

An Economic Analysis of Sugarcane Production Technology

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ABSTRACT

A study was conducted to determine the effect of new and old sugarcane production technologies such as varieties, fertilizer, manure, weeding, pesticide (Heptachlor) and Furadan 3G on the yield and income of the farmers. Modern varieties on an average contributed 7.6 t/ha compared to local variety. Transplanted sugarcane contributed on an average 20.4 t/ha compared to conventional planting and cash gross margin increased by Tk. 8,466.8/ha. Fertilizer application above the farmer's level increased cane yield in transplanted cane with an average of 35.5 t/ha. High level fertilizer application accrued full gross margin about Tk. 39,694.5/ha. Yield of high and medium manuring were significantly higher than low manuring. Average organic manuring increased cash gross margin by Tk. 6834.0/ha more than low manuring in conventional planting of sugarcane. Average cash gross margin of intensive weeding increased about Tk. 11748.2/ha compared to minimum weeding. Intensive weeding had significant effect on yield. Furadan 3G + Heptachlor had significant effect on yield. Across farm size and yield levels, large farms had the highest cash gross margin of Tk. 34229.0/ha and high yield farms revealed the highest cash gross margin of Tk. 47,667.2/ ha.

INTRODUCTION

Sugarcane is the second most important cash crop in Bangladesh. New technologies for sugarcane production are presently available in Bangladesh. Many others are continuously created. The potential contribution of different important factors on production and income needs to be evaluated (Schuh, 1970).

The farmers may think a higher risk element is associated with it. The importance of the study lies in quantifying and demonstrating economic benefit of adopting a new technology to the neighbouring traditional growers (Kabir *et. al.*, 1982).

However, it is essential to have a clear understanding and knowledge on how these new production inputs and technology adoption are affecting the cost of reduction of the traditional practices, inputs and resources of the individual farmer.

Some costs and returns studies were conducted on different crops by Abdullah-Al-Farouque and Hossain (1973) on jute, Talukder and Hossain (1969) on T.Aman paddy, Uddin and Hossain (1972) on IR-20 Aman paddy, Rahman and Islam (1975) on Tobacco, Jabbar and Haque (1972) on Aus paddy and Rahman (1975) on Boro rice.

Some farm management studies of different crops like B.Aus (Local) (Anon; 1979 a); T. Aman (Local) (Anon., 1979 b); wheat (Anon., 1979 c); jute (Anon., 1979 d); sugarcane (Kabir and Shajahan, 1983; SRTI Annual Report 1983), and potato (Rahim, 1978) were conducted.

Therefore, the present study was conducted to assess the effect of new and old technologies of sugarcane production on the yield and income of the farmers with the following objectives :

- i) To study high, medium and low cost technologies of sugarcane at some selected areas of NBSM zone under rainfed conditions;
- ii) To recommend appropriate technologies for sugarcane production.

MATERIALS AND METHODS

The study was based on collection of data from three purposively selected cane growing villages namely, Puratan Ishurdi and Zokadoha villages of Laipur Upazilla in the district of Natore and Ilshamari village of Ishurdi Upazilla in the district of Pabna. Stratified random sampling was followed in selecting the samples. Samples were selected proportionately 10% from the total sugarcane cultivated plots of the three villages, 1988-89.

In the selected villages, 92 plots were selected from 54 farmers at random from a stratified distribution of farms. Selection of sample farm was preceded by a preliminary survey in the area. The criteria for stratification were farm size and adoption level of sugarcane production technologies. Data were collected by interviews from the selected cane growers by the investigators starting from Jan. 1, 1988 to March 31, 1989. The partial budgeting analysis has been employed to estimate the farm income and profitability of the crops through costs and returns analysis. In partial analysis, some partial measures of productivity such as crop yields, gross benefit, cash gross margin and full gross margin were employed. In partial measures of productivity, output and/or net income is expressed per unit of a single input category (Bhuiyan, 1987).

Therefore, the samples were classified according to level of input use and sugarcane production practices. The classifications were made by varieties, high, medium and low level manure and fertilizer use, low, minimum and intensive weedings, insecticides use for pest control, different farm size and yield groups.

Crop yields : Yield per ha in tonnes were estimated for sugarcane. Gross benefit : It is the estimated gross value of sugarcane and by-product per hectare.

Total variable cost : This refers to the sum of the costs of human and animal labour, setts/seedlings, fertilizers, insecticides, life irrigation, marketing including the imputed costs of family supplied human and animal labour (Mandal, 1986).

Total cash cost : This refers to the sum of the cash costs incurred for purchasing hired labour, setts/seedlings, fertilizer, insecticides, irrigation water and marketing of sugarcane.

Full gross margin : This is estimated as gross benefit less total variable cost.

Cash gross margin : This is estimated as gross benefit less cash costs. Gross margin being a return mostly over cash or out of pocket expenses, farmers are

sometimes assumed to maximize this rather than profit in the short run (Bachman and Christensen, 1967).

The sugarcane farms of small (0.0-0.4046 ha), medium (0.4047-0.8094 ha) and large (0.8095 ha and above) and the yield groups of low (0.0-36.88 t/ha), intermediate (36.89-73.76 t/ha) and high (73.76 t/ha and above) were classified.

Manures, fertilizers and weedings were classified as follows :

The samples were classified into three groups of manures and fertilizer users :

- i) High-farmers using recommended levels of manures and fertilizers or higher.
- ii) Medium-farmers using manures and fertilizers less than recommended dose but not less than half of the recommended level.
- iii) Low-farmers using manures and fertilizers below the medium level or less than half of the recommended level.

Weedings were classified as follows :

- i) Intensive weedings - weedings and mulching were done as and when necessary after plantation. The farmers who have practiced at least two weedings and two mulching were also included.
- ii) Minimum weedings - farmers practiced maximum two weedings and one mulching after plantation.
- iii) Low weedings - farmers practiced only two weedings after plantation (Ahsan and Haque, 1977).

RESULTS AND DISCUSSION

The average sugarcane cultivated area per farm was 0.8 ha. The sugarcane area for small, medium and large farms were 0.3, 0.6 and 1.8 ha respectively.

Altogether, 73% of sample plots were of clay loamy and 27% were of sandy loamy soils. In aggregate 59% of the area were found medium high land, 38% were high land and 3% were medium low land area. The high and medium high land have significant effect on yield than medium low land.

Ninty nine percent plots were planted during the third week of October to the fourth week of November, 1987.

The average yield of sugarcane farms growing modern varieties under STP was 72.9 t/ha as compared to 52.1 t/ha for the local variety (Table 1). The yield of modern varieties under conventional planting was also higher (46.9 t/ha) as compared to local variety (37.4 t/ha) (Table 1). The yields of transplanted sugarcane for both modern and local varieties were higher as compared to conventional planting of sugarcane of modern and local varieties (Table 1).

Farmers growing transplanted modern sugarcane varieties earned about Tk. 11,010.3/ha higher than farmers growing transplanted local variety on cash gross margin basis. Farmers obtained Tk. 5495.1/ha on cash gross margin basis by cultivating modern varieties greater than local variety under conventional planting of sugarcane (Table 1).

Transplanted modern and local varieties had higher cash gross margin (Tk. 11,224.4 and Tk. 5,709.2/ha respectively) than that of conventional planting of modern and local varieties (Table 1). Sugarcane yield differences between transplanted and conventional planting modern varieties (26.0 t/ha) appeared to be substantially higher than between transplanted and conventional planting of local varieties (14.7 t/ha) (Table 1).

The yield differences between the farms using low and high levels of fertilizer in transplanted modern and local varieties were 57.3 and 54.4 t/ha respectively (Table 2).

Table 1. Costs and returns of local and modern sugarcane varieties, 1988-89.

(Value in Tk/ha)

Items	Transplanted		Conventional	
	LV*	MV*	LV	MV
Yield (t/ha)	52.1	72.9	37.4	46.9
Full cost	18,530.1	24,815.3	15,742.1	15,701.4
Cash cost	15,564.4	19,409.8	9,847.5	11,000.7
Gross benefit	39,962.2	54,817.9	28,536.1	35,184.4
Gross margin (GM)				
Full GM	21,432.1	30,002.5	12,794.0	19,483.0
Cash GM	24,397.8	35,408.1	18,688.6	24,183.7

LV* = Local variety, MV = Modern variety

Source : Field survey.

Yield of medium level fertilizer of transplanted modern varieties and transplanted local varieties appeared to be higher (59.1 and 41.9 t/ha respectively) than on low level fertilizer (34.8 and 35.8 t/ha respectively) (Table 2). The same was true in case of high level fertilizer in STP (MV) and STP (LV) in obtaining higher yields (92.2 and 90.2 t/ha respectively) than on medium level fertilizer (Table 2). The cost and return data showed that cash gross margin were substantially higher in STP (MV), STP (LV) with high (Tk. 45,217.5 and Tk. 53,082.6 /ha respectively) and medium (Tk. 27,257.3 and Tk. 16,778.9/ha) level fertilizer use than those of low (Tk. 12,235.6 and Tk. 13,466.7/ha respectively) level fertilizer (Table 2). The same was true in case of conventional planting (MV) and (LV) (Table 2).

In total, 81% area was manured. The table 3 indicates that yield appeared to be higher on high manuring STP (MV) (81.4 t/ha) than on medium manuring STP (MV) and STP (LV) (73.7 and 60.7 t/ha respectively) and low manuring STP (MV) (35.8 t/ha).

Cash gross margin was also higher on high manuring STP (MV) (Tk. 41,062.8/ha) than that of medium manuring STP (MV) and STP (LV) (Tk. 35,148.0 and Tk. 30,258.8/ha respectively) and low manuring STP (MV) (Tk. 13,709.6/ha). Yields and cash gross margin on STP (MV) and STP (LV) were higher than those on low

Table 2. Costs and returns of farmers using three levels of fertilizers on local and modern varieties of transplanted and conventional planting of sugarcane, 1988-89.
(Values in Tk/ha)

Items	Low fertilizer		Medium fertilizer		High fertilizer	
	LV	MV	LV	MV	LV	MV
Transplanted Sugarcane						
Yield (t/ha)	35.8	34.8	41.9	59.1	90.2	92.2
Full cost	20,403.0	19,228.7	21,219.5	23,006.1	28,009.2	29,543.7
Cash cost	13,863.0	13,926.1	15,212.5	17,498.7	15,806.1	23,966.8
Gross benefit	27,339.7	26,161.7	31,991.4	44,755.1	67,062.8	69,238.2
Gross margin (GM)						
Full GM	6,926.7	6,932.9	10,771.9	21,749.0	39,053.6	39,694.5
Cash GM	13,466.7	12,235.6	16,778.9	27,257.3	53,082.6	45,271.5
Conventional Planting						
Yield (t/ha)	29.4	33.2	55.8	56.7	—	—
Full cost	15,106.3	15,202.1	20,697.1	17,903.8	—	—
Cash cost	9,968.7	9,646.6	13,640.5	13,095.7	—	—
Gross benefit	22,482.3	25,133.0	42,592.6	42,551.3	—	—
Gross margin (GM)						
Full GM	7,376.1	9,930.8	21,895.5	24,647.5	—	—
Cash GM	12,513.6	15,486.3	28,952.1	29,455.5	—	—

Source : Field survey.

Table 3. Costs and returns of farmers using three levels of organic manure on local and modern varieties of transplanted and conventional planting of sugarcane, 1988-89.
(Values in Tk/ha)

Items	Low manuring		Medium manuring		High manuring	
	LV	MV	LV	MV	LV	MV
Transplanted Sugarcane						
Yield (t/ha)		35.8	60.7	73.7	—	81.4
Full cost		15,878.9	22,574.4	25,388.0	—	24,404.7
Cash cost	—	13,133.1	16,100.3	20,241.5	—	20,009.1
Gross benefit		26,842.7	46,359.0	55,389.5	—	61,071.9
Gross margin (GM)						
Full GM	—	9,963.8	25,784.6	30,001.5	—	36,667.2
Cash GM	—	13,709.6	30,258.8	35,148.0	—	41,062.8
Conventional Planting						
Yield (t/ha)	42.9	35.8	—	57.8	92.5	—
Full cost	15,693.3	16,054.3	—	22,784.2	19,969.8	—
Gross benefit	32,792.6	26,892.5	—	43,440.8	68,814.6	—
Full GM	17,099.4	10,838.2	—	20,656.6	48,844.8	—
Cash GM	21,228.4	17,035.3	—	27,229.2	57,262.1	—

Source : Field survey.

Table 4. Costs and returns of farms using three levels of weedings on local and modern varieties of transplanted and conventional planting of sugarcane, 1988-89.

(Values in Tk/ha)

Items	Low weeding		Medium weeding		Intensive weeding	
	LV	MV	LV	MV	LV	MV
Transplanted Sugarcane						
Yield (t/ha)	—	—	35.8	58.2	57.5	73.9
Full cost	—	—	18,074.3	23,220.0	23,304.7	25,106.5
Cash cost	—	—	12,950.2	17,240.9	16,185.8	19,702.8
Gross benefit	—	—	26,605.3	43,690.5	43,938.7	55,550.0
Gross margin (GM)						
Full GM	—	—	8,531.0	20,472.5	20,634.0	30,444.4
Cash GM	—	—	13,655.1	26,449.6	27,752.9	35,848.0
Conventional Planting						
Yield (T/ha)	—	35.5	35.8	36.8	—	52.8
Full cost	—	18,619.2	16,756.6	16,920.1	—	17,964.3
Cash cost	—	14,503.9	10,861.5	12,439.1	—	11,549.4
Gross benefit	—	26,750.9	32,254.7	38,158.7	—	39,567.2
Gross margin (GM)						
Full GM	—	8,131.8	15,498.1	21,238.6	—	21,602.8
Cash GM	—	12,247.0	21,393.1	25,719.6	—	28,017.8

Source : Field survey.

manuring (MV) was higher (92.5 t/ha) than on conventional medium manuring (MV) (57.8 t/ha) and low manuring (LV) and (MV) (42.9 and 35.8 t/ha respectively). High manuring conventional planting (LV) gave higher cash gross margin (Tk. 57,262.1/ha) than that of medium manuring (MV) (Tk. 27,229.2/ha) and low manuring (LV) and (MV) (Tk. 21,229.2/ha and 17,035.3/ha respectively) (Table 3). The yield differences between STP high manuring (MV) and STP medium manuring (MV) and between STP high manuring (MV) and STP low manuring (MV) were 7.7 and 45.6 t/ha respectively (Table 3). Yields of high and medium manuring were significantly higher than low manuring.

Table 4 depicts that yields on intensive weeding STP (MV) and STP (LV) (73.9 and 57.5 t/ha respectively) appeared to be higher than on minimum weedings STP (MV) and STP (LV) (58.2 and 35.8 t/ha respectively). Costs and returns analysis of weedings showed that cash gross margin of intensive weeding STP (MV) and STP (LV) (Tk. 35,848.0 and Tk. 27,752.9/ha respectively) were higher than those of minimum weeding STP (MV) and STP (LV) (Tk. 26,449.6 and Tk. 13,655.1/ha respectively). The same trend was also observed in case of conventional (MV) and (LV) (Table 4). Intensive weedings had significant effect on yield.

The yield difference between intensive weeding STP (MV) and minimum weeding STP (MV) (15.7 t/ha) observed to be more or less equal to the gaps between intensive weeding conventional planting (MV) and minimum weeding conventional planting (MV) (Table 4). It was observed that the yield difference between intensive weeding STP

(MV) and minimum weeding STP (LV) was the highest (Table 4). In total, 71.4% area was applied with insecticides. Furadan 3G+Heptachlor and only Heptachlor were applied in 54.5% and 16.9% area respectively. The yield differences between conventional planting (MV) with Heptachlor treated and untreated was 2.5 t/ha and the difference between gross benefit was Tk. 1806.2/ha. The effect of using only Heptachlor in terms of yield difference was not significant. When Furadan 3G and Heptachlor was applied, the yield difference was highly significant.

Costs and Returns of Farm size and Yield Groups of Sugarcane Farms : Table 5 revealed that the yield gap between average high and intermediate yield group (36.3 t/ha) was higher than that of average low and intermediate yield group (24.5 t/ha). The yield gaps between the average high and low yield group (60.8 t/ha) was the highest (Table 5).

Average high yield group had the highest cash gross margin (Tk. 47,667.2/ha) than that of average intermediate (Tk. 27,901.4/ha) and low (Tk. 14,407.0/ha) yield group of sugarcane farms (Table 5).

Table 5. Average costs and returns of low, intermediate and high yield group of sugarcane farms, 1988-89.

(Values in Tk/ha)

Items	Low	Intermediate	High
Yield (t/ha)	32.4	56.9	93.2
Full cost	15,726.6	20,446.7	28,103.3
Cash cost	10,099.4	14,994.6	22,407.5
Gross benefit	24,506.4	42,896.0	70,074.7
Gross margin (GM)			
Full GM	8,779.8	22,449.3	41,971.5
Cash GM	14,407.0	27,901.4	47,667.2

Source : Field survey.

Table 6. Average costs and returns of small, medium and large sugarcane farms, 1988-89.

(Values in Tk/ha)

Items	Small	Medium	Large	Average
Yield (t/ha)	47.1	48.2	69.8	59.6
Full cost	18,288.8	19,589.0	22,669.6	20,939.6
Cash cost	11,093.5	19,589.0	18,154.8	15,377.2
Gross benefit	36,060.4	36,338.2	52,383.8	44,878.0
Gross margin (GM)				
Full GM	17,771.7	16,749.3	29,714.2	23,938.4
Cash GM	25,020.9	23,129.6	34,229.0	29,500.8

Source : Field survey.

Table 6 revealed that large sugarcane farms yielded higher (69.8 t/ha) than medium (48.2 t/ha) and small farms (47.1 t/ha). The average yield of all farms was 59.6 t/ha.

Yield gaps between large and small farms was higher (22.7 t/ha) than that between large and medium farms (21.6 t/ha) and between medium and small farms (1.1 t/ha) (Table 6).

Average large sugarcane farms obtained the highest cash gross margin (Tk. 34,229.0 /ha) than that of small (Tk. 25,020.9/ha) and medium farms (Tk. 23,129.6/ha). Small farms had a slight edge of cash gross margin than medium farms although there was a slight higher yield of medium farms than small farms (Table 6). Effect of large sugarcane farms on yield was found to be significantly higher than small and medium sugarcane farms respectively.

The results revealed that the recommended varieties, early planting, spaced transplanting, high and medium high land use, high level fertilizer and organic manure dose, intensive weeding and pest control by chemicals were found to have higher yield and income increasing effect compared to intermediate and low level sugarcane production technologies.

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