Vol XXII
No. 2

APRIL-
JUNE
1967

ISSN 0019-5014

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

NOTES

FACTORS AFFECTING ACREAGE UNDER SUGARCANE IN INDIA*

During the period of planned developmental effort there has been a rapid growth in sugarcane acreage in many States in India. The importance of price and yield for changes in areas under crops has been the subject matter of several research investigations.[1] It is useful to identify and measure the impact of relevant economic variables on acreage under sugarcane.

Object and Scope

The object of this paper is to study the influence of the following factors on acreage under sugarcane : (*i*) the installed capacity of sugar industry; (*ii*) the relative mill price of sugarcane; (*iii*) the relative price of *gur*; and (*iv*) the relative yield of sugarcane. The analysis has been carried out both at the all-India level and State level for the period 1950-51—1962-63 for which the appropriate data were readily available. Seven important sugarcane growing States, namely, Andhra, Madras, Mysore, Maharashtra, Uttar Pradesh, Bihar and Punjab were chosen for this analysis. The total sugarcane production of these States constituted more than 90 per cent of the all-India production.

Methodology

Linear growth rates of sugarcane acreage and installed capacity are calculated to see how far the trend values of cane acreage are related to the trend values of installed capacity of sugar industry. The hypothetical model to estimate the effect of the individual variables is of the following form.

$$A_t = L_0 + L_1 C_t + L_2 \frac{(P_1^t)}{(P_2^{t-1})} + L_3 P_{t-1} + L_4 Y_{t-1} + U$$

where,

A_t = The sugarcane acreage at time t (in lakh acres).

C_t = Installed capacity of sugar industry in terms of annual sugar production at time t (in lakh tons).[2]

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* The author is grateful to Shri B. D. Dhawan and Shri D. U. Sastry for their valuable suggestions in the preparation of this paper.

1. Dharm Narain: The Impact of Price Movements on Areas under Selected Crops in India 1900 to 1939, Cambridge University Press, London, 1965; Raj Krishna, "Farm Supply Response in India-Pakistan," *Economic Journal*, Vol. LXXII, No. 291, September, 1963, and "Some Production Functions for the Punjab," *Indian Journal of Agricultural Economics*, Vol. XIX, Nos. 3 & 4, July-December, 1964; C. H. Hanumantha Rao: Agricultural Production Functions, Costs and Returns in India, Asia Publishing House, Bombay, 1965; D. Romesh, "A Dynamic Model Analysis of Foodgrains Production and Price" and "Long and Short Run Elasticities of Acreage under Crops," *Agricultural Situation in India*, Vol. XIX, No. 4, July, 1964 and Vol. XX, No. 5, August, 1965 respectively; V. M. Jakhade and N. A. Mujumdar, "Response of Agricultural Producers to Prices—The Case of Jute and Rice in India," *Indian Journal of Agricultural Economics*, Vol. XIX, Nos. 3 & 4, July-December, 1964; Also see contributions by several participants in the Conference issue of *Indian Journal of Agricultural Economics*, Vol. XX, No. 1, January-March, 1965.

2. Installed sugar production capacity has been computed in the following way :
C_t = Cane crushing capacity per day × per cent sugar recovery × average number of working days.

$$\frac{(P_1^t)}{(P_2^{t-1})} = \frac{\text{The current year mill price of cane}}{\text{The price of a major competing crop in the previous year}}.$$

$$P_{t-1} = \frac{\text{The farm harvest price of } gur \text{ at time (t—1)}}{\text{The farm harvest price of a major competing crop at time (t—1)}}.$$

$$Y_{t-1} = \frac{\text{The yield of sugarcane at time (t—1)}}{\text{The yield of a major competing crop at time (t—1)}}.$$

$$U = \text{The error term.}$$

All the explanatory variables were not, however, simultaneously included in the model as one or more of the last three variables were found to be insignificant in preliminary analysis. The estimates of the parameters may be biased due to serial correlation in the residuals.

Since the Central Government used to announce the minimum mill price of cane one year in advance of the sowing season, it is appropriate to consider the relative mill price of cane in the above defined form to study the effect of mill price of cane on cane acreage. Only one major competing crop was considered at the State level as well as at the all-India level. The weighted indices of price and yield of a number of competing crops calculated on the basis of arbitrary weights, cast doubt for their representativeness in serving our purpose. Relative yield and relative price series based on one major competing crop is expected to show a better picture as to how the acreage changes are influenced by the corresponding changes in price of *gur* and yield of cane. The competing crops considered are rice in case of Madras, Mysore, Bihar, Andhra and all-India, wheat in case of Punjab and Uttar Pradesh and cotton in case of Maharashtra Producers generally had to sell away their production immediately after harvest to meet their cash requirements and therefore farm harvest prices had a direct bearing on the decision of the producer to allot his land resources among different competing crops.

Sources of Data

The acreage and yield data on sugarcane have been obtained from the Report of Sugar Enquiry Commission, 1965, Ministry of Food and Agriculture, Government of India. The data on installed capacity of sugar industry have been obtained from B. D. Dhawan (Institute of Economic Growth). The average mill price of cane received by the farmers was not available. The minimum price of cane at factory gate delivery was taken from the Report of Sugar Enquiry Commission, 1965. The State average farm harvest prices of *gur* and competing crops were obtained from various relevant issues of (1) Agricultural Prices in India, and (2) *Agricultural Situation in India.* In the absence of farm harvest prices of *gur* for Uttar Pradesh, wholesale prices for the year (November-October) at Hapur were taken. The wholesale prices of the competing crop, *i.e.*, wheat, at Hapur were taken in calculating the price ratios for the State. It has been assumed that the farm harvest price series of Andhra region upto 1956-57 is representative for

Andhra Pradesh. Similarly, for Maharashtra, the Bombay State data before 1956-57 were taken. In case of Mysore farm harvest prices of *gur* for the years 1949-50 and 1954-55 and rice for the year 1949-50 were not known. The price of *gur* for 1954-55 was estimated by means of Newton Formula for interpolation and the analysis was carried out for twelve years. The price of cleaned rice has been taken to be $1\frac{1}{2}$ times that of paddy wherever it is not available.[3] Yield data for competing crops were obtained from (1) Estimates of Area and Production of Principal Crops in India, Ministry of Food and Agriculture, Government of India, and (2) *Agricultural Situation in India.* All-India farm harvest prices of *gur* and rice have been taken as the simple average of these State averages.

Results and Discussions

The parameters of the models were estimated by the method of ordinary least squares and the facts relevant to the interpretation of the results and the inferences suggested by them are discussed below :

TABLE I—$A_t' = a + bt$; A_t' = INDEX OF AREA WITH 1950-51 = 100
(1950-51—1963-64)

State	a	b	r^2	Linear growth rates of installed capacity during 1950-51—1963-64(%)
1	2	3	4	5
Tropical Region				
Andhra Pradesh ..	76.60	4.63* (1.07)	0.60	9.31*
Mysore	81.92	7.31* (0.68)	0.91	18.90*
Maharashtra ..	71.15	9.54* (1.30)	0.32	20.37*
Madras	62.57	6.22* (1.25)	0.68	17.42*
Sub-Tropical Region				
Uttar Pradesh ..	95.04	2.42* (0.80)	0.43	2.39*
Bihar	83.30	1.50** (0.78)	0.24	0.52*
Punjab	94.13	5.72* (0.88)	0.78	16.33*
All-India	90.17	3.53* (0.71)	0.67	5.91*

* Significant at 5 per cent level.
** Significant at 10 per cent level.
Note : Figures in brackets are the standard errors of regression coefficients.

3. See Rice in India, compiled by R.L.H. Ghose, M.B. Ghatge and V. Subrahmanyan, Indian Council of Agricultural Research, New Delhi, 1960. The price approximation has been done on the basis of their weight approximation.

In all the States there is significant upward linear trend in sugarcane area series. The growth rates of sugarcane area of all the States in the sub-tropical belt would have been relatively lower than those that are in the tropical belt if and only if the growth rate of Punjab were lower than that of Andhra Pradesh. These growth rates bear perfect positive rank correlation with the corresponding growth rates of installed capacity given in column 5 of Table I. The regional and inter-State differences in growth rates of cane acreage might have arisen mainly due to the fact that the licensing of additional capacity of sugar industry during this period was not proportional to the existing capacity of these States in the beginning of the First Five-Year Plan. Of all the States, Mysore achieved most stable growth rate ($r^2 = .91$) and Bihar was comparatively most unstable in its performance ($r^2 = .24$). This instability was perhaps due to lack of assured irrigation facilities. In Bihar about 73 per cent of the cane sowing acreage depended on rainfall. Particularly in North Bihar sugarcane was grown usually under rain-fed conditions.

Let us now estimate the relationship between installed capacity and acreage under sugarcane.

TABLE II—$A_t = L_0^1 + L_1^1 C_t + U'$ (1950-51—1962-63)

State	L_0^1	L_1^1	r^2	Average sugar yield per acre during 1955-56—1962-63† (tons)
1	2	3	4	5
Tropical Region				
Andhra Pradesh ..	1.169	0.548* (0.162)	0.509	2 93
Madras	0.551	0.995* (0.165)	0.767	2.83
Mysore	0.704	0.921* (0.049)	0.970	2.87
Maharashtra	1.189	0.481* (0.082)	0.759	3.44
Sub-Tropical Region				
Uttar Pradesh	—6.728	3.751* (1.085)	0.521	1.45
Bihar	—17.551	6.150* (2.139)	0.544	1.28
Punjab	2.910	3.061* (0.414)	0.832	1.24
All-India	13.453	1.748* (0.305)	0.749	1.68

†Yield of sugarcane adjusted for quality of cane.
* Significant at 5 per cent level.
Note : Figures in brackets are the standard errors of regression coefficients.

The States in the tropical region yielded coefficients for the installed capacity variable smaller than unity while the States in the sub-tropical region yielded coefficients greater than three. The corresponding coefficient for all-India lies in between these two. The interpretation is that a unit change in installed capacity

brings on an average 1.748 units change in all-India cane acreage. For a unit change in installed capacity the States in the sub-tropical belt register at least a three fold change in sugarcane area as compared to those that are in the tropical belt.

The above differences in the coefficients of installed capacity variable cannot be taken as a measure of difference in farmers' response to installed capacity. The main reason can better be understood if we consider the average sugar yield per acre of these States. For example, a farmer in Bihar and a farmer in Maharashtra, although they want to supply cane for the production of same quantity of sugar, must allot acreage differently depending upon the yield per acre and the quality of cane. It has been observed that the rank correlation between the coefficients of installed capacity variable and the corresponding sugar yield per acre of the States given in column 5 is —0.93 which is statistically significant. The differences in coefficients of installed capacity variable are therefore largely influenced by the differences in average sugar yield per acre among the States. There was practically no change in installed sugar capacity in these States and all-India during 1950-51—1954-55 and therefore only the average yield for the period 1955-56 —1962-63 has been considered for making inter-State comparisons among the coefficients of installed capacity variable. The good linear relationship between acreage and capacity is indicative of the regulation of cane supplies to sugar factories.

By means of 't' test it has been found that the mean yield of sugar per acre in Andhra Pradesh-Maharashtra and Madras-Mysore are not significantly different. Both the insignificance of the mean yields and the closeness of the corresponding coefficients of installed capacity variable given in Table II, suggest for testing the equality of farmers' response to installed capacity. By means of following analysis it is found that sugarcane acreage response to installed capacity of sugar industry was not significantly different in Andhra and Maharashtra.

TABLE III—ANALYSIS OF VARIANCE FOR TESTING EQUALITY OF L^1, COEFFICIENTS IN THE ABOVE REGRESSION†

Andhra-Maharashtra	Residual due to	D.F.	S.S.	M.S.	F.
	Deviation from the hypothesis	1	0.0072	0.0072	15.44* (22.1)
	Separate regressions	22	2.4460	0.1112	
	Common regression	23	2.4532		

†. See Advanced Statistical Methods in Biometric Research, C. Radhakrishna Rao, John Wiley & Sons, Inc., New York, 1952, pp.113.
* Significant at 5 per cent level.

The same analysis disputes the hypothesis in case of Madras-Mysore.

Inclusion of the relative mill price variable in the previous model brought no improvement in multiple correlation except in case of Bihar (see Table IV). Greater coefficients for installed capacity variables have been obtained for all the States except Bihar. This means that stable relative mill price improves the acreage response to installed capacity. Except in case of Maharashtra the sign of

the coefficient of relative price variable is in conformity with the *a priori* hypothesis. Only in case of Bihar this coefficient is significant. This means that installed capacity remaining constant, a unit change in relative mill price brings about 12.691 units change in sugarcane acreage. The minimum mill price was attractive to the producer[4] and practically there was complete utilization of capacity in all the States except Bihar.[5] The interesting fact revealed by these results is that a mere

TABLE IV—$A_t = L_0'' + L_1'' C_t + L_2'' \frac{(P_1^t)}{(P_2^{t-1})} + U''$

State	L_0''	L_1''	L_2''	R^2	N
Tropical Region					
Andhra Pradesh	1.073	0.570* (0.210)	0.635 (0.515)	0.510	13
Madras	0.254	1.085* (0.201)	2.426 (3.046)	0.782	13
Mysore	0.689	0.928* (0.083)	0.108 (0.958)	0.970	12
Maharashtra	1.095	0.481* (0.062)	—2.072 (27.831)	0.759	13
Sub-Tropical Region					
Uttar Pradesh	—15.636	3.993* (1.064)	68.606 (51.312)	0.593	13
Bihar	—17.363	5.783* (1.482)	12.691** (6.511)	0.676	13
Punjab	1.295	3.207* (0.426)	13.951 (12.221)	0.852	13
All-India	5.090	1.920* (0.418)	63.528 (95.028)	0.755	13

* Significant at 5 per cent level.
** Significant at 10 per cent level.
Note : Figures in brackets are the standard errors of regression coefficients.

change in relative mill price will not bring any change in acreage provided there is no change in installed capacity that has been completely utilized. The significance of relative price coefficient in case of Bihar indicates that even if installed capacity had remained constant, a unit change in relative mill price would have brought more acreage under sugarcane and hence greater supplies to sugar factories for the improvement in capacity-utilization.

The next step is to drop the relative mill price variable and then to include the variables of relative price of *gur* and relative yield of cane. There is some improvement in multiple correlation in case of Mysore, Uttar Pradesh and Bihar.

4. See Indian Sugar, February, 1965, p. 712 ; also see Table VI in this paper.
5. See Dharm Narain and B.D. Dhawan: Productivity Trends in the Indian Sugar Industry, Institute of Economic Growth, Delhi-7, Appendix Table 10 (mimeo.).

TABLE V—$A_t = L_0 + L_1C_t + L_3 P'_{t-1} + L_4 Y_{t-1} + U$

(1950-51 — 1962-63)

State	L_0	L_1	L_3	L_4	R^2	N
Tropical Region						
Andhra Pradesh	1.567	0.451** (0.240)	—0.127 (0.250)	—0.002 (0.123)	0.528	13
Madras	1.138	0.849* (0.376)	0.218 (0.318)	—0.011 (0.018)	0.779	13
Mysore	1.001	0.901* (0.036)	—0.203* (0.054)	0.002 (0.002)	0.989	12
Maharashtra ..	0.924	0.485* (0.093)	0.300 (1.372)	0.0001 (0.0007)	0.761	13
Sub-Tropical Region						
Uttar Pradesh	—28.421	4.550* (1.122)	—2.106 (2.589)	0.356** (0.190)	0.660	13
Bihar	—18.628	5.839* (1.543)	1.966** (0.976)	0.011 (0.011)	0.689	13
Punjab	1.955	3.011* (0.517)	0.145 (0.573)	0.026 (0.040)	0.842	13
All-India	—2.481	1.831* (0.432)	—2.725 (8.259)	0.333 (0.301)	0.780	13

* Significant at 5 per cent level.
** Significant at 10 per cent level.
Note : Figures in brackets are standard errors of regression coefficients.

The coefficient of relative price variable is negative and significant at five per cent level in case of Mysore (—0.203), and it is positive and significant at ten per cent level in case of Bihar (1.966). These results could be studied in contrast with the results of Table VI.

TABLE VI

State	Value of output per rupee of input		Col. (3) / Col. (2) × 100
	Sugarcane	Competing crops	
(1)	(2)	(3)	(4)
Uttar Pradesh	3.2	1.5	47
Punjab	3.6	3.1	86
Bihar : North Monghyr	3.9	1.5	38
Central Monghyr	—	2.0	51
Mysore	3.6	3.5	97
Andhra Pradesh	3.2	2.2	69

(The results are on the basis of cash and kind only).
Source : Report of the Sugar Enquiry Commission, Ministry of Food and Agriculture, Government of India, 1965, p. 44.

The percentage of output value per rupee of input of competing crops to sugarcane was 38-51 in Bihar and 97 in Mysore. Even if the farmer disposed of his production for manufacture of *gur*, sugarcane cultivation was more profitable than competing crops in Bihar. Although the coefficient of relative price variable is very small in case of Mysore, its significance has some real meaning. Relative profitability of cane cultivation was very small in case of Mysore. If the cane production was particularly meant for the manufacture of *gur*, the producer had to incur loss as far as the relative price of *gur* was concerned. Sugarcane being a sturdy crop limits price influence in the farmer's decision to allot his land resources under one of the competing crops. This coefficient is not significant in other States and further it possess negative sign in case of Andhra Pradesh and Uttar Pradesh. The sign of the coefficient of Uttar Pradesh is influencing the sign of all-India.

Only in Uttar Pradesh, the coefficient of relative yield variable is significant at 10 per cent level. Although no significant linear trend is discernible in the relative yield series of Uttar Pradesh, the acreage response to relative yield is statistically significant. The year to year fluctuations in relative yield series had a significant effect on sugarcane acreage. The trends in cane yield in the States of Mysore, Maharashtra, Punjab, Bihar and all-India appears to have no significant impact on acreage changes. The coefficient of relative yield variable takes expected sign in all the States except in case of Andhra Pradesh and Madras.

Having found separately the importance of relative mill and *gur* price variables in case of Bihar, regression was run by including both the variables simultaneously with installed capacity.

$$A_t = \underset{}{-17.720} + \underset{(1.516)}{5.755^*}\ C_t + \underset{(8.085)}{8.645}\ \frac{(P_1^t)}{(P_2^{t-1})} + \underset{(1.089)}{0.953}\ P_{1-1}$$

$$R^2 = 0.702$$

Both the price variables turn out to be insignificant due to inter-correlation between them (0.58).

Conclusions

1. The State-wise installed sugar capacity of sugar industry had a direct bearing for positive changes in acreage under sugarcane. Indirectly this means that the mill price was attractive to the producer and there was significant regulation in cane supply to sugar factories at the State level. The quantitative impact of installed sugar capacity on acreage under sugarcane appears to be the same in Andhra and Maharashtra.

2. In Bihar a change in relative mill price of cane has brought about a change in sugarcane acreage which affects capacity-utilization of sugar industry. Also changes in acreage under sugarcane were positively associated with the price of *gur* as the price of *gur* was more profitable than the price of its competing crop, rice. In Mysore, farmers had responded negatively to relative price movements of *gur* during

this period. No valid inferences in regard to price movements could be drawn in case of other States on the basis of this analysis.

3. This analysis shows that in Uttar Pradesh acreage changes were positively associated with the relative yield. No such relationship had been observed in case of other States.

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A CASE STUDY OF REPAYMENT OF CROP LOANS AND CAUSES OF THEIR NON-REPAYMENT IN MAHARASHTRA STATE

During the last three Five-Year Plans, various facilities and loans are extended to the farmers in the National Extension Service, Community Development Block, Intensive Agricultural Development Project, Intensive Agricultural Area Programme and other allied schemes for giving them incentives to increase agricultural production. These facilities are offered to the farmers to make them production-oriented. But in spite of these facilities made available to them either in cash or kind, it is found that they are unable to repay the loan. An attempt is made in this note to enquire into the position of repayment and the causes of non-repayment of crop loans.

Investigation into the position of repayment of crop loans and causes of non-repayment of crop loans was undertaken in the Panvel taluka of Kolaba district in Maharashtra State. Out of the total of 43 societies, 16 societies—8 each from small size and big size (depending upon the number of members at 200 and above 200)—were selected randomly. While selecting members, two groups were formed. The first group consisted of defaulters who have not paid crop loan during 1964-65 and the second consisted of non-defaulters who paid crop loan during the said period. Out of the total number of defaulters and non-defaulters from each randomly selected society, 50 per cent defaulters and 50 per cent non-defaulters were randomly selected. From each society eight members composed of defaulters and non-defaulters were selected. Thus, in all, 128 cultivators—64 defaulters and 64 non-defaulters—were interviewed and data were collected by canvassing a questionnaire. While tabulating the data collected from 128 cultivators, it was found that data relating to 8 cultivators were unrealiable and hence they were excluded from the analysis. Thus the total sample was reduced to 120 cultivators. In addition to this sample, Chairmen and Secretaries of the selected societies were also interviewed and the information supplied by them was recorded in a separate questionnaire.

It was considered as to whether education and age of the head of the family as a member of society is related to the repaying capacity for crop loan but the result of the Chi-square test was found to be non-significant. The same test when applied to the holding-size of the member of the society was found to be significant which indicated that repaying capacity does depend upon the holding-size as could be seen from Table I.

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