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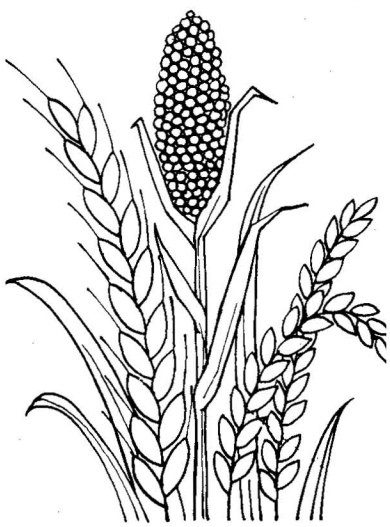

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IMPACT OF PRICE AND PRICE VARIABILITY ON ACREAGE ALLOCATION IN HARYANA

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INTRODUCTION

Agriculture is by far the most important sector in the economy of a nation. In India, during the last decade, increase in population has been more pronounced than increase in agricultural production, creating a lag in the availability and requirement of food crops. Thus, to feed and clothe the teeming millions of India, the pace of agricultural production has to be increased. For proper planning and policy formulation, it is a matter of paramount importance to study the behaviour of farmers' attitudes towards price variations. If the study favours the farmers' response to price changes in allocating their resources among different crops they grow, the desired allocation of the available resources could be obtained by using price as an incentive to the farmers. This is particularly important for the crop prices fixed by the Agricultural Prices Commission. A considerable body of literature has been developed in this field and at present, different opinions on supply response prevail. One view is that the farmers in under-developed countries are not responsive to the changes in relative prices,[1] while the other view is that they are no less responsive than those in the developed countries.[2]

The present study aims at studying the farmers' responsiveness to changing price levels and other factors affecting the output supply. The selection of area for such type of studies depends upon the homogeneity of the region. In a country like India where the cropping pattern, types of soil, climatic conditions, etc., vary widely from one region to another, no unique hypothesis could be formulated for the country as a whole. Even within a State the sowing and harvesting seasons for the same crop are different. The distribution of rainfall varies from place to place and wide differences are found in the quality of the product produced in different districts which lead to large differences in the prices of that product. Thus, one has to strike a balance between the homogeneity of the region and the level of aggregation at which the data are available.

The present study pertains to the State of Haryana which has experienced an unprecedented annual linear agricultural growth rate of 15.50 per cent

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1. Dharm Narain: Impact of Price Movements on Area under Selected Crops in India 1900-1939, Cambridge University Press, London, 1965.

2. Raj Krishna, "Farm Supply Response in India-Pakistan: A Case Study of the Punjab Region," *The Economic Journal*, Vol. LXXIII, No. 291, September, 1963, pp. 477-487.

during 1966-1972.[3] In particular, the output growth rates of the important crops of the State, *viz.*, wheat, gram, rice, bajra, rapeseed and mustard have been remarkably high. These are the crops which have been included in this study.

The adjustment of farmers in acreage allocation to a change in the price level is not an instantaneous one. It is a process involving time. Once we accept the adjustment of farmers to a change in the price level as a phenomenon of distributed lags, we are left with a wide choice in selecting a particular distributed lag model. In recent years, sufficient literature has been developed in the area of distributed lag models.[4]

DATA AND METHODOLOGY

In the present study, a model of the Nerlovian type[5] has been used in the simplest form and is based on the relations:

$$A_t^* = a + b\, P_{t-1} + U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$A_t - A_{t-1} = B\,(A_t^* - A_{t-1})\;;\; 0 < B < 1 \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

and the reduced form becomes

$$A_t = A_0 + A_1\, P_{t-1} + A_2\, A_{t-1} + V_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

where $A_0 = aB$, $A_1 = bB$, $A_2 = (1-B)$ and $V_t = BU_t$

The coefficient 'B' is known as Nerlovian coefficient of adjustment and is based on Hick's elasticity of expectations. This coefficient indicates how fast the farmers are adjusting to their expectations. A value of 'B' near zero means that the farmers are very slowly adjusting to the changing prices and other factors. 'B' value closer to one means that the adjustment is quick to the changing levels of prices and other factors.

Statistics relating to rainfall and irrigated area, area under crop, production, prices of wheat, gram, rapeseed and mustard, maize, bajra, rice and sugarcane in Haryana State were recorded from the Statistical Abstract of Haryana.

As the information was available from 1960-61 onwards, the study was restricted to the period from 1960-61 to 1972-73 only.

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3. I. J. Singh and A. C. Gangwar, "Green Revolution and Agricultural Growth Rates in Haryana," Department of Economics, Haryana Agricultural University, Hissar, 1975 (unpublished).
4. Zvi Griliches, "Distributed Lags: A Survey," *Econometrica*, Vol. 35, No. 1, January, 1967, pp. 16-49.
5. Marc Nerlove: The Dynamics of Supply, Johns Hopkins Press, Baltimore, 1958.

The functional relationship considered was

$$A_t = \phi (Y_{t-1}, \bar{P}_{t-1}, R_{t-1}, Z_{t-1}, T_t)$$

where A_t=area under the crop at (t)th time,

Y_{t-1}=yield of the crop at (t—1)th period,

$\bar{P}_{t-1}$=relative price of the crops at (t—1)th period.

The competing crops selected in respect of each of the crops studied were as follows :

Crop	Competing crops
Wheat	Gram, rapeseed and mustard
Rice	Bajra, maize, sugarcane
Bajra	Maize, rice, sugarcane

Relative prices were taken as the weighted average of the harvest prices of competing crops in each season, weights being the yield of a crop.

R_{t-1}=average rainfall during (t—1)th period.

Average was taken over three month's rainfall preceding to the season concerned.

Z_{t-1}=one year lagged irrigated area in the season concerned and T_t=trend variable.

To examine the effectiveness of the additional variables like price variability and yield variability to the acreage allocation, the coefficient of variation of prices (SP_t) and the coefficient of variation of yield (SY_t) over the preceding four years were included in the function considered.

The estimates of the short-run (SR) and long-run (LR) elasticities of price and price variability were worked out along with their 95 per cent fiducial limits. The fiducial limits of parameters $\hat{\beta}$ were worked out as :

$\hat{\beta} \pm$ t at 5 per cent level of significance $\times$ Standard Error ($\hat{\beta}$).

Two types of functions, linear and logarithmic, in the above stated variables were fitted for estimating the farmer's response to the prices and price variations. As logarithmic function was found a better specification than linear function, the former has been presented here. The study could not be carried out for maize and rapeseed and mustard as these crops had shown irregular trends.

In the results presented, signs such as *, ** and *** stand for the significance at 1 per cent, 5 per cent and 10 per cent level of significance and figures in parentheses indicate the standard errors of the estimates of the coefficients.

RESULTS

1. *Wheat*

The acreage response equations for wheat are as follows :

$$(1\cdot1)\quad \text{Log } A_t = -\cdot2679 + \underset{(\cdot0559)}{\cdot0286 \text{ Log } \bar{P}_{t-1}} + \underset{(\cdot0852)}{\cdot9827^{*} \text{ Log } A_{t-1}}, \qquad R^2 = \cdot9672$$

$$(1\cdot2)\quad \text{Log } A_t = -\cdot3927 + \underset{(\cdot0693)}{\cdot0452 \text{ Log } \bar{P}_{t-1}} + \underset{(\cdot0876)}{\cdot9815^{*} \text{ Log } A_{t-1}} - \underset{(\cdot0054)}{\cdot0037 \text{ Log } T_t}, \qquad R^2 = \cdot9688$$

$$(1\cdot3)\quad \text{Log } A_t = -1\cdot1082 + \underset{(\cdot0579)}{\cdot0509 \text{ Log } \bar{P}_{t-1}} + \underset{(\cdot0244)}{\cdot0542^{***} \text{ Log } \bar{SP}_{t-1}} + \underset{(\cdot0832)}{\cdot9703^{*} \text{ Log } A_{t-1}} - \underset{(\cdot0045)}{\cdot0030 \text{ Log } T_t}, \qquad R^2 = \cdot9807$$

$$(1\cdot4)\quad \text{Log } A_t = \cdot2788 + \underset{(\cdot0441)}{\cdot0144 \text{ Log } \bar{P}_{t-1}} + \underset{(\cdot1309)}{\cdot6674^{*} \text{ Log } A_{t-1}} + \underset{(\cdot0949)}{\cdot2862^{***} \text{ Log } Z_{t-1}}, \qquad R^2 = \cdot9837$$

The above equations reveal that the lagged variables acreage, irrigated area in the season and the price variability had significant effect on the allocation of land for wheat. Though the price coefficient was not significant its sign was as expected. The negative coefficient of trends indicated a downward shift in the allocation of area to wheat.

The estimates of SR and LR elasticities of price and price variability along with their 95 per cent fiducial limits are summed up in Table I.

TABLE I– ESTIMATES OF SR AND LR ELASTICITIES AND THEIR 95 PER CENT FIDUCIAL LIMITS

Equation No.	Coefficient of adjustment	Estimates of elasticity with respect to				95% fiducial limits of SR elasticity estimate with respect to			
		Price		Price variability		Price		Price variability	
		SR	LR	SR	LR	UL	LL	UL	LL
1.1	.0173	.0286	1.6531			.1531	—.0959		
1.2	.0185	.0452	2.4432			.2019	—.1115		
1.3	.0297	.0509	1.7138	.0542***	1.8249	.1844	—.0826	.1105	—.0021
1.4	.3326	.0144	0.0432			.1141	—.0853		

The estimates of SR elasticity of price and price variability were found quite low which showed that an increase in the relative price of wheat or in the price variability would bring about a small increase in the allocation of

land to wheat. Equation 1.1 showed the estimate of SR elasticity with respect to price as 0.0286 and corresponding 95 per cent fiducial limits were 0.1531 and —0.0959. The policy implication of this finding is that (*i*) other things being equal, if the relative price of wheat is increased by one per cent an increase in the land under wheat would be 1/35 of one per cent and (*ii*) an increase of one per cent in the relative price of wheat would bring about an increase in the area under wheat by not more than 1/7 of one per cent and a decrease by not less than 1/10 of one per cent. In other words, Table I and the acreage response equations show that in the short-run, a change in the relative price of wheat may bring about a marginal change in the area under wheat. Assured irrigation may also affect the area as its coefficient was found positive and significant.

2. *Bajra*

Following are the equations showing the farmers' response for allocation of land to bajra :

$$(2.1)\ \text{Log } A_t = 2.8353 + \underset{(.0561)}{.2009^{*}}\ \text{Log } \bar{P}_{t-1} + \underset{(.1681)}{.4587^{**}}\ \text{Log } A_{t-1}, \qquad R^2 = .8062$$

$$(2.2)\ \text{Log } A_t = 2.7489 + \underset{(.0606)}{.2458^{*}}\ \text{Log } \bar{P}_{t-1} + \underset{(.1584)}{.4453^{**}}\ \text{Log } A_{t-1} - \underset{(.0041)}{.0062}\ \text{Log } T_t, \qquad R^2 = .8457$$

$$(2.3)\ \text{Log } A_t = 2.5401 + \underset{(.0667)}{.1661^{**}}\ \text{Log } \bar{P}_{t-1} + \underset{(.1417)}{.5063^{**}}\ \text{Log } A_{t-1} - \underset{(.0039)}{.0027}\ \text{Log } T_t + \underset{(.0210)}{.0451^{***}}\ \text{Log } S\bar{P}_{t-1}, \qquad R^2 = .8956$$

$$(2.4)\ \text{Log } A_t = 2.8639 + \underset{(.0596)}{.2095^{*}}\ \text{Log } \bar{P}_{t-1} + \underset{(.1739)}{.4636^{**}}\ \text{Log } A_{t-1} - \underset{(.0719)}{.0443}\ \text{Log } R_{t-1}, \qquad R^2 = .8141$$

$$(2.5)\ \text{Log } A_t = 2.8097 + \underset{(.0611)}{.2019^{*}}\ \text{Log } \bar{P}_{t-1} + \underset{(.1949)}{.4663^{**}}\ \text{Log } A_{t-1} - \underset{(.0401)}{.0027}\ \text{Log } Y_{t-1}, \qquad R^2 = .8063$$

These equations showed that the variables like price, area and price variability were found to be positive as well as significant. It indicated that the changes in these variables would affect the allocation of land under bajra crop significantly. The coefficient of multiple determination was observed varying from 80 to 90 per cent. Inclusion of trend variable showed a downward shift in the area. Rainfall had also shown a decrease in area but its coefficient was low and statistically insignificant.

The estimates of SR and LR elasticities of price varied between 0.1661 and 0.4431 and those of price variability were 0.0451 and 0.0909. Also, these coefficients were found significant.

Corresponding to each estimate of elasticity, 95 per cent fiducial limits are given in Table II. It is apparent from the table that for one per cent increase in the relative price of bajra, an increase in the area allocated to

TABLE II—ESTIMATES OF SR AND LR ELASTICITIES AND THEIR 95 PER CENT FIDUCIAL LIMITS

Equation No.	Coefficient of adjustment	Estimates of elasticity with respect to				95% fiducial limits of SR elasticity estimate with respect to			
		Price		Price variability		Price		Price variability	
		SR	LR	SR	LR	UL	LL	UL	LL
2.1	.5413	.2009*	.3711			.3258	.0760		
2.2	.5547	.2458*	.4431			.3828	.1088		
2.3	.4937	.1661**	.3364	.0451***	.0909	.3060	.0262	.5294	—.4392
2.4	.5364	.2095*	.3905			.3443	.0747		
2.5	.5357	.2019*	.3768			.3427	.0611		

bajra cannot be more than one-third of one per cent and not less than 1/38 of one per cent. As observed in the case of wheat, the relative price, price variability and area under bajra were found significantly effective in allocating land to this crop.

3. *Rice*

The acreage response equations for rice are as follows :

$$(3.1)\quad \text{Log } A_t = .7964 + \underset{(.1855)}{.2319}\ \text{Log } \bar{P}_{t-1} + \underset{(.2177)}{.7022^*}\ \text{Log } A_{t-1}, \qquad R^2 = .9426$$

$$(3.2)\quad \text{Log } A_t = .4838 + \underset{(.1839)}{.2620}\ \text{Log } \bar{P}_{t-1} + \underset{(.2156)}{.7360^*}\ \text{Log } A_{t-1} - \underset{(.0058)}{.0068}\ \text{Log } T_t, \qquad R^2 = .9502$$

$$(3.3)\quad \text{Log } A_t = .2937 + \underset{(.2175)}{.1975}\ \text{Log } \bar{P}_{t-1} + \underset{(.2549)}{.8116^*}\ \text{Log } A_{t-1} - \underset{(.0062)}{.0058}\text{Log}T_t + \underset{(.0244)}{.1051}\ \text{Log } \bar{SP}_{t-1}, \qquad R^2 = .9525$$

$$(3.4)\quad \text{Log } A_t = .7603 + \underset{(.1960)}{.2294}\ \text{Log } \bar{P}_{t-1} + \underset{(.2298)}{.6995^{**}}\ \text{Log } A_{t-1} + \underset{(.0982)}{.0150}\ \text{Log } R_{t-1}, \qquad R^2 = .9427$$

$$(3.5)\quad \text{Log } A_t = 1.9024 + \underset{(.1577)}{.3540^{**}}\ \text{Log } \bar{P}_{t-1} + \underset{(.2932)}{.1136}\ \text{Log } A_{t-1} + \underset{(.1095)}{.2748^{**}}\ \text{Log } Y_{t-1}, \qquad R^2 = .9662$$

$$(3.6)\quad \text{Log } A_t = 1.2127 + \underset{(.1128)}{.3738^{**}}\ \text{Log } \bar{P}_{t-1} + \underset{(.2149)}{.2628}\ \text{Log } A_{t-1} + \underset{(.0840)}{.1796^{***}}\ \text{Log } Y_{t-1} + \underset{(\cdot 0385)}{.1196^{**}}\ \text{Log } SY_{t-1}, \qquad R^2 = .9847$$

A study of the above equations reveals that lagged area, yield, price and price variability were contributing significantly towards the positive direction for the allocation of land under the rice crop. The trend variable showed a downward shift as observed for wheat and bajra. Average rainfall in the previous year had shown an increase as its coefficient was positive.

TABLE III—ESTIMATES OF SR AND LR ELASTICITIES AND THEIR 95 PER CENT FIDUCIAL LIMITS

Equation No.	Coefficient of adjustment	Estimates of elasticity with respect to				95% fiducial limits of SR elasticity estimate with respect to			
		Price		Price variability		Price		Price variability	
		SR	LR	SR	LR	UL	LL	UL	LL
3.1	.2978	.2319	.7787			.6518	—.1880		
3.2	.2640	.2620	.9924			.6779	—.1539		
3.3	.1884	.1975	1.0483	.0151	.0801	.6990	—.3040	.5778	—.5477
3.4	.3005	.2294	.7633			.6116	—.1528		
3.5	.8864	.3540**	.3993			.7107	—.0027		
3.6	.7372	.3738*	.5070			.6339	.1137		

Table III shows that the estimates of SR and LR elasticity of price varied from 0.1975 to 0.3738 and from 0.3993 to 1.0483 respectively. The estimates of price variability were found very low, being 0.0151 and 0.0801 for SR and LR respectively. The study of fiducial limits revealed that these limits, in the case of price, were not fluctuating much and were centred between 0.6642 and—0.1525. The highest and lowest values of upper limit were 0.7107 and 0.6116 and of lower limit were —0.0027 and —0.3040. These results show that an increase in the amount of land under rice would be observed at the most by 71 per cent and a decrease not less than by 0.27 per cent whenever an increase by 100 per cent in the relative price of rice is observed.

CONCLUSIONS

In the present study, the farmer's supply response to the changing circumstances was studied only for crops wheat, rice and bajra in Haryana State over the period of 1960-61 to 1972-73. The farmers in the area considered were found responsive to the changes in relative prices (weighted average of harvest prices) and price variability of wheat, rice and bajra as the coefficients had the right positive sign and were significant in most of the cases. Similar responses to the changes in yield and yield variability were observed. The negative coefficient of rainfall for wheat and bajra indicated a downward shift in the allocation of land to wheat and bajra. A positive response to the changing levels of irrigated area in the season concerned with the crop under study was obtained for wheat and rice. The coefficients of trend variable were observed negative in all the cases and showed a downward shift in the acreage allocation to wheat, rice and bajra over a period of time. The values of Nerlovian coefficient of adjustment were found low which meant that although the farmers were adjusting to the changing levels of price, price variability, yield, etc., yet the adjustment was not rapid.