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DETERMINANTS OF SUGARCANE ACREAGE FLUCTUATIONS IN UTTAR PRADESH*

Agriculture being the predominant sector of its economy, the level and pace of economic development in Uttar Pradesh have been and still continue to be significantly influenced by the pace of its agricultural development. Within the agricultural sector, sugarcane and sugar industry occupy an important place as a source of income and employment to millions of people in the State. Sugarcane is cultivated over 3.22 million hectares in the country out of which Uttar Pradesh accounted for 1.69 million hectares (1977-78) and contributed about 44 per cent of the total production of sugarcane in the country. Roughly 60 per cent of the State's cane acreage falls in the western region, 20 per cent in the eastern and 12 per cent in the central region. The acreage under sugarcane in the State has expanded from 1.01 million hectares in 1950-51 to about 1.69 million hectares in 1977-78. Growth in acreage, however, has not been uniform or steady. There have been considerable year to year fluctuations in both acreage and production. Fluctuations in sugarcane acreage have always been a matter of concern to sugar policy makers and sugar factory owners, and have recently assumed grave dimensions. This study was designed to investigate into the causes of this instability and to arrive at some meaningful explanations.

Fluctuations in sugarcane acreage are caused by variations in prices of sugarcane, gur and competing crop(s), weather conditions, availability of irrigation and other inputs, marketing of the produce, etc. The statement that cultivators in poor economies are responsive to price movements is substantiated by numerous studies including those conducted by Dharm Narain,[1] Raj Krishna,[2] Kamala Devi and Rajagopalan,[3] Sinha, Sinha and Thakurta,[4] Satyanarayana[5] and Jha.[6] However, as Lipton discusses,[7] there is a variety of peasant motivations; and a sensiti-

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* This paper forms part of the Ph. D. dissertation submitted by the senior author to the G.B. Pant University of Agriculture and Technology, Pantnagar, District Nainital (U.P.) in 1979.

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3. P. Kamala Devi and R. Rajagopalan, "Price and Acreage Response: A Study of the Groundnut Crop in North Arcot District", *Indian Journal of Agricultural Economics*, Vol. XX, No. 1, January-March 1965. pp. 31-35.

4. A. R. Sinha *et. al.*, "Indian Cultivators' Response to Prices," *Sankhya*, Vol. I, Parts 2-3, May 1934, pp. 155-165.

5. Y. Satyanarayana, "Factors Affecting Acreage under Sugarcane in India", *Indian Journal of Agricultural Economics*, Vol. XXII, No. 2, April-June 1967, pp. 79-87.

6. Dayanatha Jha, "Acreage Response of Sugarcane in Factory Areas of North Bihar", *Indian Journal of Agricultural Economics*, Vol. XXV, No. 1, January-March, 1970, pp. 79-91.

7. Michael Lipton, "The Theory of the Optimising Peasant", *Journal of Development Studies*, Vol. IV, No. 3, April 1968.

vity to price tempered by a subjective notion of the supposed value or 'superiority' of one crop over another (as suggested by Gupta and Majid[8]) could equally fall within the definition of rational behaviour. It is postulated that variations in cane acreage were induced by changes in relative prices and non-price variables like yield, proportion of irrigated area under the crop, area infested with pests and diseases and rainfall, etc. More specifically, the obpectives of this study were (1) to study the impact of relative price and non-price variables on sugarcane acreage and (2) to study the influence of risk arising from both the price and yield variations on cane acreage.

THE DATA

Out of the five agro-climatic regions into which the State of Uttar Pradesh has been delineated, this study was confined to three major sugarcane growing regions, *viz.*, western, central and eastern. Bundelkhand and Hill regions were excluded because they accounted for a small percentage of area under sugarcane. The study covers the time period from 1950-51 to 1974-75 for which data on prices, yields, rainfall, irrigated area, area infested with pests and diseases, etc., were collected from secondary sources published and/or maintained by the Government. The published sources include mainly the Bulletin of Agricultural Statistics, Season and Crop Report and the Monthly Bulletin of Prices and Arrivals of Agricultural Commodities.

THE MODEL

Sugarcane growers face a number of problems while making production decisions in response to changes in price and non-price factors. It is very seldom that they are able to make hundred per cent adjustments while responding to various economic factors, or adjust instantaneously. This suggests the use of distributed lag model for measuring the farmers' response behaviour. Nerlovian adjustment lag model was used to obtain the response relation.

The long run supply, Y_t^*, is assumed, in the Nerlovian framework to be related to the prices (P_t) in a simple linear manner:

$$Y_t^* = a + b P_{t-1} + U_t \qquad \text{.....(I)}$$

Variations in Y_t^* are connected by variations in observed or actual supply by assuming the following relationship between the actual and long run desired levels of supply.

$$Y_t - Y_{t-1} = r\left(Y_t^* - Y_{t-1}\right) \ldots\ldots 0 < r < 1. \qquad \text{.....(II)}$$

The current supply, then, is:

$$Y_t = Y_{t-1} + r\left(Y_t^* - Y_{t-1}\right) \qquad \text{.....(III)}$$

8. S. C. Gupta and A. Majid: Producers' Response to Changes in Prices and Marketing Policies, Agricultural Economics Research Centre, University of Delhi, Delhi, 1965, Chapter IV, p. 51.

r is the coefficient of adjustment, which accounts for the forces which cause the difference between the short run and long run supply-price elasticities.

By substituting the value of Y_t^* in equation (II) we get:

$$Y_t = A + BP_{t-1} + CY_{t-1} + V_t \qquad \text{.....(IV)}$$

where $A = ar$, $B = br$, $C = (1-r)$ and $V_t = r\,U_t$. Here equation (IV) is the computational equation, the parameters of which are estimated by the least squares method. The reduced form would remain basically the same even if we include more independent variables than the ones included in equation (IV). This model also helps in the estimation of both the short run and long run supply elasticities.

Using the adjustment lag model as the basic frame of analysis, the response relationships in the study were estimated with the help of the following equation:

$$\begin{aligned} \text{Log } Y_t = {} & \log a + b_1 \log Y_{t-1} + b_2 \log Z_{t-1} \\ & + b_3 \log P^g_{t-1} + b_4 \log W_t + b_5 \log D_{t-1} + b_6 \log I_t \\ & + b_7 \log P_{yt} + b_8 \log V_{yt} + \log V_t \end{aligned}$$

where

Y_t = sugarcane acreage in thousand hectares in the t th year;

Y_{t-1} = sugarcane acreage in thousand hectares, lagged one year;

Z_{t-1} = relative yield of cane to wheat, lagged one year;

P^g_{t-1} = gur price deflated by wheat price, lagged one year;

W_t = rainfall during sowing months (October-February) in mm.;

D_{t-1} = per cent cane acreage infested with pests and diseases, lagged one year;

I_t = irrigated area in thousand hectares during growing season;

P_{yt} = price risk measured by the standard deviation of sugarcane prices over the three preceding years;

V_{yt} = yield risk represented by the standard deviation of cane yields over the three preceding years;

a = constant term;

b_i's = regression coefficients (i = 1....8); and

V_t = random error in the t th year.

The log form of the function was chosen because it yielded consistently better results with respect to signs, values and levels of significance of the regression coefficients. Besides, the logarithmic forms also provided ready made estimate of short run elasticities.

Since the Durbin Waston test is inappropriate in a model which includes a lagged dependent variable (lagged acreage for example), the Durbin 'h' statistic appropriate to testing autocorrelation in lagged models was computed, where :

$$h = (1 - \tfrac{1}{2} d) \sqrt{\frac{n}{1 - n \hat{v} (\hat{b}_1)}}$$

where

d = Durbin-Watson statistic,

n = sample size,

$\hat{v} (\hat{b}_1)$ = estimate of variance b_1.

RESULTS AND DISCUSSION

The estimating model initially included prices, yields, irrigation, diseases and pests infestation, and rainfall as the independent variables, and sugarcane acreage as the dependent variable. The price and yield risks were also incorporated at a later stage. The results of the simple correlations indicated that there was no serious problem of multicollinearity present in any of the equations. In the case of the equation finally chosen, the 'h' statistic was within the acceptable range and, hence, the null hypothesis was accepted in favour of absence of serial correlation. Regression equations with relative gur price with other variables and relative gur price with risk variables are presented in Tables I and II respectively.

Relative Price

Relative sugarcane price and relative gur price were tried as alternative variables in separate regressions explaining sugarcane acreage but as the latter yielded consistently better results it was selected. Relative gur price was a better explanator probably because the gur sector accounts for a greater part of the sugarcane acreage and output in Uttar Pradesh, and since the cultivator converts cane into gur himself, the price of gur appears to be a more relevant decision variable. If higher relative gur price is expected, the farmers would plant more acreage under sugarcane. They would, however, not like to expand their output beyond the margin of safety in terms of marketability, and, therefore, this expansion is controlled. So while making adjustments in sugarcane price one must take into consideration gur prices as this has a significant bearing on cane acreage.

Lagged Sugarcane Acreage

The elasticity estimates of lagged sugarcane acreage were found to be consistently positive and highly significant. The magnitude of coeffi-

cients of this variable varied in the State from 0.560 in the central region, indicating a higher rate of adjustment to 0.726 in the western region, indicating a comparatively low rate of adjustment. In the eastern region, the regression coefficient was observed to be 0.664 which was significant at one per cent probability level. Inclusion of the lagged variable yielded a logical picture of adjustment behaviour of the sugarcane farmers, besides enabling regression models to explain a relatively greater variance in total acreage in response to changes in the explanatory variables.

Lagged Relative Sugarcane Yield

Relative sugarcane yield shows a positive and significant influence on cane acreage in all the regions and the State as a whole. The magnitude of the coefficient was highest in the central region and lowest in the eastern region. Since income of the farmers is determined by both the price and the yield of a crop, it is only logical that the relative yield turned out to be an important determinant of sugarcane acreage.

Rainfall

Of all the variables, rainfall during sowing months emerged as the weakest factor in determining acreage variations in the eastern and the central regions of Uttar Pradesh. In the western region and Uttar Pradesh as a whole, however, rainfall turned out to be an effective variable. The effect of this variable was found to be positive and significant at 5 per cent probability level in both the cases, indicating that favourable moisture conditions during planting time encourage to allocate a little more area under sugarcane. It can be said that as sugarcane growers become more and more aware of price relationships, they also start taking advantage of favourable weather conditions.

Pests and Diseases

The regression coefficient for diseases and pests variable turned out to be negative and significant in all the regions, except the western region. The farmers in the western region seem to have reacted only mildly to the occurrence of serious diseases and pests problems in sugarcane as compared to their counterparts in the eastern and central regions. On the whole, the results suggest that the incidence of pests and diseases did not have a significant impact on the farmers' acreage allocation decisions in the State. The negative response of farmers, however, indicated that sugarcane growers did not altogether ignore the deterrent effects of pests and diseases while allocating land under sugarcane.

Irrigated Area

The effect of irrigation on acreage under sugarcane was found to be positive and strong in the western region with an elasticity coefficient of 0.427, which was significant at one per cent level, followed by the

State as a whole where the acreage elasticity was of the order of 0.179, which was also significant at one per cent level (Table I). In the eastern and central regions, however, the coefficient of irrigation, though positive, appeared statistically non-significant.

Risk Aversion

Being a commercial crop, sugarcane is highly vulnerable to price changes. The attitude towards risk arising out of year to year price and yield variabilities could be assumed to be identical in all the sub-sectors of agriculture producing different commodities under different conditions. Hence, nothing conclusive could be said on *a priori* belief whether farmers are responsive or non-responsive to risks. Both the kinds of risk were incorporated in the model and the results of the regression are presented in Table II. The results reveal that yield risk had no effect on the acreage allocation decisions of the farmers as the regression coefficients of this variable were found to be negative but non-significant at all the levels in all the regions and the State as a whole. The acreage under sugarcane responded negatively to price risk in all the regions and the State as a whole. The impact of price risk on sugarcane acreage was strong in the eastern region followed by the central and the western region. Thus, the results suggest that farmers in all the three regions of the State responded negatively and reasonably significantly to the risk of price fluctuations.

The study envisaged to test the hypothesis of response of sugarcane acreage to changes in relative prices and some non-price variables. The existence of positive response to prices was conclusively established by the regressions presented in the earlier sections. The estimated coefficient of adjustment, short and long run elasticities of acreage with respect to relative gur price are presented in Table I. The elasticities of acreage with respect to relative gur price both in the short run and the long run showed considerable variation among the regions. The magnitude of the long run elasticity was found to be the highest in the western region, followed by the central and the eastern region. The estimates of long run elasticity and adjustment coefficient reveal some important features. The coefficient of adjustment for the central region was found to be highest, which implies that the desired adjustments in acreage were more rapidly made and that the price inducements operated rather quickly. The lowest rate of adjustment coefficient was observed in the case of State as a whole, indicating that acreage was influenced more by technological and institutional rigidities and that price inducement operated only gradually and slowly in the State as a whole.

Implications

Stability in sugarcane production is essential for continued and steady progress of the sugar economy in the State. The system of regulation of sugarcane price under conditions of free market is inequitous for the

TABLE I—REGIONWISE ESTIMATED ELASTICITY COEFFICIENTS OF THE DETERMINANTS (WITH RELATIVE GUR PRICE) OF FLUCTUATIONS IN SUGARCANE ACREAGE IN UTTAR PRADESH

Region/State	Elasticities										
	Constant (in log terms)	Gur/ wheat t—1	Cane acreage t—1	Cane/ wheat t—1	Rainfall t	Per cent cane acreage infested with pests and diseases t—1	Irrigated area t	Coefficient of multiple determination	Estimated value of 'h' statistic	Adjustment coefficient	Long run elasticities
	a	p^g_{t-1}	Y_{t-1}	Z_{t-1}	W_t	D_{t-1}	I_t	R^2	h		
Western region	0.749	0.604*** (0.194)	0.726*** (0.020)	0.234*** (0 042)	0.036** (0.013)	—0 058 (0.086)	0.427*** (0.030)	0.916	0.539 (NSC)	0.274	2.207
Eastern region	0.126	0.235** (0.081)	0.664*** (0.019)	0.069** (0.024)	0.008 (0.009)	—0.069*** (0.010)	0.122 (0.142)	0.913	—0.349 (NSC)	0.336	0.699
Central region	0.210	0.317** (0.115)	0 560*** (0.056)	0.564*** (0.095)	0.035 (0.024)	—0.016** (0.006)	0.029 (0.042)	0.869	0 470 (NSC)	0.440	0.721
Uttar Pradesh	0.333	0 415** (0.150)	0.741*** (0.013)	0.106*** (0.019)	0.018** (0.007)	—0.080 (0.087)	0.179*** (0.017)	0.925	0.870 (NSC)	0.259	1.600

*** Significant at 1 per cent, ** Significant at 5 per cent. * Significant at 10 per cent.

NSC = No serial correlation.

Figures in parentheses are the standard errors of the regression coefficients cncerned.

TABLE II—REGIONWISE ESTIMATED REGRESSION COEFFICIENTS OF DETERMINANTS (INCLUDING RISK VARIABLES) OF FLUCTUATIONS IN SUGARCANE ACREAGE IN UTTAR PRADESH

Region/State	Constant (in log terms)	Elasticities					Coefficient of multiple determination	Estimated value of 'h' statistic
		Cane acreage in t—1	Gur/wheat price t—1	Price risk	Yield risk	Rainfall		
	a	A_{t-1}	p^g_{t-1}	P_{yt}	V_{yt}	W_t	R^2	h
Western region	0.696	0.742*** (0.018)	0.565*** (0.035)	−0.012 (0.006)	−0.018 (0.022)	0.026** 0.013	0 946	0.908 (NSC)
Eastern region	0.203	0.672*** (0.171)	0.243** (0.096)	−0.149 (0.007)	−0.008 (0.010)	0.009 (0.009)	0.961	−0.361 (NSC)
Central region	0.457	0.597*** (0.054)	0.298 (0.192)	−0.110*** (0.020)	−0.009 0.038)	0.031 (0.026)	0.882	0.516 (NSC)
Uttar pradesh	0.596	0.744*** (0.012)	0 429* (0.153)	−0.013*** (0.004)	−0.008 (0.015)	0.127** (0.056)	0.948	0.805 (NSC)

*** Significant at 1 per cent.
** Significant at 5 per cent.
* Significant at 10 per cent.
NSC = No serial correlation.
Figures in parentheses are the standard errors of the regression coefficients concerned.

sugar industry. If efficiency in sugarcane cultivation is to be promoted and fostered over a long period of time the present system of regulation of cane price will need to be reformed. Mere adjustments in the sugarcane prices without taking into consideration the gur and wheat prices would not be meaningful because the latter two do exercise a potent influence on sugarcane acreage. Secondly, the risk arising out of price fluctuations and through infestation of pests and diseases need to be minimized. So, in a nutshell, the price and risk factors need to be taken care of through appropriate policy measures in order to provide the necessary incentives to the producers to maintain sugarcane acreage at desired levels.

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AN ECONOMIC EVALUATION OF LAND ALLOTMENT TO THE LANDLESS POOR IN AHMEDNAGAR DISTRICT OF WESTERN MAHARASHTRA : A CASE STUDY*

The Government of Maharashtra passed the bill amending the earlier Ceiling Act of 1961 in 1972 to enact the legislation, *viz.*, "The Maharashtra Agricultural Lands (Lowering of Ceiling on Holdings) and (Amendment) Act, 1972" and subsequently brought it into force with effect from September 19, 1975 in the State. This legislation, lowering ceiling on holdings, was an important step in the sphere of land reforms to follow the ideal of socialistic pattern of society by way of removing inequalities in land distribution and providing land to the landless poor. It was decided by the State Government that the surplus land acquired under this legislation will be distributed among the weaker sections of the society on or before June 30, 1976. Since two years have passed after the allotment of land to the new allottees, it was thought appropriate and worthwhile at this stage to attempt a scientific assessment of cultivation of allotted land as well as to examine changes in employment and income pattern of the new allottees as a result of land allotment to them. With this view in mind, the present study was undertaken in Ahmednagar district of Western Maharashtra during the year 1978-79.

Objectives

Specifically, this paper seeks to study the cultivation pattern and farm business economy of the sample new allottees in the cultivation of allotted land as well as the changes in their household economy as a

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