

Trends and Growth Patterns in Sugarcane Area, Production and Productivity in Bangladesh

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ABSTRACT

Time series data for the period 1951-86 revealed that annual growth rates of sugarcane area and production were higher in the millzone as compared to non-millzone and Bangladesh as a whole. Sugarcane area and production showed increasing trends with slight to wide fluctuations except declining area trends in non-millzone. The growth rates of sugarcane productivity were less in millzone and Bangladesh as a whole than that of non-millzone. The study also indicated that yield was lower and slightly fluctuating around a constant value or the growth was low in millzone and Bangladesh as a whole as compared to non-millzone. Some preliminary causes for low yield in the millzone have been discussed.

INTRODUCTION

Sugarcane is the second most important cash crop in Bangladesh. Its production concentrates mainly in the greater districts of Rajshahi, Kushtia, Jessore, Rangpur, Bogra, Pabna, Faridpur, Barisal, Dhaka and Mymensingh of Bangladesh occupying about 1.6 lakh hectares of land (Anon, 1978). Sugarcane and sugar mills of the country are contributing significantly to the development of rural areas by providing rural employment, improvement of the rural infrastructure and also saving foreign exchange and adding directly and indirectly to the national exchange (Annual Report, 1985). Sugar and gur production fluctuated from year to year (Anon, 1986). The government of Bangladesh is emphasizing to attain self-sufficiency in sugar and gur production by the end of the third five year plan (1985-90) by stabilizing sugarcane area and enhancing yield (Anon, 1986). In order to raise production, it is essential to know how far the area and productivity varies and factors responsible for such variations which is of great concern to the policy makers and sugar manufacturers of the country. The study was planned to study the trends of sugarcane area, production and productivity in millzone, non-millzone and whole of Bangladesh during 1951-86; and to study the growth patterns during 1951-86 of sugarcane area, production and productivity in millzone, non-millzone and Bangladesh as a whole.

MATERIALS AND METHODS

The study was conducted comprising millzone, non-millzone and whole of Bangladesh by collecting relevant time series data for the period 1951-52 to 1985-86 from serial and non-serial publications related to sugarcane (Anon. 1986a; Anon. 1986b; Anon. 1986c). Trends in sugarcane area, production and productivity were studied through compound growth rates computed for millzone, non-millzone and Bangladesh as a whole. The compound growth rates were estimated by taking time as the independent variable and index numbers of area, production and productivity of sugarcane as dependant variables. Exponential equations were fitted for estimating the compound growth rates. The exponential equation directly gives a constant rate of increase/decrease per unit of time. The equation was calculated as follows:

$$Y = AX^I$$

$$\text{Log} = \text{Log } A + \text{log} X$$

Where, Y=Index numbers of area, production and productivity.

X = Time

A = Intercept

Compound growth rate = $\text{Anti log } (\log X) - 1$,

Percent growth rate = $(\text{Anti log } X) - 1 \times 100$.

Variability in area, production and productivity of sugarcane was worked out by estimating the variability coefficients.

For analytical purposes, the year 1951-52 to 1985-86 has been divided into seven periods, viz.,

Period I : 1951-52 to 1955-56

Period II : 1956-57 to 1960-61

Period III : 1961-62 to 1965-66

Period IV : 1966-67 to 1970-71

Period V : 1971-72 to 1975-76

Period VI : 1976-77 to 1980-81

Period VII : 1981-82 to 1985-86.

RESULTS AND DISCUSSION

Trends and Growth Patterns of Sugarcane in Bangladesh : Growth rates of sugarcane area, production and productivity for the period 1951-52 to 1985-86 are

presented in table 1. Output growth of sugarcane is estimated to have increased (2.1% per annum). Production of sugarcane was not uniform or stable characterized by variations in the performances recorded (Table 3). Sugarcane production reached the peak level (82.0 lakh MT) during 1966-67 and the lowest in 1951-52 (34.8 lakh MT) (Fig. 2). There were nine cases of positive (rising) and twenty six cases of negative (downfall) year to year comparative slight to wide fluctuations recorded in sugarcane production (Table 2). Output growth during period III depicted an increasing trend, while it increased insignificantly during I and V periods and the rest had shown decreasing production trends (Table 1).

Growth of sugarcane area had increased (1.5% per annum) significantly while a very low rate of increase in sugarcane productivity (0.6% per annum) was achieved (Table 1). Sugarcane area for cultivation was the highest during 1966-67 and reached its lowest level in 1951-52 (Fig. 1). There were comparatively ten positive (rising) and twenty five negative (fall) with slight to moderate fluctuations in sugarcane area (Table 2). Sugarcane production increased because of shifting area under cane and its cultivation declined presumably owing to other remunerative crops during that year (1951-52).

Growth of sugarcane area indicated insignificant increase in trends during I, II, III, V and VI periods and the rest showed declining area trends (Table 1). Quinquennial averages of sugarcane area showed increase in differences of different periods during III and II (33.5%), IV and III and VI (8.4%), it rose insignificantly during II over I, VI over V periods and it revealed negative differences in V over IV period (Table 3). Quinquennial averages revealed prominent increase over differences in sugarcane output during III and II (49.0%), IV and III (34.1%), VII and VI (7.5%) periods, while there was a significant negative difference in V over IV period and the rest indicated positive differences (Table 3).

The average yield of sugarcane which was 37.2 MTH during period I increased to 44.4 MTH in period VII (Table 3). Productivity growth had increased significantly during periods III and V (Table 1). Productivity had shown slight to moderate year to year fluctuations (Table 2). Quinquennial average yield differences of different periods observed an improvement during III over II (11.3%) and IV over III (8.7%) periods but it improved insignificantly in II over I and VI over V periods, whereas a significant negative difference was found during V over IV period (Table 3).

Trends and growth patterns in Millzone : Maximum annual growth of 3.71% per annum in sugarcane production was achieved during 35 years period (Table 1). Sugarcane production was the highest (39.3 lakh MT) during 1982-83 and the lowest (7.5 lakh MT) in the year 1953-54. Sugarcane production curve indicated an

Table 1. Annual percentage growth rates and coefficient of variations of area, production and productivity of augarcane.

Location of area, production and productivity	I	II	III	IV	V	VI	VII	1951 to 1986
AREA								
Millzone	3.7 (13.6)	15.9 (30.0)	8.2** (12.6)	-0.5 (5.8)	3.2 (16.1)	-1.1 (17.1)	-5.3 (11.0)	3.8** (37.0)
Non-Millzone	3.0 (7.3)	-6.1 (21.5)	5.1** (8.0)	-1.1 (4.1)	-0.7 (4.7)	1.6 (13.2)	4.0 (7.4)	0.1 (13.4)
Bangladesh	3.1 (5.5)	0.8 (7.1)	6.5 (10.0)	0.9 (1.6)	0.8 (7.5)	0.1 (3.4)	-1.2 (3.3)	1.5** (17.5)
PRODUCTION								
Millzone	3.3 (13.2)	11.3 (27.2)	5.6 (9.9)	-2.7 (17.6)	15.7 (31.5)	2.7 (9.7)	-6.5 (11.4)	3.7** (40.9)
Non-millzone	3.1 (10.5)	-4.5 (15.2)	19.9* (32.1)	-0.9 (3.2)	-1.4 (3.7)	-2.2 (6.3)	5.5* (9.2)	1.2** (26.1)
Bangladesh	3.1 (6.1)	0.0 (3.8)	14.4** (22.3)	-1.5 (3.9)	2.6 (8.9)	-0.2 (3.1)	-0.5 (2.4)	2.1** (24.5)
PRODUCTIVITY								
Millzone	-0.0 (2.7)	-3.7 (0.1)	-2.4 (0.2)	-2.2 (0.2)	12.4 (0.2)	3.7 (0.2)	-1.7 (0.1)	-0.1 (14.4)
Non-millzone	-0.1 (0.0)	1.7 (0.3)	14.1* (0.0)	0.1 (0.1)	0.6 (0.1)	-3.8 (0.2)	1.4 (0.0)	1.1** (19.0)
Bangladesh	-0.1 (0.0)	-0.9 (0.1)	7.2 (0.1)	-0.6 (0.0)	1.9* (0.0)	0.3 (0.0)	0.8 (0.0)	0.6** (9.0)

Values within parentheses are coefficient of variation.

*, ** Significant at 5% and 1% level respectively.

Table 2. Deviations of indices from trend value (%) of sugarcane area, production and productivity.

Years	Millzone			Non-millzone			Bangladesh		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
1951-52	-11.4	0.5	14.8	-12.5	-19.4	-7.2	-12.3	-14.3	-1.8
1952-53	-21.0	-16.3	7.0	-2.0	-7.7	-6.3	-7.1	-9.9	-2.4
1953-54	-36.0	-31.1	-0.7	9.9	4.8	-4.5	-2.9	-4.7	-1.7
1954-55	-14.9	-9.7	6.8	1.9	-13.7	-15.6	-4.4	-13.0	-9.3
1955-56	-15.1	-5.4	14.3	-0.9	-8.6	-8.1	-6.7	-8.3	-1.5
1956-57	-31.8	-27.7	6.6	3.1	-4.7	-7.6	-9.8	-11.7	-2.1
1957-58	-34.3	-30.2	6.5	3.0	-12.5	-14.7	-11.2	-18.3	-7.7
1958-59	-11.4	1.1	14.1	-15.6	-22.7	-7.7	-15.9	-16.9	-0.8
1959-60	22.0	19.5	-1.2	-42.0	-39.2	5.5	-22.2	-23.3	-1.9
1960-61	-13.0	-21.3	-8.9	0.2	-14.6	-14.9	-6.8	-17.8	-11.6
1961-62	17.9	30.9	11.9	-14.4	-25.2	-12.8	-5.0	-9.9	-5.4
1962-63	28.9	36.9	6.1	-7.9	-21.2	-14.6	3.2	-5.2	-7.9
1963-64	36.8	55.0	13.5	-1.4	-14.7	-13.9	10.4	-4.9	-4.9
1964-65	33.9	42.2	5.9	2.5	12.3	9.3	11.8	19.3	-6.7
1965-66	42.7	40.6	-1.8	3.8	46.4	40.4	16.3	41.7	20.8
1966-67	35.7	44.9	5.7	24.7	54.1	23.9	25.8	49.0	17.8
1967-68	45.3	22.3	-16.6	14.2	48.0	30.2	24.0	36.6	10.5
1968-69	22.5	-16.7	-32.6	24.6	55.7	25.3	20.7	28.7	6.9
1969-70	18.0	0.2	-16.1	19.6	46.9	22.9	16.0	28.2	10.5
1970-71	21.9	16.0	-6.3	15.2	39.6	20.7	15.7	28.6	10.9
1971-72	17.0	-45.8	-36.1	13.9	19.2	4.5	-2.1	-5.8	-4.0
1972-73	-27.6	-49.5	-30.9	6.0	9.2	3.5	-11.9	-13.6	-2.2
1973-74	-17.1	-7.1	11.0	18.9	8.8	-8.3	-0.3	0.9	0.9
1974-75	-0.6	-6.0	-7.1	8.4	12.4	3.5	2.9	3.4	0.6
1975-76	-31.1	-31.5	-1.6	8.4	3.2	-4.4	-12.4	-11.6	0.9
1976-77	-14.1	-5.4	7.9	3.1	-2.8	-5.3	-6.6	-5.7	0.6
1977-78	20.4	-9.4	1.5	-24.4	2.7	35.9	-1.6	-3.8	-2.2
1978-79	-8.1	-5.2	0.6	2.9	0.4	-2.5	-2.4	-3.6	-1.2
1979-80	-26.6	-21.8	8.1	6.8	-3.5	-10.0	-10.1	-12.3	-2.7
1980-81	-13.6	-3.0	8.8	-6.3	-15.6	-9.7	-9.0	-12.0	-3.3
1981-82	2.8	23.7	16.9	-14.2	-25.5	-13.3	-3.1	-6.8	-3.8
1982-83	3.2	25.0	17.3	-12.9	-25.4	-14.3	-1.6	-5.8	-4.3
1983-84	-3.5	4.0	4.6	-7.8	-18.5	-11.6	-2.5	-10.1	-7.7
1984-85	-8.0	-7.0	-1.3	-10.4	-20.4	-11.1	-6.2	-15.5	-8.9
1985-86	-30.9	-14.4	20.1	2.5	-11.2	-11.2	-13.3	-13.3	-0.1

Table 3. Quinquennial average of area, production and yield in millzone, non-millzone and Bangladesh as a whole the period 1951-52 to 1985-86.

Locations and other particulars	Mean of area, production and yield of different (average of five years) periods						
	I	II	III	IV	V	VI	VII
AREA (‘000’ ha)							
Millzone	26.4	34.4	63.0	73.4	56.0	75.6	91.8
Non-millzone	75.0	68.0	73.4	91.2	85.0	74.0	70.4
Bangladesh	102.0	102.2	136.4	164.6	140.4	149.4	162.0
PRODUCTION (‘000’)							
Millzone	958.4	1,165.0	2,225.4	2,128.6	1,644.4	2,474.2	3,440.4
Non-millzone	2,849.2	2,696.8	3,528.8	5,587.8	4,365.8	4,073.6	3,396.4
Bangladesh	3,807.6	3,861.8	5,754.2	7,716.4	6,010.2	6,547.8	6,836.8
YIELD (MTH)							
Millzone	36.3	34.1	35.5	28.9	29.2	33.3	37.7
Non-millzone	38.0	40.4	47.4	61.3	52.1	56.2	51.1
Bangladesh	37.2	37.3	41.5	45.1	40.7	44.8	44.4
Differences of periods							
	II & I	III & II	IV & III	V & IV	VI & V	VII & VI	
	8.0	28.6 * *	10.4 *	-17.4 *	19.6 *	16.2 *	
	-7.0	5.4	17.8 * *	-6.2 *	-11.0 *	-3.6	
	0.2	34.2 **	28.2 * *	-24.2 * *	9.0	12.6 *	
	206.6	1,060.4 * *	-96.8	-484.2	829.8 *	966.2 * *	
	-152.4	832.0	2,059.0 * *	1,222.0 * *	-292.2 *	-477.2 * *	
	54.2	1,892.4 *	1,962.2 *	-1,706.2 *	537.6	489.0 * *	
	-2.2	1.4	-6.6 *	0.3	4.1	4.4	
	2.4	7.0 * *	13.9 * *	-9.2 * *	4.1	-5.1	
	0.1	4.2 *	3.6 *	-4.4 *	4.1	-0.4	

* * * Significant at 5 % and 1 % level respectively.

increasing trend with pronounced depressions except short spells of downfall (Fig. 2). There were five peaks and eight depressions in sugarcane production curve. Trends of output growth increased insignificantly during I, II, III, V and VI periods, while declining trends were observed in IV and VII periods (Table 1).

Growth rate of sugarcane cultivation area was the highest of the order of 3.8% per annum (Table 1). Sugarcane area curve indicated an increasing trend in sugarcane cultivation. Area under sugarcane reached its lowest level during 1953-54 and the highest in the year 1982-83 (Fig. 1). Comparatively, there were 15 cases of positive (rising) and 20 cases of negative (fall) year to year slight to side fluctuations in sugarcane area (Table 2). There were seven peaks and seven troughs in sugarcane area (Fig. 1). Growth rates of sugarcane area implied an increasing trend in period III, while the growth during I, II and V periods showed insignificant increasing trends and the rest revealed decreasing area trends (Table 1). Quinquennial averages indicated increasing trends in sugarcane area and noteworthy increasing differences were found during periods III and II (83.1%), IV and III (16.5%), VI and V (35.0%), VII and VI (21.4%); it declined significantly in V over IV period (Table 3). Consequently, sugarcane production showed rising trends and the differences of output of different periods and increased significantly during III and II (90.0%), VI and V (50.5%) VII and VI (39.1%) periods, while the differences of IV over III and V over IV periods indicated decrease in production (Table 3).

The average yield of sugarcane was 36.3 MTH during period I which increased to 37.3 MTH in period VII (Table 3). There was no significant rise in sugarcane productivity and revealed negative trends during most of the periods (Table 1). There were twenty two cases of slight to moderate increase (positive) and thirteen negative (fall) year to year fluctuations of yield except sharp downfall during 1968-69, 1971-72 and 1972-73 (Table 3). The downfall in sugarcane productivity may be due to climatic factors, marketing problems, resources endowment and related scarcities (Lal and Bajpai, 1985).

Trends and growth patterns in Non-millzone: Table 1 depicted that sugarcane output growth had increased significantly (1.2% per annum) (Table 1). Sugarcane production was the highest during 1968-69 (58.4 lakh MT) and the lowest in 1959-60 (20.4 lakh MT) (Fig. 1). Deviations of indices from trend values indicated fifteen cases of positive (rising) and twenty negative (fall) year to year slight to wide fluctuations in sugarcane production (Table 2). There were five peaks and equal troughs in sugarcane production (Fig. 2). Sugarcane output had shown significant increase during III and VII periods, while positive trend in period I and the rest indicated negative trends (Table 1). Quinquennial averages revealed negative

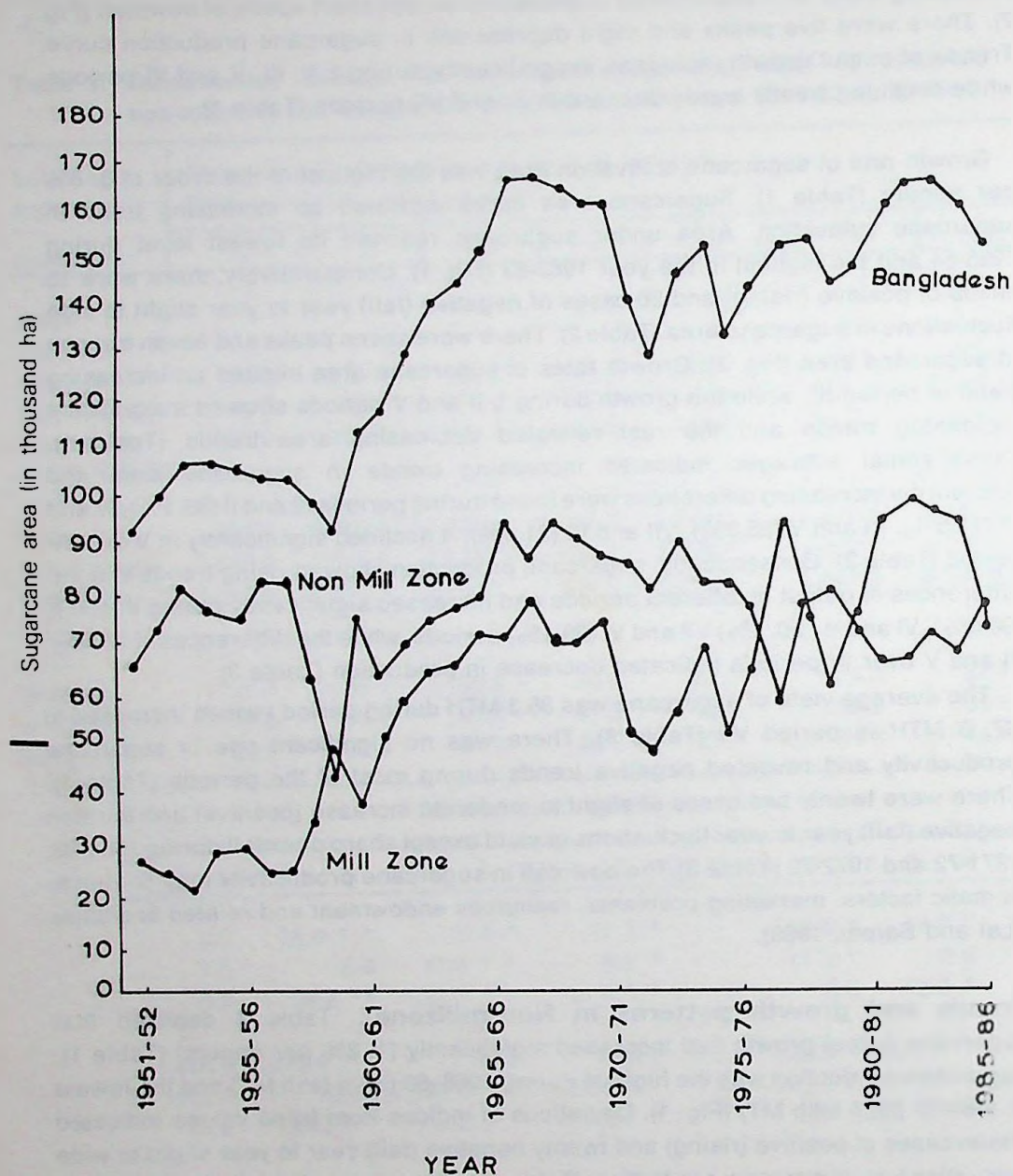


Figure 1. Fluctuations in sugarcane area.

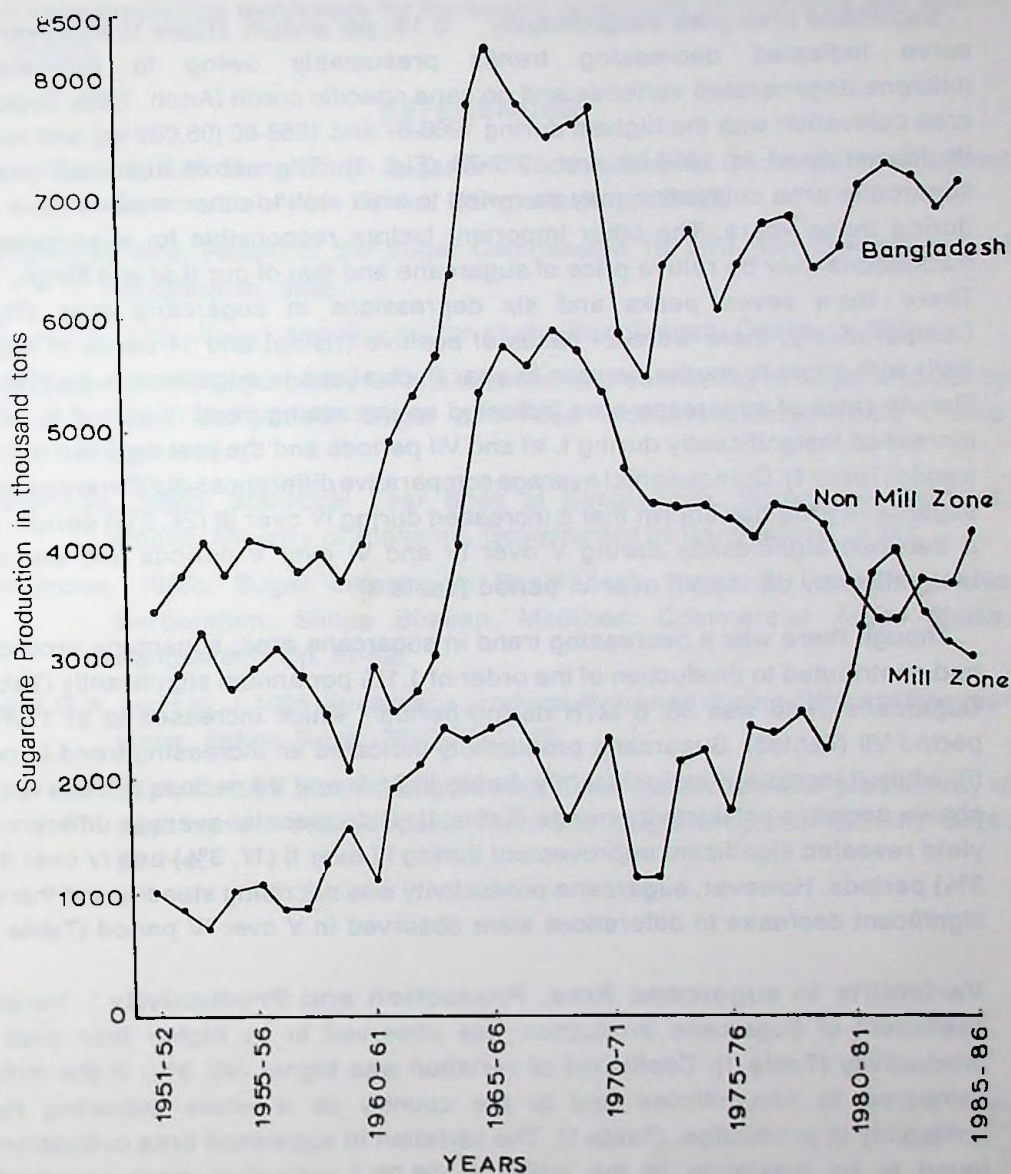


Figure 2. Fluctuations in sugarcane production

significant production differences during V over IV, VI over V and VII over VI periods while significant increasing differences were found in IV over III period (Table 3).

Sugarcane area grew insignificantly 0.1% per annum. (Table 1). However, area curve indicated decreasing trends presumably owing to extension of millzone, degenerated varieties and no cane specific credit (Anon. 1985). Sugarcane area cultivation was the highest during 1966-67 and 1968-69 (95,000 ha) and reached its lowest level in 1959-60 and 1977-78 (Fig. 1). The above abnormal years in sugarcane area cultivation may be owing to area shift to other remunerative crops during those years. The other important factors responsible for sugarcane area fluctuations may be relative price of sugarcane and that of gur (Lal and Singh, 1986). There were seven peaks and six depressions in sugarcane area (Fig. 1). Comparatively, there were 21 cases of positive (rising) and 14 cases of negative (fall) with slight to moderate year to year fluctuations in sugarcane area (Table 2). Growth rates of sugarcane area indicated an increasing trend in period III, while it increased insignificantly during I, VI and VII periods and the rest depicted declining trends (Table 1). Quinquennial average comparative differences of different periods of sugarcane area has shown that it increased during IV over III (24.3%) period, while it declined significantly during V over IV and VI over V periods and decreased insignificantly during VII over VI period (Table 3).

Though there was a decreasing trend in sugarcane area, sugarcane productivity had contributed to production of the order of 1.1% per annum significantly (Table 1). Sugarcane yield was 38.0 MTH during period I which increased to 51.1 MTH in period VII (Table 3). Sugarcane productivity indicated an increasing trend in period III, while it increased insignificantly during II, IV, V and VII periods and the rest had shown negative productivity trends (Table 1). Quinquennial average differences of yield revealed significant improvement during III over II (17.3%) and IV over III (29.3%) periods. However, sugarcane productivity was not rising steadily and thereby a significant decrease in differences were observed in V over IV period (Table 3).

Variability in sugarcane Area, Production and Productivity : Variability coefficient of sugarcane production was observed to be higher than area and productivity (Table 1). Coefficient of variation was higher (40.9%) in the millzone compared to non-millzone and to the country as a whole indicating higher unstability in production. (Table 1). The variation in sugarcane area cultivation was found to be maximum in the millzone (36.9%) indicating more vastability in sugarcane cultivation than non-millzone and Bangladesh as a whole (Table 1). The variability coefficient of sugarcane productivity was lower (8.9%) in Bangladesh as a whole and millzone (14.4%) as compared to non-millzone indicating that yield have

not been increasing or slow (Table 1). There is need for strengthening credit facilities, adoption and diffusion of recommended high level seed-fertilizer sugarcane production technology for increasing productivity per unit area and time in the country.

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