehensive analytical techniques such as Profitability function, Cobb-Douglas production function and allocative efficiency ratio are applied to achieve the objectives. Additionally, this study pays attention to address the constraints faced by sugarcane growers and ranked those problems based on the grower's perception on those constraints by utilizing a Problems Confrontation Index (PCI). It is found that sugarcane production is profitable in the study area with net return of Tk.20373.99 per bigha and a benefit-cost ratio 1.96 over the total cost. The OLS estimation results of the Cobb-Douglas production function reports that the variables tillage cost, seed cost, labor cost, rent of land, fertilizer cost and pesticide cost have significant impact on sugarcane production. Findings with regard to resource use efficiency analysis revealed that farmers do underutilize tillage, irrigation, labor, and transport variables while they over-utilize seed, fertilizer, pesticide and land for the production of sugarcane. Finally, the barriers of producing sugarcane such as lack of capital, lack of credit in the peak period, low payment by sugar mills and so on are identified and ranked on the basis of the perception of farmers in the study area. Consequently, the paper provides policy implications to formulate policy towards increasing sugarcane production in the study area as well as in the whole country.

Keywords: Sugarcane, Cobb-Douglass Production Function, Profitability, Resource Use Efficiency, North Bengal Sugar Mills Area, Bangladesh.

1. Introduction

Sugarcane is one of the most important cash crops in Bangladesh. Cultivation of sugarcane helps to enhance the income and employment opportunities of the farmers

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especially in the northern areas of Bangladesh. It ranked second among the cash crops and third among the major field crops in the country (Rahman et al., 2016). According to BBS (2018), 38.6 lakh tons of sugarcane was produced in 2016-2017 fiscal year which was 44.3 lakh tones in 2014-2015. However, production of sugarcane as a crop comprises a low share in the total agricultural production as well as in the national economy. It is reported that approximately 34.03 lakh tons of sugarcane was produced in 2017-2018 that contributes almost 5.52% to total agriculture and 0.81% to national economy (BSRI, 2019). About 0.6 million growers produce sugarcane occupying 0.17 million hector (0.87% of total cultivable land) arable land (BSRI, 2019). The amount of sugarcane contributes to produce about 0.20 million tones sugar and 0.60 million tones molasses (Gur) (BSRI, 2019).

Although sugarcane production is decreasing gradually the demand for sugar is increasing in Bangladesh. The local supply is still inadequate to meet its demand in this country. According to the Food and Agricultural Organization (FAO), every individual needs to consume 13 Kg of sugar or 17 Kg of molasses per annum. In Bangladesh, the quantity is still less than 3 Kg of sugar per person. Production of sugar and molasses is able to meet only 5% and 20% of total demand, respectively, in which 75% of demand is satisfied by importation of sugar (Rahman et al., 2016). While shortage of sugar can be satisfied by importation, shortage of molasses cannot be met by importation due to unavailability of molasses in the international market (KA, 1996). In this circumstance, government of Bangladesh has tried to reduce dependency on sugar importation and to boost up the production at home through developing sugarcane production technologies, sugarcane pest management, and sugarcane disease management by BSRI (Rahman et al., 2016). The area of cultivation of sugarcane was equally distributed between mill zones and non-mill zones (Alam et al., 2005 and Rahman et al., 2016). In recent times, growers of non-mill zones have been discouraged to cultivate the long-duration crop. It is reported that about 62.12% of total land in the mills' zone area is being used for sugarcane cultivation by the farmers. Basically, the sugarcane producers are still unable to meet mill's demand even though the sugar mill has to fully depend on cultivated sugarcane by the farmers in the areas of the mill zones. Thus, there is no alternative to increase the cultivation of sugarcane in mill zones in Bangladesh.

There are fifteen sugar mills in Bangladesh and most of them are operating in the northern regions of the country. North Bengal Sugar Mills (NBSM) is one of the biggest and traditional sugar mills in the northern area and in the country as well. This mill plays a vital role to contribute to sugar production, employment generation as well as to enhance socio-economic development in the mills area. Basically, sugarcane is the main cash crop produced by the farmers in the area. Sugarcane growers can utilize their raw sugarcane either by producing molasses or selling to the mills. Farmers contribute more to make molasses than to sell their sugarcane for sugar production due to lower price offered by the mills' authority and administrative difficulties (Reza et al., 2016). The total number of traditional molasses making power crashers under the mill's zone is 654 which was 1298 in the season 2006-07 (Reza et al., 2016). A large share of the produced sugarcane has been supplied to power crashers for molasses production as higher prices are offered by the molasses producers. Therefore, sugar production of industries is slowed down due to

shortfall of the main raw material and sugar industries are unable to reach their estimated production target and thus incurring through substantial financial loss as well.

In addition, unlike the tendency towards cultivation of cash crops like jute, the trend of sugarcane production has been reducing day by day as production of food grains has been increasing for meeting increasing food demand of the people. Sugarcane is one of the longest-duration cash crops while the cost of producing sugarcane is higher than any other crops in the country (Islam et al., 2016). In this circumstance, it is necessary to document whether sugarcane cultivation is profitable or not for the growers.

Further, the productivity of factors and technical efficiency of farmers have a significant impact on the growth sugarcane yield and the growth of the economy as well (Madi et al., 2020). It is reported that technical efficiency of sugarcane farmers is positively related to farmers' age and experience, access to credit, fertilizer application, soil type, and farm size (Fernandez et al, 2001). Again farmer's education and area of land cultivated showed a positive effect on efficiency whereas negative effect is found by the distance of a tube-well from the plot for irrigation (Khanna, 2006). The sugarcane growers in Bangladesh including the farmers in the NBSM zone cultivate sugarcane on the basis of the conventional way of production. Lack of skill, education, and modern technologies adopted in production reduce the productivity of inputs used by the farmers. As a result, sometimes lower input productivity contributes to reduced growth of total production. While an appropriate and balanced combination of inputs like seeds, fertilizer, herbicides, and labor utilization could increase sugarcane production (Dlamini, 2010 and Basak, 2010), in reality, most of the farmers are used to apply overdoses of fertilizers and pesticides in production. Moreover, farmers' lower skill reduces the resource use efficiency in production.

Furthermore, farmers in the NBSM zone are affected by different constraints in cultivating sugarcane. Generally, farmers are highly discouraged by technical, social, and economic constraints in cultivation of sugarcane. Firstly, the technical constraints include the cultivation-related problems faced by the growers is a common problem. Secondly, economic problems are also there which include lack of financial inclusion, low access to credit, the lower market price of sugarcane and, so on. Finally, farmers face a number of social problems such as crop safety problem, political problem, corruption problem, etc. In this situation, to boost up the growers, it is necessary to take steps to identify the problems and pay attention to mitigate the constraints faced by them.

Therefore, this study aims to perform an economic analysis of sugarcane production focusing on the profitability, factors productivity, and resource use efficiency among the smallholder farmers in the North Bengal Sugar Mills area. Additionally, this study pays attention to identifying the constraints and ranking those constraints on the basis of famer's perception regarding those constraints.

The current study contributes to reveal the economic viability of sugarcane production through assessing profitability, productivity, resource use efficiency and, ranking the constraints faced among the farmers in the study area. Some studies have been devoted to assessing the profitability and factor productivity in sugarcane production in

Bangladesh, scant attention has been given on the issue of resource use efficiency or estimation of allocative efficiency of resources in sugarcane production. This study therefore contributes to document the resource use efficiency in sugarcane production in the study area. This analysis would help famers and policymakers to take decisions focusing on resource use in sugarcane production. It is evident that sugarcane production is decreasing day by day and farmers are discouraged to cultivate sugarcane due to social, economic and, technical problems. Finally, this study concentrates on identifying the problems related to sugarcane cultivation and ranked them from the perspective of farmers so that policymakers can formulate policy to increase sugarcane production in the study area as well as in Bangladesh.

The rest of the paper organized as follows. In the next section, the related literatures are reviewed very extensively focusing on the objectives, methods, techniques and findings of previous studies. In Section 3, we described the data collection procedure and analytical techniques applied in this study to achieve the objectives. Results and findings of the study are described in the Section 4. Finally, Section 5 reports the concluding notes of the study.

2. Literature Review

Researchers have given extensive attention to document the economic viability of sugarcane production in the perspective of both developed and developing countries. Basically, most of the previous studies paid a role to report the profitability of sugarcane cultivation of farmers and estimate the productivity of factors of production. Profitability analysis has been done on the basis of profitability function and Cobb-Douglas production was estimated to report productivity of factors of production in most of the previous studies.

Findings of the previous studies reported that sugarcane cultivation is profitable in India (Jawanjal et al., 2015, Upreti and Singh, 2017, Amala and Rjagopal, 2017) focusing on the states Maharastra, Uttar Pradesh and Tamil Nadu. Profitability of sugarcane production was also reported in Pakistan (Naeem et al., 2007) and in Nigeria (Girei and Giroh, 2012, Olukunle, 2016 and Sulaiman et al., 2015) they found sugarcane as a profitable cash crop in the perspective of both countries. Studies conducted on the farmers of Bangladesh reported that despite having constraints sugarcane production is still a profitable cash crop (Reza et al., 2014 and Islam et al, 2016).

Further, some studies tried to estimate the productivity as well as factor elasticity of factors of production through estimating the Cobb-Douglas production function. Fertilizers, land preparation, seed and its application, irrigation and welding cost have significant impacts on the production of sugarcane in the study area (Nazir et al., 2013). The gross production value of sugarcane increases with an increase in labor uses in small farms, land uses in medium farms, and variable inputs (fertilizer, seed, chemical, etc) in large farms (Armagan and Ozen, 2007). In addition, the productivity of factors of production was estimated focusing on both Char lands and Plain lands in Bangladesh and the findings of study varied across areas. Islam et al. (2016) estimated Cobb-Douglas

production function based on major char lands and found human labor, Urea, TSP and irrigation to be positively and significantly related to sugarcane cultivation. On the other hand, cost of fertilizers and pesticides have a positive impact on production but cost of seed has a negative impact (Reza et al., 2014) in the Northern area of Bangladesh.

Although there are some studies already done on various aspects of sugarcane cultivation in Bangladesh, still there is huge scope to conduct studies in this field. It is found that findings of the previous studies varied depending on regions of the country. As a result, every area cultivating sugarcane should be given priority to report the economic viability of the production of this cash crop. It is worth emphasizing that, none have tried to report the status of resource use efficiency in sugarcane production in Bangladesh. In contrast, the analysis of allocative efficiency has received extensive emphasis in the case of sugarcane cultivation in a study in Pakistan done by Nazir et al., (2013). This study contributes specially to the literature on sugarcane production in Bangladesh through analyzing resource use efficiency. Considering this gap of the earlier studies in the case of Bangladesh this study aims to indentify and rank the constraints faced by the farmers in sugarcane cultivation.

3. Methodology

3.1. Data

This study is mainly based on primary data that are collected randomly from 90 sugarcane producers living in the North Bengal Sugar Mills area. Ten villages of Lalpur, and Bagatipara Upazillas of Natore district and five villages of Ishurdi Upazilla of Pabna district were selected purposively. A well-structured questionnaire has been made to collect required information based on inputs, input costs, output, yield and constraints related to sugarcane production and data are collected by face-to-face interview method. Collected data are summarized, analyzed, and tabulated that helped complete a comprehensive analysis using inferential and descriptive statistics. Therefore, the collected data permitted us to show the profit condition of sugarcane producers, the association between sugarcane production and inputs used in production and resource use efficiency of sugarcane producers in the study area as well.

3.2. Profit Function

We have used a profit equation to assess the profitability of sugarcane cultivation in the study area. Gross return (GR) was calculated by multiplying the total volume of sugarcane produced by per-unit price of sugarcane plus the value of by-product. The following equation (1) was used to estimate the (GR):

$$GR = (QP + QBPB) \quad \ldots \quad (1)$$

Where

GR = Gross return from the output (Tk/Bigha)

Q = Total quantity of output per bigha

P = Per-unit price of output.

QB = Total quantity of by-product per bigha

PB = Per-unit price of by-product

Net return was calculated by deducting all costs (variable and fixed costs) from gross return. To determine the net return following equation was used in the study:

$$\pi = \mathrm{GR} - \sum_{j=1}^{n} \mathrm{PxjXj} - \mathrm{TFC}$$

$$\pi = (\mathrm{QP} + \mathrm{QBPB}) - \sum_{j=1}^{n} \mathrm{PxjXj} - \mathrm{TFC} \qquad \ldots \qquad (2)$$

Where,
Π = Profit per bigha.
P_{xj}= Per unit price of the j^{th} input.
X_i = Total quantity of j^{th} input used for production per bigha.
TFC = Total fixed costs producing output per bigha

3.3. Cobb-Douglas Production Function

The Cobb-Douglas production function is used to estimate the effects of factor inputs on sugarcane production in the study area. Production function analysis is also used to assess the productivity of resources in sugarcane production. Cobb-Douglas production function can be written as:

$$Y_i = \beta_0 X_{1_i}^{\beta_1} X_{2_i}^{\beta_2} X_{3_i}^{\beta_3} X_{4_i}^{\beta_4} X_{5_i}^{\beta_5} X_{6_i}^{\beta_6} X_{7_i}^{\beta_7} X_{8_i}^{\beta_8} e^{u_i} \qquad \ldots \qquad (3)$$

Above function can be expressed in the log-linear function by taking logarithm in both sides and the log-linear function can be expressed as:

$$\ln Y_i = \ln \beta_0 + \beta_1 \ln X_{1_i} + \beta_2 \ln X_{2_i} + \beta_3 \ln X_{3_i} + \beta_4 \ln X_{4_i} + \beta_5 \ln X_{5_i} + \beta_6 \ln X_{6_i} + \beta_7 \ln X_{7_i} + \beta_8 \ln X_{8_i} + u_i \ldots\ldots \qquad (4)$$

Table 1: Description of Variables used in the Production Function

Variables	Description of Variables
Yi	Average value of per bigha yield of sugarcane
X_{1i}	Cost of tillage per bigha for producing sugarcane measured in Taka
X_{2i}	Cost of seed per bigha for producing sugarcane measured in Taka
X_{3i}	Cost of fertilizer per bigha for producing sugarcane measured in Taka
X_{4i}	Cost of irrigation per bigha for producing sugarcane measured in Taka
X_{5i}	Cost of pesticides used per bigha for producing sugarcane measured in Taka
X_{6i}	Cost of labor per bigha for producing sugarcane measured in Taka
X_{7i}	Cost of transportation measured in Taka
X_{8i}	Rental cost of land per bigha for producing sugarcane measured in Taka

Source: Author's Own Calculation

3.4. Efficiency of Resource Allocation in Producing Sugarcane

In this study, the ratio of marginal value product (MVP) to marginal factor cost (MFC) for each input is computed to estimate the relative efficiency of resource use (r) in sugarcane production, which is expressed as follows:

$$r = \frac{MVP}{MFC} \quad \ldots \quad (5)$$

Where
r = Efficiency ratio
MVP = Marginal value product calculated by multiplying the MPP by price of output
MFC = Marginal factor cost (cost of one unit of a particular resource)

If r is smaller than one, then resource is considered to be extensively used or over-utilized indicating that decreasing the quantity use of that resource increases the profit. When r is greater than one then it means that the resource is under-utilized and increasing the quantity use of resources will increase the profit level. Finally, if r is equal to one then it indicates that the resource is efficiently used to the point of profit maximization. Resource use efficiency is a necessary condition to maximize profit and production is referred to efficiently organized when MVP is equal to MFC. If the value of r is equal to one, then the resources used in the production are optimally allocated.

3.5. Problem Confrontation Index

The problems or constraints identified by sugarcane growers that can hinder or constrain the cultivation have been investigated and ranked in this study applying a Problem Confrontation Index (PCI). Farmers in the study area were asked to rate their perception of each constraint on a modified four-point Likert scale ranging from “not encountered” to “high”. Frequencies for each level of response for each issue were multiplied by a weight of from o to 3 (0 for not encountered, 1 for low, 2 for moderate and 3 for high). Finally, all problems were ranked on the basis of their estimated PCI value. The PCI value was estimated using the formula (Adopted from Ndamani and Watanabe, 2015) as given below:

$$PCI = P_n \times 0 + P_l \times 1 + P_m \times 2 + P_h \times 3 \quad \ldots \quad (6)$$

Where,
PCI= Problem Confrontation Index.
P_n= Frequency of farmers who rated the problem as not encountered.
P_l= Frequency of farmers who rated the problem as low.
P_m= Frequency of farmers who rate the problem as moderate.
P_h= Frequency of farmers who rated the problem as high.

According to the value of PCI the constraints are ranked higher if the value of PCI is higher meaning higher intensity of the constraints.

4. Results Discussion

4.1. Profitability Analysis of Sugarcane Cultivation

Profitability of sugarcane growers has been reported on the basis of the estimated profit function. The sugarcane crop is characterized by requiring a higher amount of inputs like labor, fertilizer, irrigation, pesticide, etc. Therefore, the cost of fixed input is very negligible and the variable cost dominates the total cost of sugarcane production.

In this study, cost of inputs and quantity of output are taken measured in taka per bigha and the price of output is taken as the sum of taka per ton of sugarcane. The results of profit function revealed taht the cost incurred for variable inputs is higher than that of the fixed inputs. 76.50% of total cost incurred is for variable inputs and the left 23.50% is for fixed inputs. Among the variable inputs, the factor labor incurs a higher cost that is 36.85% of the total cost. Sugarcane production is less dependent on use of pesticides and the share of cost of pesticides in total cost is lower that is 1.95% of the total cost.

Table 2: Results of Profitability Analysis of Sugarcane Cultivation

Input Cost	**Tk/Bigha**	**Percentage of Total Cost**
Labor Cost	7,800.00	36.85%
Fertilizer Cost	2,402.70	11.35%
Irrigation Cost	625.82	2.96%
Tillage Cost	1,054.30	4.98%
Pesticide Cost	412.89	1.95%
Seed Cost	2,197.20	10.38%
Transport Cost	1,700.00	8.03%
Total Variable Cost	16,192.91	76.50%
Total Fixed Cost	4,973.10	23.50%
Total Cost	21,166.01	100%
Value of Output		
Yield (Ton/Bigha)	12.5	
Price (Tk/Ton)	2860	
Value of Sugarcane (Tk/Bigha)	35,750	
Value of By-product (Tk/Bigha)	5800	
Gross Return (Tk/Bigha)	41,550	
Net Return (Tk/Bigha)	20373.99	
BCR over Variable Cost	2.57	
BCR over Total Cost	1.96	

Source: Author's Own Calculation

It is documented by the study that the total cost of producing sugarcane per bigha is about Tk. 21166.01. On the other hand, on average 12.5 tones sugarcane is produced by the growers per bigha in the study area and revenue collected by the producers is estimated at about Tk. 35,750. In addition, producers are able to sell by-products of sugarcane that is estimated at about Tk.5,800. Finally, the profitability analysis of this study reports that despite incurring a higher cost of production compared to other cash crops it is still

profitable in the study area. The estimated net return reported by the study is Tk.20,337 per bigha earned by the sugarcane growers in the study area.

3. Factor Productivity in Sugarcane Production

The widely used Cobb-Douglas production function used in this study and it is estimated by OLS method to identify the significant factors in sugarcane production in the study area. Productivity of factors of production is an important issue to increase the production of any agriculture output. The estimation results of the Cobb-Douglas production function presented in Table 3 help to observe the impact of factors of production on sugarcane cultivation.

Table 3: Results of Factors Productivity of Sugarcane Production

Variables	Coefficient	Std. Error	t –value	P-value
Constant	123.05	100.041	1.23	0.224
Tillage Cost (X1)	0.05**	0.024	2.08	0.042
Seed Cost (X_2)	0.02*	0.011	1.85	0.069
Fertilizer Cost (X_3)	-0.22**	0.104	-2.11	0.039
Irrigation Cost (X_4)	0.19	0.003	0.76	0.450
Pesticide Cost (X_5)	-0.15**	0.076	1.98	0.053
Labor Cost (X_6)	0.25***	0.070	3.56	0.001
Transportation Cost (X_7)	0.16	0.116	1.38	0.173
Rent of land (X_8)	0.015**	0.007	2.21	0.031
R^2=0.65				

Source: Author's Own Calculation

In the earlier studies it is found that there are many factors that have positive impact on production of sugarcane and some factors affect inversely the yield of sugarcane production (Reza et al., 2016). The implications of the value of the coefficients found from the OLS estimation of Cobb-Douglas production function is presented in the following way:

The variable tillage cost is measured in Taka per bigha in this study. The result of the regression analysis reports the value of the coefficient by 0.05. The implication of this result explains that, if tillage cost is increased by one percentage point holding other factors constant then the sugarcane production will increase by 0.05%. This finding is similar to the findings of previous studies. Reza et al., (2016) found tillage cost as a positively significant factor in sugarcane production with inter-crop production. On the other hand, Islam et al., (2016) found tillage cost with a positive but insignificant impact on the sugarcane production of char lands in Bangladesh.

The factor seed has a significant impact on the production of sugarcane in the study area. The value of the coefficient interprets that, other factors holding constant, one percent increase in the seed cost results to increase in the production of sugarcane by 0.02 percent. This result is similar to the findings of the earlier researchers- Raza et al (2009) and Fernandez (2009). Reza et al., 2016 found the variable seed cost with a negative significant impact on the production of sugarcane. Researchers believe that

fertilizer is an important factor that can increase the production of agriculture output significantly. In sugarcane production, most of the studies found negative and significant impact of fertilizer on sugarcane production (Dlamini et al, 2010, Kabir, 1997 and Islam et al., 2016). In the same manner, this study found fertilizer with a negative coefficient and interprets that a one percent increase in fertilizer cost results in 0.22% decrease in sugarcane production.

It is also reported in Table 3 that the factor pesticide has also a negative impact on the production of sugarcane in the study area. The coefficient of pesticide interprets that the production of sugarcane will be decreased by 0.15% if the cost of pesticides is increased by one percent. This finding is consistent with the findings of earlier studies done by Islam et al. (2016) and Fernandez (2009). The share of labor cost is the highest found in the productivity analysis of this study. The variable labor also found a highly significant factor that contributes to produce sugarcane in the study area. The value of coefficient found by the regression analysis interprets that if the labor cost is increased by one percent then production of sugarcane will be increased by 0.25 percent. Finally, the input variable which is found significant in the regression analysis is land-cost and it has a very negligible impact on the production of sugarcane. If the rent of land is increased by one percent then sugarcane production will be increased by 0.015 percent.

In a nutshell, this study found the factors tillage cost, seed cost, human labor cost, and rent of land have a positive and significant impact on the production of sugarcane. It is also reported in the above Table 3 that the variable irrigation and transportation have a positive but not significant impact on production. On the other hand, the variable fertilizer cost and pesticide cost have a significant negative impact on the production of sugarcane in the study area.

3. Resource use Efficiency Analysis

Analysis of resource use efficiency is done to understand whether the inputs in the sugarcane production are efficiently utilized. The result of the analysis that is the values of the marginal value product and efficiency ratio (r) reveals that half of the total inputs are underutilized and left are over-utilized by the cane growers in the study area.

Table 4: Results of Resource Use Efficiency Analysis

Inputs	MVP	MFC	Efficiency Ratio (r)	Comment
Tillage Cost	1.017974	1	1.017974	Underutilized
Seed Cost	0.195403	1	0.195403	Over utilized
Fertilizer Cost	-1.96541	1	-1.96541	Over utilized
Irrigation Cost	6.51681	1	6.51681	Underutilized
Pesticide Cost	-7.79808	1	-7.79808	Over utilized
Labor Cost	1.798281	1	1.798281	Underutilized
Transport Cost	2.008421	1	2.008421	Underutilized
Rent of Land	0.064743	1	0.064743	Over utilized

Source: Author's Own Calculation

It is revealed by the Table 4 that the values of efficiency ratio associated with the factors tillage cost (1.017974), irrigation cost (6.51681), labor cost (1.798281) and transport cost (2.008421) are greater than one and the factors are underutilized by the sugarcane growers. The underutilization of resources explains that increasing the cost of these factors would help to increase the profit of sugarcane growers. It is also reported by the results of resource use efficiency analysis that there are opportunities to increase the costs of these underutilized factors.

The analysis of resource use efficiency documents that the variables seed costs, fertilizer cost, pesticide cost and rent of land are over-utilized by the sugarcane producers in the study area. The values of resource use efficiency associated with these factors are less than unity. Finally, it is observed by the results of the resource use efficiency that there are opportunities to decrease the cost of production of sugarcane by cutting the cost of factors that are over-utilized by the farmers.

4. Constraints of Sugarcane Cultivation

Problem confrontation index is used in this study to identify and rank the constraints faced by the farmers in producing sugarcane in the study area. A number of financial, technical, and social constraints play a role to discourage farmers to cultivate sugarcane. This index helps to identify the problems and rank them on the basis of the opinion of farmers. The rank of the problems reports the intensity of problems and contributes to formulate proper policies to increase the production of sugarcane.

Results of PCI index reveals the barriers to produce sugarcane which are presented in Table 5. With a PCI value of 161, lack of capital is ranked the most critical constraint producing sugarcane in the study area. Lack of credit in pick period, low price of output, late payment by sugar mills, and long-duration harvest are ranked second, third, fourth, fifth-most pressing constraints, respectively.

Table 5: Results of Problem Confrontation Index

	Degree of problems					
Constraints	**High**	**Medium**	**Low**	**Not at all**	**PCI**	**Rank**
Lack of capital	41	15	8	1	161	1
Lack of credit in peak period	38	17	7	3	155	2
Low price of output	39	14	6	7	151	3
Late payment by sugar mill	32	20	8	5	144	4
Long duration Harvest	39	7	12	7	143	5
Corruption inside mills	21	14	11	9	132	6
Lack of training	27	18	10	10	127	7
Lack of collaboration from management	28	15	12	10	126	8
Unavailability of labor	26	15	14	10	122	9
Uncertainty of weather	12	13	26	14	88	10
Lack of varieties of sugarcane	14	7	18	16	84	11
Lack of modern agricultural equipment	15	12	14	24	80	12
Lack of clean seed	13	8	21	23	76	13
Thieve problem	12	5	25	22	71	14

Source: Author's Own Calculation

This analysis reports that financial problem is ranked as the most critical problem faced by the farmers in the study area. In addition to financial problems, some technical problems also play a role to discourage the farmers such as lack of training, lack of collaboration of mills management with farmers, scarcity of labor, lack of varieties of sugarcane and lack of modern agriculture equipment. On the other hand, some social problems like corruption inside the mills and thieve problems are also found by the analysis.

5. Conclusion

It is undeniable to report that rural economy of Bangladesh is heavily dependent on agriculture. Agriculture is the largest employment sector in Bangladesh. Sugarcane is one of the most important cash crops in Bangladesh that can help to uplift the income and employment of sugarcane producers. However, farmers are discouraged to produce sugarcane because it is less profitable compared to other cash crops and long-duration features. This study aimed at performing the economic analysis of sugarcane production focusing on profitability, factors productivity and resource use efficiency of sugarcane growers in the study area. Profitability function, Cobb-Douglas production function and allocative efficiency ratio were applied to report economic viability of sugarcane production. This study also contributed to address the constraints faced by growers in sugarcane production and ranked those problems based on the growers' perception regarding those constraints based on Problems Confrontation Index. Sugarcane production was found profitable in the study area with net-return of Tk.20373.99 per bigha and benefit-cost ratio of 1.96 over the total cost. The findings of the profit function contributed to document that the cultivation of sugarcane is still profitable in the study area. In addition, cost calculation helped to concentrate on the cost-share of the inputs used in sugarcane production. The findings also reported the variable human labor cost was found the highest among the other costs. Moreover, the OLS estimation of the Cobb-Douglas production function reported that, the variables tillage cost, seed cost, labor cost and rent of land have a positive and significant impact on production of sugarcane in the study area. On the other hand, the variables fertilizer cost and pesticide cost have a negative and significant impact on sugarcane production. Consequently, both farmers and policymaker entities can be benefited from factor productivity analysis to take decisions about factor inputs in sugarcane production. Further, this study paid extensive attention assessing the resource use efficiency and identifying the intensity of problems faced by farmers that contribute quite significant to the existing literature. Findings of resource use efficiency analysis revealed that tillage cost, irrigation cost, labor cost and transport cost are underutilized by the sugarcane growers. In contrast, the variables seed costs, fertilizer cost, pesticide cost and rent of land were found over-utilized by the sugarcane producers in the study area. Finally, the barriers to produce sugarcane such as lack of capital, lack of credit in pick period, low payment by sugar mills, and so on are identified and ranked on the basis of perceptions of farmers in the study area. The findings of these analyses help policymakers extensively to take policies on inputs used and constraints of farmers in sugarcane cultivation.

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