CHAPTER VIII

ESTIMATES OF TOTAL SUPPLY RESPONSE FOR WHEAT AND SUGARCANE

Estimates of price elasticities of supply for wheat and sugarcane crops are presented and discussed in this chapter. The first part of the chapter deals with the details of the models used, the variables included and the estimation procedures followed for estimating the elasticities. Details pertaining to time series data of price and acreage used in the analysis are given in the second part. In the third part estimates of supply response worked out by using Merlovian-type adjustment lag model are presented to show how significantly the inferences about the responsiveness change when expected prices computed from the models developed in this study are used in place of prices computed from other price expectation models. Estimates of supply elasticity, worked out by using an autoregressive linear regression model and, following Aitken's, generalised least squares estimation procedure are given in the last part of this chapter.

I

MODELS, VARIABLES AND ESTIMATION PROCEDURES

(A) Choice of Model: A number of different types of models are available for estimating supply response. In the present analysis, however, the following two types of models have been used: -
(i) Nerlovian - type adjustment model.

(ii) Autoregressive linear regression model.

It was pointed out in chapter II that after the work of Nerlove most users of lag models have used Nerlovian adjustment lag model, which is a three equation model. This model in its structural form is not directly estimable because several unobservable variables are included. Though a brief description of the model has already been given in chapter II, the basic equations are again repeated here for the purpose of easy reference. The three equations of the basic Nerlovian model are:

\[ (i) \quad x_t^d = a_0 + a_1 p_t^e + u_t \]
\[ (ii) \quad p_t^e - p_{t-1}^e = \beta (p_t - p_{t-1}) \]
\[ (iii) \quad x_t - x_{t-1} = \gamma (x_t^d - x_{t-1}) \]

where, \( p_t^e \) is the expected price in the year \( t \), \( x_t^d \) is the desired planted area in the year \( t \) and \( x_t \) and \( p_t \) are the actual planted area in the year \( t \) and the actual price in the year \( t \) respectively.

The equation (i) relates the desired planted area to expected future price while equation (iii) indicates that in

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1 See Chapter II, pp. 35-36.

2 This part is heavily dependent on Marc Nerlove (II-26), and Behraman (II-2).
period actual planted area is adjusted in proportion to the difference between the desired area and actual planted area and similarly equation (ii) indicates that expected price in the year t is the price in the previous year plus $\beta$ times the difference between the expected and realised price in the previous year.

The equation (ii) and (iii) are difference equations in $p^e_t$ and $x^d_t$ respectively. By substituting values of $p^e_t$ and $x^d_t$ in the equation (i) and doing more algebraic manipulation the following reduced equation can be obtained in which two unobservable variables $x^d_t$ and $p^e_t$ have been eliminated.

\[(\text{IV}) \quad x_t = a_0 + a_1 p^e_t + [1 - \beta + 1 - \gamma] x_{t-1} - (1 - \beta) (1 - \gamma) x_{t-2} + \gamma [u_t - (1 - \beta) u_{t-1}]\]

or

\[x_t = \pi_0 + \pi_1 p^e_{t-1} + \pi_2 x_{t-1} + \pi_3 x_{t-2} + \gamma v_t\]

It is basically this equation which has been used mostly for estimating the supply response though at times such variables as rainfall, area irrigated, expected yield etc. have also been included on the right hand side of the above equation.

There are, however, well known and serious difficulties in estimating the above equation. They are mainly the problems of identifications\(^3\) and of finding an estimation

\[^3\] For problem of identification in this model, see Marc Nerlove (II-26).
procedure which yields consistent and unbiased estimates of the structural parameters. Here we shall not go into the full details of these problems mainly because in the present analysis the above equation has not been used. However, the difficulties and the limitations associated with the modified version of the above model used in the present analysis shall be dealt with in full details.

The inadequacies of $\beta$ and $\gamma$ coefficients were pointed out in chapter II. The results pertaining to the nature of farmers' expectations of future prices and overall expectational behaviour given in chapter V to VII show very clearly that the expected prices had not been formed by the farmers in the way they have been assumed to be formed in the Nerlovian model. It may be recollected from chapter VI that not all the selected farmers had the same type of expectancy behaviour and the expectation models used by the most farmers were, in fact, extrapolative in nature and not 'adaptive' as envisaged in the Nerlovian model. Due to these reasons the above stated Nerlovian model has not been used in the present study for estimating the supply elasticity. However, for comparing the efficiency of the expectation models developed in this study with the other price expectation models in explaining the acreage under wheat and sugarcane of the selected farmers in the last 15 years

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4 For problems of finding an appropriate estimation procedure, see, Nerlove (II-26) and Behraman (II-2).
i.e. 1955-56 to 1969-70 a modified version of the above stated Nerlovian model has been used.

The findings of this study revealed that the 90 selected farmers could be divided into 10 groups on the basis of their expectational behaviours. These groups can be further reduced to six judging from their expectation pattern (See part III of chapter VII). In the chapter VII these 10 price expectation models were developed. For finding the supply response the expected price computed from these models have been used in place of the adaptive price expectations envisaged in the equation (ii) of the above stated Nerlovian model. Thus, the modified version of the above stated Nerlovian model used in this study consisted of two equations i.e. the equations (i) and (iii) and in the equation (i) $\hat{P}_t^e$ is the expected price in the year $t$ computed from the models developed in this study.

The reduced equation form used for finding the estimates was

$$(V) x_t = a_0 \gamma + a_1 \gamma P_t^e + (1-\gamma) x_{t-1} + u_t$$

or

$$x_t = \gamma' P_t^e + \gamma' x_{t-1} + \nu_t$$

Other details of the model will be examined in the discussion pertaining to estimation procedures.

**Autoregressive Linear Regression Model:** As was pointed out earlier the adjustment lag hypothesis reflects technological and/or institutional constraints which permit only a fraction
of the intended levels to be realised during a short period. In other words the above stated Nerlovian distributed lag hypothesis, considered to be one of the best, implies that in a year, a farmer is able to achieve only a fraction of the desired (intended) changes in his acreage allocations to different crops. The limitations of the Nerlovian $\gamma$ coefficient which were pointed out by Johnson, Watts etc., were discussed in the chapter II. Here, however, we shall discuss why, in the present context, use of distributed lag model does not appear to be appropriate.

It has been observed in some studies that traditional models (in which adjustment lag hypothesis is not specified) gives sufficiently close estimates of supply elasticities to those obtained by using Nerlovian type adjustment model. An examination of acreage under wheat and sugarcane in the last 15 years presented in the second part of this chapter reveals that in some years the acreage under sugarcane was above or below 40.00 per cent of the previous year's acreage. In the case of wheat the changes in acreage from one year to another were quite significant and marked. This clearly shows that the farmers were in a position to effect quite significant changes.

5 For example Jai Krishna and Rao on the basis of their study of acreage allocation for wheat in U.P. mentions "we may, therefore, infer that the traditional model formulations for estimating acreage response coefficients seem to be as satisfactory, as if not superior to, to adjustment lag models of the Nerlovian type." See Jai Krishna and M.S. Rao (I-40), pp. 48.
in their acreage allocations from one year to next year. This is supported by the analysis carried out in the third part, to show how significantly inferences about the price responsiveness change, when expected prices generated from the models developed in this study are used, in the basic framework of the Nerlovian adjustment model. It can be seen from the Table Nos: VIII-1 and VIII-2 that value of the \( \gamma \) (adjustment coefficient) for the six expectancy groups varies from 0.579 to 0.984 in the case of sugarcane and 0.732 to 0.911 in the case of wheat. This implies that there are no reasons to believe that the lagged effect of the acreage is distributed over a number of time periods. Mainly due to this, and partly due to the estimational problems to be discussed later in the chapter, an autoregressive linear regression model of the following type was used in the present study for finding the estimates of supply response in place of distributed lag model:

\[
(Vi) \quad X_t = \alpha + \beta P_e + \gamma X_{t-1} + U_t
\]

It may be noted that in the above equation also lagged endogenous variables appear as one of the independent variables.

**Variables:** Two variables, other than the lagged acreage and expected price, commonly used as explanatory variables in supply response equations are rainfall as a proxy for weather
variability and expected yield. This study has been carried out in an area where more than 90 per cent of the cultivated area is irrigable and moreover both the crops considered are largely irrigated crops. Under these circumstances the rainfall is very unlikely to effect sowing of these crops. Hence, in the analysis here rainfall has not been included as one of the explanatory variables. It was shown earlier in chapter V that except 8 selected farmers none anticipated the change in the relative profitability level of the wheat crop vis-a-vis sugarcane due to anticipation of change in the yield levels. If this observation is viewed in the light of the fact that during the last three years preceding the year of enquiry i.e., 1970 farmers in the selected villages progressively brought more areas under the high yielding varieties of wheat from local and from HY varieties like 2-04 and Larma Roze to still higher yielding varieties like 2-227 and Kalyan Sona etc., it will not be wrong to say that, prima facie, there is no case for inclusion of expected yield as an explanatory variable to explain changes in the acreage planted under a particular crop. Hence, expected yield too has not been included as one of the explanatory variables in the estimating equation.

Inspite of the wide awareness of the prevalence and

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6 For example while Raj Krishna (1941) includes rainfall area irrigable as two other shift variables while Jai Krishna and M.S. Rao (1940) include expected yield also.
rationality of risk aversion among farmers of underdeveloped countries no economist, prior to Behraman\(^7\) has attempted to include explicitly a relevant variable as a measure of uncertainty attached with the price expectation. Behraman includes standard deviations (S.D.) of the prices of the crop of concerned relative to the standard deviation of the price index of alternatives as a proxy for the uncertainty attached with the expected price of particular crop. This appears to be a very satisfactory measure since in the case of risk aversion behaviour, characteristics other than the expected value of the probability distribution become very important.

In the analysis, here thus \(\sigma_{P_t}\) i.e. the standard deviation (S.D.) of the price of the crop concerned relative to the S.D. of the price of competing crop in the preceding three years, are included as proxies for the variances of the subjective probability distributions.

Thus for the Nerlovian type adjustment model used in this study the reduced equation form actually used for estimating the coefficient is of the following form:

\[
(\text{vii}) \quad X_t = \alpha + \beta_1 P_t^e + \beta_2 X_{t-1} + \beta_3 \sigma_{P_t}^R + \nu_t
\]

Where \(\sigma_{P_t}^R\) is the S.D. of the prices of the concerned crop in the years \(t-1, t-2, t-3\) relative to S.D. of the

\(^7\) Behraman (II-2).
competing crop for the same period.

This equation differs from the reduced equation (v) only in one respect i.e. in this equation one variable $\sigma_{Pt}^R$ also appears on the right hand side.

It may be mentioned that in the autoregressive linear regression model the variable $\sigma_{Pt}^R$ is not included. This is because the estimates obtained by using equation (vii) indicated that the inclusion of this variable does not improve the explanatory power of the regression equations and the sign of the coefficient is opposite to what it should have been.

**Estimation Procedures:** The relative difficulty of the appropriate estimation procedure varies considerably with different assumptions about the disturbance term in the reduced equation (iv). If statistically consistent and unbiased estimates of the parameters in equation (iv) are to be obtained by using least square estimation procedure, the residuals $v_t$ must be independent i.e. $v_t's$ are not serially correlated.

It is this difficulty that forced Nerlove and most users of Nerlovian adjustment model to make the following set of

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8 For different types of assumptions about the disturbance term of the reduced equation and for appropriate estimation procedures in case of some assumptions see Behrman (II-2), pp. 172-184.


10 Raj Krishna (I-41), makes these assumptions implicitly by using a least square estimation procedure.
assumptions about the reduced equation disturbance terms \( V_t \); 
\( V_t \) is distributed with mean zero, a diagonal variance 
covariance matrix with a constant own variance \( \sigma^2 \) and that 
this disturbance term and the contemporaneous elements of the 
\( X \) matrix are distributed independently.

It may be mentioned that in almost all the studies\(^1\) 
Durbin Watson tests\(^2\) have been applied to test serial correla­
tion to justify partially the assumption of a diagonal variance 
covariance matrix. However, the Durbin Watson test is most 
unappropriate in these situations. Nerlove\(^3\) himself has shown 
that the use of Durbin Watson test has been made quite 
inappropriately in all the econometric investigation of supply 
response. To quote Nerlove and Wallis

"When lagged endogenous variables are included 
in an equation estimated by ordinary least 
squares, however, the Durbin-Watson statistic 
is asymptotically biased towards 2 (the value 
which it should have if no serial correlation 
in the residuals is in fact present). It is 
doubtful, therefore, that the statistic should 
be used either to test for serial correlation 
in the residuals or to provide any indication 
of the extent of such correlation when the 
estimated equation contains lagged value of 
any "indogenous variable"\(^4\).

\(^{11}\) For example, Nerlove (II-26), Raj Krishna (I-41) etc. 
all used Durbin Watson test.

\(^{12}\) Durbin J. (I-15) and Durbin and Wattson (I-16).

\(^{13}\) Marc Nerlove and Wallis (I-67).

\(^{14}\) Marc Nerlove and Wallis ibid. pp.235.
Since the other tests for testing the serial correlation are very cumbersome; even if no autocorrelation is present in the disturbance term of the reduced equation (iv) or (vii) the ordinary least squares estimates will not be unbiased; moreover, the purpose of the analysis given in part III is only to show how the price expectation models developed in this study fare in comparison with other expectation models rather than to find unbiased and consistent estimates (which is done in part IV) though ordinary least squares estimates of the reduced equation (vii) have been worked out but no test has been applied to test the serial correlation. Thus, the estimates given in the Part III are least squares estimates of the reduced equation (vii) under the same set of assumptions about the disturbance terms as made by Nerlove and other users of Nerlovian models and cited above.

II: Generalised Least Squares Estimation Procedure: It was pointed out above that even if no autocorrelation is present in the disturbance terms of the reduced equation (vii) the ordinary least estimates will not be unbiased if and autocorrelation is there the estimates will not only be biased but will be inconsistent too. Though non-linear estimation

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15 For other test see Thiel and Nager (I-90) and Richard C. McKelway, Jr. (I-27).

16 Goldburger (II-9), pp. 272 - 274 and Johnston (II-17), pp. 212.
procedures have been developed which give unbiased and consistent estimates\textsuperscript{17}, are very cumbersome and involve too much use of high-speed digital computers. These estimational problems in the case of reduced equation (vii) on the one and and inappropriateness of coefficient\textsuperscript{19}on the other were, in fact, the two considerations to go in for the auto-regressive linear regression model i.e., equation (vi), in the case of which it was possible to get without making to many assumptions, unbiased and constant estimates of structural parameters. In the following pages details of the procedure followed for estimation of equation (vi) and its merits will be discussed\textsuperscript{18}.

For easy reference the auto-regressive linear regression model used in the present study is again being given below.

(6) \[ x_t = \alpha + \beta P_t^e + \gamma x_{t-1} + \epsilon_t \]

Notice that at time \( t \), \( x_{t-1} \) is not independent of \( \epsilon_{t-1}, \epsilon_{t-2}, \ldots \) since, for instance \( x_{t-1} \) is determined in part by its lagged value \( x_{t-2} \) which is dependent on \( \epsilon_{t-2} \). However, the contemporary value of \( \epsilon_t, \epsilon_t \), id dependent of \( x_{t-1} \).

\textsuperscript{17}For non-linear estimation procedure see Behraman (II-2) pp. 179-184, and for efficient estimation procedure in the case of Multivariate regression model in which lagged endogenous variables also appear on the right hand side of the equation see Balestra and Marc Nerlove (I-2).

\textsuperscript{18}This part of the discussion is heavily depended on Zellner (I-101), Zellner and Haung (I-102), Haung (II-14).
so that by deduction $x_t$ is independent of $U_{t+1}, U_{t+2}, U_{t+3}, \ldots$.

In short, there is a partial dependence between the lagged dependent variables and the disturbances. The main difference between the above model and the disturbed lag model discussed above is that in the case of the latter the lagged dependent variable $x_{t-1}$ is not independent of the disturbance term while in the case of the former contemporary value of $U_t$, $U_t$ is independent of $x_{t-1}$. It is the property of contemporary value of $U_t$, $U_t$, being independent of lagged dependent variable that makes it possible to get consistent estimates by even ordinary least squares estimation procedure.

The problem before us is to find an estimation procedure which will yield the best linear unbiased estimates of the above given equation (vi) for each of the six different expectancy group or a set of following equations is to be estimated.

$$
\begin{align*}
\chi_t^1 &= \alpha^1 + \beta^1 p_{t}^c + \gamma^1 x_{t-1} + U_t^1 \\
\chi_t^2 &= \alpha^2 + \beta^2 p_{t}^c + \gamma^2 x_{t-1} + U_t^2 \\
\chi_t^3 &= \alpha^3 + \beta^3 p_{t}^c + \gamma^3 x_{t-1} + U_t^3 \\
\chi_t^4 &= \alpha^4 + \beta^4 p_{t}^c + \gamma^4 x_{t-1} + U_t^4 \\
\chi_t^5 &= \alpha^5 + \beta^5 p_{t}^c + \gamma^5 x_{t-1} + U_t^5 \\
\chi_t^6 &= \alpha^6 + \beta^6 p_{t}^c + \gamma^6 x_{t-1} + U_t^6
\end{align*}
$$

(viii)

The disturbances of the above set of equations, may be correlated at least contemporaneously due to the following:

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19 For proof that OLS estimates of the equation (vi) will be consistent see Christ (II-4), pp. 374-379.
reasons, (i) in the specification of the above regression equations certain commonly correlated variables may not have been included (ii) the dependent variables may be some how correlated, and (iii) when conditions (i) and (ii) exist, for example, it is possible that in the same year all the farmers of the different expectancy groups might have been subjected to some common shock not accountable by the independent variables. The above stated set of equations is just similar to what Zellner calls seemingly unrelated equation and Theil disturbance related equations. Thus the procedure popularly known in the field of econometrics as the efficient estimation or Aitken's generalised least squares used for seemingly unrelated regressions, can be used for finding the estimates of the above set of equations.

In the following pages an attempt has been made briefly to discuss the Aitken's generalised least squares estimation procedures for unrelated equations. The equation (viii) above can be written in the matrix form as:

\[
\begin{align*}
\begin{pmatrix}
    1 & x_1 \\
    1 & x_2 \\
    & \vdots \\
    1 & x_n \\
\end{pmatrix}
\begin{pmatrix}
    \alpha_1 \\
    \beta_2 \\
    \vdots \\
    \beta_n \\
\end{pmatrix}
+ U
\end{align*}
\]

where

\[
Y = \begin{pmatrix}
    y_1 \\
    y_2 \\
    \vdots \\
    y_m \\
\end{pmatrix}, \\
\alpha = \begin{pmatrix}
    \alpha_1 \\
    \beta_2 \\
    \vdots \\
    \beta_n \\
\end{pmatrix}, \\
\beta_i = \begin{pmatrix}
    \alpha_i \\
    \beta_i \\
    \gamma_i \\
\end{pmatrix}, \\
U = \begin{pmatrix}
    u_1 \\
    u_2 \\
    \vdots \\
    u_m \\
\end{pmatrix},
\]

\[
Z_i = \left( p_{e_i}, x_{t-1} \right)
\]

20 Zellner A. (I-101)
21 Thiel (II-35)
Our task here is to ascertain that under the conditions
\[(X) \quad Z_i \neq Z_j \quad \text{or} \quad i \neq j\]
\[(XI) \quad E(U_i U_j) = \sigma_{ij} I \quad i, j = 1, \ldots, 6\]
where \(\sigma_{ij} \neq 0\), Aitken's generalized least squares applied to (8) yields estimators that are more efficient than the estimators given by the equation by equation least square procedure:

From the equation (XI) we have,
\[(XII) \quad E(U U') = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{16} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{26} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{61} & \sigma_{62} & \cdots & \sigma_{66} \end{bmatrix} \]
\[
= \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{16} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{26} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{61} & \sigma_{62} & \cdots & \sigma_{66} \end{bmatrix} \times I = \Sigma \otimes I
\]

Thus now treating (IX) as one 'regression equation and noticing that \(E(U U')\) is not diagonal, we apply Aitken's generalized least squares to (IX).

Moving on, the variance covariance matrix (XII) implies that transformation of \(Y\) on \(Z\) and \(U\) is to be taken so that
\[
\begin{align*}
(XIII) & \quad T^T = (E U U')^{-1} \\
(XIV) & \quad T Y = T Z \beta + T U = (\Sigma \otimes I)^{-1}
\end{align*}
\]
The Aitken's estimator $\hat{\beta}$ is

$$b^* = (Z' T' T Z)^{-1} (Z' T' T Y)$$

$$= [Z' (\Sigma \otimes I)^{-1} Z]^{-1} [Z' (\Sigma \otimes I)^{-1} Y]$$

The variance covariance matrix is

$$V(b^*) = \begin{bmatrix}
\sigma_{11} Z_1' Z_1 & \sigma_{12} Z_1' Z_2 & \cdots & \sigma_{16} Z_1' Z_6 \\
\sigma_{21} Z_2' Z_1 & \sigma_{22} Z_2' Z_2 & \cdots & \sigma_{26} Z_2' Z_6 \\
\vdots & \vdots & \ddots & \vdots \\
\sigma_{61} Z_6' Z_1 & \sigma_{62} Z_6' Z_2 & \cdots & \sigma_{66} Z_6' Z_6
\end{bmatrix}$$

The estimator $b^*$ has all the usual properties of the Aitken estimator. Now, the true variance covariance matrix of $u_i$ in (ix) is not known, so that matrix $\Sigma$ in (xiii) must be estimated from the sample. Let the $\Sigma$ matrix estimated from the sample be $S = (S_{ij})$ and define

$$S_{ij} = \frac{1}{n-3} \hat{u}_i' \hat{u}_j \quad i, j = 1, \ldots, 6$$

$$\hat{u}_i = y_i - Z b_i$$

where $b_i$ is the usual estimate of $\beta_i$ in (ix).

Zellner has shown that

$$b = [Z' (S \otimes I)^{-1} Z]^{-1} [Z' (S \otimes I)^{-1} Y]$$
constant of $b^*$ and $\sqrt{n} (b - \beta)$ has the same asymptotic covariance matrix as that of $\sqrt{n} (b^* - \beta)$. For proofs see Zellner\textsuperscript{22}, Zellner and Haung\textsuperscript{23}.

This estimation procedures gives the estimates which are Best Linear Unbiased Estimates (BLUE) for the system taken together, so that any other unbiased linear estimator, including the equation by equation least squares estimator, will at best be as efficient. It can be shown that though the 'size' of the gain in efficiency that accrues to Aitken's estimates relatives to the single equation least squares estimates depends on the canonical correlation between $z_i$ and $z_j$ and the correlation between the disturbances $u_i$ and $u_j$, in most cases the gain is quite significant. The above given procedure has thus been applied to find the estimates of II

THE DATA

For an analysis designed to find the impact of change in one variable on another variable, when both the variables can possibly assume different values at different time periods, time series data of both the variables are required.

\textsuperscript{22} Zellner (I-101)
\textsuperscript{23} Zellner and Haung (I-102)
If the second variable can be influenced by the change in some other variable(s), controlling of this (these) other variable(s) becomes desirable, otherwise the impact of the different variables on the dependent variable will be confounded. For finding the impact of changes in the expected prices on acreage allocation, therefore, it became desirable to select only such farms whose operational area did not change significantly, qualitatively as well as quantitatively during the period covered by the study (as the changes in the operational holding itself could have influenced the acreage allocation) and the decision makers of the farms were the same persons during the entire period covered.

Selection of Farmers: For the purpose of analysis being presented in this chapter from the 93 sample farmers only those 62 farmers were selected who continued to be the main decision makers on their farm for at least last 15 years and whose operational holdings have not changed significantly in the last 15 years. As a first step in this selection, from the 90 sample farmers those 69 farmers who have been decision makers of their farm activities since at least last 15 years were selected. Further, from these 69 farmers, 5 farmers whose operational holding has undergone a significant change, in terms of area or irrigability, at least once in the last
fifteen years were dropped. Two farmers who occasionally took land on lease were also dropped, since in the case of these farmers it would have been impossible to trace in the last 15 years in which particular year how much land they had leased-in. In this way, 62 such farmers were selected from the 90 sample farmers who themselves were decision makers and whose operational holding also did not change much in the last 15 years. The Table No. VIII-1 in the appendix gives the distribution of these 62 farmers in the 10 expectancy groups and also gives their operational holdings in the year 1955-56 and 1969-70 along with changes in it during the last 15 years period (i.e. between 1955-56 to 1969-70). The table clearly shows that operational holdings of these 62 farmers remained more or less stable in the last 15 years.

24 Of these 5 farmers' operational holding of two farmers changed due to further division in the family and in the case of the other two though land under plough remained the same a very large chunk of it which was unirrigable before, became irrigable in 1964. The operational holding of the fifth just doubled during the last 15 years due to purchase of land thrice in the last fifteen years.

25 In both the cases it was a case of concealed tenancy and it could not have been possible to find the area and, the crops grown on these plots. The remaining 62 farmers were such who neither took nor gave their land on lease, though, the practice of share-cropping is common in the case of kharif crops but in that case the decision of what to grow and what not to grow remain with the land-owners.
Acreage Allocation Data: Data pertaining to acreage allocation under different crops in each of the last fifteen years (1955-56 to 1969-70) by each of the 62 selected farmers was collected in the following way. First of all survey numbers of all the plots or fragments which a respondent farmer cultivated in the year 1969-70 were listed. The list containing the survey numbers of the plots cultivated by a farmer in 1969 was then updated for each of the preceding 14 years, by suitably incorporating the changes which had taken place in any particular year. In this way plot-wise details of the operational holdings of each of 62 farmers for each of the 15 preceding years were prepared.

Plot-wise land utilisation data for each of the 62 farmers was collected from the old Khasra records for a period of 12 years i.e. from 1955-56 to 1966-67. For the remaining three years it was first collected from the farmers which was later on verified and checked from the Khasra records available with the Patwari. It will not be out of place to

26 Farmers were asked to give details of the changes which might have taken place in their operational holdings in any year during the preceding 15 years, which was verified from revenue records and also from the documents specially sale or purchase deeds, kept by the farmers themselves. Since, here the point of interest was only the quantative changes which could have taken place mainly due to purchase of sale of land, it was not difficult to find the change which had taken place in any year in the last 15 years.

27 The crops grown in different survey numbers of a village are recorded by the village level revenue official (Patwari or Lakhpal) in village Khasra. These Khasra records are kept with Patwari for three years and after that period they are handed over to Tehsil Headquarters, where they are kept for 12 years.
mention here one particular difficulties encountered in collecting plot-wise land utilisation data from old Khasra records. Some times farmers divide a survey number into two or more number of small plots. In the old Khasra records though names of all the different crops grown in a particular survey number in any crop season are mentioned the area under different crops in a survey number is not given. In these circumstances the only way to arrive at the area under any particular crop is to make some realistic assumption regarding proportion in which the area of the survey numbers might have been divided between different crops. The safest assumption, however, would be to assume that area within a survey number was equally divided under different crops. In any case this approximation can hardly affect the results, as the average size of a survey number is only 0.48 acre, the maximum is 1.68 acres, and moreover, such bifurcations of survey numbers are common mostly in Kharif season, but very rare during rabi seasons.

Acreage Under Sugarcane and Wheat: The Table No. VIII-2 in the appendix gives the acreage sown by the farmers of different expectancy groups under sugarcane and wheat in the last fifteen years (1956 to 1970). The table also gives the percentage

28 In the case of sugarcane and wheat in the fifteen years period such problem arose only 4 times and that too on plots of size 0.54, 0.43, 0.42 and 0.27 acres.
change in acreage in any year from the acreage sown in the preceding year. It may be mentioned here that the area of sugarcane and wheat given for the year 1970 are in fact the area shown under these crops in February - March 1969 and November 1969 and which were to be harvested in January - February 1970 and in June 1970 respectively. This is true of all the years.

It can be seen from the appendix table IX-2 that in case of both wheat and sugarcane year to year variation in acreage has been quite marked in case of all the six expectancy groups. In case of sugarcane maximum change in any year from the previous year's acreage has been of the order of 40 per cent in one year, while in the case of wheat the percentage increase in acreage from the earlier year's acreage has been of the order of 49 per cent in one year in the case of expectancy group third.

Expected Prices: The expected prices used for different expectancy groups for wheat and gur are those computed and discussed in the earlier chapter.

Relative Price of Guri: It was mentioned in the chapter third that sowing season for sugarcane is February - March and it is October - November for wheat. At the time of sowing of sugarcane the relevant expected prices of wheat is the price which a farmer expects for wheat to be harvested in March - April. Since the acreage sown under sugarcane, say, in the
February - March 1969 is shown as area in 1970 (as this is to be harvested between November 1969 to March 1970); and the same is the case with expected price; therefore, the expected price of gur in 1970 should be deflated by the index of expected price of wheat for the farm harvest period of 1969. The expected price of gur for the years 1956 to 1970 thus were deflated by the index of expected price of wheat in the previous year, treating 1955 as base (=100.00). For wheat the relative expected prices have been calculated by deflating the expected price of wheat of any year by the index of expected prices of gur for the same year taking the base year 1956 = 100.0). The relative expected price of gur and wheat for different years by farmers of different expectancy groups are given in appendix table No. VIII-3.

It will be worthwhile to compare the changes in the acreage with the change in the expected prices computed from the expectation models commonly used by researchers in the field of agriculture supply analysis. For this purpose, expected price of gur and wheat were computed from the two expectation models viz., (i) the average of pre-sowing in the preceding 3 years, and (ii) last farm harvest price. The results are given in appendix table No. VIII-3.

29 Jai Krishna and Rao obtained a higher value of $R^2$ in comparison with 8 other price specifications. See Jai Krishna and Rao (1960).
The estimates of the structural parameters of the Nerlovian type adjustment model for the six expectancy groups are given in the Table Nos: VIII-1 and VIII-2. Three price expectation models viz., (i) the expectation model developed in this study for a particular expectancy group (ii) the average of the pre-sowing period prices in the preceding three years (iii) the average price realised by farmers in the last farm harvest period have been considered. In addition to the estimates of structural coefficients, their standard errors, the value of $R^2$ and $F$ are also given.

(A) Sugarcane: An indication of the efficiency or otherwise of the different price expectation models in explaining the acreage under sugarcane from 1956 to 1970 of each of the six expectancy groups is provided by the coefficient of multiple determination ($R^2$) and the level of significance of the coefficients. The value of $F$ indicates the significance of the coefficient of determination i.e. whether a given regression under a specified price expectation model gives a significant fit or not.

A perusal of the table No. VIII-1 indicates that the $R^2$ is more than .90 in each of the case when relative expected prices generated from the models developed in this study are used as one of the independent variables, while in the case of the expected relative prices computed as an average of the
<table>
<thead>
<tr>
<th>Expectancy</th>
<th>Price expectation</th>
<th>Constant</th>
<th>Estimates of the coefficient of</th>
<th>( \chi^2 )</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>groups</td>
<td>Models</td>
<td></td>
<td>Expected price</td>
<td>Lagged acreage price</td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>I</td>
<td>31.16898</td>
<td>0.70737***</td>
<td>-0.49067*</td>
<td>0.16858*</td>
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<tr>
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<td>(0.13333)</td>
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<td>(0.07816)</td>
<td>(0.13563)</td>
<td>(0.06147)</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>27.26991</td>
<td>0.50735***</td>
<td>-0.16889</td>
<td>0.075682</td>
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<td>(0.19918)</td>
<td>(0.17399)</td>
<td>(0.07667)</td>
<td>(0.08589)</td>
<td>(0.04727)</td>
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<tr>
<td></td>
<td>III</td>
<td>20.40659</td>
<td>0.46720***</td>
<td>-0.13989</td>
<td>0.12663**</td>
</tr>
<tr>
<td></td>
<td>(0.06997)</td>
<td>(0.12535)</td>
<td>(0.05358)</td>
<td>(0.07067)</td>
<td>(0.03679)</td>
</tr>
<tr>
<td>Second</td>
<td>I</td>
<td>42.11672</td>
<td>0.30593*</td>
<td>-0.29241</td>
<td>0.21430</td>
</tr>
<tr>
<td></td>
<td>(0.36375)</td>
<td>(0.32557)</td>
<td>(0.34531)</td>
<td>(0.07067)</td>
<td>(0.03679)</td>
</tr>
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<td>39.36285</td>
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<td>(0.11466)</td>
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<td>(0.03679)</td>
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<tr>
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<td>III</td>
<td>16.44099</td>
<td>0.06809***</td>
<td>0.29479**</td>
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<td>(0.09757)</td>
<td>(0.12661)</td>
<td>(0.08021)</td>
<td>(0.07067)</td>
<td>(0.03679)</td>
</tr>
<tr>
<td>Third</td>
<td>I</td>
<td>2.89581</td>
<td>0.61573**</td>
<td>0.29670</td>
<td>-0.09452</td>
</tr>
<tr>
<td></td>
<td>(0.23822)</td>
<td>(0.21050)</td>
<td>(0.11596)</td>
<td>(0.07067)</td>
<td>(0.03679)</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>-1.54407</td>
<td>0.55038***</td>
<td>0.30932***</td>
<td>-0.17662*</td>
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<td>(0.13553)</td>
<td>(0.09727)</td>
<td>(0.07067)</td>
<td>(0.03679)</td>
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<td></td>
<td>III</td>
<td>4.43435</td>
<td>0.62366**</td>
<td>0.42123***</td>
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<td>(0.06147)</td>
<td>(0.75735)</td>
<td>(0.07067)</td>
<td>(0.03679)</td>
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contd...
### Table No. VIII-1 (contd.)

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<tr>
<th>Expectancy groups</th>
<th>Models</th>
<th>Constant</th>
<th>Estimates of the coefficient of</th>
<th>S.D. of acreage prices</th>
<th>R²</th>
<th>F</th>
</tr>
</thead>
<tbody>
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<td>Fourth</td>
<td>I</td>
<td>2.60325</td>
<td>0.81353**</td>
<td>0.02954</td>
<td>-0.0369</td>
<td>0.75613</td>
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<td>II</td>
<td>6.32610</td>
<td>0.46769*</td>
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<td>0.02359</td>
<td>0.30919</td>
</tr>
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<td>III</td>
<td>8.89464</td>
<td>0.61589***</td>
<td>0.11921</td>
<td>0.0917</td>
<td>0.90424</td>
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<tr>
<td>Fifth</td>
<td>I</td>
<td>19.37094</td>
<td>1.08999***</td>
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<td>0.05462</td>
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<td>II</td>
<td>21.98617</td>
<td>0.78526**</td>
<td>0.22051</td>
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</tr>
<tr>
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<td>III</td>
<td>14.32015</td>
<td>0.74242***</td>
<td>0.01553</td>
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<td>0.77289</td>
</tr>
<tr>
<td>Sixth</td>
<td>I</td>
<td>21.37620</td>
<td>0.58402*</td>
<td>-0.20165</td>
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<td>II</td>
<td>17.56077</td>
<td>0.59010**</td>
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<td>III</td>
<td>16.12485</td>
<td>0.52148**</td>
<td>0.09433</td>
<td>0.10371</td>
<td>0.93338</td>
</tr>
</tbody>
</table>

a Description of Expectation Models.

I - The average of pre-sowing period prices in the preceding three years.
II - Farm harvest price lagged one year.
III - Model developed in this study for the particular expectancy group.

N.B.: Figures in the parentheses are standard errors of regression coefficients.

* Significant at 10 per cent level of significance.
** " " 5 " " " "
*** " " 1 " " " "
### TABLE VIII-2

Estimates of acreage response equation (vii) for wheat for the six expectancy groups

<table>
<thead>
<tr>
<th>Expectancy groups</th>
<th>Model</th>
<th>Constant</th>
<th>Estimates of the coefficient of</th>
<th>( R^2 )</th>
<th>( F )</th>
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<td></td>
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<td>Relative</td>
<td>Lagged</td>
<td>S.D. of acreage prices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
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<td>18.39351</td>
<td>-0.0734</td>
<td>0.22423</td>
<td>0.16732</td>
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<td></td>
<td>(0.23967)</td>
<td>(0.26931)</td>
<td>(0.11863)</td>
</tr>
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<td>11.57153</td>
<td>0.26009</td>
<td>0.25234</td>
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<tr>
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<td></td>
<td></td>
<td>(0.22149)</td>
<td>(0.24346)</td>
<td>(0.12619)</td>
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<tr>
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<td>III</td>
<td>10.35076</td>
<td>3.1113*</td>
<td>2.1364*</td>
<td>0.66808</td>
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<tr>
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<td></td>
<td></td>
<td>(0.17049)</td>
<td>(0.21366)</td>
<td>(0.09427)</td>
</tr>
<tr>
<td>Second</td>
<td>I</td>
<td>31.08930</td>
<td>-0.06746</td>
<td>0.21627</td>
<td>0.12943</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>(0.21564)</td>
<td>(0.25937)</td>
<td>(0.11571)</td>
</tr>
<tr>
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<td>II</td>
<td>27.44959</td>
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<td>(0.19035)</td>
<td>(0.29201)</td>
<td>(0.09969)</td>
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<td>III</td>
<td>13.42245</td>
<td>0.54513**</td>
<td>0.2552</td>
<td>0.05574</td>
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<td></td>
<td>(0.12147)</td>
<td>(0.19357)</td>
<td>(0.07203)</td>
</tr>
<tr>
<td>Third</td>
<td>I</td>
<td>29.08943</td>
<td>0.15645</td>
<td>0.06373</td>
<td>0.13546</td>
</tr>
<tr>
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<td>(0.13566)</td>
<td>(0.20211)</td>
<td>(0.07463)</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>22.34406</td>
<td>0.30016</td>
<td>0.15261</td>
<td>0.02376</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.12448)</td>
<td>(0.15766)</td>
<td>(0.06256)</td>
</tr>
<tr>
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<td>III</td>
<td>17.93956</td>
<td>0.21759**</td>
<td>0.25737</td>
<td>0.17779</td>
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<td>(0.06192)</td>
<td>(0.14716)</td>
<td>(0.06749)</td>
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contd....
### Table No. VIII-2 (contd.)

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<th>Expectation Groups</th>
<th>Model</th>
<th>Constant</th>
<th>Relative Expected Price</th>
<th>Lagged Acreage</th>
<th>S.D. of Prices</th>
<th>$R^2$</th>
<th>$F$</th>
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</thead>
<tbody>
<tr>
<td>Fourth</td>
<td>I</td>
<td>14.72933</td>
<td>0.05898</td>
<td>0.09907</td>
<td>-0.00276</td>
<td>0.04684</td>
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</tr>
<tr>
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<td>II</td>
<td>9.88691</td>
<td>0.24323*</td>
<td>0.17879</td>
<td>0.07150</td>
<td>0.29342</td>
<td>1.384</td>
</tr>
<tr>
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<td>III</td>
<td>8.24846</td>
<td>0.15716**</td>
<td>0.25650</td>
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<td>0.40501</td>
<td>2.269</td>
</tr>
<tr>
<td>Fifth</td>
<td>I</td>
<td>37.37063</td>
<td>-0.14929</td>
<td>-0.24725</td>
<td>0.16346*</td>
<td>0.30644</td>
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<td>II</td>
<td>30.89649</td>
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<td>1.080</td>
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<td>III</td>
<td>11.50522</td>
<td>0.36428*</td>
<td>0.14934</td>
<td>0.11767</td>
<td>0.46827</td>
<td>2.935*</td>
</tr>
<tr>
<td>Sixth</td>
<td>I</td>
<td>15.61659</td>
<td>0.06411</td>
<td>0.19671</td>
<td>0.21577</td>
<td>0.54516</td>
<td>3.995**</td>
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<tr>
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<td>0.61323</td>
<td>5.285**</td>
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<td>0.19430</td>
<td>0.14727</td>
<td>0.75763</td>
<td>10.420**</td>
</tr>
</tbody>
</table>

* Significant at 10 per cent level of significance.
** Significant at 5 per cent level of significance.
*** Significant at 1 per cent level of significance.

a Description of expectation models.
I - The average of pre-sowing period prices in the preceding three years.
II - Farm harvest price lagged one year.
III - Model developed in the study for the particular expectancy group.

N.B: Figures in the parentheses are standard errors of regression coefficients.
pre-sowing prices in the preceding three years, the value $R^2$ in the case of different expectancy groups varies from 0.61713 to 0.88076. It can also be seen that the minimum value of $R^2$ is 0.50919 in the case of expectancy group (four) when the average relative price realized by farmers in the last farm harvest is used as expected prices; the maximum $R^2$ in the case of this price is 0.82335. A comparison of the $R^2$s obtained by using three different types of expected price in the case of each expectancy group clearly shows that $R^2$ is larger in every case when the price variable is the relative expected prices generated from the models developed in this study.

An examination of the F test indicates that in the case of regressions in which expected relative prices generated from the models developed in study are used the coefficients of multiple determination are significantly non-zero at 1 per cent level for each of the six expectancy groups. In the case of regressions in which relative expected price is the average price during the preceding farm harvest, the coefficient of determination is significant at 1 per cent level in the case of only five expectancy groups though the value of F are much lower in comparison with the values of F in the earlier cases. Similar is the situation in the case of regressions in which expected price is the average of pre-sowing prices in the last three years. In this case the coefficient of determination is not significant in one case while in three others it is significant only at 5 per cent.
In the case of regression in which expected relative price of the models developed in this study are used the coefficients of expected price are significant in the case of all the six expectancy groups at one per cent level of significance. In case when expected price is taken as the average of the pre-sowing period prices in the preceding three years, coefficient of the expected price is significant only in two cases at 1 per cent level of significance.

(B) Wheat: In the case of wheat maximum coefficient of determination is 0.7576 when expected prices developed in this study are used. It can be seen from the Table No.VIII-2 that when the expected price is taken as the average of pre-sowing prices of the preceding three years and also when it is taken as the farm harvest price of the preceding year the value of is significantly lower in comparison with the cases when expected prices taken from the models developed in this study for each expectancy group are considered. It should be noted that in all cases the $R^2$ is significantly less in the case of wheat as compared to $R^2$ in case for sugarcane.

The coefficient of expected price is significantly non-zero in only 7 cases of the total 18. Of the 7 cases, 5 are those in which the expected prices used in the regressions are of the models developed in this study. The coefficient of is positive in most cases and is not significant.
Shunt run elasticities of planted sugarcane and wheat area with respect to relative expected price.

<table>
<thead>
<tr>
<th>Expectancy groups</th>
<th>Wheat I</th>
<th>Wheat II</th>
<th>Wheat III</th>
<th>Sugarcane I</th>
<th>Sugarcane II</th>
<th>Sugarcane III</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>-0.011</td>
<td>0.266</td>
<td>0.294</td>
<td>0.646</td>
<td>0.146</td>
<td>0.321</td>
</tr>
<tr>
<td>Second</td>
<td>-0.087</td>
<td>0.413</td>
<td>0.491</td>
<td>0.472</td>
<td>0.435</td>
<td>0.386</td>
</tr>
<tr>
<td>Third</td>
<td>0.1726</td>
<td>0.225</td>
<td>0.243</td>
<td>0.649</td>
<td>0.598</td>
<td>0.439</td>
</tr>
<tr>
<td>Fourth</td>
<td>0.124</td>
<td>0.352</td>
<td>0.395</td>
<td>0.902</td>
<td>0.499</td>
<td>0.566</td>
</tr>
<tr>
<td>Fifth</td>
<td>0.220</td>
<td>0.067</td>
<td>0.436</td>
<td>0.974</td>
<td>0.664</td>
<td>0.597</td>
</tr>
<tr>
<td>Sixth</td>
<td>0.098</td>
<td>0.261</td>
<td>0.335</td>
<td>0.596</td>
<td>0.601</td>
<td>0.417</td>
</tr>
</tbody>
</table>

N.B.: All elasticities are at the point of means and are based on estimates in Tables VIII-1 and VIII-2. Short run refers to the elasticity after one year.

Description of Expectation Model: I: The average price sowing prices in the preceding 3 years.

II: Farm harvest price lagged one year.

III: Models developed in this study for the particular expectancy group.
It can also be seen from the tables that the coefficient of $\hat{\delta \delta_{k}}$ has a positive sign in most cases and it is significantly non-zero in six of the 36 cases even at 10 per cent level of significance. The value of the coefficient $\gamma'$ varies from 0.493 to 1.493. The coefficient is significantly non-zero in only three cases even at 10 per cent level of significance; when the expected price is taken as the average of the pre-sowing prices in the preceding three years or as the average of the prices during the preceding farm harvest periods; in contrast, in the case of the expected prices of the models developed in this study values of the coefficient $\gamma'$ varies from 0.573 to 0.933.

On the basis of the above it can be said that in the case of both the crops and for each of the six expectancy groups the regressions in which the expected prices from the models developed in this study are used give significantly better fit in comparison with the regression in which expected price used are either the average of the pre-sowing prices in the preceding three years or the average price during the last farm harvest. Further, the coefficients of expected prices have larger value and are significantly non-zero in the case of the expected prices of the models developed in this study. Had the analysis been carried out by taking expected prices as the average of the pre-sowing prices during the preceding three years or as the average price of preceding farm harvest period, the conclusion would have been that a large part of the
variations in the acreage are not explainable by the expected price and the lagged acreage and the coefficient of the expected price is significantly non-zero in only a few cases. On the contrary, when expected prices from the models developed in this study are used, the coefficient of determination ($R^2$) is significantly non-zero in almost all cases. Thus, the price expectation models developed in this study are capable of explaining the variations in acreage more significantly in comparison to other price expectation models.

The estimates of supply elasticities worked out from the above equations for wheat and sugar cane are given in the Table No. VIII-3. An examination of the table clearly indicates how significantly the inferences about the price responsiveness change when expected prices generated from the models developed in this study are used.

(IV)

Estimates from Alternative Estimation Procedure: Estimates of the structural parameters of the auto regressive linear regression model i.e., of the equation (viii) following joint estimation procedure for a set of regression equations are given in the Table No. VIII-4 and VIII-5. Standard errors of estimates are also given in the tables. The estimates of the structural parameters following equation by equation estimation of equations in (viii) by ordinary least squares are given in the appendix tables No. VIII-4 and VIII-5.
Generalized least squares estimates of acreage response equation (ix) for acreage under sugarcane

<table>
<thead>
<tr>
<th>Expectancy groups</th>
<th>Constant</th>
<th>Estimates of the coefficients of Relative expectancy</th>
<th>Lagged Acreage price</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5.6144</td>
<td>0.51479</td>
<td>0.51776</td>
</tr>
<tr>
<td></td>
<td>(1.17479)</td>
<td>(0.000273)</td>
<td>(0.000714)</td>
</tr>
<tr>
<td>II</td>
<td>10.88040</td>
<td>0.61872</td>
<td>0.41408</td>
</tr>
<tr>
<td></td>
<td>(0.62389)</td>
<td>(.000114)</td>
<td>(.000172)</td>
</tr>
<tr>
<td>III</td>
<td>1.26777</td>
<td>0.47271</td>
<td>0.68559</td>
</tr>
<tr>
<td></td>
<td>(2.37538)</td>
<td>(.001139)</td>
<td>(.001685)</td>
</tr>
<tr>
<td>IV</td>
<td>12.28852</td>
<td>0.80326</td>
<td>-0.11375</td>
</tr>
<tr>
<td></td>
<td>(0.59023)</td>
<td>(.000262)</td>
<td>(.00055)</td>
</tr>
<tr>
<td>V</td>
<td>13.08298</td>
<td>0.80524</td>
<td>0.02332</td>
</tr>
<tr>
<td></td>
<td>(0.81823)</td>
<td>(.000305)</td>
<td>(.000420)</td>
</tr>
<tr>
<td>VI</td>
<td>16.21360</td>
<td>0.39248</td>
<td>0.30164</td>
</tr>
<tr>
<td></td>
<td>(0.76788)</td>
<td>(.000308)</td>
<td>(.000429)</td>
</tr>
</tbody>
</table>

N.B.1- Figures in the parentheses are standard errors of the regression coefficients.
Estimates of the regression coefficients for all the six expectancy groups are significant at 1 per cent level of significance.
### TABLE No.VIII-5

Generalised least squares estimates of acreage response equation \((lx)\) for acreage under wheat

<table>
<thead>
<tr>
<th>Expectancy groups</th>
<th>Constant (7.87835)</th>
<th>Estimates of the Coefficients of Relative expected: Lagged acreage price</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>(0.46605)</td>
<td>(0.32564)</td>
</tr>
<tr>
<td></td>
<td>((0.33302))</td>
<td>((0.00033))</td>
</tr>
<tr>
<td></td>
<td>((0.46605))</td>
<td>((0.00033))</td>
</tr>
<tr>
<td></td>
<td>((0.00025))</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>(18.92062)</td>
<td>(-0.06922)</td>
</tr>
<tr>
<td></td>
<td>((1.00602))</td>
<td>((0.00037))</td>
</tr>
<tr>
<td></td>
<td>((0.06922))</td>
<td>((0.00037))</td>
</tr>
<tr>
<td></td>
<td>((0.00084))</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>(38.29124)</td>
<td>(-0.19205)</td>
</tr>
<tr>
<td></td>
<td>((2.72744))</td>
<td>((0.00031))</td>
</tr>
<tr>
<td></td>
<td>((2.12059))</td>
<td>((0.00031))</td>
</tr>
<tr>
<td></td>
<td>((0.001407))</td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>(19.89994)</td>
<td>(-0.17238)</td>
</tr>
<tr>
<td></td>
<td>((1.30305))</td>
<td>((0.00027))</td>
</tr>
<tr>
<td></td>
<td>((1.7238))</td>
<td>((0.00027))</td>
</tr>
<tr>
<td></td>
<td>((0.00203))</td>
<td></td>
</tr>
<tr>
<td>Fifth</td>
<td>(-18.61227)</td>
<td>(0.55743)</td>
</tr>
<tr>
<td></td>
<td>((2.12249))</td>
<td>((0.00047))</td>
</tr>
<tr>
<td></td>
<td>((0.55743))</td>
<td>((0.00047))</td>
</tr>
<tr>
<td></td>
<td>((0.00126))</td>
<td></td>
</tr>
<tr>
<td>Sixth</td>
<td>(4.02111)</td>
<td>(0.46059)</td>
</tr>
<tr>
<td></td>
<td>((0.26632))</td>
<td>((0.00015))</td>
</tr>
<tr>
<td></td>
<td>((0.46059))</td>
<td>((0.00015))</td>
</tr>
<tr>
<td></td>
<td>((0.00030))</td>
<td></td>
</tr>
</tbody>
</table>

**N.B.** Figures in the parentheses are standard errors of the regression coefficients.

Estimates of the coefficients for all six expectancy groups are significant at 1 per cent.
An examination of the tables No. VIII-4 and VIII-5 reveals that the coefficients of expected price have positive sign in every equation. The coefficients are highly significant. In most cases they are larger in comparison with coefficients obtained from reduced equation (V).

The gains of this estimation procedure over the ordinary least squares estimates are reflected in the lower values of standard errors of estimates. It should be noted that the standard errors of estimates in this case are significantly lower than those obtained from following an ordinary least squares estimation procedure. Further the estimates have the statistical qualities of being unbiased and consistent estimates of structural parameters.

The estimates of supply elasticities for the two crops wheat and sugarcane for each of the six expectancy groups are given in the Table No. VIII-6.

It can be seen from the table that in the case of wheat the estimates of elasticity for different expectancy groups varies from 0.158 to 0.667. All the elasticity coefficients are significant and positive. Similarly, in the case of sugarcane the elasticity coefficient varies from 0.3539 to 0.7387. In this case also all the coefficients are statistically significant. On the basis of the results given in the table
TABLE NO. VIII-6

Estimates of planted sugarcane and wheat area with respect to relative expected price.

<table>
<thead>
<tr>
<th>Expectancy groups</th>
<th>Crops</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheat</td>
<td>Sugarcane</td>
</tr>
<tr>
<td>First</td>
<td>0.3589</td>
<td>0.3539</td>
</tr>
<tr>
<td>Second</td>
<td>0.4645</td>
<td>0.3928</td>
</tr>
<tr>
<td>Third</td>
<td>0.1583</td>
<td>0.4798</td>
</tr>
<tr>
<td>Fourth</td>
<td>0.3344</td>
<td>0.7387</td>
</tr>
<tr>
<td>Fifth</td>
<td>0.6666</td>
<td>0.6477</td>
</tr>
<tr>
<td>Sixth</td>
<td>0.4721</td>
<td>0.3995</td>
</tr>
</tbody>
</table>

N.B: All elasticities are at the point of means and are based on estimates in tables VIII-4 and VIII-5. Elasticities for both crops and for each of the six expectancy groups are significant at 1 per cent level of significance.

It becomes quite clear that the farmers of different expectancy groups respond positively and significantly to change in their expected prices.

It should be noted that the elasticities in the case of wheat are significantly higher than the estimates obtained for wheat by Jai Krishna and N.C.A.E.R.\(^\text{30}\). (See Table II-1 appendix).

30 Jai Krishna (I-40) and N.C.A.E.R. (II-25).
This comparison supports the view expressed in Chapter VI that the estimates of supply response can significantly be improved by using the actual expected prices in place of expected prices computed from models in which it is necessary to assume that all the farmers expect in the same way and expectation behaviour remains invariant in all situations.

The estimates of supply elasticity of sugarcane compares well with the estimates obtained by Chandresh Kumar\(^ {31} \) for Meerut district and U.P. (see Table No. II-1 appendix).

On the basis of the above it could be concluded that farmers are price responsive, the acreage changes significantly with changes in the expected relative price of the crop. The results thus provide further positive support to the a priori hypothesis presented in Chapter II\(^ {32} \) viz., "Farmers in underdeveloped countries respond quickly, normally and efficiently to relative price changes".

\(^{31}\) Chandresh Kumar (I-48)

\(^{32}\) Chapter II, pp.22.