FARMER'S RESPONSE TO PRICE IN ALLOCATING ACREAGE TO JUTE IN WEST BENGAL

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The response of farmers to changes in price depends upon a number of factors, *viz.*, the nature of the crop—subsistence or cash; alternative opportunities for the use of the land; the element of risk or uncertainty involved in extending the area under the crop; the concentration of large, medium or small farmers in the area under study, etc. It is also common knowledge that in various regions and for several crops, agronomic factors including the nature of soil, the amount of rainfall received, rotation practices etc., are more important determinants of the area to be sown under a crop than economic considerations. Technological development affecting the productivity and cost of production of the crop has also revealed the compatibility of income advantage with price disadvantage. It may not therefore be unreasonable to assume that, depending on the various factors, the farmers' response to prices may vary widely—it may be highly positive in some cases and hardly significant in others. And since this response cannot be taken for granted a separate study needs to be made in every case, in the light of the agro-economic complex of the region, to find out how far variations in prices affect the acreage decisions of the farmers.

For the purpose of this study, which is intended to be illustrative rather than exhaustive, we have selected a crop which is generally believed to be responsive to prices, a district where there is a large cultivation of the crop and a state, which accounts for nearly fifty per cent of the total area under the crop in the whole country. The crop is jute, the district is 24 Parganas, and the state is West Bengal.

It is intended to find out the response not so much to year-to-year variations in prices but to what may be called changes in expected normal prices. In other words, the endeavour will be to find out mainly long term price elasticity of supply, which in the present case, is being identified with that of acreage.[1]

The concept of a long term normal price is no doubt subjective but the farmer arrives at his notion of a normal price expected at a future date by taking into account the behaviour of prices in the past. For the purpose of estimating normal price. it may be considered to be a weighted average of past prices, with weights diminishing in value as one goes back in time. Symbolically, this may be expressed as

$$P^*t - P^*_{t-1} = B\,(P_{t-1} - P^*_{t-1})$$

where P^*_t is the expected normal price at time t

P^*_{t-1} is the expected normal price at time $t-1$

B is the co-efficient of expectation

P_{t-1} is the observed or actual price lagged one year.

Along with the concept of a long term normal price, the farmer has his own notion of what may be called an 'equilibrium acreage'. The actual acreage at time t, according to this concept, is adjusted in proportion to the difference between equilibrium acreage and actual acreage at time $t-1$. In the from of an equation, the relation may be expressed as follows :

$$x_t - x_{t-1} = A\,(x^*_t - x_{t-1})$$

where x_t is the acreage at time t

x_{t-1} is the acreage at time t—1

x^*_t is the acreage desired in the long term equilibrium

and A is the co-efficient of adjustment.

The farmer thus is interested in knowing the effect of a change in normal prices not only on the current acreage but also on the long run equilibrium acreage.

The difference between the co-efficient of price expectation and co-efficient of acreage adjustment also needs to be clarified at this stage. While with the help of the former co-efficient, expected normal price is determined from past prices, with the help of the latter co-efficient, the current acreage is seen as a function of the intended level of acreage.

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1. The author has drawn heavily on the pioneering work done by Marc Nerlove in the choice of the models for dealing with the problems discussed.

The methodology adopted for estimating farmers' response to prices is one which links equilibrium acreage with expected normal price. This relationship can be expressed in the following form:

$x^*_t \quad = a_0 + a_1 P^*_t + U_t$ ....(1) [N.B. 2]

where x^*_t is the equilibrium acreage

P^*_t is the expected normal price

U_t is the error term.

Since x^*_t and P^*_t are both unobserved variables, in solving for them, it will be necessary to express them in terms, of actual or observed variables, lagged one or two years, as the case may be. Such a substitution is possible by virtue of the relationship already discussed between expected normal price and actual price and between current acreage and equilibrium acreage. The procedure is briefly explained below:

We have seen that

$$x_t - x_{t-1} = A\,(x^*_t - x_{t-1})$$

or

$$Ax^*_t = x_t - (1-A)\,x_{t-1}$$

Multiplying (*i*) by A and applying the above relation we have:

$$Ax^*_t = Aa_0 + Aa_1 P^*_t + AU_t$$

or

$$x_t = Aa_0 + (1-A)\,x_{t-1} + Aa_1 P^*_t + AU_t \text{............}(2)$$

or

$$(1-B)\,x_{t-1} = (1-B)\;Aa_0 + \;(1-A)\;(1-B)\;\;x_{t-2} + Aa_1\,(1-B)\;P^*_{t-1} + A\;(1-B)\;U_{t-1} \text{............}(3)$$

Subtracting (2) from (3) and having regard to the fact that

$P^*_t - (1-B)\;P^*_{t-1} = BP_{t-1}$ we have;

$$x_t = a_0\;BA + a_1\;BAP_{t-1} + \{(1-A) + (1-B)\}\;x_{t-1} - (1-A)\;(1-B)\;x_{t-2} + A\;\{U_t - (1-B)\;\;U_{t1}\} \text{...........}(4)$$

or

$$x_t = L_0 + L_1\;P_{t-1} + L_2\;x_{t-1} + L_3\;x_{t-2} + V_t \text{.............}(5)$$

The next step is to obtain estimates of L_s, through regression analysis and derive the estimate of a_1, the co-efficient of P^*_t in equation (1). Once this is done, the long-term elasticity with respect to expected normal price can be estimated. The estimation of a_1 from the least square estimates of L_s is effected in the following manner.

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2. It is extremely difficult to introduce prices of two crops in this acreage equation, unless it is assumed that co-efficients of price expectations for both the crops are the same and the co-efficients of acreage adjustments are also equal—assumptions which are hardly realistic. Two prices are not also strictly necessary in the model where the object of the study is the impact of a change in the expected normal prices of a crop on long-term equilibrium acreage.

$$L_1 = a_1\ BA\ ;\ L_2 = 1 - B + 1 - A$$

and

$$L_3 = -(1-B)(1-A)$$

$$\frac{L_1}{1 - L_2 - L_3} = a_1 \quad \text{[N.B. 3]}$$

It may be mentioned here that since the coefficients BA appear symmetrically, it is not possible to identify them separately but as shown above a unique estimate of a_1 is possible.

Application of data. Data on acreage under and harvest prices of jute in 24 Parganas, West Bengal for a period of 17 years, 1949-50 to 1965-66, have been fitted into the model. A unique estimate of a_1 has been obtained, with the help of the least square estimates of L_s. The long-run elasticity with respect to expected normal price works out at 0.82 (Table 1). This is indicative of the high degree of responsiveness of jute cultivators to the expected normal price in allocating acreage to this crop.

For readers who are interested in finding out the impact of a change in lagged observed price on actual or observed acreage, it may be pointed out that such an analysis can be undertaken directly from the previous model by assuming the two co-efficients of expectation and adjustment to be unity. For instance, where B, the co-efficient of expectation is unity, the relation $P^*_t = (1-B)\ P^*_{t-1} + BP_{t-1}$ resolves itself into $P^*_t = P_t - 1$, or the expected normal price at time t, becomes the same as the observed or actual price at time $t-1$. Similarly, if A, the co-efficient of acreage adjustment, is taken to be unity, the equilibrium acreage turns out to be the same as the observed acreage, as will be clear from the following :

$$x_t - x_{t-1} = A(x^*t - x_{t-1})$$

when $A = 1,\ x_t - x_{t-1} = x^*_j - x_{t-1}$ or $x^*_t = x_t$

when both the co-efficients are unity the original equation :

$$x^*_t = a_o + a_1\ P^*_t + U_t \text{ becomes}$$

$$x_t = a_o + a_1\ P_{t-1} + U_t \quad \text{[N.B. 4]}$$

which is nothing but a simple linear regression analysis on the effect of a change in lagged price on actual acreage.

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3. A word may be said about the error term or the problem of multicollinearity. Since non-iterative procedure is followed by us, the residuals of Vt (equation 5) have to be independent if the parameters are to be considered unbiased and eonsistent. In that event, however, the expression $\{U_t - (1-B)\ U_{t-1}\}$ in equation has to satisfy auto regressive relationship. There is reason to believe that when $o < B \leqslant 1$, U_t is positively serially correlated. Hence least square estimates of the parameters in equation 5 have been obtained to derive estimates of a_o and a_1 in equation 4.

4. The error term in this case is assumed to be mutually independently distributed with zero mean and finite variance and no serial or auto-correlation.

In estimating the elasticity, on the basis of *actual* or observed variables, it is possible and useful to introduce a new variable, *i.e.* the price of *aus* (autumn) rice which competes for area with jute. Accordingly, the harvest prices of jute in 24 Parganas have been deflated by those of *aus* rice in that district and the elasticity has been taken at the mean values of price lagged one year and observed acreage. The results have been shown in Table 2. It will be seen that this elasticity (0·11) with respect to preceding year's price (which may be termed as short runs elasticity) is much lower than the long run elasticity (0·82) estimated earlier. This lends support to a view that it is not necessarily the past price only which the farmers take into account in planning their acreage for the ensuing season. This lagged price is likely to have a limited and temporary response. The farmers do not regard any particular past price as suggestive of long term normal conditions and hence it was considered useful to introduce the expectation model in our exercise.

Again, there is a feeling that the observed acreage does not represent a position of complete adjustment to the prices considered by the farmers in arriving at their acreage decisions. The farmers have their own notion of acreage desired in the long run. Whatever may be the prices considered, the current acreage need to be adjusted in proportion to the difference between the equilibrium (long term) and observed (short term) acreage. Hence it was considered useful to introduce the adjustment model also in the exercise.

A word of caution is however necessary in regard to the use of the expectations model. When there is sufficient basis for concluding that the regression coefficient associated with acreage lagged two years is not significantly different from zero, the hypothesis that neither A nor B is equal to one needs to be rejected and one has to accept the alternative hypothesis that either A or B equals one. In that event, depending on whether A or B equals one, the long term equilibrium acreage becomes the same as the observed acreage—or the expected normal price becomes the same as the observed price lagged one year *i.e.* P_{t-1} and in both cases, the jute acreage lagged two years, x_{t-2}, disappears from the regressions. The elasticity co-efficient is accor-
ingly changed.

When however equations (1) (Page 111) is the true generator of
ta, any partial adjustment modely by arbitrarily assuming one
wo co-efficients, A or B equal to one, would cause, what is
y known as "specification error" and make the estimates of
o-efficients and standard errors biased.[5]

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Of late, doubts have been expressed by some researchers about the rationaility of an expectation model based on the behaviour of only past prices. A modified version of expectation model which in addition to prices takes into account observed deviations of yield from its normal value, has been suggested by Prof. Nowshirvani.[6] While there is no doubt that such suggestions for modification or improvement need serious consideration, our main purpose in this paper was to illustrate the advisability of assessing supply response to price by taking into account long term normal conditions and not merely the observed acreage in relation to any particular past price.

TABLE 1

Area—'000 hectares
Harvest price—Rs. per md.

Acreage under and harvest prices of jute in 24 Parganas, West Bengal

Year	x_t	x_{t-1}	x_{t-2}	P_{t-1}
1949-50	32·5	26·4	16·6	35·0
1950-51	39·3	32·5	26·4	37·5
1951-52	50·5	39·3	32·5	40·5
1952-53	51·8	50·5	39·3	44·0
1953-54	27·8	51.8	50·5	24·0
1954-55	32·4	27·8	51·8	21·8
1955-56	41·5	32·4	27·8	21·0
1956-57	26·9	41·5	32·4	23·3
1957-58	33·1	26·9	41·5	24·5
1958-59	42·0	33·1	26·9	23·0
1959-60	25·8	42·0	33·1	19·8
1960-61	25·6	25·8	42·0	20·0
1961-62	50·3	25·6	25·8	34·4
1962-63	48·4	50·3	25·6	33·0
1963-64	52·3	48·4	50·3	26·5
1964-65	53·9	52·3	48·4	31·4
1965-66	49·2	53·9	52·3	36·8

$x_t = L_0 + L_1 P_{t-1} + L_2 x_{t-1} + L_3 x_{t-2} + V_t$ where

P_t=price in the previous year.

x_{t-1}=area in the last year.

x_{t-2}=area in the year before last and

x_t=area in the current year

6. "A modified Adaptative Expectation Model"—American Agricultual Economics, Volume 53, No. 1, February 1971.

The values are:

$$x_t = L_o + 0{\cdot}83\ P_{t-1} + 0{\cdot}198\ x_{t-1} + 0{\cdot}071 x_{t-2} \qquad R^2 = 0{\cdot}50$$

when we consider the original equation $x^*_t = a_o + a_1\ P^*_t + U_t$ we have:

$$a_1 = \frac{L_1}{1 - L_2 - L_3} = \frac{0{\cdot}83}{1 - 0{\cdot}198 - 0{\cdot}07} = 1{\cdot}13$$

Elasticity $= 0{\cdot}82$

TABLE 2

Area — '000 hectares
Price — Rs per md.

Acreage under jute and jute/and price ratio in 24 Parganas in West Bengal

Year	X_t	P_{t-1} *(adjusted)*
1949-50	32·5	35·00
1950-51	39·3	42·50
1951-52	50·5	34 42
1952-53	51·8	33·15
1953-54	27·8	24·14
1954-55	32·4	27·88
1955-56	41·5	23 80
1956-57	26·9	26·35
1957-58	33·1	23·80
1958-59	42·0	20 75
1959-60	25·8	18·00
1960-61	25·6	17·85
1961-62	50·3	27·20
1962-63	48·4	25·50
1963-64	52·3	18·70
1964-65	53·9	20·40
1965-66	49·2	22·85

$$x_t = a_o + a_1 P_{t-1} + U_t$$

where

x_t=price in the current year

and P_{t-1}=jute/*aus* price ratio (adjusted).

The values are:

$$x_t = a_o + 0{\cdot}17\ P_{t-1}$$

$$\text{Elasticity} = a_1 \times \frac{\overline{P_{t-1}}}{\bar{x}_t} = 0{\cdot}17 \times \frac{25{\cdot}90}{40{\cdot}19} = 0{\cdot}11$$

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