# Economic Analysis of Sugarcane Crop in District Charsadda

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# ECONOMIC ANALYSIS OF SUGARCANE CROP IN DISTRICT CHARSADDA

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## ABSTRACT

**A study was conducted during 2008 to make economic analysis of sugarcane crop in district Charsadda. The study was based on primary data collected from randomly selected five villages namely Dargai, Mani Khela, Sapula Khile, Qalat Naseer and Khule. The data were collected through structured questionnaire using a sample size of 50 farmers, allocating proportionally to these villages. The results reveled that the socio-economic variables like capital employment, labor employment, marketing, credit and financing and sources of income were more closely related with sugarcane production. The major economic practices were; preparation of land, water management, weed control, insecticides and making of black sugar (Gur). Main sugarcane varieties grown were 77/400, 44, Mardan-92, 48, 310 and 722082. Variety 77/400 was observed as the most profitable variety. The average per acre cost was calculated as Rs. 35450 for all varieties. The major cost elements were; land rent, labor input, seed, manure, irrigation, land preparation, fertilizer, hand weeding and making of black sugar (Gur). The net revenue of variety-77/400, 44, Mardan-92, 48, 310 and 722082 were observed as Rs. 54550, 48550, 48550, 45550, 48550 and 45550, respectively. Sugarcane crop was characterized by increasing returns to scale. It is recommended that modern techniques should be adopted for making Gur. Awareness among sugarcane growers about improved varieties should be created.**

**KEYWORDS: Sugarcane; farmers; input-output analysis; Pakistan.**

## INTRODUCTION

Sugarcane (*Sacchrium officinarum)* is a major raw material source for white sugar production in Pakistan. The total production of sugarcane in Pakistan for the year 2003-04, 2004-05, 2005-06, 2006-07 and 2007-08 were 5319.0, 4744.1, 44665.5, 54742 and 63920 thousands tons, respectively. In NWFP, during the year 2003-04, 2004-05, 2005-06, 2006-07 and 2007-08

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sugarcane was grown on 104.8, 106.4, 98.6 100.2 and 103.3 thousand hectares with a production of 4745.6, 4816.2 and 4436.9 4604.2 and 4751.0 thousand tons, respectively (3, 5). This crop is the historical and major cash crop of district Charsadda. Major growing varieties in the district are 77/400, 44, Mardan-92, 48, 310 and 72082. Total area and production of sugarcane in this district for the year 2006-07 were 31532 hectares and 1429671 tons, respectively (Statistical Officer, Crop Reporting Service Charsadda, 2006-07).

Nixon and Simmonds (13) observed that yields were improved from 129 to 141-144 tons per hectare after fallowing and green manuring on soil conditions and growth of sugarcane in Swaziland. They noted positive relation between root length and air-filled porosity. Pillay (14) studied the adoption of new sugarcane varieties by non-miller-planters in Mauritius. The first hand information about varieties played vital role in selecting varieties for planting. Yadav and Yaduvanshi (15) observed that yield of millable cane from planted sugarcane was affected by N fertilizer rather intercropped green manuring or plant arrangement. They also observed that plant crop as well as ratoon crop, do not affect quality of cane juice. The organic carbon content and available N in the soils have been increased by residues from green manures and N fertilizer treatments. Chattha *et al.* (7) stated that sugarcane yield improved by 21.96 percent through trench planting, 43.75 percent through effective weed control, 34.50 percent through the integrated use of press mud and fertilizers, 26 percent through skip furrow irrigation and 50 percent through urea application by drilling. They also observed 32 percent improvement in ratoon crop due to proper weed management. Bhatti and Yanagida (6) developed a supply response model and empirically estimated standard regression procedures. The principal factors affecting sugarcane supply response were the official procurement price for sugarcane paid at sugar mill gate, scale of operation and relative returns to alternative uses of sugarcane. Muhammad *et al.* (12) observed that non-adoption of recommended agricultural technologies was the responsible factor for low per hectare yield of crops. The data indicated that awareness and adoption of sugarcane production practices were very poor. Lack of awareness of recommendations appeared to be the major cause of non-adoption. Ali *et al.* (2) pointed out the average fertilizer use efficiency (FUE) to be 36.10 in weed-free crops compared with 21.94 in weedy crops, with corresponding yields of 99.87 and 75.94 tons per hectare. FUE ranged between 150 and 225 kg N per hectare. Farooq *et al.* (8) outlined the possible causes of wide spread cultivation of a non-recommended, high

yielding but low in sucrose contents sugarcane variety i.e. Co-1148. It has created different problems for both the farmers and sugar mills.

The present study was conducted to make economic analysis of different sugarcane crop production factors in district Charsadda and also to know how these factors contribute to net revenue of farming community.

## MATERIALS AND METHODS

This study was conducted during 2008 in district Charsada, Khyber Pakhtunkhwa, Pakistan. Five villages namely Dargai, Mani Khela Sapula Khile, Qalat Naseer and Khule were selected randomly. Primary data were collected from these villages using a sample size of 50 farmers. The sample size was allocated on the basis of their relative population (proportionally). The information was personally collected from the farmers through a structured questionnaire. The perceptions of the farmers about economic practices in sugarcane cultivation, cost elements and revenues of different varieties were noted. The cost and revenues were calculated at prevailing market rates. For input output relationship of sugarcane crop, following log-linear model was estimated using least square method.

$\ln SP = \ln a_0 + a_1 \ln SA + a_2 \ln TRHS + a_3 \ln FERTS + a_4 \ln SDS + a_5 \ln LABS + a_6 \ln PSTS + e_1$ ----------(1)

SP = Total sugarcane production in maunds
SA = Area under sugarcane crop in acres
TRHS = Tractor hours for cultivated area of sugarcane
FERTS = Total fertilizer used for cultivated area of sugarcane (in bags)
SDS = Seed used for cultivated area of sugarcane (in kg)
LABS = Total labour used for cultivated area of sugarcane (in man days)
PSTS = Total pesticides/insecticides used for cultivated area of sugarcane (in Rs.)

$a_o$ = Shows the impact of innovations or technology

$a_1$, $a_2$, $a_3$, $a_4$, $a_5$ and $a_6$ = Output elasticities of SA, TRHS, FERTS, SDS, LABS and PSTS, respectively.

$e_1$ = The residual term (absorbs the effect of those variables, which are not included in the model).

The equation indicates that sugarcane production (SP) is dependent variable while SA, TRHS, FERTS, SDS, LABS and PSTS are the explanatory variables. Irrigation cost was excluded from the set of explanatory variables because it was available free of cost in the study area. To check whether the sugarcane crop is characterized by constant, increasing or decreasing returns to scale, Wald test was used. The chi-square statistic is equal to the F-statistic times the number of restrictions under test (10). In this case, there is only one destruction i.e. the sum of exponents equal 1 for each crop. If the two test statistics are identical with p-values of both statistics, this indicates that null hypothesis of constant returns to scale can be decisively rejected. If the sum of exponents on explanatory variables in eq. 1 equals one, then input-output relationship holds constant returns to scale of sugarcane crop i.e. any proportional increase in sugarcane inputs results in an equal increase in sugarcane output. If the sum of exponents on explanatory variables in equation 1 is greater than one, then input-output relationship holds increasing returns to scale i.e. sugarcane output increases faster than sugarcane inputs. If the sum of exponents on explanatory variables in equation. 1 is less than one, the input-output relationship holds decreasing returns to scale i.e. sugarcane output increases slower than sugarcane inputs.

Further simple arithmetics, classification and tabulation were also used for data analysis. Statistical package such as Eview (10) was used for deriving the results.

## RESULTS AND DISCUSSION

### Economics practices in sugarcane production

Sugarcane production practices differ from place to place but in this study all those activities which are generally practiced in the district were considered. After land preparation in dry conditions, fields are divided in suitable plots for better water management and other operations. The field is thoroughly puddled after irrigation. It reduces water percolation and creates ideal condition for sugarcane growth. To get higher sugarcane yield, proper water management plays an important role. Also proper and effective weeding ensures better sugarcane productivity. In district Charsadda, it was observed that pests and diseases of crops were minimum. In case it occurs, the services of agricultural research station are utilized. There is one or two diseases of sugarcane that attack the crop rarely in Charsadda. The use of chemical fertilizer has been proved to increase sugarcane productivity when it is applied at proper time and proper dosage. Major fertilizers used mostly

for sugarcane are DAP and urea. During harvesting proper care is taken to preserve quality characteristics to ensure high quality standards. Sugarcane is harvested by labour which gets return in kind. The labour gets the sugarcane straw and harvests the sugarcane. In some cases, when there is a lot of grass and other food available for the animals, the farmers make payment to the labour. Most of farmers use sugarcane crop for making black sugar (Gur) because price of black sugar in the market is better than sugarcane mill rate. In making of black sugar five to six labourers are used who produce four 'pur' (unit used in the research area) per day in the farm, which called Ganre. Sugarcane produce is carried to the local mills and is milled to bring it into sugar form for consumption.

## Economic significance of sugarcane production

***Capital employment in per acre sugarcane production:*** The capital includes all those instruments and equipment, which are helpful for sugarcane production. Oxen and tractors were used for ploughing. The majority of the farmers owned at least one pair. But with the passage of time now-a-days ploughs have been replaced by the tractors.

***Labour employment in per acre sugarcane production:*** Sugarcane production absorbs a large portion of total labour force of local community. At the level of peak activities, it took local as well as non-local labours into account. Labourers are hired for compensation of sugarcane straw. The average age of labour force involved in the production activities ranged 12-50 years. It was difficult to estimate the exact number of labourers employed in the field. However, during field survey, information was obtained about average number of labourers employed on the cultivation of one acre of sugarcane. On average, 60 labourers per acre were employed for all activities in sugarcane production.

## Labour distribution within the district

The distribution of labour in the district depends upon the nature of occupation and skill. The villagers already have strong local tradition of cooperation and mutual help. For example, when a resident has a large task to undertake and requires assistance, many other villagers contribute and help him.

## Women participation and decision making in the households

Normally none of the women works for wages in district Charsadda. The women just only tend to household activities. Charsadda women generally hold principal responsibilities for cooking, house maintenance and childcare. Men were considered as the undisputed heads of the family who make all the important decisions. Women make the decisions in case of saving money.

**Marketing channels for sugarcane**

The majority of small and medium size farmers sold their produce in the village markets, while the big growers with heavy surplus preferred to sell their produce outside the village markets. The major portion of surpluses is brought to the wholesale markets. More than one third of the sugarcane growers were reported to produce black sugar and then sell in the local market. Some of the farmers were found to sell sugarcane to the mills because of expensive and time consuming task of producing black sugar. The marketing of all sugarcane produce (apart from small quantity which growers retain for home consumption) was controlled by the local markets.

***Credit and financing patterns:*** The farmers in district Charsadda are basically poor and readily depended upon their relatives, friends, moneylenders, arthiays and commission-agents. To meet the daily routine expenses credit facilities available to the farmers in district were probably inadequate for financing sugarcane cultivation, and it was found that only a very small proportion of loans actually went to finance farm operations. Cash advances from local market owners (Mandi) served as a stopgap between harvest and receipt of a cheque from the sugarcane market, and were used mainly for domestic consumption or to finance weddings and other day to day expenses. The market owners get the money after selling of sugarcane produce (Gur).

***Sugarcane production and framers' internal economy:*** Sugarcane is a major contributor to total income of sugarcane farmers in the area. Some farmers have their own shops in the village while some were found investing their incomes in animal trade. Mostly they were relying on subsistence level of farming. Foreign remittances were also the main non-agriculture incomes of the people. Consumption pattern of the sugarcane farmers depends upon sugarcane production. Food items were the major share of expenditure. Food items include beef, mutton, tea, chicken, sugar, flour, vegetables, eggs and fruits. The average expenditure on these items was Rs. 4350 per month. The average expenditure on clothing was Rs. 300 per month.

Expenditure on education was estimated at Rs. 800 per month. Total average expenditure on health was estimated at Rs. 650 per month. Electricity charges were, on average, Rs. 500 per month. Sui-gas was also consumed at the rate of Rs. 450 per month. The expenditure on water purposes was Rs. 60 per month.

***Cost elements of per acre sugarcane production:*** Various cost items were observed during the field survey and were valued at market prices. The per acre cost of land preparation, seed, fertilizer (all types), irrigation, insecticides/pesticides, cleaning/handling, harvesting, making Gur and land rent were Rs. 800 per acre, Rs. 6750, Rs. 900, Rs. 800, Rs. 1050, Rs. 4500, Rs. 10000 and Rs. 8000, respectively (Table 1). On the average, per acre cost of sugarcane crop of all varieties was Rs. 35450. Making of Gur takes that highest cost of Rs. 10000 per acre. The land rent was also a major component amounting to Rs. 8000 per acre.

**Table 1. Average per acre cost for all varieties.**

| Particulars | Unit | Quantity | Rates (Rs.) | Amount/acre (Rs.) |
|---|---|---|---|---|
| Land preparation with tractor | Hr | 2 | 400 | 800 |
| Seed | Maund | 45 | 150 | 6750 |
| Fertilizers | | | | |
| i) DAP | Kg | | | 650 |
| ii) Urea | Kg | | | 1500 |
| iii) Manure | Troly | | | 500 |
| Maliya/Irrigation | Rs | - | - | 900 |
| Insecticides/Pesticides | - | - | - | 800 |
| Cleaning/Handling | Day | 7 | 150 | 1050 |
| Harvesting | Day | 30 | 150 | 4500 |
| Making of Gur* | Day | 50 | 200 | 10000 |
| Land rent | -- | -- | -- | 8000 |
| Total cost | -- | - | - | 35450 |

*For making Gur, different types of labours locally called Permar, Gari, Jokmar and Dankmar are used.

***Per acre average revenue of different varieties:*** The total and net amount received from variety-77/400 from one acre of land was observd as Rs. 90000 and 54550, respectively (Table 2). It is clear that variety-77/400 is the most profitable variety in terms of both total and net revenue. Further, by-product of sugarcane (Pog) is also a portion of total revenue but it is given as remuneration to labours at the time of harvesting. It is also used as fuel for making Gur compensating electricity charges.

**Table 2. Per acre average revenue of different varieties.**

| Name of variety | Quantity (in Pur*) | Rate/ Pur (Rs.) | Total revenue/acre (Rs.) | Net revenue/acre (Rs.) |
|---|---|---|---|---|
| Variety-77/400 | 30 | 3000 | 90000 | 54550 |
| Variety-44 | 28 | 3000 | 84000 | 48550 |
| Mardan-92 | 28 | 3000 | 84000 | 48550 |
| Variety-48 | 27 | 3000 | 81000 | 45550 |
| Variety-310 | 28 | 3000 | 84000 | 48550 |
| Variety-722082 | 27 | 3000 | 81000 | 45550 |

*Unit of sugarcane used locally.

## Estimation of log linear sugarcane production function

The following log linear Cobb-Douglas production function was estimated:

*In SP = 2.876+0.245781*in SA+0.6712*In TRHS+0.0789123* In FERTS+0.871245*In SDS+0.12487*In LABS+0.004871*In PSTS…….(2)*
*Or in the most general form:*

$$SP = 17.74316 \times SA^{0.245781} \times TRHS^{0.6712} \times FERTS^{0.07891} \times SDS^{0.871245} \times LABS^{0.12487} \times PSTS^{0.004871} \text{……..(3)}$$

Where $a_0=e^{2.4708} = 17.74316$

The results indicate that SA, TRHS, LABS and SDS are statistically significant at both 10 and 5 percent level of significance. FERTS is significant at 5 percent level only. PSTS is not statistically significant variable. The reason is that the farmers rarely used pesticides/insecticides due to low threat of diseases in study area. Fertilizer use was also at minimum level because the land was very fertile and suitable for sugarcane cultivation.

According to equations 2 and 3, value of sugarcane area elasticity of production (0.245781) (Table 3) indicates that if sugarcane area increases by one percent and all other inputs remain unchanged, sugarcane production will increase by 0.24 percent. If TRHS increases by one percent sugarcane production will increase by 0.67 percent taking all other variables unchanged. The output elasticities of other variables can be interpretted in the same way. Value of Durbin Watson statistic (1.91) shows that no problem of autocorrelation exists.

**Table 3. Estimated log linear sugarcane production function results.**

| Dependent variable: ln SP<br>Included observation: 20<br>Sample: 1200 | | | | |
|---|---|---|---|---|
| Variables | Coefficient | Std. error | t-statistic | Prob. |
| C. | 2.876 | 0.12487 | 23.032 | 0.0000 |
| ln SA | 0.245781 | 0.012457 | 19.73 | 0.0083 |
| ln TRHS | 0.6712 | 0.09871 | 6.7997 | 0.0034 |
| ln FERTS | 0.07891 | 0.0045781 | 17.237 | 0.0468 |
| ln SDS | 0.871245 | 0.012481 | 69.806 | 0.0008 |
| ln LABS | 0.12487 | 0.003458 | 36.11 | 0.0463 |
| ln PSTS | 0.004871 | 0.0009124 | 5.3387 | 0.8523 |
| R-squared | 0.718713 | Durbin-Watson stat | | 1.912121 |
| Adjusted R-squared | 0.727029 | | | |

The R-square and adjusted R-square values show that the fit is good. The high value of $R^2$ = 0.72 shows that 72 percent of variations in (log of) total sugarcane product is explained by the (log of) included explanatory variables (Table 3). Most of the explanatory variables had a strong relationship with the dependent variable.

## Determination of returns to scale

To input-output relationship, it is necessary to show how the inputs and output go side by side. The sum of all output elasticities equals to 1.9969 (i.e. >1) indicates that sugarcane production is characterized by increasing returns to scale. The Wald-Test (Table 4) also supports the result. The test has the null hypothesis that sugarcane production is characterized by constant returns to scale and has only one restriction i.e. a1 + a2 + a3 + a4 + a5 +a6 = 1. As the Chi-square statistic is equal to F-statistic times the number of restrictions under test, so the null hypothesis of constant returns to scale is decisively rejected.

**Table 4. Wald test results.**

| **Wald Test**<br>**Sample: 1200** | | | | |
|---|---|---|---|---|
| **Null hypothesis:** | **$a^1 + a^2 + a^3 + a^4 + a^5 + a^6 = 1$** | | | |
| **F-statistic =** | **8.689398** | **Probability** | **=** | **0.007222** |
| **Chi-square =** | **8.689398** | **Probability** | **=** | **0.007210** |

***$a^1 + a^2 + a^3 + a^4 + a^5$ and $a^6$ are the coefficients of SA, THRS, FERTS, SDS, LABS and PSTS respectively.**

## CONCLUSION AND RECOMMENDATIONS

The study revealed that variables like capital and labour employment, marketing, credit and financing and sources of income are most closely ralated with sugarcane crop cultivation. The major economic practices in cane cultivation were; preparation of land and water management, weed control, fertility management, insecticides and making of black sugar. Among main sugarcane varieties grown in district Charsadda, Vareity-77/400 was observed as the most profitable. The average per acre cost was observed as Rs. 35450 for all varieties. The major cost elements were; land rent, labour input, seed, manure, irrigation, land preparation, fertilizer and hand weeding and making of black sugar. Area, tractor hours, labour and seed were found statistically significant at both (10 and 5%) levels of significance. Fertilizer was significant at 5 percent level. PSTS was not statistically significant variable. With regards to output elasticities of different variables it is found that if sugarcane area is increased by one percent remaining all other inputs uncharnged, the sugarcane production will increase by 0.24 percent. Value of Durbin Watson statistic (1.91) shows that there exist no problem of autocorrelation. The high value of $R^2$ showed that the fit was good. In the log linear Cobb-Douglas production function, the sum of all output elasticities equals to 1.9969 (i.e. > 1) indicated that sugarcane production was characterized by increasing returns to scale (also supported by Wald-Test results).

It is recommended that improved and recommended varieties should be grown in the area. Awareness about improved varieties should be given through effective extension services programs. Government should provide sufficient capital facilities to the farmers for increasing per acre productivity in district Charsadda.

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