EFFECT OF DIFFERENT FACTORS ON SUGARCANE PRODUCTION IN SINDH: A REGRESSION ANALYSIS

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ABSTRACT: *To determine the effect of input variable such as cost, Cobb-Douglas production function was estimated. The results of five varieties showed that the maximum coefficient of multiple determinations R^2 (0.9838) was found for sugarcane variety GT-11 was as compared to other observing varieties i.e., BL-4, BF-129, Gulabi-95. Furthermore 98% variation was observed for Q-88. Varieties in the creation of yield were clarified by every single informative variable and the balanced R^2 were found to be 97%. The models used in the present study fit the data set in a quite good extant. On the basis of overall results, it can be concluded that GT-11 was the leading variety among all the varieties used in the present research. The results from regression analysis show that all the independent variables i.e., Cane girth, germination, plant height and tillers were significantly effect on the dependent variable sugarcane production.*

INTRODUCTION

Sugarcane is an important cash crop after cotton in Pakistan and it is grown in 105 countries; Brazil is the biggest sugarcane growers in the world. It is generally cultivated for sugar and sugar-related products beside with an input for paper and board industry. It contributes 3.1 percent in agriculture and 0.6 percent in GDP of Pakistan. During July-March 2014-15. Sugarcane is a water-intensive crop that remains in the soil all year long. As one of the world's thirstiest crops, sugarcane has a significant impact on many environmentally sensitive regions, like the Mekong Delta and the Atlantic Forest. Historic planting of sugarcane around the world has led to significant impacts on biodiversity [1].

The sugar industry in Pakistan is the second largest agro – based industry comprised of 81 sugar mills with an annual crushing capacity of over 6.1million tones. The Sugar production is a seasonal activity and industries are mostly located in the rural areas of Punjab and Sindh. A small number of mills are also located in the KPK province. The operating average of mills are 150 days and supply of sugarcane made was throughout the year [2]. Sugarcane is tall perennial true grasses of the genus Saccharum, tribe and ropogoneae,one of the several species of native to the warm temperate to tropical regions of South Asia, used for sugar production. It has stout jointed fibrous stalks, are rich in the sugar sucrose, which accumulates in the stalk internodes. The plant is two to six meters (six feet seven inches to nineteen feet eight inches) tall. All sugarcane species interbreed and the major commercial cultivars are complex hybrids and economically important seed plant family that includes maize, wheat, rice, and sorghum and many forage crops [3].

The variety evolution program in Sindh is not empowering as released by Provincial Research Institute, Tandojam, its last verity (BF 129), during 1996. Nuclear institute of agriculture (NIA), Tandojam, has released two varieties, NIA 1998 and NIA 2004. A PARC Sugar Crops Research Institute, Thatta, develops one variety Thatta 10. The Sindh Sugar Industry is somehow trying to meet its requirements by unscientific and irregular introduction of varieties from Punjab (SPSG 26, SPF 234, CPF 237, and HSF 240). Habib Sugar mills make its own efforts to test varieties for its tract [4]. Managing social and environmental risks is important for sugarcane growers, processors and food companies due to regulatory pressures as well as shareholder and consumer expectations for sustainably produced goods.

Sugarcane production is a multifarious procedure and be able to envisaged as a purpose of numerous factors. The awareness of the comparative significance of the reserve contribution influence. Sugarcane production is essential for the growers for introducing beneficial alter in their process at the micro level, and for the strategy maker it is creating plans to improve agricultural efficiency depended on resonance monetary values at the macro level. Production techniques such as, planting time, soil type, different varieties, use of inputs and ease of use of irrigation water; have significant blow on sugarcane production [5]. The ecological situations and administrative approach differ from one farm to a new eventually; these aspects influence the crop productivity [6].

The evaluation of land management practices and their impact on environmental quality requires adequate analytical tools and experimental designs. A significant progress to understand crop production has already made by measuring and analyzing on-site processes. Traditionally soil scientists have used random sampling techniques, assuming independence between samples, in order to analyze the effect of soil properties on crop growth and yield. Hence, crop development variables and soil attributes collected at especially different locations relative to each other, in general manifest low correlation when classical statistical analysis is used [7]. According to [8], the importance of special and temporal variability of soil chemical and physical properties and their relation to crop yield should not be underestimate in planning soil management. Recently, applied analytical techniques in agriculture, such as the state-space methodology have shown to provide opportunities for on-site analysis and for a suitable identification of special relations between crop and soil variables taking into account their special association. State-space modeling is a technique that can filter noise underlying crop and soil processes at various scales if the observation density supports the identification of the correlation length. Hence, this technique can applied to identify landscape-scale processes and generate reliable predictions, having practical advantages, and it can be a more effective research tool in comparison to other approaches to understand and explain landscape-scale variation in agricultural systems [9].

The high costs of inputs and low prices of outputs, delay in payments and lack of scientific knowledge were the major problems in sugarcane production [10] and [11]. Therefore, this study is conducted to investigate the factors affecting the sugarcane production in Sindh province. Whereas the results will be helpful to the policymakers to protect the sugarcane growers not only the province but in the country.

OBJECTIVES

i. To investigate different factors affecting the sugarcane production in Sindh province of Pakistan.
ii. To estimate input-output relationship in sugarcane production.
iii. To apply the regression model in the form of Cobb-Douglas function.

MATERIAL AND METHODS

The major objectives of the present study were to apply multiple regression analysis models. The data for this study were collect from the sugarcane section, Agriculture Research Institute (ARI) Tandojam, the secondary data of sugarcane production for last 10 years on various factors, which influence sugarcane production. Five varieties, BL-4, BF-129, Gulabi-95, GT-11 and Q-88 were studied .To decide the impacts of variable information costs, Cobb-Douglas production function is given was evaluated. The practical from of relapse model will be utilized as a part of this study looks as takes after.

Statistical measures that attempt to determine the strength of the relationship between one dependent variable (usually denoted by Y). Moreover, a series of other changes variables (known as independent variables).The two basic types of regression are simple linear regression and multiple linear regressions. Simple linear regression uses one independent variable to explain and/or predict the outcome of Y, while multiple linear regressions uses two or more independent variables to predict the outcome of dependent variables. The general form of each type of regression is:

Simple Linear Regression: $Y = \alpha + \beta X + \mu$

Multiple Linear Regression: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_t X_t + \mu$

Where:

Y= is the variable that we are trying to predict

X= is the variable that we are using to predict Y

α= is the intercept

β= is the slope of the regression line

μ=is the residual from regression model

Model Specification:

In general, the Cobb-Douglas production function in its stochastic form proposed for this study is expressed as follows:

$$Y = \beta_0 X_{1i}^{\beta 1} X_{2i}^{\beta 2} X_{3i}^{\beta 3} \ldots . X_{ni}^{\beta n} e^{ui}$$

Where:

$Y = Output$

$X_i = inputs$

$u = stochasticdistrubanceterm$

$e = Baseofnaturallogarithm$

In particular, the following parameters were selected for this study in order to study their effects on sugarcane production.

i. Germination (Gr)
ii. Plant height (Pl)
iii. Cane girth (Cg)
iv. Tillers (Tl)

Thus the particular Cobb-Douglas production function for this study will looks as follow:

$$Y=\beta_0 gr^{\beta 1} ph^{\beta 2} cg^{\beta 3} tl^{\beta 4} e^{ui}$$

From the mathematical statement, it is clear that the relationship in the middle of yield and the two inputs is non-linear. Nevertheless, if we use the log transform a model we obtain will be:

To decide the impacts of variable information costs, Cobb-Douglas production function was assessment. This utilitarian type of relapse model utilized as a part of this study as takes after for sole sugarcane generation.

$$\ln Y = \beta_0 + \beta_1 \ln gr + \beta_2 \ln ph + \beta_3 \ln cg + \beta_4 \ln tl + u_i$$

Specifically following parameters to be estimate for this study expected results, after evaluating the parameters the log regress function will be anti-log in order to bring origin Cobb-Douglas production function.

In fact, the Cobb-Douglas production function can be used to estimate returns to scale if all inputs will be incorporated into the capacity. The benefits of this capacity are that it is anything but difficult to gauge, it might indicate lessening peripheral returns. The possible disadvantages are that it cannot show both increasing and diminishing marginal returns in a single response curve, and that may lead to over-estimate of the economic optimum [5].

RESULTS AND DISCUSSION

The present study aims at exploring the effects of different factors on sugarcane production. The table 1 shows that the parameters of sugarcane variety BL-4 as Cane girth, Germination, Plant Height and Tillers were significant. However, the coefficient of cane girth -26.697 per year, with the standard error founded to be 6.821. Furthermore, when the germination of sugarcane studied, were reported that the coefficient average of the sugarcane plant were approximately -0.38446 with the standard error were 0.063, the coefficient of regression for the variables of cane girth and germination were negative, would reduce the sugarcane production by -26.69%, -0.38% observing the other variables. Likewise, the height coefficient of plant were founded to be 0.04747 with the standard error were 0.01722. Moreover, the coefficients of tillers of sugarcane per years were 1.66345 and the standard error 0.52747 whereas.

The parameters of BF-129 were significant. Have the coefficient of cane girth -6.98711 per year with the standard error 1.01197. Furthermore, when the germination of sugarcane were studied, explore that the coefficient average of the sugarcane plant were approximately -0.15212 with the standard error were 0.03344. Likewise, the height coefficient of plant founded to be equal to -0.6459 with the standard error were 0.01523. The coefficient of regression for the variables of cane girth, germination and plant height were negative, would reduce the sugarcane production by -6.98%, -0.15%, -0.06. Moreover, the coefficient of tillers per year

founded to be equal to 0.83181 and the standard error were 0.31733 respectively.

In table 1, all parameters of cane variety Gulabi-95 were significant and the coefficient of parameters were cane girth 23.9984 per year with the standard error were 3.30633, when the germination of sugarcane were studied, to explore that the coefficient average of the sugarcane plant were approximately 0.05603 with the standard error were 0.01684, the height coefficient of plant founded to be -0.08219 with the standard error were 0.01772 and the coefficient of tillers per year founded were -0.98891 with the standard error were 0.39754. The coefficient of regression for the variables of plant height and tillers were negative, because the productions of sugarcane were reduced by -0.08%, -0.98% observing the other variables. The variables of GT-11 variety as Cane girth, Germination, Plant Height and Tillers were significant. Nevertheless, the P-values of Plant Height and Tillers were highly significant as compare to Germination and Cane Girth showed in table below. The coefficients of cane girth -3.38424 per year with the standard error were 0.64746. When the germination of sugarcane were studied, reported that coefficient average of the sugarcane plant were -0.11347 with the standard error were founded to be 0.02140. The coefficient of regression for the variables of Cane girth and Germination were negative, would reduce the sugarcane production by -3.38%, -0.09% observing the other variables. Likewise, the height coefficient of plant were founded to be 0.09263 with the standard error were founded to be 0.01153. Respectively the coefficients of tillers of sugarcane per year were founded to be 0.62280 with the standard error were 0.40038, these results were shown in (Table 1).

Results revealed that the parameters of sugarcane variety Q-88 have less than the significance level of 0.05, which indicates that is statistically significant. The coefficients of cane girth -27.505 per year with the standard error were 8.735. The coefficients of regression for the variable of Cane girth were negative, would reduce the sugarcane production by -3.38% observing the other variables, the germination of sugarcane were studied, to explore that coefficient average of the sugarcane plant were approximately 0.290 with the standard error were found to be 0.051. Likewise, the height coefficient of plant were found to be 9.092 with the standard error were 2.040. Moreover, the coefficients of tillers of sugarcane per year were found to be 6.113 with the standard error were found to be 1.571.

The table 2 shows that the coefficient of multiple determinations R-square of five observing varieties were found significantly high BL-4 (0.9074) that is 90%, BF-129 (0.9578) 95%, GULABI-95 (0.9613) 96%, GT-11 (0.9838) 98% and Q-88 (0.9193) 91%. Variation. The adjusted R^2 were BL-4 (0.8334), BF-129 (0.9240), GULABI-95 (9304), GT-11 (0.9708) and Q-88 (0.8547).

Table 1: Results of sugarcane varieties BL-4, BF-129, Gulabi-95, GT-11 and Q-88 Using multiple regression analysis

Varieties	**Variables**	**Coefficient**	**Standard Error**	**T-Value**	**P-Value**
BL-4	Constant	2086.16	21.9804	94.91	0.0000
	Cane Girth	-26.6976	6.82192	-3.91	0.0113
	Germination	-0.38446	0.06320	-6.08	0.0017
	Plant Height	0.04747	0.01722	2.76	0.0400
	Tillers	1.66345	0.52747	3.15	0.0253
BF-129	Constant	2049.61	5.00251	409.72	0.0000
	Cane Girth	-6.98711	1.01197	-6.90	0.0010
	Germination	-0.15212	0.03344	-4.55	0.0061
	Plant Height	-0.06459	0.01523	-4.24	0.0082
	Tillers	0.83181	0.31733	2.62	0.0470
Gulabi-95	Constant	1974.85	6.31722	312.61	0.0000
	Cane Girth	23.9984	3.30633	7.26	0.0008
	Germination	0.05603	0.01684	3.33	0.0209
	Plant Height	-0.08219	0.01772	-4.64	0.0056
	Tillers	-0.98891	0.39754	-2.49	0.0553
GT-11	Constant	1984.68	3.37390	588.24	0.0000
	Cane Girth	-3.38424	0.64746	-5.23	0.0034
	Germination	-0.11347	0.02140	-5.30	0.0032
	Plant Height	0.09263	0.01153	8.03	0.0005
	Tillers	3.62280	0.40038	9.05	0.0003
Q-88	Constant	2019.13	30.4386	66.33	0.0000
	Cane Girth	-27.5050	8.73510	-3.15	0.0254
	Germination	0.29023	0.05181	5.60	0.0025
	Plant Height	9.09220	2.04048	4.46	0.0067
	Tillers	6.11371	1.57150	3.89	0.0115

Table 2: R. (MSE), R^2, adjusted-R^2 and Std. Deviation of the Estimated Model

Varieties	R^2	Adjusted R^2	Resid. Mean Square (MSE)	STD
BL-4	0.9074	0.8334	1.52748	1.236
BF-129	0.9578	0.9240	0.69645	0.834
GULABI-95	0.9613	0.9304	0.63778	0.799
GT-11	0.9838	0.9708	0.26760	0.517
Q-88	0.9193	0.8547	1.33236	1.154

Table 3 shows that the analysis of variance of different varieties of sugarcane. In this table, the varieties F-ratio equal to BL-4 (12.25), BF-129 (28.36), GULABI-95 (31.09), GT-11 (75.82) and Q-88 (14.23) suggests that the estimated production function were overall significant. While the mean square of regression of predictor variables of five observing varieties founded to be equal to BL-4 (18.7157), BF-129 (19.7544), GULABI-95 (19.8278), GT-11 (20.2905) and Q-88 (18.9596).

Table 3: Analysis Of Variance (ANOVA) Table

Varieties	Source	DF	SS	MS	F	P
BL-4	Regression	4	74.8626	18.7157	12.25	0.0085
	Residual	5	7.6374	1.5275		
	Total	9	82.5000			
BF-129	Regression	4	79.0177	19.7544	28.36	0.0012
	Residual	5	3.4823	0.6965		
	Total	9	82.5000			
GULABI-95	Regression	4	79.3111	19.8278	31.09	0.0010
	Residual	5	3.1889	0.6378		
	Total	9	82.5000			
GT-11	Regression	4	81.1620	20.2905	75.82	0.0001
	Residual	5	1.3380	0.2676		
	Total	9	82.5000			
Q-88	Regression	4	75.8382	18.9596	14.23	0.0061
	Residual	5	6.6618	1.3324		
	Total	9	82.5000			

This study was based on secondary data which were taken for last ten years since 2005 to 2014 of sugarcane crop. Cobb-Douglas production functions were used to examine different factors affecting and input-output relationship in sugarcane production. All parameters were highly significant for five observing varieties, highly significant difference were observing the other variables of sugarcane variety GT-11 by other parameter cane girth and germination of five selected varieties BL-4, BF-129, Gulabi-95 and Q-88. [12] and [13] were assessed of various assortments, the assortment HSF-240 gave the most astounding factory capable sticks (98.91) while the least number of plant capable sticks (61.60) was delivered by S-98-SP-133 over the span of study.

The effects of significant difference were observed between affects for all parameters using multiple regression analysis has been talked to a responsible extent. The five-chose varieties expanded sugarcane parameters were test for creation soundness for past ten successive years 2005-2014 at Pakistan Agriculture Research Institute Tandojam in Sindh. The essential yield segments were certain corresponded at 5% level of significance. Results of five selected varieties suggests that the maximum coefficient of multiple determinations R^2 value of sugarcane variety GT-11 were 0.9838 by four other observing varieties BL-4, BF-129, Gulabi-95 and Q-88, which indicated that 98%. Variations in the production of outputs were defined by all explanatory variables and the adjusted R^2 were 97%.

Therefore, we can say that the variety of cane crop GT-11 was dominated variety on other varieties BL-4, BF-129, Gulabi-95 and Q-88. Moreover, the parameters plant height and tillers were more effectiveness by other observing parameters cane girth and germination on sugarcane production. The coefficient of different determinations R^2 was 0.7249, which assigned that 72% difference in the expense of data generation was elucidate by the greater part of the informative components and the balanced R^2 is 0.71.

The creation practices, for example, soil sort, planting's opportunity, assortments, inputs use and availability of watering system water; they all have broad effect on sugarcane generation. While breaking down the information expenses and net continues relationship of sugarcane creation, the indispensable data costs, for example, urea, DAP, FYM, watering system, seed and weeding was considering. The utilization of various instruments other than straightforward cultivator is crucial for good seedbed planning to get incredible germination and enhanced product stand. Sugarcane is a profound root crop and suitable area planning assumes a vital part in the improvement of stick root framework, for accomplishing most great development of the harvest.

CONCLUSION

The results of five varieties showed that the maximum coefficient of multiple determinations R^2 (0.9838) was found for sugarcane variety GT-11 was as compared to other observing varieties i.e., BL-4, BF-129, Gulabi-95. Furthermore 98% variation was observed for Q-88. Varieties in the creation of yield were clarified by every single informative variable and the balanced R^2 were found to be 97%. The estimated F-value was 75.82 which was exceeded the critical value at 5% level of significance, showing models used in the present study fit the data set in a quite good extant. On the basis of overall results, it can be concluded that GT-11 was the leading variety among all the varieties

used in the present research. Similarly, the next suggested major varieties include Gulabi-95, BF-129, Q-88, and BL-4. The results from regression analysis show that all the independent variables i.e., Cane girth, germination, plant height and tillers were significantly effect on the dependent variable sugarcane production.

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