# *COST FUNCTION FOR SELECTED SUGARCANE FARMS IN BANGLADESH**

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## ABSTRACT

Sixty sugarcane farms of Rajshahi Division were studied to examine cost-output relationships. With the statistical findings of the sample sugarcane farms based on overall fit and significance of the coefficients, the log-linear functional forms were the best fit equations. In addition, the analysis showed that at the higher output levels the difference in ATC between the educated and less educated farmers in Bangladesh were highly significant.

## I. INTRODUCTION

Under the deterministic cost theory of the firm, optimum farm output occurs at the minimum of U-shaped average cost courve. Since the deterministic theory has proved to be a powerful tool for modeling firm behaviour, the empirical evidence in the existing production techniques in sugarcane farms of Bangladesh has been examined. Sugarcane is one of the major cash crops grown in Bangladesh. For this study, a cross-section sample of 60 sugarcane farms were selected from Rajshahi Division for analysing the cost-output relationships. These farms produced cane for selling to sugar mills.

## II. ANALYTICAL METHOD AND RESULTS Size of Sugarcane Farms

The area under sugarcane on the sample farms varied from 0.16 to 12 acres. The distribution by size is shown in Table 1. The average sugarcane area per farm was 2.46

* Derived from the author's Master in Agricultural Development Economics thesis, Australian National University, 1982.

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acres. It also indicates that fragmentation of holdings is gradually declining as the farm size increases. It reflects that fragmentation of holdings is very much high upto the farm size of 5.00 acres due to probable case of uneconomic size of holdings. The sugarcane acreage as a proportion of total farm land increases, then decreases as the farm size increases.

**TABLE 1: DISTRIBUTION OF FARMS AND THEIR CHARACTERISTICS ACCORDING TO SUGARCANE AREA IN 1979-80**

| Indicators / Size Groups (Acres of Sugarcane) | Number of farms | Acres of Sugarcane Per farm | Sugarcane Plots per acre (No) | Average Total Farm Size | Cane Area as % of total farm |
|---|---|---|---|---|---|
| <1 | 15 | 0.5 | 4.9 | 0.8 | 62.50 |
| 1—4.99 | 35 | 2.0 | 2.3 | 2.8 | 71.43 |
| 5—9.99 | 8 | 6.0 | 1.9 | 6.3 | 95.24 |
| 10 + | 2 | 11.0 | 0.5 | 17.2 | 63.95 |
| All farms | 60 | 2.46 | 2.0 | 3.25 | 75.69 |

### Average Returns and Costs in the Production of Sugarcane

The average gross returns for growing sugarcane both from the cane itself and its by-products was Tk. 5851 per acre. The cost of producing sugarcane from land preparation to marketing was Tk. 4888 per acre leaving a net return of Tk. 963 per acre (Table 2). Deducting the value of by-product for sugarcane, the average net cost per acre of producing sugarcane was Tk. 4718 .

While labour was a major cost item, accounting for 21% of the total, land was the single most important cost, accounting for 37%. This reflects the great scarcity of land in the sample area and net aggregate high demand for land of cash cropping potential. Sugarcane setts are a further expensive item, needing replacement every two years. The marketing cost is incurred in transporting the cane from the farm to the mill. Usually bullock carts or rail transport are hired for this purpose.

**TABLE 2. AVERAGE RETURNS AND COSTS PER ACRE IN GROWING SUGARCANE : SAMPLE FARMS 1979-80.**

| Returns & Costs | Quantity | Average Returns (Taka) | Percentage |
|---|---|---|---|
| **RETURNS :** | | | |
| 1. Yield (Maund) | | 455 | |
| 2. Gross Margin (Taka) | | 5851 | |
| 3. By Product (Taka) | | 169 | |
| **COSTS :** | | | |
| 1. Human Labour (Man Day) | 104.8 | 1047.8 | 21.0 |
| 2. Animal Labour (Day | 16.4 | 246.5 | 5.0 |
| 3. Setts (seed) (Maunds) | 58.3 | 728.4 | 15.0 |
| 4. Munure (Maund) | 136.3 | 136.3 | 3.0 |
| 5. Fertilizers (Maund) | 3.0 | 237.0 | 5.0 |
| 6. Insecticides | | 5.1 | 0.1 |
| 7. Tools and Eqn. | | 5.5 | 0.1 |
| 8. Marketing | | 530.5 | 11.0 |
| 9. Interest on operating capital | | 147.2 | 3.0 |
| 10. Land use cost | | 1803.7 | 37.0 |
| 11. Total cost | | 4888.0 | |
| 12. Net cost | | 4718.0 | |
| 13. Cost of production per maund | | 10.4 | |
| 14. Net return | | 963.0 | |

It order to examine the relationship between costs and output levels they have been plotted in graph and observed that there is a sharp decline in total cost (TC) upto the output level of 500 maunds, thereafter, total cost decline moderately upto output level of 1200 maunds (Fig. 1). Total costs declines by 4.05 percent between 250 and 500 maunds, by 9.7 percent between 500 and 1000 maunds of output. This empirical total cost (TC) function supports the cost output theory (Heady 1961) .The relationship between average total cost (ATC) and output (Q) is that ATC declines sharply upto output levels of 500 maunds, thereafter rises (Fig. 1), indicating that economics of scale prevails.

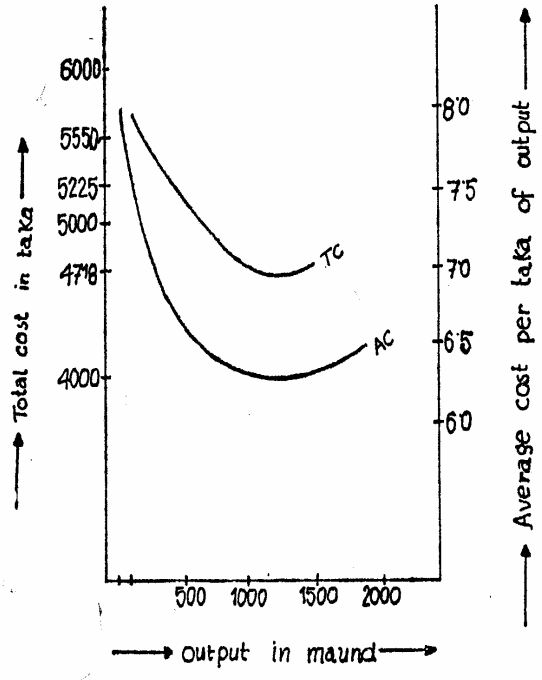


Fig-1: Total cost Curve and Average cost curve with output

To draw definite judgement regarding economies of scale regression analysis is done to estimate parameters of an average cost curve. It was found from cost data that farms having equivalent size incurred significantly differing average total cost (ATC). There are several major possible explanations for such cost variation :

1. Different natural endowments of farms : differences in land quality and topography lead to difference in ATC.

2. Variations in managerial ability : the knowledge and ability of farmers influences both technical and allocative efficiency and thus the per unit cost of the output. This variable may well be related to educational background.

3. External pecuniary effects : the sample under consideration covers different sugarcane farms situated in difierent places. The prices which farmers pay for their inputs vary between farms of equal scale due to probable market imperfection, so the average costs of production are different.

## Statistical Characteristics of the Cost Curve

Different functional forms have particular characteristic shape. For the linear average cost curve the absolute change in average total cost is the same for each unit change in the scale of the farm ; and there is no turning point at which average total cost begin to increase with further changes in scale or size of the farm. With a log-linear curve, average total cost initially decline rapidly with increases in scale but then the decline shows gradually in absolute terms ( although the rate of decline remains the same) and average total cost approach an asymptotic minimum. The second degree polynomial has a characteristic U-shape with average total cost declining with increases in scale until a minimum point is reached, beyond which they rise again with further scale increases i.e. diseconomies of scale exist. This functional form implies a total cost function of the conventional shape, that is, one that initially increases at a decreasing rate and then increases at an increasing rate. It also allows for fixed costs. In this study the linear and polynomial forms were used due to lack of statistical significance.

The cost curve estimated from the data of this study will be a long run average cost curve in a strict economic sense. The cost observations derived from the survey are for farms at one point in time. Each farm will have some inputs, the application of which can be varied, and inputs are available only in fixed quantities. Because of the fixed costs, each farmer is located on a point on a short-run average cost curve. However, when all these observation are brought together to estimate an overall cost curve, all inputs are varied, i.e., the estimated curve shows the relationship between per unit cost and scale of farm.

**Functional Analysis**

The dependent variable, $ATC_i$ is derived by adding together the costs of inputs, then deividing it by total output. The independent variable farm output of sugarcane (Q) is in maunds (27.5 maunds=1 ton approximately). The logarithmic equation is as follows :

$$\text{Log } ATC = \text{Ln}A_o + A_1 \text{Ln}Q + A_2 D_4 + U_i$$

where, $D_4$=Education dummy and $U_i$=Random disturbance term, which absorbs (mainly) the influence on costs of all the factors which do not appear explicitly in the cost function (Koutsoyannis 1973, p 48-54). The expected signs of the coefficients for the equation are $A_0^+$, $A_1^-$ and $A_2^+$.

A dummy was used in the equation to test whether difference in education level affects costs. Here education level from the sample farms are divided into two groups: those from no education to 8 years of schooling in one group and education above 8 years of schooling in the second group. Two estimates were made, one including family labour in total cost and another excluding family labour in total cost. Parameters were estimated using OLS regression. The estimated regression lines are shown in Figure 2. The significance of the coefficients and the variations are detailed in Table 3. The estimates show that there is a significant joint impact of output and education on ATC.

**TABLE 3. COST-OUTPUT RELATIONSHIP FOR SUGAR-CANE FARMS IN BANGLADESH 1979-80**

| | | | |
|---|---|---|---|
| 1. LN ATC=2.5676 | − 0.1029LNQ | +0.130 D4 | |
| | (0.168) | (0.0251) | (0.049) |
| | **(15.306) | **(−4.106) | *(1.613) |
| $R^2$=.29 | F=11.47 | D.F.=57 | |
| 2. LN ATC=LN2.356 | − 0.095 LNQ | +0.082 D4 | |
| | (0.181) | (0.026) | (0.070) |
| | **(12.96) | **(-3.586) | *(1.157) |
| $R^2$=.28 | F=7.59 | D.F.=56 | |

**Significant at 1% level Siginificant at 5% level

Equation 1 : Including Family labour in TC

Equation 2 : Excluding Family labour in TC

With both of these equations the ATC declines rapidly with increase in output between 0 and 1000 maunds of farm output. After that decline in ATC with more output is much less (Fig. 2). Although long-run cost curves were assumed, certain costs could be counted as fixed for practical purpose. The shape of these average fixed costs (AFC) is a hyperbola and declines continuously, approaching both axes asymptotically. This is because as more units of output is produced, the average fixed cost (AFC) fall proportionately. As the output level increases the average costs decrease.

The log-linear relationship of between ATC and output equation 1 is negative upto a level of 4000 maunds (Fig. 2) and after that the cost output relationship is inelastic i.e. not significantly decreasing. When the function was reestimated without family labour cost (equation 2) the regression results were found to be significant and the cost function exhibited constant returns to scale with almost horizontal average total cost curve as shown in figure 2.

The education variable was found to be statistically significant with the right expected sign. It was our assumption that educated-farmers are more responsible to research findings such as fertilizer application, HYV's extension services and better management. As a result there is a possibility of lowering average cost of production by educating the less-educated farmers.

The percentage change of ATC resulting from the education variable has been tested at different levels of outputs. The finding is that the higher the level of output, the greater is the percentage change in the ATC attributed to education. In other words, at the higher output levels, the difference in ATC between the educated and less-educated farmers is greater than in lower levels of output. From this, it can be concluded that there is a positive relationship between the economies of scale and the level of education i.e. the educated farmers can exploit the returns to scale better than the less-educated farmers.

## III. CONCLUSIONS

The statistical results showed that economies of scale exist in sugarcane farms upto 4000 maunds. Cost economies appear to be substantial with respect to the level of education among the farmers. Education is found to be an important factor affecting costs and returns of sugarcane farms in Bangladesh. A better level of education of farmers can significantly contribute to economies of scale in sugarcane production.

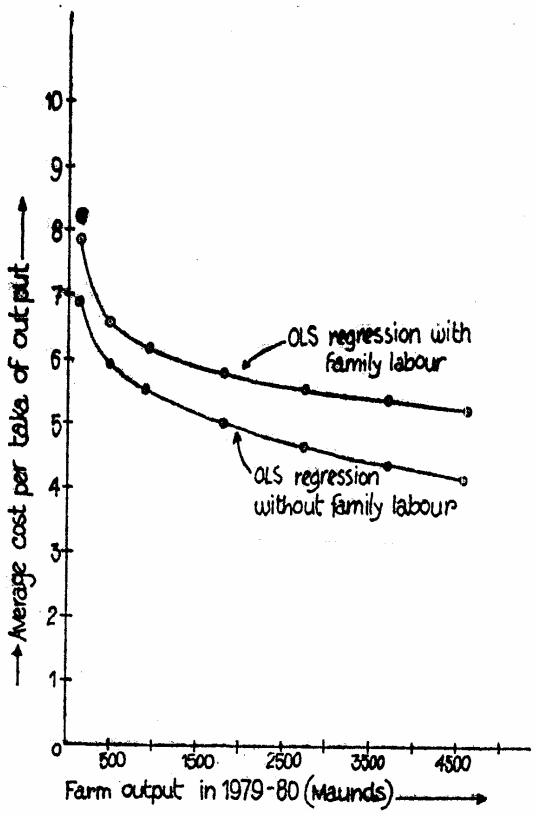


Fig: 2., Average cost as a function of farm output with & without family labour

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