Vol XL
No. 2

APRIL-
JUNE
1985

ISSN 0019-5014

# INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

# RESEARCH NOTES

## PREDICTING CROP ACREAGE AND SHORT-TERM PRODUCTION CREDIT REQUIREMENT IN HISAR DISTRICT

Technological transformation, the on-going revolution in Indian agriculture is indicative of increasing capital investment in the business. The core of this new strategy implies the application of heavy doses of fertilizers, intensive irrigation and the use of high-yielding crop varieties which essentially assume the development of adequate infrastructure on the farm. The development of an infrastructure which is a pivot of agricultural transformation requires massive capital investment in its initial stages. In a developing economy like ours where farming is more a way of life than an industry, this huge capital requirement cannot be met fully by the farmerc out of their own savings. This creates a need for outside financial assistanve to sustain and accelerate the technological change in agriculture.

As under the present institutional agricultural credit policies, the short-term production credit is linked with the acreage of crops, a prior knowledge of likely acreage under different crops in the near future is a pre-requisite for any short-term production credit requirement projections. In the present study, an attempt has been made to project the acreage of crops and short-term credit requirement in Hisar district for the year 1978-79 to 1984-85.

### METHODOLOGY

This study relates to old Hisar district (including Sirsa and Bhiwanie of Haryana State. It is based on primary as well as secondary data collecte) from primary and published sources. The study is limited to the alternatds uses of land for nine important crops, *viz.*, wheat, gram, barley, rape ani mustard, bajra, paddy, maize, *desi* cotton and American cotton covering about 87.6 per cent of the total cropped area of the district.

To estimate the relative contribution of the independent variables to crop acreage, four single equation linear models of the Nerlovian type were fitted individually to each crop. These models are described below:

$$X_{it} = a + b_1 x_{it-1} + b_2 P_{ijt-1} + b_3 w_{ikt} + e_{it.}$$

$$X_{it} = a + b_1 x_{it-1} + b_2 I_{it-1} + b_3 w_{ikt} + e_{it.}$$

$$X_{it} = a + b_1 x_{it-1} + b_2 RP_{ijt-1} + b_3 w_{ikt} + e_{it.}$$

$$X_{it} = a + b_1 x_{it-1} + b_2 RI_{it-1} + b_3 w_{ikt} + e_{it.}$$

$X_{it}$ and $X_{it-1}$ = total area under ith crop in thousand hectares in year t and t—1 respectively,

$P_{ijt-1}$ = price of ith crop in jth model in (t—1)th year,

$I_{it-1}$ = per hectare gross income of ith crop in (t—1)th year,

$RP_{ijt-1}$ = relative price of ith crop with competing crop,
$RI_{it-1}$ = relative income of ith crop,
$e_{it}$ = an error term of the ith relationship,
i = 1, 2.....9 crops,
j = 1, 2, 3/price models,
k = 1, 2 weather models.

The three price expectation models used were:

$P_{t-1}$ (1) = harvest price,
$P_{t-1}$ (2) = average wholesale price during 12 post-harvest months,
$RP_{t-1}$ (3) = relative price.

Two weather models used in estimating the equation were:

$W_t(1)$ = average rainfall in cm. of two pre-sowing months of the relevant crop.
$W_t(2)$ = average rainfall in cm. of three pre-sowing months of the relevant crop.

In order to obtain the estimates of crop acreage from regression analysis the best fit equations were selected. While selecting the best fit equations, in addition to the usual criteria of $R^2$ values and the test of significance of the regression coefficients, Theil ' U ' test is also used.

Theil ' U ' test is defined as:

$$'U' = \sqrt{\frac{\Sigma (X_{it} - \hat{X}_{it})^2/n}{(\hat{X}_{it})^2/n}}$$

$X_{it}$ = observed value of crop acreage,
$\hat{X}_{it}$ = expected value of crop acreage,
n = number of observations.

To make the predictions more meaningful, it is a pre-requisite to calculate the minimum and maximum acreage flexibility limits for various crops in any year. Thus, to examine the flexibility limits of the crops under study, the maximum annual acreage limits were worked out.

The following model was used:

$$bj, max. = \sum_{r=1}^{m} \frac{(X_{rt} - X_{r\,t-1})}{X_{r\,t-1}} / m \text{ (where } X_{rt} > X_{rt-1})$$

$$bj, min. = \sum_{s=1}^{n} \frac{(X_{s\,t-1} - X_{st})}{X_{s\,t-1}} / n \text{ (where } X_{s\,t-1} > X_{st})$$

$$m + n = t-1$$

These are the constant percentage increase or decrease over the preceding year's actual acreage. Expressed in terms of mathematical notations, there are (t—1) proportionate changes in t years. Here 'm' is the number of positive flexibility limits and 'n' is the number of negative flexibility limits.

Based on the regression analysis and flexibility coefficients, year by year projections for area were made upto 1984-85 for Hisar district. The total acreage for which the farmers would need short-term production credit was worked out based on the credit requirement data collected from the sample farmers. It was found that only 57 per cent of the total farmers needed short-term credit for 50 per cent of their total cropped acreage. Thus, the total acreage for which farmers required credit was found to be 28.5 per cent of the total area under different crops. As such, the yearwise predicted acreage under different crops were deflated to 28.5 per cent and the credit requirement was worked out. The short-term credit requirements were worked out based on three different scales of finance. The second and third scale of finance were obtained through adjusting the first scale of finance, *i.e.*, scale of finance fixed by the District Co-operative Bank, Hisar for the year 1980-81 by the on-going inflation rate and input price trend respectively.

## RESULTS AND DISCUSSION

### *Estimated Regression Equations Used for Predicting Crop Acreage*

A perusal of Table I shows that in the case of *rabi* crops, amongst the important factors studied affecting crop acreage, rainfall came out to be the

TABLE I—ESTIMATED REGRESSION EQUATIONS USED FOR PREDICTING CROP ACREAGE

| Sr. No. | Crop | Equation | | | | Theil 'U' | $R^2$ |
|---|---|---|---|---|---|---|---|
| 1. | Wheat | $X_t$ = 235·4043 | +0·1111*$X_{t-1}$ (0·0020) | +0·2222$P_{t-1}$(1) (0·2069) | +2·7222*$W_t$(2) (0·2035) | 0·2260 | 0·8256 |
| 2. | Gram | $X_t$ = 491·7094 | +0·0150$X_{t-1}$ (0·0060) | +0·0150$P_{t-1}$(1) (0·0074) | +0·6000*$W_t$(2) (0·0934) | 0·2469 | 0·9314 |
| 3. | Barley | $X_t$ = 2·5131 | +0·0677$X_{t-1}$ (0·3464) | +0·2604*$P_{t-1}$(1) (0·0807) | —2·3483$W_t$(2) (5·1819) | 0·3824 | 0·5303 |
| 4. | Rapeseed and mustard | $X_t$ = 14·2576 | —0·1818$X_{t-1}$ (0·4388) | +0·1516$P_{t-1}$(1) (0·2314) | +3·4242*$W_t$(2) (1·2285) | 0·3886 | 0·4039 |
| 5. | Bajra | $X_t$ = 316·5669 | —0·0909$X_{t-1}$ (0·5770) | +0·5455$P_{t-1}$(1) (0·3162 | +15·1819*$W_t$(3) (1·7464) | 0·0932 | 0·6242 |
| 6. | Paddy | $X_t$ = —94·6839 | +0·4738$X_{t-1}$ (0·7747) | +1·5885*$P_{t-1}$(1) (0·5213) | — | 0·4367 | 0·4548 |
| 7. | Maize | $X_t$ = 3·6620 | +0·3912$X_{t-1}$ (0·9531) | — | —0·0033$W_t$(3) (0·1695) | 0·1500 | 0·5634 |
| 8. | Cotton (*desi*) | $X_t$ = 74·4857 | +0·4918$X_{t-1}$ (0·2058) | —0·1475$P_{t-1}$(2) (0·4463) | +5·5490*$W_t$(2) (2·0091) | 0·1918 | 0·3631 |
| 9. | Cotton (American) | $X_t$ = 88·7187 | +0·1541*$X_{t-1}$ (0·0055) | +0·0733$P_{t-1}$(2) (0·0004) | —8·7284$W_t$(2) (5·4328) | 0·2104 | 0·8534 |

*Significant at 5 per cent level of significance.

*Note:*— Figures in parentheses indicate standard errors of respective regression coefficients and in all cases n=10.

most important factor influencing the area under *rabi* crops significantly, except for barley. In the case of barley, it was the lag year price affecting the current year acreage decision significantly. For wheat, in addition to rainfall, its lag year acreage had also a significant impact on current year acreage. The main reason for the negative coefficient of rainfall in the case of barley may be that in good rainfall years, the barley acreage is likely to be substituted under unirrigated wheat. The significant impact of rainfall in the case of gram and rape and mustard is supported with the fact that in the study area, the sowing of these two crops is determined by their pre-sowing months' rainfall whereas for wheat the *rabi* season rainfall supplements the farmers' existing irrigation resources. In the case of *kharif* season too, it is the rainfall which plays a significant role in acreage decision-making process followed by lag year price and lag year acreage.

*Cropwise Area Projections for 1984-85*

Table II shows that the total cropped area of the nine major crops under study in Hisar district is expected to increase from 1,742.2 thousand hectares in 1977-78 to 1,746 thousand hectares in 1984-85. The area under paddy is projected to increase from 30 thousand hectares in 1977-78 to 138.9 thousand hectares in 1984-85. The area under bajra is also expected to increase from 425.1 thousand hectares to 458 thousand hectares during the same period. The area under foodgrains (wheat, gram, bajra, maize and paddy) is projected to increase from 1,407.2 thousand hectares in 1977-78 to 1,417.10 thousand hectares in 1984-85. Taking each crop studied individually, it is apparent from Table II that the area under gram and cotton (*desi*) crops is expected to decline during 1984-85, while all the other crops show an increasing trend.

The main policy implication of the finding is that the area under pulse crop in the district which is expected to decline goes against the present national strategy of increasing pulses production in the country. The decreasing trend in gram acreage which goes against the present national strategy may be due to lower gross income per hectare from gram as compared to its close substitutes. The above findings suggest the need for higher support price for gram as a short-term policy measure and to evolve high-yielding varieties of gram as a long-term policy measure to increase pulses production. The above findings are also supported by other similar findings.[1]

*Credit Requirement Based on 1980-81 Scale of Finance*

On the basis of 1980-81 scale of finance fixed by the District Co-operative Bank, Hisar, cropwise total short-term production credit requirement worked out for the years 1978-79 to 1984-85 is presented in Table III.

1. Daya Singh and A. S. Kahlon, "Predicting Crop Production in Haryana (Application of Recursive Programming Technique)," *Indian Journal of Agricultural Economics*, Vol. XXVII, No. 1, January-March 1972; R. P. Singh, Parmatma Singh and K. N. Rai, "Acreage Response to Rainfall, New Farm Technology and Price in Haryana," *Indian Journal of Economics*, Vol. LIV, Part II, No. 213, 1973; and I. J. Singh and K. N. Rai, "Need for Higher Support Price for Gram," *Commerce*, Vol. 139, Annual Number, 1979, p. 179.

TABLE II—ESTIMATES OF AREA OF MAJOR CROPS IN HISAR DISTRICT: PROJECTIONS FOR 1978-79 TO 1984-85

('000 hectares)

| Year/ Crop | Wheat | Gram | Barley | Rape and mustard | Bajra | Paddy | Maize | Cotton (*desi*) | Cotton (American) |
|---|---|---|---|---|---|---|---|---|---|
| 1978-79 .. | 294·0 | 510·3 | 27·4 | 81·5 | 432·0 | 58·8 | 4·6 | 71·3 | 129·9 |
| 1979-80 .. | 298·5 | 507·7 | 30·1 | 88·9 | 437·0 | 78·0 | 5·4 | 69·0 | 130·6 |
| 1980-81 .. | 300·0 | 507·9 | 31·6 | 92·0 | 441·0 | 92·8 | 5·7 | 65·0 | 132·4 |
| 1981-82 .. | 301·7 | 508·1 | 33·1 | 95·8 | 445·0 | 105·0 | 5·8 | 60·2 | 134·4 |
| 1982-83 .. | 303·2 | 508·2 | 34·6 | 99·5 | 449·0 | 116·7 | 5·9 | 55·0 | 136·4 |
| 1983-84 .. | 304·6 | 508·3 | 36·1 | 103·1 | 454·0 | 128·0 | 5·95 | 49·6 | 138·4 |
| 1984-85 .. | 306·1 | 508·1 | 37·5 | 106·9 | 458·0 | 138·9 | 6·0 | 44·1 | 140·4 |

TABLE III—CREDIT REQUIREMENT AT 1980-81 SCALE OF FINANCE: PROJECTIONS FOR 1978-79 TO 1984-85

(*Rs. lakhs*)

| Year/ Crop | Bajra | Paddy | Maize | Cotton (*desi*) | Cotton (American) | Wheat | Gram | Barley | Rape and mustard | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1978-79 .. | 1,241·78 | 272·08 | 15·86 | 259·93 | 710·37 | 1,329·93 | 1,538·42 | 58·58 | 254·26 | 5,681·21 (2,879·0)* |
| 1979-80 .. | 1,256·16 | 360·93 | 18·62 | 251·56 | 714·20 | 1,349·85 | 1,530·88 | 64·36 | 277·36 | 5,823·92 |
| 1980-81 .. | 1,267·66 | 429·41 | 19·65 | 236·98 | 724·05 | 1,356·62 | 1,531·17 | 67·57 | 287·03 | 5,920·14 |
| 1981-82 .. | 1,279·16 | 485·85 | 20·00 | 219·47 | 734·97 | 1,364·31 | 1,531·78 | 70·73 | 298·89 | 6,005·16 |
| 1982-83 .. | 1,290·65 | 540·00 | 20·34 | 200·51 | 745·91 | 1,371·09 | 1,532·08 | 73·98 | 310·42 | 6,084·98 |
| 1983-84 .. | 1,305·03 | 592·28 | 20·51 | 180·82 | 756·85 | 1,377·42 | 1,532·38 | 77·19 | 321·65 | 6,164·13 |
| 1984-85 .. | 1,316·53 | 652·33 | 20·69 | 160·77 | 767·79 | 1,384·21 | 1,532·69 | 80·19 | 333·51 | 6,248·71 |

* The figure in parenthesis indicates actual amount of loan disbursed.

On the whole, the total short-term production credit requirement of the district for all the nine crops under study shows an increase of 9.99 per cent. The increase in the credit requirements for cereals and oilseeds crops is expected to be 18.36 per cent and 31.16 per cent respectively. The credit requirements for pulse and fibre crops are estimated to decrease by 0.37 and 4.30 per cent respectively during the period.

*Credit Requirement Based on Inflation Rate*

The current rate of inflation which was about 16 per cent was assumed to continue at the same rate in the near future. So the credit requirement was estimated by inflating the 1980-81 scale of finance fixed by the co-operative bank by the constant rate of 16 per cent per annum for the future years. Table IV shows the short-term production credit requirement for various crops in Hisar district projected to 1984-85.

The credit requirements worked out at 16 per cent inflation rate per annum for all the nine crops under study showed a significant increase in the future years. The total short-term production credit requirements for all the crops under study were expected to be doubled in a short span of seven years (*i.e.*, from 1978-79 to 1984-85). The total credit requirements were projected to be Rs. 5,729.54 lakhs in 1978-79 and Rs. 11,295.32 lakhs in 1984-85, indicating an overall increase of about 97.14 per cent. The total increase in the credit requirement for cereals during the period of study was estimated to be 110.13 per cent. In the case of fibre crops an increase of 73.53 per cent in the credit requirement was estimated. The pulse and oilseed crops indicated an increase of 80.48 and 137.27 per cent respectively.

*Credit Requirement Based on Input Price Trend*

To work out the input price trend, all the inputs used for different crops were divided into three groups, *viz.*, 'fertilizer',[2] including insecticides and pesticides, 'seed' and 'other inputs' including bullock labour, human labour and water charges. Finally, to work out the credit requirement for different crops for different years, 1980-81 scale of finance was adjusted on the basis of input price trend. The input price index worked out for each of the three input groups indicated an increasing trend. The total short-term production credit requirement of the district for the nine crops under study, worked out on the basis of input price trend, was estimated to be Rs. 5,583.06 lakhs in 1980-81 which was expected to increase to Rs. 7,623.14 lakhs by 1984-85 (Table V). The total increase in the credit requirement thus estimated was 36.54 per cent.

## SUMMARY AND CONCLUSIONS

The findings of the credit requirement projections indicate that the short-term production credit requirement for the Hisar district as a whole as well as

2. In the absence of reliable insecticides/pesticides use data and a wide range in their prices, credit limit fixed for this input was pooled with the credit limit fixed for fertilizer and it was treated as fertilizer for the adjustment of credit limit based on input price trend.

TABLE IV—CREDIT REQUIREMENT AT ADJUSTED SCALE OF FINANCE BY 16 PER CENT RATE OF INFLATION: PROJECTIONS FOR 1978-79 TO 1984-85

(*Rs. lakhs*)

| Year/ Crop | Bajra | Paddy | Maize | Cotton (*desi*) | Cotton (American) | Wheat | Gram | Barley | Rape and mustard | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1978-79 .. | 1,241·78 | 321·16 | 15·55 | 259·93 | 710·37 | 1,329·49 | 1,538·42 | 58·58 | 254·26 | 5,729·54 |
| 1979-80 .. | 1,256·16 | 360·92 | 18·55 | 251·55 | 714·19 | 1,349·85 | 1,530·88 | 64·36 | 277·36 | 5,823·82 |
| 1980-81 .. | 1,276·66 | 429·41 | 19·58 | 236·93 | 124·05 | 1,536·62 | 1,531·17 | 67·57 | 287·03 | 5,929·07 |
| 1981-82 .. | 1,485·06 | 563·87 | 23·18 | 254·49 | 852·75 | 1,582·18 | 1,777·58 | 82·10 | 346·57 | 6,967·78 |
| 1982-83 .. | 1,737·65 | 726·54 | 27·25 | 269·54 | 1,004·11 | 1,845·13 | 2,062·96 | 99·70 | 417·16 | 8,190·04 |
| 1983-84 .. | 2,037·11 | 924·31 | 31·74 | 282·02 | 1,181·85 | 2,148·36 | 2,394·79 | 120·72 | 501·64 | 9,622·54 |
| 1984-85 .. | 2,382·59 | 1,163·72 | 37·39 | 290·92 | 1,390·88 | 2,504·46 | 2,776·66 | 145·38 | 603·32 | 11,295·32 |

TABLE V—CREDIT REQUIREMENT BASED ON INPUT PRICE TREND: PROJECTIONS FOR 1978-79 TO 1984-85

(*Rs. lakhs*)

| Year | Bajra | | | | Paddy | | | | Maize | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fertilizer | Seed | Other inputs | Total | Fertilizer | Seed | Other inputs | Total | Fertilizer | Seed | Other inputs | Total |
| 1978-79 .. | 466·62 | 49·11 | 491·18 | 1,006·91 | 257·67 | 10·29 | 88·62 | 356·58 | 8·56 | 0·63 | 6·33 | 15·52 |
| 1979-80 .. | 482·22 | 50·76 | 507·59 | 1,040·57 | 262·66 | 13·66 | 117·57 | 393·89 | 10·20 | 0·74 | 7·56 | 18·50 |
| 1980-81 .. | 456·90 | 48·09 | 480·95 | 985·94 | 273·25 | 16·26 | 139·88 | 429·39 | 10·77 | 0·79 | 7·98 | 19·54 |
| 1981-82 .. | 477·53 | 51·81 | 522·95 | 1,052·29 | 330·53 | 20·60 | 175·94 | 527·07 | 11·79 | 0·85 | 9·04 | 21·68 |
| 1982-83 .. | 494·44 | 54·68 | 551·40 | 1,100·52 | 391·90 | 24·53 | 212·72 | 629·15 | 12·74 | 0·90 | 10·01 | 23·65 |
| 1983-84 .. | 505·68 | 54·96 | 580·43 | 1,141·07 | 455·88 | 29·60 | 254·86 | 740·34 | 13·58 | 0·94 | 10·97 | 25·49 |
| 1984-85 .. | 513·82 | 57·56 | 605·50 | 1,176·86 | 519·03 | 34·08 | 297·01 | 850·12 | 14·46 | 0·98 | 11·97 | 27·41 |

(*Contd.*)

TABLE V (*Concld.*)

(*Rs. lakhs*)

| Year | Cotton (American) | | | | Cotton (*desi*) | | | | Wheat | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fertilizer | Seed | Other inputs | Total | Fertilizer | Seed | Other inputs | Total | Fertilizer | Seed | Other inputs | Total |
| 1978-79 .. | 332·21 | 25·55 | 332·21 | 689·97 | 99·55 | 9·95 | 149·33 | 258·33 | 841·18 | 103·06 | 412·24 | 1,329·48 |
| 1979-80 .. | 333·31 | 25·63 | 333·30 | 692·24 | 90·30 | 9·02 | 135·44 | 234·76 | 826·64 | 104·63 | 418·55 | 1,349·82 |
| 1980-81 .. | 334·12 | 25·70 | 334·12 | 693·94 | 81·46 | 8·14 | 122·20 | 211·89 | 830·80 | 105·16 | 420·66 | 1,356·62 |
| 1981-82 .. | 357·84 | 28·31 | 371·58 | 757·73 | 78·01 | 7·99 | 121·40 | 207·40 | 894·73 | 117·56 | 469·57 | 1,481·86 |
| 1982-83 .. | 382·49 | 30·08 | 405·70 | 818·27 | 73·52 | 7·73 | 117·07 | 198·32 | 956·58 | 125·56 | 514·42 | 1,596·56 |
| 1983-84 .. | 406·36 | 31·85 | 443·39 | 881·60 | 67·87 | 7·29 | 111·05 | 186·21 | 1,020·78 | 136·67 | 563·78 | 1,721·23 |
| 1984-85 .. | 426·85 | 34·48 | 477·74 | 939·07 | 60·55 | 6·67 | 101·54 | 168·76 | 1,077·32 | 148·07 | 609·47 | 1,834·86 |

| Year | Gram | | | | Barley | | | | Rape and mustard | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fertilizer | Seed | Other inputs | Total | Fertilizer | Seed | Other inputs | Total | Fertilizer | Seed | Other inputs | Total | |
| 1978-79 .. | 643·99 | 178·89 | 715·54 | 1,538·42 | 20·17 | — | 38·42 | 58·59 | 111·42 | 2·85 | 139·98 | 254·25 | 5,508·05 |
| 1979-80 .. | 640·83 | 178·00 | 712·03 | 1,530·86 | 22·15 | — | 42·20 | 64·35 | 121·53 | 3·11 | 152·70 | 277·34 | 5,602·33 |
| 1980-81 .. | 640·95 | 178·04 | 712·18 | 1,531·17 | 23·25 | — | 44·30 | 67·55 | 125·77 | 3·22 | 158·03 | 287·02 | 5,583.06 |
| 1981-82 .. | 687·52 | 192·35 | 790·82 | 1,670·69 | 25·97 | — | 51·48 | 77·45 | 140·37 | 4·03 | 182·69 | 327·09 | 6,123·28 |
| 1982-83 .. | 730·41 | 206·65 | 862·24 | 1,799·30 | 29·11 | — | 58·70 | 87·81 | 154·86 | 4·18 | 206·49 | 365·53 | 6,619·11 |
| 1983-84 .. | 776·88 | 220·94 | 940·81 | 1,938·63 | 32·13 | — | 66·81 | 98·94 | 170·58 | 5·05 | 233·47 | 409·10 | 7,142·61 |
| 1984-85 .. | 816·24 | 235·24 | 1,012·29 | 2,063·77 | 34·96 | — | 74·66 | 109·62 | 185·86 | 5·99 | 260·82 | 452·67 | 7,623·14 |

for most of the individual crops will increase significantly in the near future at each of the three scales of finance used. Even at the constant scale of finance, *i.e.*, the scale of finance fixed by the Hisar District Co-operative Bank for the year 1980-81, it is expected to increase by about 9.99 per cent due to the projected increase in the total cropped acreage. The projected credit requirement figure and the actual credit disbursed figure for the year 1978-79 show that the actual amount of credit disbursed was only half of the total credit required indicating too large a gap to be bridged. This gap gets further widened with the credit requirements worked out at the scale of finance adjusted by the input price trend and on-going inflation rate.

The policy implication of the above findings is that to keep the wheel of the so-called present agricultural revolution moving and to accelerate its pace, while preparing the credit plan of a district, likely changes in the cropping pattern and inputs prices are to be taken into account which are bound to take place with the increased availability of irrigation facilities, adoption of improved technologies and change in the general price level.

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## DETERMINANTS OF WHEAT ACREAGE FLUCTUATIONS IN BIHAR: A STUDY OF TEMPORAL-SPATIAL VARIATIONS

The crucial decisions relating to what crop and how much to grow on how much land with what levels of non-land factors of production, etc., are essentially based on the relative profitability of each crop. Any change in the production levels of different crops is thus brought about through inter-crop shifts on land, owing to varying profitability from crop to crop. Most of the previous writers[1] have, however, considered price as an important factor of decision. Price may be the only consideration if the yield rate remains unchanged over the period. If the yield rate varies, price may not be the sole decisive factor. In fact, when technological developments take place, the year-to-year changes in the land allocation reflect changes in the farmers' decisions not only owing to variations in prices but also because of variations in the yield rates. Again, if the farmers produce the crop mainly for the market, price may be an important consideration for them but the subsistence farmers may attach more importance to the yield rates because most of the crops are grown for their own consumption. The consumer-producer farmers might also consider price and yield rate both simultaneously and be interested in income from the crop, specially the net cash income.

Bihar has three natural regions, *viz.*, North Bihar Plain, South Bihar Plain and Chotanagpur Plateau regions (hereafter referred to as NBP, SBP

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1. Like Batra (1978), Behrman (1968), Raj Krishna (1963), Krishna and Rao (1967), Dharm Narain (1965), Nerlove (1958), Oury (1966), Parikh (1971), Singh (1979) and many others.