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CONCLUSIONS

Although the number of studies relating to supply response in agriculture in India is very small, such studies have yielded conflicting results. In this paper we have tried to study the consequences of using different price expectations on inferences relating to response of acreage under wheat in Uttar Pradesh. The inferences relating to acreage response change drastically as we change our hypotheses relating to the expectation models used by farmers. Therefore, one should not hasten to draw inferences based on any one of the expectation models. The preconceived notions of both the schools of thought, *i.e.*, those hypothesising high degree of supply response and those hypothesising negligible supply response, can be substantiated if the results presented above for different models are looked at individually. We feel that given the present store of knowledge available in the country regarding the expectational behaviour of farmers, one would be on very shaky ground to draw valid inferences. The response coefficients are valid only to the degree that the hypotheses regarding price expectations are valid.

EFFECT OF FARMER'S DECISION AND BEHAVIOUR IN SUBSTITUTING AREAS UNDER JUTE AND PADDY IN WEST BENGAL

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I

INTRODUCTION

Jute being a cash crop the response of production to price variations is significant. Observations have revealed that in case of cereals the response of supply to price especially in downward direction, is limited. Tracing back the response of production to prices, it has been found that prices bear a close relationship with the area under jute and fluctuations in production are, by and large, due more to variations in the area sown to the crop than the average unit yield. This responsiveness of area to prices, in case of jute, has further been accentuated by the relatively small share of jute acreage to the total cultivated area and the substitutability between jute and paddy.

In most of the jute growing areas in India, rice is the main food crop and so the major part of the cultivated area is put under paddy. The soil, climate and other natural factors are also suitable for raising two or even three paddy crops from the same land. However, the grower's preference for an alternative crop lies not only on subsistence requirement but on broad economic considerations as well. These economic considerations generally refer to relative cash income from jute and *aus* paddy which ultimately place these two crops on a competitive or substitutive plane. It may, however, be mentioned that the competition or substitution between jute and *aus* paddy is not perfect. The imperfections may be attributed mainly to some inherent characteristics of these two crops. For example, jute being an industrial raw material has some definite market potential while *aus* paddy which is a variety inferior to *aman*, has a negative preference function under an assured food supply. Thus the variations in area sown to jute or the extent of jute cultivation in any particular season, is determined broadly by two components, namely, economic decision and the tradition and other extraneous variables jointly. The analysis and discussion in the present paper is, however, devoted mainly to the economic decisions. Therefore, though the present approach does not fully explain the variations in the area under jute, it nevertheless throws some light on the behaviour pattern of cultivators which may prove useful in the future planning.

II

FARMER'S DECISION UNDER RESTRAINTS[1]

Let us first study the attitude of the grower in allocating area under jute under some axioms. Considering the most stringent assumption that the cultivator has "A" acre of land which is suitable for growing both jute and *aus* paddy and is likely to remain stable under any condition and at the same time, natural, physical and other influencing factors act equally on both jute and paddy, the cultivator will frame his decision according to "output-input ratio"—N_1 and N_2 for jute and *aus* paddy respectively in the following manner :—

(*i*) the cultivator will cultivate jute if $N_1 > N_2$;

(*ii*) the cultivator will cultivate paddy if $N_1 < N_2$ and

(*iii*) the cultivator will remain undecided if $N_1 = N_2$,

$$\text{where } N_1 = \frac{Y_1^* p_1}{c_1} \quad \text{and} \quad N_2 = \frac{Y_2^* p_1}{c_2}$$

Y_1^* stands for expected unit yield, p_1 for expected price and c_1 for expected cost for jute. Similarly Y_2^*, p_2 and c_2 stand for unit yield, expected price and cost for *aus* paddy respectively.

Accordingly the decision of the cultivator rests on forecast values of yield, price and cost. Under Indian conditions these decision variables ys, ps, and cs may be considered as last year's performances. The cultivators thus face the decision position as indicated in (*i*), (*ii*) and (*iii*) above. In actual practice, however, the expected values of yield, price and cost have to be determined from the past data, along with other variables some of which are exogenous and some predetermined endogenous variables.

1. The whole treatment in this section is made on the assumption that the farmers are interested in the immediate gain with minimum risk rather than long-term gain with higher risks.

Let the forecast figures for yield, price and cost for both jute and *aus* paddy are y^*_{1f}, p^*_{1f}, c^*_{1f} and y^*_{2f}, p^*_{2f}, c^*_{2f}. Let the confidence intervals for y^*_{1f}, p^*_{1f} and c^*_{1f} are (y_1, y_2), (p_1, p_2) (ψ_1, ψ_2) and (y'_1, y'_2), (p'_1, p'_2), (ψ'_1, ψ'_2) respectively level α. Accordingly, the decision of selecting one crop out of the two will depend upon :

$$\eta^* = \frac{y^*_{1f}\, p^*_{1f}}{c^*_{1f}} \text{ and } \xi^* = \frac{y^*_{2f}\, p^*_{2f}}{c^*_{2f}} \text{ and on closed intervals}$$

$$\eta = [\eta_1, \eta_2],\ \xi = [\xi_1, \xi_2]$$

where η^* is an interior point of η and ξ^* is an interior point of ξ.

The intervals $[\eta_1, \eta_2]$ and $[\xi_1, \xi_2]$ is defined by :

$$\eta_1 = \frac{y_1\, p_1}{\psi_2};\ \eta_2 = \frac{y_2\, p_2}{\psi_1} \text{ and } \xi_1 = \frac{y'_1\, p'_1}{\psi'_2};\ \xi_2 = \frac{y'_2\, p'_2}{\psi'_1}.$$

The decision procedures that will follow under different restrictions on η and ξ are discussed below :

Case—1

Suppose intersection of the η and ξ is null, *i.e.*, $\eta \cap \xi = 0$ (null), the cultivator will accept η^* or ξ^* whichever is greater, even when $\eta \neq \xi$.

Case—2

Suppose intersection of η and ξ be, $\eta \cap \xi = \eta\xi$ where $\eta\xi \subset \eta$ and ξ, but $\eta\xi \not\supset \eta$ or ξ. Under the circumstances, the decision will be based on the minimisation of risk and also on the maximisation of profit.

Accordingly, if $\eta = \xi$, the cultivator will accept η^* or ξ^* whichever is greater.

But when $\eta \neq \xi$ and $\xi > \eta$, the cultivator will accept η^* straightway if $\eta^* > \xi^*$. On the other hand, if $\xi > \eta$ and $\eta^* < \xi^*$ the cultivator will choose as indicated below, *i.e.*,

$$\text{he will accept } \xi^* \text{ if } \frac{\xi^*}{\eta^*} > \frac{/\xi/}{/\eta/}$$

$$\text{he will accept } \eta^* \text{ if } \frac{\xi^*}{\eta^*} < \frac{/\xi/}{/\eta/} \text{ provided } /\ \xi^* - \eta^*\ / < \epsilon$$

where ϵ denotes some pre-assigned constant which depends upon η. Similarly, if $\eta > \xi$ the same procedure will be followed.

Case—3

Finally, under the condition when $\xi \subset \eta$ or $\eta \subset \xi$ the cultivator will accept η^*, provided $\eta^*(\xi_2-\xi_1) > \xi^*(\eta_1-\eta_2)$ and will accept ξ^*, if $\eta^*(\xi_2-\xi_1) < \xi^*(\eta_2-\eta_1)$. But when $\xi^*/\eta^* < \frac{\xi_2 - \xi_1}{\eta_2 - \eta_1}$ and $\xi \supset \eta$, the cultivator is likely to accept for minimising the risk.

III

ECONOMIC MODEL

Coming back to economic decision of the cultivator, let us assume that areas under jute and *aus* paddy for a cultivator in a particular season have registered a rise or fall over the previous season. This increase or decrease in the areas under jute and *aus* paddy are designated as x_j and x_p respectively and the increment or decrement in the total area under jute and paddy is denoted as x_o. At this stage it may again be assumed that natural and physical factors do not provide any scope for utilization of land other than raising these two crops. Resultantly, the following restriction comes in :

$$x_o - x_j - x_p = 0.$$

As stated earlier, this increase or decrease in the areas under these two crops may be attributed to a number of causal factors. But there can be no denying the fact that cultivator's decision in allocating area under a crop depends primarily on economic considerations. These economic considerations in respect of a cash crop like jute mainly refer to relative income potential of jute and cash requirement of the cultivator. Thus, taking these variables under consideration and assuming that the variables are directly observable it may be written as :

$$x_j = F(\alpha_1, Y_{-1}, Z_{-1}, C_1) + U_1$$

where α is a constant, Y_{-1} and Z_{-1} are previous year's incomes from jute and *aus* paddy respectively, C_1 is cash requirement and U_1 denotes structural disturbances.

Similarly, in case of *aus* paddy, economic considerations depend on previous year's income from paddy and total production of other varieties of paddy in the last year (this condition may be considered same as that of paddy stock position at the beginning of the following season). So it may be presented as :

$$x_p = F'(\beta, Z_{-1}, H) + U_2$$

where β is a constant, Z_{-1} is income from *aus* paddy in the previous season and H is the total production of other varieties of paddy in the last year.

Thus, the increment or decrement in the total area under jute and paddy over the previous season may be considered as dependent upon H and C_1. Assuming that the functional relationship is linear, the above relations may be presented in the form of a model which closely resembles the Ezekiel model of savings and investment.

$$
(1)\quad
\begin{array}{llllll}
(a) & x_O - x_j - x_p = 0 & & & & \\
(b) & x_O & & + \alpha_1 H + \alpha_2 C + & & \alpha_O = U_1 \\
(c) & & x_j & + \beta_1 Y_{-1} + \beta_2 Z_{-1} + \beta_3 C_1 + & & \beta_O = U_2 \\
(d) & & x_p & + \gamma_1 Z_{-1} + \gamma_2 H + & & \gamma_O = U_3
\end{array}
$$

where, α_s, β_s and γ_s denote structural constants and U_s are structural disturbances. Other variables included in the model have already been explained.

IV

IDENTIFIABILITY OF THE MODEL

Apart from these economic considerations, the model may also be examined from the point of view of practical utility and validity. Again in studying the models in respect of its predictive quality and internal consistency, it is essential to estimate the structural constants. But, as identifiability of equations is a prerequisite for estimation of constants, the equations in Model (1) is studied according to our identifiability criterion.[2] It is known that for identifiability in a model of 4 equations, we must have, in each equation, at least 3 excluded variables.

In order to apply the rank criterion for the identifiability of the equation 1(b) we must consider the matrix :

x_j	x_p	Y_{-1}	Z_{-1}
−1	−1	0	0
1	0	β_1	β_2
0	1	0	γ_2

Selection of non-vanishing determinant of order 3 from this matrix may be made in several ways. Thus the above model is valid and identifiable. To be more precise, it may be said that equations 1(b) and 1(d) are over-identified. In case of equation 1(c), however, due to presence of only one non-vanishing determinant of order 3 it is just identified. Thus validity of the model has been established. This validity in the real universe can, however, be judged only by its application.

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2. The question of identifiability arises here due to the presence of endogenous variable c_1 in the equation 1(b) and 1(c). The complexity in the estimation procedure, however, does not arise in the equation 1(d) as it does not contain more than one endogenous variable.

V

FITTING OF DATA IN THE MODEL

Finally, fitting of data in the model will lead us to ascertain how much of the total variations of the dependent variables will be explained by the selected determining variables. Though the explaining capacity of the selected variables is considered as a desirable criterion for testing the validity of the model yet sometime it may not give a correct index. For instance, inclusion of a large number of variables in the model may reduce the residual variance but the effect of each variable for explaining the part of total variability may be negligible. Hence, we propose to evaluate the constants and to study the direction in which the explaining variables are related with the dependent variables. This will enable us also to see whether the relationship between the dependent and explaining variables conform to our hypothesis.

In doing so, we restate the model for the sake of simplicity. As variable C_1 (cash requirement) is a function of last year's income and prices of consumer goods in the year under study (this may also be taken as cost of living index in the current year), C_1 and Y_{-1} is supposed to be correlated. With this analogy, the model (1) proposed earlier, reduces to (2) as given below. It may, however, be mentioned that model (1) is expected to explain a higher proportion of total variations than model (2).

Model (2)

(*a*) $X_O - X_j - X_p = 0$

(*b*) $X_O + A_1 Y_{-1} + A_2 H + A_O = U_1$

(*c*) $X_j + B_1 Y_{-1} + B_2 Z_{-1} + B_O = U_2$

(*d*) $X_p + \Pi_1 Z_{-1} + \Pi_2 H + \Pi_O = U_3$

Now fitting the model in the data for the Belakoba centre in North Bengal the estimates for A's, B's and Π's have been arrived at. Thus, with these numerical constants the model may be written as :

(*a*) $X_O - X_j - X_p = 0$

(*b*) $X_O - .001014\ Y_{-1} + .000485\ H + .123148 = 0$

(*c*) $X_j - .000939\ Y_{-1} - .002198\ Z_{-1} + .155123 = 0$

(*d*) $X_p + .000226\ Z_{-1} - .000001\ H + .007069 = 0$

It may be seen from the above that our hypothesis conforms exactly to the relations according to the signs of the constants in the model (2). The plausibility of the equations in the model may be seen from the following figures :

Model (2)		R^2 (coefficient of determination)
Equation 2(b)	—	.1561
Equation 2(c)	—	.6331
Equation 2(d)	—	.1089

Considering the total variations in the area under jute which is a composite effect of the economic behaviour of the cultivator and other extraneous variables, the determining capacity of the equations in Model (2), though not as high as expected, is nevertheless quite satisfactory. No doubt, Model (1) is expected to yield better results but in our study this has been reduced to Model (2) in order to suit the available data as well as for simplification in the computation process. Fitting of data in Model (2), however, has been attempted only to indicate the direction in which the variables are reacting rather than the magnitude.

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PRICE AND ACREAGE RESPONSE

(A Case Study of Groundnut Crop in North Arcot District)

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The object of this study is to examine the influence of relative prices of groundnut and its competing crops on acreage in North Arcot district, Madras State, a major groundnut growing district. The period studied is 1934-35 to 1961-62.