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A Key to Uncover the Envelop of Backwardness of Sugar Industry in Bangladesh: An Application of Regression Analysis

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Abstract

In this paper, an effort is taken to fish out the inherent backwardness of sugar industry in Bangladesh by applying the multiple regression analysis. The prime objective of the research is to describe the present situation of backwardness of production level and to find out a technique to increase the production level of sugar mills in Bangladesh. Data is chosen from secondary sources i.e. performance reports, annual reports of the selected sample sugar mills and reports of the BSFIC. The total sugar production ($Y_{prod.}$) is treated as dependent variable and LSM = X_{LSM} (loss of sugar in molasses), RMC = X_{RMC} (Repair and maintenance cost), MH = X_{MH} (Machine hours), UEU = X_{UEU} (Units of energy used) and RR = X_{RR} (Recovery rate) are selected independent variables under the study period. It is implied from analysis that 1 percent decrease in loss of sugar in molasses would result in 7939.63 units upturn in the gross output of sugar if the other factors remain to keep unchanged in the mean position. The coefficient of MH, UEU and RR was found significant at 1 percent level by positive sign indicating these variables had positive impact on sugar production process. It also indicated that 1 percent increase in MH, UEU and RR would result in 3.49 units, 56.59 units and 1174.73 units total production of sugar respectively if other components holding unchanged position at the mean level for each of the variables including in the model. So that the management could increase the amount of total production 9137.63 units by taking the necessary action to increase 1 percent of recovery rate (RR) and at the same time to decrease 1 percent of loss of sugar in molasses (LSM) under the technical arrangement of production procedure of sugar.

Keywords

Recovery Rate, Loss of Sugar in Molasses, Sugarcane, Regression Analysis, Bangladesh

1. Introduction

The main problem of BSFIC in general and selected units in particular is non-availability of good quality of cane in sufficient quantities. Modernization and rehabilitation are also one of the foremost difficulties of the corporation. Due to financial constraints, the corporation is sustaining loss year after year and it is passing through a phase of crisis. Sugar producing units contributed a satisfactory expression about 50 years from the beginning of its journey but thereafter some of the units were closed and some started showing signs of sickness. For proper management and rehabilitating the closed sugar factories, government established BSFIC to enhance the sugar production. But unfortunately there has been a decline in sugar production having adverse effect on the economy of Bangladesh which is shown in Table 1.

It is clear that almost every year cultivated land area, sugarcane production, sugar production and recovery rate are decreasing and the corporation is suffering losses and its financial liability towards the banks is increasing day by day.

Table 1. Statement of cultivation area, sugarcane production, sugar production recovery rate & loss.

Year	Cultivated Land ("000" Acre)	Sugarcane Production ("000" MT)	Sugar production ("000" MT)	Recovery Rate (%)	Loss in sugar production (Crore Tk.)
2003-04	404	6484	119	7.26	
2004-05	388	6423	107	7.53	
2005-06	377	5511	133	7.19	
2006-07	371	5770	165	7.1	
2007-08	312	4984	164	7.16	141
2008-09	312	5233	80	6.75	186
2009-10	290	4491	62	7.17	136
2010-11	287	4671	101	6.38	191
2011-12	266	4603	69	6.62	312
2012-13	269	4468	107	6.85	315
2013-14	265	4508	128	7.06	575
2014-15	266	4579	77	6.37	541
2015-16	243	4208	58	6.04	528
2016-17	227	3863	60	6.05	641
2017-18	223	3639	69	5.77	835

Source: MIS, 2018 BSFIC; Bangladesh Economic Review-2019, Ministry of finance, Bangladesh.

It consists for more than 69 percent cost of production (MIS, 2018 BSFIC). In Bangladesh only sugarcane is used as raw materials for manufacturing sugar. There are several factors responsible for low yield and poor quality of cane in Bangladesh. The main problem before the sugar mills is non-availability of good quality of cane in sufficient quantities. The supply of sugarcane to factory depends upon the number of working days of sugar factory and payment of cane price to the farmer. It is general practice that sugar mills in our country delay payment of cane price to cane growers which in turn create uncertainty with respect of availability of cane to sugar factories.

The price of sugar cane is paid on the basis of quality of cane especially consider sugar content, fiber, impurities in most of the developed sugar producing countries. But in Bangladesh, payments made the management of sugar industries are weight basis (Hossain et al., 2006). The price payment system of sugarcane should be revised and sugarcane price should be based on quality of sugarcane and by applying decision support system stakeholders will be benefited (Lejarsa et al., 2009).

Sugar producers have to face both national and international competitions and inputs costs are key factors for their competitions (Galovic & Bezic, 2019). The Sugars Mills in Bangladesh are very old. Modern technological equipment should be introduced in the production process by changing the outdated low productivity equipment (Hossain et al., 2006). Technicians, staff are well trained and strong relation must be developed in operational functions, ensuring job satisfaction and reducing stress (Hossain et al., 2006; Rahman & Gazi, 2014).

Different types of by product or co-products are produced from sugar cane alt the time of processing sugarcane into sugar like molasses, ethanol, bagasse's, mart etc. (Lejarsa et al., 2009; Hossain et al., 2006). But 67% of the workers in Bangladeshi sugars mills are not aware about those products and are not properly maintained and utilized (Rahman & Gazi, 2014). Huge amount of by product bagasse's are produced which may be used as a valuable raw material for producing paper, particle board etc. It is a matter of sorrow that in Bangladesh, it is used to burn for the purpose of generating stream of the factory. The second by-product is molasses may be used as a raw material for producing alcohol and export for generate foreign currency. The other by products is press mud and cane trash. The use of these by-products has a wide field. A proper utilization of this by product will result in the setting up of a number of subsidiary industries. Therefore, by product of sugar industry should be profitable utilize to bring down the cost of production. Due to the application of proper utilization of technology and techniques excessive sucrose content have been lost through these by-products during the crushing period of sugarcane.

2. Review of the Related Literature

During the study, different types of articles, books are reviewed. Some of related reviews are stated below:

Researchers used regression technique for predicting the famer's decision to allocate their land for the production of sugar cane based on the price and non-price factors in the study area. It was suggested that technological advancement in the sugar cane production will enhancement the quality and quantity of cane. They also express that government should ensure the supply technical equipment to all farmers (Saddik et al., 2012).

In this paper, researchers calculated the estimated amount of agricultural crop production with the help of linear regression and to find out the capabilities of neural networks for the prediction of yield of crops (Paswan & Begum, 2013).

In research study Hayat et al. (2022) explained that different factors affected the production of wheat and justified satisfied or dissatisfied factors by applying regression model. The researchers found that zinc, phosphorous, saturation, previous sown crops, seeds variety, land types etc. were the most significant factors for wheat production in Multan of Pakistan.

In the research works, linear regression analysis has been applied to find out profitability and productivity of the sugarcane cultivators. On the basis of significant regression coefficients of the selected input variables of sugarcane cultivation, recommendations are given to increase the profitability and productivity (Reza et al., 2016).

In this study, researchers made an attempt to find out the factors which affects gross national product of Bangaldesh using regression analysis. It is noted that populations, labour forces, imported goods and services agriculture value added etc. have significant positive impact on GDP in Bangladesh (Hasan et al., 2016).

Hossain et al. (2006) stated the problems and prospects related of the sugar mills in Bangladesh. After analyzing collected data, researchers found that problems are faced both mills and the famers of sugarcane. In the factory side, poor management and finance are the major problems whereas farmers faced problems relating farming process of cane, supply chain process and payment policy. Adaption of policy and program, strong management, modernization, effective utilization of resources, support to growers etc. may be assist for mills to be profitable in future.

It is noted that various research study have been conducted on the sugar mills in Bangladesh but no comprehensive study were made to use regression analysis for the purpose of discover the problems. So that research gap may be answered by adopting the under taken study to discover the backwardness of sugar industry in Bangladesh with the application of regression analysis.

3. Concepts of the Related Terms

3.1. The Multiple-Regression Model

The relationship between the dependent variable (Y) and a set of independent variables like X_1, X_2, X_3, $\cdots$, X_n can be expressed by the function as $Y = f(X_1, X_2, X_3, \cdots, X_n)$. In the Multiple Regression Model, this function may be written as

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n + u$$

where $\beta_i' s_{are}$ the slope coefficient of the respected independent variables, Y, the dependent variable and u, the error terms of the Ordinary Least Square (OLS) method (Gupta, 2000).

3.2. Variance Inflationary Factors (VIF)

In the application of multiple regression analysis, the independent variables are found sometimes highly correlated among each other and it is a problem of find out exact impact on dependent variable by the predictors included in the analyzed model. The value of VIF is considered within (1 - 5) by most of the researchers as the expected level of multicollinearity for the better prediction of the response variable (Gujarati & Porter, 2009).

4. Objectives of the Study

The main objective of the study is to know the present situation of backwardness of production level and to find out a technique to increase the production level of sugar industry in Bangladesh. For achieving the main objective some specific objectives are set out as follows:

1) To explore the present status of the production level of sugar industry in Bangladesh;

2) To identify influential factors related to the production of sugar of the sugar industry in Bangladesh;

3) To identify the problems of sugar expected level of sugar production of sugar industry in Bangladesh; and

4) To suggest recommendations for the betterment of the sugar industry in Bangladesh.

5. Research Methodology

The study is covered with six sugar mills in Bangladesh those are Thakurgoan Sugar Mills Ltd. (TSM), North Bengal Sugar Mills Ltd. (NBSM), KushtiaSugar Mills Ltd. (KSM), Panchagarh Sugar Mills Ltd. (PNSM), Carew and Co. (Bangladesh) Ltd. (C & Co.) and Faridpur Sugar Mills Ltd. (FSM) following the method of purposive selection. Secondary data were mainly collected from performance reports, annual reports, articles, books, journals, newspapers etc. The period of the study is 2003-2017. The collected data are summarized, analyzed and interpreted in logical manner with the help of multiple regression models. The selected variables are sugar production, loss of sugar in molasses, repair and maintenance, machine hours, units of energy used and recovery rate.

6. Analysis and Finding

6.1. Selection of Variables

The dependent variable is the total sugar production ($Y_{\text{prod.}}$) and the independent variables are LSM = X_{LSM} (loss of sugar in molasses), RMC = X_{RMC} (Repair and

maintenance cost), MH = X_{MH} (Machine hours), UEU = X_{UEU} (Units of energy used) and RR = X_{RR} (Recovery rate) under the study period. These influential variables are extracted from eleven variables like as sugarcane used in production process, number of employees, units of energy used, loss of sugarcane in transportation, capacity utilization, loss of sugar in molasses, repair and maintenance cost, machine hours, recovery rate, loss hours and conversion cost. On the basis of detecting small variance inflationary factor (less than 2), these variables identified and included in the model. The estimated R-square is found to be 0.822 indicating 82.2 percent variance is explained by the five variables of the model.

6.2. Analysis and Interpretation

The collected data have been prepared to serve the purpose of analysis, interpretation and findings of the study where it is used the widely used software SPSS version-22. The outputs are depicted clearly in Table 2.

It was evident from the above table, the coefficient of loss of sugar in molasses and repair & maintenance cost statistically insignificant at 1 percent level with negative sign indicating each of the variables had significant negative effect in the sugar production process. It also implied that 1 percent decrease in loss of sugar in molasses would result in 7939.63 units increase in the gross output of sugar if the others factors remain to keep unchanged in the mean position. In case of repair & maintenance cost the coefficient was found to be 23.29 with

Table 2. Model of sugar mills in Bangladesh.

$$Y_{\text{prod.}} = \text{Const.} + a_1 X_{\text{LSM}} + a_2 X_{\text{RMC}} + a_3 X_{\text{MH}} + a_4 X_{\text{UEU}} + a_5 X_{\text{RR}} + e$$

Parameter	Coefficients	Standard error	T-value	Sig	VIF
Constant	11087.84*	4109.74	2.70	0.00	
LSM	−7939.63*	1503.15	−5.28	0.00	1.15
RMC	−23.29*	3.75	−6.21	0.00	1.10
MH	3.49*	0.25	13.90	0.00	1.27
UEU	56.69*	21.30	2.66	0.00	1.31
RR	1174.73*	288.47	4.07	0.00	1.07

Model Summary			
R	R-square	Adjusted R-square	Standard error of estimate
0.907	0.822	0.811	1719.86

$$Y_{\text{prod.}} = 11087.84 - 7939.63 X_{\text{LSM}} - 23.29 X_{\text{RMC}} + 3.49 X_{\text{MH}} + 56.69 X_{\text{UEU}} + 1174.73 X_{\text{RR}} + 1719.86$$

N = 90 and *significance level at 1%, VIF = Variance inflationary factor. Data source: MIS report (BSFIC); Bangladesh Economic Review-2019, Ministry of Finance, Bangladesh.

negative sign indicating 1 percent decrease of the variable would increase in 23.29 units of total production of sugar if others factors remain constant in their mean level.

The coefficient of MH, UEU and RR were found significant at 1 percent level by positive sign indicating these variables had positive impact on sugar production process. It is also indicated that 1 percent increase in MH, UEU and RR would result in 3.49 units, 56.59 units and 1174.73 units of total sugar production respectively keeping other factors constant at their mean level for each of factors.

If it is possible for the management to increase 1 percent of recovery rate (RR) and at the same time to decrease 1 percent of loss of sugar in molasses (LSM) then the total production level will be increased by the amount of the following figures:

The original regression equation

$$Y_{\text{prod.}} = 11087.84 - 7939.63X_{\text{LSM}} - 23.29X_{\text{RMC}} + 3.49X_{\text{MH}} + 56.69X_{\text{UEU}} + 1174.73X_{\text{RR}} + 1719.86$$

The changed equation

$$Y_{\text{Chprod.}} = 11087.84 - 7939.63(X_{\text{LSM}} - 1) - 23.29X_{\text{RMC}} + 3.49X_{\text{MH}} + 56.69X_{\text{UEU}} + 1174.73(X_{\text{RR}} + 1) + 1719.86$$

Now the increased production will be obtained by $(Y_{\text{Chprod.}} - Y_{\text{prod.}}) = 9137.63$ units. So that the management could increase the amount of total production 9137.63 units by taking the necessary action to increase 1 percent of recovery rate (RR) and at the same time to decrease 1 percent of loss of sugar in molasses (LSM) under the production procedure of sugar.

6.3. Hypothesis of the Study

H$_0$: There is a significant difference of production to total inputs among the selected sugar mills.

Hypothesis # 3 this analysis is done on the basis of physical production to total inputs during the study period. The calculated value of F is 12.54 and the table (Table 3) value is 2.32 that are indicated that the null hypothesis is rejected. So it may be concluded that there is a significant difference of production to total inputs among the selected sugar mills.

Table 3. ANOVA-single factor for production of selected sample sugar mills.

Sources of variation	SS	df	MS	F	P-value	F-crit
Between the groups	458.68	5	91.74	12.54	0.00	2.32
Within the groups	614.64	84	7.32			
Total	1073.31	89				

Source: Calculated from secondary data of MIS annual report-2003-18 (BSFIC).

7. Identified Problems in the Sugar Industry

On the basis of analyses, interpretations and review of the related literatures reviews the following problems have been identified:

1) Lack of high quality of sufficient sugarcane grown.

2) Maximum time gap between harvesting and crushing.

3) Sugarcane price fixation system.

4) Poor recovery rate of the sugar.

5) Inappropriate purchasing price of sugarcane.

6) Lack of skilled technical manpower.

7) Intention of the cultivation of other profitable crops etc., are the main causes of shortage supply of sugarcane.

8) The mills cannot concentrate more for efficient utilization of plant capacity due to shortage of different issues.

8. Conclusion

The sugarcane development program in sugar industry is to be given the highest priorities to yield the best quality of sugar cane of adequate quantity to ensure fulfillment of supply which will helpful for the management to avoid the loss of working hours. The successful implementation of that program will reduce the cost of production by utilization of maximum machine hours during the crushing season. Modernization and rehabilitation are also one of the main problems of the corporation. It is noted that most of sugar mills in Bangladesh came up during **1930-35**; hence they are more than **75** years old. Plants of theses factories are out dated. Their crushing capacity has gone down. They record high sugar losses, high fuel consumption and low productivity of labor. All ties result in high cost and low production of sugar.

9. Suggestions and Recommendations

Considering the analysis, interpretations and observations the following suggestions/recommendations are suggested to overcome the backwardness of sugar industry in Bangladesh:

1) Cultivating lands of sugarcane, production of sugar canes, quality sugarcane production are in decreasing trends. So the supply of sufficient quality sugarcane is needed to overcome the vital problems of sugar industry in Bangladesh. In this regards, proper authorities should draw necessary action to motivate the growers to accelerate in cultivation and supply sufficient sugarcane to the sugar mills;

2) Agricultural research and development unit should be more attentive to introduce disease resistant and high yielded variety sugarcane;

3) Law and force implanting agencies should be more active to prevent local Gur (Molasses) making by sugarcane to ensure more supply in the mills area;

4) Friendly relationship between growers and mills management should be

enhanced in the period of harvesting and make sure supply of sugarcane should be in proper time;

5) The price of sugarcane should be fixed up on the basis of cane quality and grade that will inspire the farmer to cultivate quality sugarcane;

6) Sugarcane cultivators should be encouraged by providing easy distribution of fertilizers, insecticide, pesticide, seeds, modern agricultural equipment, incentive and capital;

7) Modern technology should be introduced by proper authority to increase recovery rate and reduce loss of sugar contained in molasses;

8) Mill management should take necessary step to minimize time gap of harvesting and crushing to obtain maximum sugar contained in sugar juice;

9) Alternative sugar contained items like beat, sucrose contained related plants should be introduced by the concerned authority to minimize the idle capacity of sugar mills in the gap period of seasonal supply of sugarcane.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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