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Vol XXV
No. 1

ISSN 0019-5014

JANUARY-
MARCH
1970

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

(2) The wheat yield per kilogram of nitrogen application was 22.8, 22.2, 20.5 and 19.8 kgs. from Sonalika, Kalyan Sona, Sharbati Sonora and Chhoti Lerma (S. 331) respectively at 140, 180, 120 and 180 kgs. nitrogen application.

(3) At the current nitrogen-wheat prices, the most profitable levels of nitrogen for Kalyan Sona, Chhoti Lerma (S. 331), Sonalika and Sharbati Sonora were 170, 157, 133 and 116 kgs. per hectare. At these optimum levels of fertilization wheat yields of 3,968, 3,551, 3,185 and 2,450 kgs. per hectare due to fertilizer application with corresponding per hectare net profits of Rs. 2,355, Rs. 2,073, Rs. 1,862 and Rs. 1,349 may be expected from Kalyan Sona, Chhoti Lerma (S.331), Sonalika and Sharbati Sonora respectively. Therefore, given the limited quantity of fertilizers, it would be more profitable for the farmers to grow the new high-yielding wheat variety like Kalyan Sona.

I. J. SINGH, K. C. SHARMA AND J. P. MISHRA†

ACREAGE RESPONSE OF SUGARCANE IN FACTORY AREAS OF NORTH BIHAR*

The Tirhut Division of North Bihar has been one of the traditional sugarcane growing tracts of the country. Grown in over three lakh acres, sugarcane is the most important cash crop of the region, providing for the much needed cash requirements of a large number of subsistence farmers and catering to the raw material requirements of 25 out of the 30 sugar factories in the State. Wide fluctuations in its acreage have always been a matter of concern, and have recently assumed grave dimensions. This study was designed to probe into the causes of this instability and arrive at a meaningful, quantifiable explanation.

It has been observed that these fluctuations stem primarily from the variability in relative price position. Dutt commented on this and indicated that variations in cane acreage were governed mainly by the relative price of sugarcane and seasonal conditions at the time of sowing.[1] The Sugar Enquiry Commission also emphasized the importance of relative prices.[2] Some recent work in this area also supports this contention.[3] It has been hypothesized in this study that varia-

† Senior Research Associate in the Department of Agricultural Economics, Associate Professor of Agronomy, and Technical Associate in the Department of Agricultural Economics respectively at the Uttar Pradesh Agricultural University, Pantnagar (Nainital).

* This paper forms a part of the author's Ph. D. dissertation, submitted to the Indian Agricultural Research Institute (1969). The work was done under the supervision of Dr. K. Kanungo and his valuable contributions at all stages of the work are gratefully acknowledged.

1. N. L. Dutt: Report on Survey of Sugarcane Research in India, Indian Central Sugarcane Committee, New Delhi, 1950.

2. Report of the Sugar Enquiry Commission, Ministry of Food and Agriculture, Government of India, New Delhi, 1965.

3. Studies containing specific reference to the sugarcane crop include :Raj Krishna, "Farm Supply Response in India-Pakistan : A Case Study of the Punjab Region," *The Economic Journal*, Vol. LXXIII, No. 291, September, 1963; Dharm Narain : The Impact of Price Movements on Areas under Selected Crops in India, 1900—1939, Cambridge University Press, London, 1965; A. S. Kahlon, S. S. Johl and H. N. Dwivedi, "Structure of Farm Prices in the Punjab," *Indian Journal of Agricultural Economics*, Vol. XX, No. 1, January-March, 1965; Y. Satyanarayana, "Factors Affecting Acreage under Sugarcane in India," *Indian Journal of Agricultural Economics*, Vol. XXII, No. 2, April-June, 1967; K. Subbarao, "Farm Supply Response—A Case Study of Sugarcane in Andhra Pradesh," *Indian Journal of Agricultural Economics*, Vol. XXIV, No. 1, January-March, 1969.

tions in cane acreage were induced by changes in relative prices and other non-price variables like yield and rainfall. It aimed at measuring their influence through elasticities, and also at analysing the changes which have occurred in these relationships in the wake of changing situations. With reference to a time horizon, these changes were the phenomenal expansion in the demand for sugarcane following grant of fiscal protection to the sugar industry in 1932, and the accelerated tempo of economic activity since the initiation of planned economic development in 1951.

Specifically, the objectives of this study were (1) to study the impact of relative price and some non-price variables on sugarcane acreage, and (2) to study the changes in the nature and magnitude of relationship between variables over time.

METHODOLOGY

Districtwise data on acreage, price and other variables were obtained from the Season and Crop Reports of the Government of Bihar for the period 1912-13 to 1964-65. Appropriate weighting procedures were used to obtain regionwise estimates of data pertaining to the Saran, Champaran, Muzaffarpur and Darbhanga districts of the Tirhut Division. Regression analysis of time-series data was the main statistical tool employed for the study. A dummy variable was introduced in the model to take care of the non-comparability in acreage series owing to the change in method of reporting from *chowkidari* to the complete enumeration method in 1949-50.[4] In order to examine changes over time, separate analyses were conducted for the 1912-13 to 1964-65, 1933-34 to 1964-65 and 1950-51 to 1964-65 segments of the time-series. Additional regressions were also run for three independent segments—1912-13 to 1932-33, 1933-34 to 1949-50 and 1950-51 to 1964-65—for a more precise picture of these changes.

The Nerlovian adjustment lag model was used to obtain the response relation. The basic functional form adopted for this study can be expressed as:

$$\overset{\#}{A}_t = a + b_1 P_{t-1} + b_2 Y_{t-1} + b_3 C_t + b_4 W_t + b_5 T_t + b_6 D_t \quad .. \text{(a)}$$

where, $\overset{\#}{A}_t$ = long run equilibrium acreage under sugarcane in thousand acres in t; P_{t-1} = price of sugarcane (and *gur*) relative to the price of competing crop (wheat)[5] in the preceding period (post-harvest); Y_{t-1} = yield of sugarcane in tons per acre in the preceding period; C_t = area under the competing crop (wheat) in thousand acres in the period t;[6] W_t = rainfall during pre-sowing months

4. The dummy variable has values zero in the years before 1949-50 and one in other years. See : William G. Tomek, "Using Zero-One Variables with Time Series Data in Regression Equations," *Journal of Farm Economics*, Vol. 45, No. 4, November, 1963.

5. Data on average prices of sugarcane paid by the factories were available only after 1931-32. Average post-harvest prices of *gur* were available for the entire period.

6. It is often hypothesized that the cropping pattern in a subsistence agriculture is largely a function of the essential food requirements of the population. Area under crops like sugarcane would then be determined on the basis of how much land has been left over after these requirements are fulfilled. Explicit inclusion of wheat acreage would enable testing of this hypothesis. It must be admitted, however, that this involves a sort of duplication because the substitution relation between the two crops also finds implicit expression in the relative price variable itself.

(October-February) in the period t in inches; T_t = trend and D_t = a dummy variable to pick up the effect of change in the method of estimation of acreage in 1949-50.

The adjustment behaviour is given by the relation:

$$A_t - A_{t-1} = \gamma(A_t^{\#} - A_{t-1}) : \quad 0 < \gamma < 1 \qquad \ldots \text{(b)}$$

where γ is the co-efficient of adjustment. Relations (a) and (b) give the reduced form :

$$A_t = \alpha + \beta_1 P_{t-1} + \beta_2 Y_{t-1} + \beta_3 C_t + \beta_4 W_t + \beta_5 T_t + \beta_6 D_t + \beta_7 A_{t-1} \qquad \ldots \text{(c)}$$

where, $\alpha = a\gamma$, $\beta_1 = b_1\gamma$, $\beta_2 = b_2\gamma$, $\beta_3 = b_3\gamma$, $\beta_4 = b_4\gamma$, $\beta_5 = b_5\gamma$, $\beta_6 = b_6\gamma$, $\beta_7 = (1-\gamma)$.

RESULTS AND INTERPRETATION

1. Relationships

Regression equations for different time periods and price specifications are presented in Table I. In all cases, a sizable proportion of total variation is explained by the regressions. The relative price variable appears consistently significant, but the same cannot be said of other variables. It is quite clear, however, that for identical time periods the relative sugarcane price equations provide a better measure of the relationships than do the relative *gur* ones. Not only are the values of R^2 higher, but the influence of non-price variables also finds a better expression in these equations. This is further substantiated by equations with significant variables presented in Table II. In the paragraphs that follow, an attempt has been made to analyse the influence of each of the explanatory variables in different time periods and under alternate price specifications.

(*i*) *Relative Price*

Higher levels of significance for the price variable and higher R^2 values obtained for the relative sugarcane price equations tended to suggest that these prices have been more important in the post-1932-33 period. It could also be inferred, from both sugarcane and *gur* equations, that prices have gained in prominence over recent years. The coefficients for the price variable are generally higher and more significant in the 1950-51 to 1964-65 than in other equations.

Significance of the relative *gur* price variable indicated that this also entered farmers' decisions. The relationship could, perhaps, be explained in the form of a two-price phenomenon—a floor provided by the minimum sugarcane prices and a free market price of *gur*. If higher relative *gur* price is expected, farmers 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,

TABLE I—ESTIMATED LINEAR ACREAGE RESPONSE FUNCTIONS FOR SUGARCANE IN DIFFERENT TIME PERIODS

Time period	Relative price	Constant	Regression co-efficients: Relative price in t—1	Cane yield per acre in t—1	Cane acreage in t—1	Wheat acreage in t	Rainfall (October-February) in t	Trend	Dummy	Co-efficient of multiple determination
			P_{t-1}	Y_{t-1}	A_{t-1}	C_t	W_t	T_t	D_t	R^2
1912-13 to 1964-65	Relative *gur* price	103.5560	50.7662*** (19.0733)	—0.9319 (2.1533)	0.5879*** (0.1225)	—0.2791** (0.1367)	1.6512 (1.7035)	1.8051** (0.7612)	29.4000 (22.5818)	0.8878***
1933-34 to 1964-65		125.6156	81.7155*** (20.8422)	2.5131 (2.3227)	0.3174*** (0.1452)	—0.0427 (0.1500)	3.2487* (1.8300)	—1.8313 (1.1384)	57.0903** (25.2131)	0.6551***
1950-51 to 1964-65		378.5931	209.4967** (87.5043)	5.9281 (3.9711)	0.9757 (0.3927)	—0.0642 (0.2128)	6.1335** (2.5324)	—13.0929* (6.3158)		0.7354**
1933-34 to 1964-65	Relative cane price	128.9455	1066.3629*** (218.8431)	3.5042 (2.0666)	0.2104*** (0.1300)	—0.0729 (0.1353)	3.0359* (1.6409)	—1.6934 (1.0168)	61.2573** (22.9695)	0.7156***
1950-51 to 1964-65		287.7389	2180.6220*** (576.4052)	7.2190* (3.1645)	0.1683*** (0.1916)	0.0137 (0.1679)	5.2982** (1.9488)	—7.5456** (3.0348)		0.8372***

* Significant at 10 per cent.
** Significant at 5 per cent.
*** Significant at 1 per cent.
The null hypothesis for the coefficient of lagged acreage is that it is equal to one.
Note : Figures in parentheses are standard errors.

TABLE II—SOME ADDITIONAL RESPONSE FUNCTIONS CONTAINING SIGNIFICANT VARIABLES

Time period	Relative price	Constant	Regression co-efficients: Relative price in t—1	Cane yield per acre in t—1	Cane acreage in t—1	Wheat acreage in t	Rainfall (October-February) in t	Trend	Dummy	Co-efficient of multiple determination
			P_{t-1}	Y_{t-1}	A_{t-1}	C_t	W_t	T_t	D_t	R^2
1912-13 to 1964-65	Relative *gur* price	.. 97.8180	46.6940** (18.2029)		0.5566*** (0.1122)	—0.2605* (0.1338)		2.0643*** (0.7066)	23.2193 (21.2435)	0.8854***
1933-34 to 1964-65		.. 107.3094	88.7272*** (19.7954)		0.4083*** (0.1216)		3.7692** (1.7041)	—1.9420* (1.1125)	53.1753** (19.1468)	0.6340***
1950-51 to 1964-65		.. 221.7091	162.0804* (84.3345)		0.8960 (0.3984)		6.0880** (2.5811)	—7.6661 (5.3824)		0.6517**
1933-34 to 1964-65	Relative cane price	.. 101.2725	1072.8925*** (215.3773)	3.7868* (1.9700)	0.2083*** (0.1281)		2.8555* (1.5827)	—1.7615* (0.9945)	53.2354*** (17.2163)	0.7121***
1950-51 to 1964-65		.. 293.0399	2175.5995*** (540.6698)	7.1659** (2.9213)	0.1708*** (0.1786)		5.3155** (1.8270)	—7.5067** (2.8272)		0.8370***

* Significant at 10 per cent.
** Significant at 5 per cent.
*** Significant at 1 per cent.
The null hypothesis for the co-efficient of lagged acreage is that it is equal to one.
Note : Figures in parentheses are standard errors.

this expansion is controlled—perhaps a few acres more than what they could sell to the factories, a level determined by the sugarcane price expectation. This interpretation makes it clear that mere adjustments in the minimum sugarcane prices without taking into consideration the *gur* prices would not be meaningful because the latter do exercise a potent influence on sugarcane acreage.

(*ii*) *Sugarcane Yield in the Previous Year*

The analysis revealed that lagged yield did not show any significant influence in any time period equation with relative *gur* prices. But in regressions with relative sugarcane prices, this variable emerged important. This seemed reasonable in view of the fact that the income obtained by the farmers is determined by both prices and yield. It appears, by inference, that this variable was not an important determinant of acreage before 1932-33.

(*iii*) *Rainfall in Pre-sowing Months*

Except for the 1912-13 to 1964-65 equation, this variable was found to be significant in others, indicating that favourable moisture conditions during planting time encourage a little more area to be put under the crop. It could be argued that as the farmers became more and more aware of the price relationships, they also started taking advantage of favourable weather conditions. Considering that sugarcane is grown largely as an unirrigated crop in the region,[7] these findings are quite rational.

(*iv*) *Acreage under Wheat*

This variable was found to be significant only in the 1912-13 to 1964-65 equation. It could be deduced that prior to the emergence of sugarcane as a stable cash crop in or around 1933-34, its acreage was determined to a large extent by the absolute acreages under other grain crops. There being no deliberate attempt to allocate areas under sugarcane, it was planted only after the grains quota was fulfilled. Later, however, this crop became important, and, in affecting acreage changes, farmers were guided by the more subtle price relationships rather than by absolute acreages under competing grain crops.

(*v*) *Trend and Dummy Variables*

The coefficient of time showed a negative sign in most of the regressions. The 1912-13 to 1964-65 equation has a positive coefficient which is attributed mainly to the rather phenomenal rise in sugarcane acreage, beginning with less than one lakh acres in the early 1910s to over three lakh acres in the 'fifties, witnessed over this period.

The dummy variable reflected the effect of change in the method of estimation of acreage. Positive coefficients were obtained in all equations suggesting that the increase in sugarcane acreage around 1949-50 was largely due to the change

7. Only about 7.5 per cent of the area under sugarcane in the region is irrigated.

in estimation method, that is, acreages reported under the *chowkidari* system before 1949-50 were under-estimated.

(*vi*) *Lagged Sugarcane Acreage*

Interesting results were obtained with respect to this variable, which, though not a functional one, enters as an independent variable in the estimating equation of the Nerlovian adjustment lag model. With relative *gur* prices, its coefficients differed significantly from one for the 1912-13 to 1964-65 and 1933-34 to 1964-65 equations. But in regressions for 1950-51 to 1964-65, its coefficients approached one. With sugarcane prices, on the other hand, its magnitude declined. It appeared that, for identical time duration, *gur* prices being inferior predictors of acreage, the bulk of the variation was picked up by the lagged acreage variable in equations with *gur* prices. This did not happen when sugarcane prices were used. Thus, the rigidity in sugarcane acreage which the *gur* equations suggested appeared only artificial and with proper specification of the price variable, a more logical picture emerged.

2. Changes in Relationships over Time

In order to confirm the tentative nature of results obtained regarding the nature and magnitude of changes in relationships over time presented in the preceding section, regressions were run for the three independent time segments—1912-13 to 1932-33, 1933-34 to 1949-50 and 1950-51 to 1964-65. For relative sugarcane price only the later two periods were relevant. These regressions along with the 't' values for differences between coefficients for the compared periods have been presented in Table III.

All the equations have fairly high R^2 values. There are some important changes in the magnitudes and signs of individual coefficients. These are subsequently discussed.

Considering the price variable first, it is clear from the 1912-13 to 1932-33 equation that relative *gur* price did not exercise any influence on sugarcane acreage during that period; it became important in the 1933-34 to 1949-50, and persuasive in the 1950-51 to 1964-65 time periods. The same appears true for relative sugarcane price also. The test of significance of differences between coefficients for price in different time periods indicates that these differ significantly amongst themselves. It confirms the hypothesis propounded in the preceding section regarding a more price conscious behaviour on the part of farmers following the emergence of an organized market for their produce and greater tempo of economic activity.

The fact that farmers respond to both sugarcane and *gur* prices is important and, what is more interesting, the commencement of the period of response to *gur* prices coincides with that of the spurt in sugar industry in the region. Prior to 1932-33, production of sugarcane was meant largely for direct consumption. The increase in the demand for cane from factories resulted in more than doubling the acreage under cane and the farmers' saleable surplus increased. With the emergence of this surplus, the farmers began exploring alternative opportunities

TABLE III—ADDITIONAL RESPONSE FUNCTIONS FOR ANALYSIS OF CHANGES IN RELATIONSHIPS OVER TIME

Time period	Relative price	Constant	Regression co-efficients						Co-efficient of multiple determination	Short run elasticity with respect to price
			Relative price in t—1	Cane yield per acre in t—1	Cane acreage in t—1	Wheat acreage in t	Rainfall (October-February) in t	Trend		
			P_{t-1}	Y_{t-1}	A_{t-1}	C_t	W_t	T_t	R^2	
1912-13 to 1932-33	Relative *gur* price	273.0684	—1.9282 (17.9722)	—4.7433 (3.8717)	0.0098*** (0.2748)	—0.3181** (0.1338)	—1.3629 (1.3479)	2.1646*** (0.5684)	0.7171***	Negative
1933-34 to 1949-50		161.6906	74.4834*** (20.5427)	1.3313 (4.3393)	0.0673*** (0.1562)	0.1310 (0.1122)	—1.0449 (2.4386)	—2.0496 (1.4618)	0.7207**	0.2607
1950-51 to 1964-65		378.5931	209.4967** (87.5043)	5.9281 (3.9711)	0.9757 (0.3927)	—0.0642 (0.2128)	6.1335** (2.5324)	—13.0929* (6.3158)	0.7354**	0.6390
1933-34 to 1949-50	Relative cane price	180.3223	768.0454** (253.7703)	1.0917 (4.7623)	0.0923*** (0.1726)	0.0925 (0.1212)	—0.8418 (2.7453)	—2.3721 (1.6103)	0.6630**	0.2765
1950-51 to 1964-65		287.7389	2180.6220*** (576.4052)	7.2190* (3.1645)	0.1683*** (0.1916)	0.0137 (0.1679)	5.2982** (1.9488)	—7.5456** (3.0348)	0.8372***	0.6585
Test of significance of difference between co-efficients for different time periods : 't' values										
Gur 13-33 Vs. 34-50			2.7971***	1.0445	0.1819	2.5722**	0.1142	2.6869**		
Gur 13-33 Vs. 51-65			2.3666**	1.9241*	2.0152*	1.0099	2.6131**	2.4061**		
Gur 34-50 Vs. 51-65			1.7338*	0.7395	4.2036***	0.8576	3.0763***	1.9682*		
Cane 34-50 Vs. 51-65			2.2720**	1.0671	0.2981	0.3990	1.8177*	1.5230		

* Significant at 10 per cent.
** Significant at 5 per cent.
*** Significant at 1 per cent.
The null hypothesis for the co-efficient of lagged acreage is that it is equal to one.
Note : Figures in the parentheses are standard errors.

for disposal of their produce and, since then, they have kept an eye on both sugarcane and *gur* prices when planning their acreage allocations.

Explicit inclusion of wheat acreage in the equations for the three time periods established that the absolute acreage under this crop had a significant influence on sugarcane acreage only during the early part (1912-13 to 1932-33) of the time period considered in this study. The fact that relative prices gained considerable significance over the later periods suggested that the substitution phenomenon was properly taken care of by the price variable itself. With regard to the influence of the lagged yield and pre-sowing rainfall variables, results obtained in this section broadly support the inferences already drawn.

The salient features of this empirical exercise may be summed up as follows:

(*a*) Before 1932-33, the acreage under sugarcane was determined primarily by area under other grain crops. But since then prices have become progressively more important. Both sugarcane and *gur* relative prices exercise an identical influence though the former enabled better explanation of the variations in sugarcane acreage in recent years.

(*b*) The non-price variables like lagged yield and pre-sowing rainfall have emerged significant only recently.

(*c*) The coefficients of lagged acreage suggested, in Nerlovian parlance, a general absence of rigidities to adjustment in sugarcane acreage.

(*3*) *Economic Interpretation*

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 a positive response to prices was conclusively established by the regressions presented in the earlier sections. Of the two relative price variables considered, relative sugarcane prices appeared more important than relative *gur* prices, though the latter too exerted an identical influence. It appeared reasonable in view of the fact that the farmers could attach greater certainty to their expectations regarding sugarcane prices. Mellor has also argued that the response would be greater if there were no, or less, price uncertainty.[8] It eliminates or reduces the need to discount planned acreages on account of price uncertainty. In order to provide an objective measure of response to price changes, Table IV gives the estimates of elasticities for the acreage response functions presented in Table I.

The most striking feature of the short run price elasticities of acreage is the order of ascendance in the estimates for successively more recent time periods. This confirms the observation made earlier regarding a more price conscious behaviour over recent years. The fact that before 1933-34 the price variable was of no importance has already been established. An assured and sizable demand for sugarcane (from factories) had, therefore, a distinct impact on producers' decisions to plant this crop. During this period (1933-34 to 1964-65)

8. J. W. Mellor : The Economics of Agricultural Development, Cornell University Press, Ithaca, New York, 1966, p. 205.

TABLE IV—ESTIMATES OF ELASTICITIES OBTAINED FOR DIFFERENT TIME PERIODS

Time period and price variable used	Elasticity with respect to price		Elasticity with respect to		Coefficient of adjustment	Years required for 95 per cent effect of price@
	Short run	Long run	Yield	Rainfall		
Relative *gur* price						
1912-13 to 1964-65 ..	0.2257***	0.5477	—0.0464	0.0343	0.4121	5.6
1933-34 to 1964-65 ..	0.2710***	0.3970	0.0998	0.0559*	0.6826	2.6
1950-51 to 1964-65 ..	0.6390**	18.6297	0.2324	0.0963*	0.0243	—
Relative sugarcane price						
1933-34 to 1964-65 ..	0.3508***	0.4443	0.1391*	0.0522*	0.7896	1.9
1950-51 to 1964-65 ..	0.6585***	0.7917	0.2830*	0.0832*	0.8317	1.7

* Significant at 10 per cent.
** Significant at 5 per cent.
*** Significant at 1 per cent.
@ Calculated as $(1-r)^n = 0.05$, where r is the coefficient of adjustment and n is the number of years required to enable 95 per cent of the effect of change in price to materialise.

both *gur* and sugarcane prices were instrumental in affecting changes in acreages—high elasticities were obtained with respect to both.

The elasticity with respect to lagged yield was very low for almost all equations except those for the 1950-51 to 1964-65 time period and it was slightly higher for the relative sugarcane price equation. Over the whole time span, the response has been negligible, understandably so because the yields have remained stationary over a large part of this period of 53 years. It was only during the late 'fifties that the yields showed significant improvement and the relatively high elasticity during this period suggested that farmers were not indifferent to changes in this variable.

With respect to rainfall during pre-sowing months, very low figures of elasticity were found indicating only a marginal response to this variable.[9] The snag in such an inference lies in the fact that elasticity is a relative measure. While a 0.08 per cent change in response to a one per cent change in the amount of pre-sowing rainfall appears negligibly small, it should be remembered that variations of $\pm$ 100 per cent are not uncommon in this variable, and this would mean, in absolute terms, a $\pm$ 8 per cent change in sugarcane acreage on account of this variable alone.

Examination of the figures for long run elasticity and coefficient of adjustment reveals some important features. With respect to relative *gur* price, erratic estimate of long run elasticity was obtained for the 1950-51 to 1964-65 period. In view of this and the associated suggestion of an almost untenable rigidity in sugarcane acreage indicated by the *gur* price equation, the observation regarding inferiority of these prices as predictors of sugarcane acreage in the long run seems confirmed. It can, therefore, be concluded that, over recent years, farmers have responded to *gur* prices in the short run only. Their long run equilibrium acreage notions have been guided by sugarcane price situation.

With respect to sugarcane prices, the ascendant feature is the high value of the coefficient of adjustment and the closeness of short and long run elasticities. A high coefficient of adjustment implies, in Nerlovian terms, a general lack of rigidities which inhibit attainment of equilibrium output. The findings of this study, interestingly enough, are in significant contrast to the commonly held view that these rigidities are more likely to be overriding in an under-developed economy. The fact that the coefficient of adjustment is large and that on an average only about two years are required for the farmers to adjust to the tune of 95 per cent of the change in price, belies this contention. The response to change in relative sugarcane price is almost spontaneous.

A situation of inelastic supply prevails in the long run in spite of a quick rate of adjustment. The long run elasticity is below unity. Inelastic acreage response at the aggregate level seems reasonable in the context of limited land resources and high premium placed on growing food crops in a subsistence-oriented agricul-

9. Jai Krishna and M. S. Rao, "Dynamics of Acreage Allocation for Wheat in Uttar Pradesh: A Study in Supply Response," *Indian Journal of Agricultural Economics*, Vol. XXII, No. 1, January-March, 1967, also obtained similar results.

ture. The food requirements of the population have a priority in acreage allocation and other crops are grown only after this constraint has been met with.

Coming next to the explanation of high rate of adjustment, it is appropriate to examine the nature of production process and the factors associated therewith. Sugarcane is grown as an unirrigated crop in the region; seed and labour form the primary inputs of production. Expenditures on irrigation, fertilizers, etc., are not important. Both the vital inputs, seed and labour, are in relatively large supply. There are, thus, no serious obstacles if the farmer wishes to expand acreage. As it is, the very traditional nature of production, involving low cash outlays and outputs, seems to be the cause of a high rate of adjustment. Similar arguments have been put forward by Mellor in hypothesizing higher flexibility in response to price changes in low income agricultures.[10]

It thus emerges that, within the restraint of meeting the food requirements of the people, the farmers have been conscious and reactive to changes in relative prices in both the short and the long run. The main cause of instability in sugarcane acreage lies not in the irrational behaviour of the farmers but in the relative price structure facing them. The problem in this context is not merely one of finding and maintaining a balance between the prices of sugarcane and other crops but also of maintaining a balance between *gur* and sugarcane prices. Farmers respond to both these prices in the short run. The closeness of the long and short run elasticities also indicated that while stability may be attainable through manipulation of the price variable, the same would have only a limited direct influence when any sizable expansion in acreage is desired in the long run.

4. *Some Implications*

The most significant finding of this study was the conclusive evidence obtained regarding farmers' response to changes in relative prices. This awareness seemed to have become more acute with the passage of time and a short run acreage elasticity of above 0.63 obtained for the 1950-51 to 1964-65 period with respect to both sugarcane and *gur* relative prices is fairly high. Further evidence on rationality of farmers was provided by the fact that though in the short run they responded to both sugarcane and *gur* prices, their long run decisions were based more on the latter. It was argued that in the short run manipulation of sugarcane prices will have to be made keeping in view its parity with *gur* prices.

The fact that the long run response was found to be inelastic in spite of a quick rate of adjustment, needs a cautious interpretation in terms of price policy measures. While in the short run moderate increases in sugarcane acreages may be brought about by pushing the relative prices higher, *ceteris paribus*, usefulness of prices as instrument to induce sizable shifts in acreage in the long run is rather limited. The explanation for this apparent paradox comes from the traditional nature of agriculture which restricts opportunities for acreage substitution to a relatively narrow range in the long run. With reference to fluctuations in acreage, a highly elastic long run response would imply much larger gyrations for a given

10. Mellor : *op. cit.*, Chapter 11.

change in relative prices. The inelasticity of long run response may, in this context, be viewed as a blessing in disguise.

This line of reasoning presents only a partial picture because it does not take into consideration the variable of technological change. From the same or even smaller parcel of land a much larger output may be obtained and this alters the whole dimension of supply given by acreage response. While it may not be possible to obtain large increases in production through expansion of acreage in the long run, the same may be realised by a superior technique of production. Land, which is the most restricting resource in the traditional framework, becomes only a secondary input and thus exercises only a minor influence on output variations under the new technology. In other words, the response of output may be highly elastic in spite of inelastic acreage response. The role of prices in this changed context is clear. They have to be such as to encourage adoption of these innovations; their impact would be more meaningfully measured in terms of variations in production rather than acreages. This is in total agreement with the inferences drawn by Mellor[11] that in a traditional agriculture price policy has a limited role to play as a direct stimulant to output in so far as this increase is supposed to come through expansion in acreage, but it has significant importance in the context of agricultural modernization and technological change.

DAYANATHA JHA*

CO-OPERATIVE CREDIT AND AGRICULTURAL DEVELOPMENT : COST AND OVERDUES IN A LESS DEVELOPED RICE REGION

Raipur in Madhya Pradesh is one of the seven districts chosen from different States for the implementation of the Intensive Agricultural District Programme in its first round. Co-operative credit was assigned an important role in the programme. Credit under this programme is production-based and production-oriented, and is to be tied to the repaying capacity of the farmer or to the additional production due to improved practices and not to tangible security.

A major reorganization of the credit structure in the district took place in December, 1959 when the primary credit societies were transformed into service societies with a broad-based membership. The introduction of Package Programme in April, 1961 resulted in another major change in the co-operative credit structure of the district. At the close of the co-operative year, 1967-68, the Central Bank had 20 branches covering the 23 development blocks in the district. Under the scheme to make the societies viable, the number of societies has declined sharply from 1,026 in 1965-66 to 593 in 1967-68.

Increasing Overdues

One of the factors which led to the selection of Raipur district for the programme was the ready availability of a strong and sound base of agricultural credit through the well established Raipur District Central Co-operative Bank and its

11. Mellor : *ibid.*

*Division of Agricultural Economics, Indian Agricultural Research Institute, New Delhi-12.