PART THREE

INFLUENCE OF CHANGING PRICES ON CROPPING & PRODUCTION PATTERN OF SELECTED CROPS IN UPPER GANGA-YAMUNA DOAB
CHAPTER FOUR

INFLUENCE OF CHANGING PRICES ON AREA
AND PRODUCTION OF SELECTED CROPS
In the previous chapters, simple trends in area, production, and prices of the selected crops (rice, jowar, bajra, maize, wheat, barley, gram, and arhar amongst foodgrains and mustard, sugarcane, potato, and cotton amongst the non-foodgrains) in the five districts of the study region from 1965-66 to 1970-71 were studied.

We have observed that the prices of all the selected crops have increased, consequently its impact was also observed on the area and production of these crops. So, we are, perhaps, justified in setting up tentatively the hypothesis that in the upper Ganga-Yamuna doab region, there is strong positive correlation between price-area and price-production of selected crops. Especially among cash crops, there is a strong positive response. Positive in the case of fine cereals and low or even negative response of area and production to prices in coarse grains.

In this chapter an attempt has been made to analyse some more complex relationships, which are generally not evident and can be brought to light only through the use of more powerful tools of statistical and economic analysis. We will analyse the responsiveness of area and production of selected crops to changes in the prices of these crops. We will also assess the nature and degree of responsiveness. This chapter has been divided into two parts. The first part deals with the influence of changing prices on area of selected crops and the second part deals with the influence of changing prices on production of selected crops.

To understand the nature and the degree of responsiveness, firstly we have used graphical analysis as a
rough guide. We plot the farm harvest prices (in logarithm form) of the selected crops along the X axis, assuming it to be the causal factor and we plot the dependent factor of area and production (in logarithm form) along the Y axis, in all the years from 1965-66 to 1990-91. Here we assume that the farmer will react to the changed prices after a season, so to take account of the time lag, we relate the price of a crop with the area and production of that crop in the immediately following year. Apart from the graphical presentation, to know the relationship, regression analysis is also worked out. The simplest assumption here is of a straight line relationship. Such relationship is usually of 'Cobb-Douglas' type (John, F.V., 1965) which is expressed as:

\[ Y = AX^b \]

Which when expressed in logarithm form would be:

\[ \log Y = a + b \log X \]

where \( X \) = Price of a crop
\( Y \) = Area of production of that crop
\( a \) = Value of the constant
\( b \) = Gradient between \( \log Y \) and \( \log X \).

4.1. INFLUENCE OF CHANGING PRICES ON AREA OF SELECTED CROPS:

In this part of the chapter, the analysis is related to responsiveness of area to changes in the prices. Relating area of each year to prices of the previous year, regression equations of the 'Cobb Douglas' type are worked out with logarithmic data and the estimated values of the equations are given in Tables 4.1, 4.2, 4.3, 4.4 and 4.5 for all the five districts of the study region from 1965-66 to 1990-91. The values of the correlation coefficients duly tested for their
significance are also shown against each equation. Graph were also drawn with logarithmic values of prices on 'X' axis and logarithmic values of area on 'Y' axis to show the relationship between these two variables and were presented in Figure 4.i, 4.2, 4.3, 4.4 and 4.5. First we try to study the responsiveness of area to changes in prices in each district separately.

4.1. Saharanpur District:

The area under mustard (0.91), wheat (0.87), arhar (0.68), sugarcane (0.66) and potato (0.65) responded positively and strongly while rice (0.46) and jowar (0.67) were the other crops which showed positive though weak correlation to the increased prices. While the area under gram (-0.85), bajra (-0.52), maize (-0.76), barley (-0.66) and cotton (-0.31) showed negative relationship to prices in Saharanpur district (Table 4.i and Figure 4.1).

1. Foodgrains:

The foodgrains which showed positive correlation were:

(i) Wheat: The area under wheat has moved with the increasing prices and responded positively. The area of wheat was increased by more than 71 per cent and it covers the maximum, 58.77 per cent of the districts gross cropped area. Here we see that high priority is given to wheat cultivation in this district due to its profitability. We also observe that wheat has gained area because of the shift in area under other coarse cereals for the cultivation of wheat. The correlation coefficient was 0.87, which was significant at one per cent level. The regression equation calculated was \[ \log Y = 4.579 + \]
TABLE 4.1: RELATION BETWEEN PRICE AND AREA IN SAHARANPUR DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>$\log Y = 4.791 + 0.097 \log X$</td>
<td>0.46</td>
</tr>
<tr>
<td>Jowar</td>
<td>$\log Y = 1.534 + 0.026 \log X$</td>
<td>0.097</td>
</tr>
<tr>
<td>Bajra</td>
<td>$\log Y = 9.516 - 3.019 \log X$</td>
<td>-0.82</td>
</tr>
<tr>
<td>Maize</td>
<td>$\log Y = 5.053 - 0.265 \log X$</td>
<td>-0.78</td>
</tr>
<tr>
<td>wheat</td>
<td>$\log Y = 4.579 + 0.317 \log X$</td>
<td>0.87</td>
</tr>
<tr>
<td>Barley</td>
<td>$\log Y = 5.191 - 1.514 \log X$</td>
<td>-0.68</td>
</tr>
<tr>
<td>Gram</td>
<td>$\log Y = 7.848 - 1.721 \log X$</td>
<td>-0.85</td>
</tr>
<tr>
<td>Arhar</td>
<td>$\log Y = 1.121 + 0.543 \log X$</td>
<td>0.81</td>
</tr>
<tr>
<td>Mustard</td>
<td>$\log Y = -0.357 + 1.433 \log X$</td>
<td>0.91</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>$\log Y = 4.645 + 0.370 \log X$</td>
<td>0.80</td>
</tr>
<tr>
<td>Potato</td>
<td>$\log Y = 1.949 + 0.624 \log X$</td>
<td>0.65</td>
</tr>
<tr>
<td>Cotton</td>
<td>$\log Y = 3.936 - 0.137 \log X$</td>
<td>-0.31</td>
</tr>
</tbody>
</table>
SAHARANPUR DISTRICT
RELATION BETWEEN PRICE AND AREA OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
\[ r = 0.46 \]

MAIZE
\[ r = 0.78 \]

WHEAT
\[ r = 0.87 \]

BARLEY
\[ r = -0.68 \]

GRAM
\[ r = -0.85 \]

ARHAR
\[ r = 0.81 \]

MUSTARD
\[ r = 0.91 \]

SUGARCANE
\[ r = 0.90 \]

POTATO
\[ r = 0.65 \]

COTTON
\[ r = -0.31 \]

FIG. 41
0.319 Log X. The graph also corroborates the high positive correlation between price and area of wheat.

(ii) Arhar: The area of arhar (264.3 per cent) has increased significantly with the increase in its prices during the study period. The correlation coefficient between prices and area was 0.81, which was significant at all the levels of significance. The regression equation calculated was Log Y = 1.121 + 0.543 Log X. The graph also points towards their positive relationship.

(iii) Rice: The prices of rice has increased by 295.8 per cent and so is the area, which has increased by about 19 per cent. It was observed that the area under rice has responded positively to the increased prices. A positive although not very strong correlation was recorded. The correlation coefficient was 0.46, which was significant at 5 per cent level. The regression equation calculated was Log Y = 4.791 + 0.097 Log X. The graph also justifies these results.

(iv) Jowar: The prices of jowar has recorded an increase of about 253 per cent but its acreage has declined during the study period. However, there was a positive correlation recorded but it was of very low degree. The correlation coefficient was 0.697, which was not significant. The regression equation was Log Y = 1.534 + 0.026 Log X. The graph also shows a low degree of positive correlation.

The foodgrains which showed negative correlations were:

1. Barley: Although the prices of barley has increased by 267.6 per cent but the area has decreased by about 73 per cent. It covers only 0.1 per cent of the districts gross cropped.
area. This crop is also used more as fodder rather than as foodgrain. That is why the prices doesn't have much influence on its area. The correlation coefficient was -0.68 and the regression equation was \( \log Y = 5.191 - 1.314 \log X \). The graph also shows the negative relationship.

2. Maize: Maize was another cereal which was not influenced by its rising prices. The area under maize has decreased considerably that's why the correlation coefficient was negative. It was -0.76 and the regression equation was \( \log Y = 3.653 - 0.205 \log X \). The graph also corroborates the results.

3. Bajra: Although the prices of bajra has increased considerably but the area under bajra has not responded to increased prices and has decreased by about 74 per cent. Bajra is one of the cereals, which is losing its area to other remunerative crops. The correlation coefficient was -0.82 and the regression equation was \( \log Y = 7.516 - 3.019 \log X \). The graph also shows negative relationship.

4. Gram: The area under gram has declined considerably, by about 77 per cent despite of increase in its prices. Which indicates that some other factors are affecting its acreage. The correlation coefficient between prices and area of gram was -0.85, while the regression equation was \( \log Y = 7.848 - 1.722 \log X \). The graph also points towards its negative relation.

2. Non-foodgrains:

The non-foodgrains which showed positive correlation were:
(i) Mustard: The prices of mustard has increased by 336 per cent, so has the area by about 600 per cent during the study period. It still covers only 0.77 per cent of the districts gross cropped area, which shows that there was negligible area under mustard in 1966-67. Strong positive relationship was observed between prices and area of mustard. The correlation coefficient was as high as 0.91, which was significant at all levels of significance. The regression equation was Log Y = -0.357 + 1.433 Log X. The equation also shows high degree of positive influence on mustards area by its prices. The graph also supports the findings.

(ii) Sugarcane: Sugarcane is also one of the most favoured crop of this district. The area under sugarcane has kept pace with its increasing prices. The area under sugarcane has increased by about 90 per cent while the prices has increased by 471 per cent. A strong positive correlation was observed between its prices and area. The correlation coefficient was 0.80, which was significant at one per cent level. The regression equation was Log Y = 4.645 + 0.370 Log X. The graph also supports the results.

(iii) Potato: The prices of potato has increased by about 475 per cent and its acreage has gone up by about 116 per cent and a positive correlation was recorded between them. The correlation coefficient was 0.65 which was significant at one percent level. The regression equation was Log Y = 1.949 + 0.624 Log X. The graph also shows the positive correlation.

The only crop amongst non-foodgrains which showed negative relationship was:
Cotton: The prices of cotton have increased by 471 per cent. However, the area has decreased by about 34 per cent. The prices of cotton have not influenced its acreage positively. The correlation coefficient was -0.31. The regression equation was $\log Y = 3.93 - 0.137 \log x$. The graph also corroborates with the negative relation.

4.1.2. Muzaffarnagar District:

Mustard (0.92), arhar (0.90), potato (0.79), sugarcane (0.79), and wheat (0.74) recorded a strong positive correlation between prices and area. Rice (0.34) was another crop which showed positive but weak correlation. While maize (-0.82), bajra (-0.79), gram (-0.75), barley (-0.67), jowar (-0.55) and cotton (-0.33) responded negatively to the increasing prices in Muzaffarnagar district (Table 4.2 and Figure 4.2).

i. Foodgrains:

The foodgrains which recorded positive correlation were:

(i) Arhar: The prices of arhar has increased by 563 per cent, so has the area by about 658 per cent. Despite such a huge increase in its area, arhar still cover negligible area. The correlation coefficient was very high between prices and area. It was 0.90 and the regression equation was $\log Y = -1.249 + 1.05 \log x$. The graph also shows the strong positive relation.

(ii) Wheat: The prices of wheat has increased by 252.7 per cent while the area has increased by 23.3 per cent during the study period. Wheat is one of the most favoured crop of the district after sugarcane and it covers 31.16 per cent of the district's gross cropped area. The correlation coefficient
## TABLE 4.2: RELATION BETWEEN PRICE AND AREA IN MUZAFFARNAGAR DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>[ \log Y = 4.532 + 0.053 \log X ]</td>
<td>0.34</td>
<td>No</td>
</tr>
<tr>
<td>Jowar</td>
<td>[ \log Y = 4.556 - 1.075 \log X ]</td>
<td>-0.55</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>[ \log Y = 9.228 - 3.710 \log X ]</td>
<td>-0.79</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>[ \log Y = 5.398 - 0.675 \log X ]</td>
<td>-0.82</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>[ \log Y = 4.977 + 0.099 \log X ]</td>
<td>0.74</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>[ \log Y = 4.635 - 0.974 \log X ]</td>
<td>-0.69</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>[ \log Y = 7.170 - 1.531 \log X ]</td>
<td>-0.75</td>
<td></td>
</tr>
<tr>
<td>Arnar</td>
<td>[ \log Y = -1.249 + 1.63 \log X ]</td>
<td>0.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Mustard</td>
<td>[ \log Y = 0.033 + 1.187 \log X ]</td>
<td>0.92</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>[ \log Y = 4.806 + 0.341 \log X ]</td>
<td>0.79</td>
<td>Yes</td>
</tr>
<tr>
<td>Potato</td>
<td>[ \log Y = 2.164 + 0.584 \log X ]</td>
<td>0.79</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>[ \log Y = 4.044 - 0.182 \log X ]</td>
<td>-0.33</td>
<td></td>
</tr>
</tbody>
</table>
MUZAFFARNAGAR DISTRICT
RELATION BETWEEN PRICE AND AREA OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
$r = 0.34$

JOWAR
$r = -0.55$

BAJRA
$r = -0.79$

MAIZE
$r = -0.82$

WHEAT
$r = 0.74$

BARLEY
$r = -0.69$

GRAM
$r = -0.75$

ARHAR
$r = 0.90$

MUSTARD
$r = 0.92$

SUGARCANE
$r = 0.79$

POTATO
$r = 0.79$

COTTON
$r = -0.33$

FIG. 4.2
between price and area of wheat was 0.74, which was significant at one per cent level. The regression equation was \[ \log Y = 4.977 + 0.077 \log A. \] The graph also corroborates the results.

Rice: The price of rice has increased by 298 per cent as its acreage increased only marginally. A weak positive correlation between prices and area was recorded. The correlation coefficient was 0.34 which was not significant. The regression equation was \[ \log Y = 4.532 + 0.053 \log A. \] The graph also justifies the results.

The foodgrains which showed negative correlation were:

1. Jowar: The prices of jowar has increased by 250 per cent but its acreage has declined by about 66 per cent. Jowar is not favoured by the farmers in the district and is generally used as fodder crop. The correlation coefficient between price and area of jowar was -0.53, while the regression equation was \[ \log Y = 4.550 - 1.075 \log A. \] The graph also points towards the negative relationship.

2. Barley: The prices of barley has increased by 210.5 per cent but its acreage has decreased by about 75 per cent during the study period. The correlation coefficient between price and area of barley was -0.69 and the regression equation was \[ \log Y = 4.035 - 0.974 \log A. \] The graph also justifies the results.

3. Gram: The prices of gram has increased by 595.4 per cent but the area has decreased by 95.2 per cent. Gram is one of the crop, whose prices could not influence positively its acreage. The correlation coefficient was -0.75 and the regression equation was \[ \log Y = 7.170 - 1.531 \log X. \] The graph also shows the negative relation.
4. Bajra: The prices of bajra has increased by about 218 per cent but its acreage decreased considerably by about 94 per cent. A negative relation was observed. The correlation coefficient was -0.79. The regression equation was \( \log Y = 9.228 - 3.710 \log X \). The graph also corroborates the results.

5. Maize: The prices of maize has increased by about 192 per cent but the area has decreased by about 44 per cent. The correlation coefficient was -0.82 between the prices and area. The regression equation calculated was \( \log Y = 3.398 - 0.695 \log X \). The graph also shows the negative relationship.

2. Non-foodgrains:

The non-foodgrains which recorded positive correlation were:

(i) Mustard: The prices of mustard has increased by 339.5 per cent and its acreage also increased significantly by about 430 per cent. Almost perfect positive correlation was observed between prices and area. The correlation coefficient was 0.92, which was significant at all levels of significance. The regression equation was \( \log Y = 6.033 + 1.189 \log X \). The graph also justifies the results.

(ii) Potato: The prices of potato has increased by 495.4 per cent while its area also increased by 152.3 per cent during the study period. Once again a high degree of positive correlation was observed between price and area. The correlation coefficient was 0.79 which was significant at one per cent level. The regression equation was \( \log Y = 2.184 + 0.564 \log X \). The graph also shows a high degree of positive relation between price and area of potato.
(iii) Sugarcane: The prices of sugarcane has increased by 451.7 per cent and its acreage also increased by 104.7 per cent. Sugarcane is the most favoured crop of the district and its share was maximum of the district's gross cropped area. A high degree of positive correlation was recorded. It was 0.79, which was significant at all levels of significance. The regression equation was Log Y = 4.506 + 0.341 Log X. The graph also justifies the findings.

Cotton was the only non-foodgrain which registered negative correlation.

Cotton: The prices of cotton has increased by 449.2 per cent but the area has decreased by 37.1 per cent. The correlation coefficient recorded was -0.33 and the regression equation calculated was Log Y = 4.044 - 0.182 Log X. The graph supports the results.

4.1.3. Meerut District:

The area under only mustard (0.73), potato (0.60), sugarcane (0.51) and arhar (0.31) has responded positively to the increasing prices, rest all the selected crops were negatively related in the district. A large part of Meerut district's area was transferred to Ghaziabad to construct it as a district. So the area under most of the crops have decreased and negative relation was observed. The crops which recorded negative relation were cotton (-0.79), bajra (-0.78), gram (-0.78), maize (-0.76), jowar (-0.65), barley (-0.56), rice (-0.56) and wheat (-0.40) during the study period in the district (Table 4.3 and Figure 4.3).
TABLE 4.3: RELATION BETWEEN PRICE AND AREA IN MEERUT DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>( \log \gamma = 5.238 - 0.437 \log \bar{x} )</td>
<td>-0.56</td>
<td></td>
</tr>
<tr>
<td>Jowar</td>
<td>( \log \gamma = 6.405 - 1.079 \log \bar{x} )</td>
<td>-0.65</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>( \log \gamma = 6.701 - 2.466 \log \bar{x} )</td>
<td>-0.79</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>( \log \gamma = 6.412 - 0.892 \log \bar{x} )</td>
<td>-0.76</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>( \log \gamma = 5.690 - 0.203 \log \bar{x} )</td>
<td>-0.40</td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>( \log \gamma = 6.517 - 1.669 \log \bar{x} )</td>
<td>-0.56</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>( \log \gamma = 7.222 - 1.458 \log \bar{x} )</td>
<td>-0.78</td>
<td></td>
</tr>
<tr>
<td>Årnar</td>
<td>( \log \gamma = 2.71 + 0.081 \log \bar{x} )</td>
<td>0.11</td>
<td>No</td>
</tr>
<tr>
<td>Mustard</td>
<td>( \log \gamma = -0.546 + 1.426 \log \bar{x} )</td>
<td>0.74</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>( \log \gamma = 5.033 + 0.121 \log \bar{x} )</td>
<td>0.51</td>
<td>Yes</td>
</tr>
<tr>
<td>Potato</td>
<td>( \log \gamma = 3.105 + 0.342 \log \bar{x} )</td>
<td>0.61</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>( \log \gamma = 6.092 - 1.028 \log \bar{x} )</td>
<td>-0.79</td>
<td></td>
</tr>
</tbody>
</table>
MEERUT DISTRICT
RELATION BETWEEN PRICE AND AREA OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
\[ r = -0.56 \]

JOWAR
\[ r = -0.65 \]

BAJRA
\[ r = -0.78 \]

MAIZE
\[ r = -0.76 \]

WHEAT
\[ r = -0.40 \]

BARLEY
\[ r = -0.56 \]

GRAM
\[ r = -0.78 \]

ARHAR
\[ r = 0.11 \]

MUSTARD
\[ r = 0.73 \]

SUGARCANE
\[ r = 0.51 \]

POTATO
\[ r = 0.60 \]

COTTON
\[ r = 0.79 \]

FIG. 4.3
i. Foodgrains:

Arhar was the only foodgrain which registered positive correlation.

(i) Arhar: The prices of arhar has increased by 550 per cent while its acreage increased only marginally by about 5 per cent. A very low degree of positive correlation was observed. The correlation coefficient was 0.11 which was not significant. The regression equation was \( \log Y = 2.71 + 0.081 \log x \). The graph also shows a very low degree of positive correlation.

The area under foodgrains which showed negative relation with their prices were:

(ii) Wheat: The prices of wheat has increased by 266.5 per cent and its area also increased marginally. Wheat covers maximum 32.65 per cent of the districts gross cropped area. But still the area under wheat was negatively related with the prices. The correlation coefficient was -0.46 and the regression equation was \( \log Y = 5.69 - 0.205 \log x \). The graph also supports the results.

(iii) Rice: The prices has increased by 275.8 per cent while its acreage has declined by 45 per cent. It covers 3.5 per cent of the districts gross cropped area. The correlation coefficient was -0.56 and the regression equation was \( \log Y = 5.23 - 0.457 \log x \). The graph also corroborates the results.

(iii) Barley: The prices of barley has increased by 208.3 per cent but it had not influenced positively its acreage. The barley acreage has declined by about 92 per cent. The
correlation coefficient was \(-0.56\) and the regression equation was \(\log Y = 6.517 - 1.069 \log X\). The graph also points towards the negative relation.

(iv) Jowar: The prices of jowar has increased by about 202 per cent but its area declined by 69.5 per cent. It was negatively related with the prices. The correlation coefficient was \(-0.65\) and the regression equation was \(\log Y = 6.405 - 1.679 \log X\).

(v) Maize: The prices of maize has increased by 191.5 per cent but its area has decreased by 47.5 per cent. It covers 5.65 per cent of the districts gross cropped area, which is second only to wheat in the foodgrain category, in this district. The correlation coefficient was \(-0.76\) and the regression equation calculated was \(\log Y = 6.412 - 0.892 \log X\). The graph also corroborates the results.

(vi) Gram: The prices of gram has increased by 628.4 per cent but its acreage declined by about 91 per cent. A high degree of negative correlation was observed between price and area of gram. The correlation coefficient was \(-0.78\). The regression equation was \(\log Y = 7.222 - 1.456 \log X\). The graph also justifies the results.

(vii) Bajra: The prices of bajra has increased by 153.6 per cent but its area has decreased drastically by 90.3 per cent. The correlation coefficient was \(-0.79\) between price and area of bajra. The regression equation was \(\log Y = 8.701 - 2.466 \log X\). The graph also shows the negative relation between price and area.
2. Non-Foodgrains:

The area under non-foodgrains which showed positive relation with prices in the district were:

(i) Mustard: The prices of mustard has increased by 330.1 per cent while the area has recorded an increase of 528.3 per cent. It still covers only 0.61 per cent of the district's gross cropped area. The fact is that there was hardly any area under mustard in 1966-67. The correlation coefficient was 0.74 which was significant at one per cent level. The regression equation was \[ \log Y = -0.548 + 1.426 \log X. \] The graph also shows the high degree of positive relation.

(ii) Potato: The prices of potato has increased by 506.4 per cent, its acreage also increased by 171.3 per cent during the study period. The correlation coefficient was 0.61 between price and area, which was significant at one per cent level. The regression equation was \[ \log Y = 3.105 + 0.342 \log X. \] The graph also shows a high degree of positive relation.

(iii) Sugarcane: The prices of sugarcane has increased by 442.3 per cent while its area has increased by 27.7 per cent during the study period. Sugarcane is one of the most favoured crop of the district after wheat. It covers 30.98 per cent of the district's gross cropped area. The correlation coefficient was 0.51 which was significant at 5 per cent level. The regression equation was \[ \log Y = 5.933 + 0.121 \log X. \] The graph also justifies the results.

The crop which showed negative correlation amongst non-foodgrain was:
Cotton: The prices of cotton has increased by 377.2 per cent but it was unable to influence the area under cotton positively. The cotton acreage declined by 77.5 per cent. The correlation coefficient was $-0.79$ and the regression equation was $\log Y = 0.072 - 1.026 \log X$. The graph also shows the negative relationship.

4.1.4. Ghaziabad District:

The area under arhar ($0.76$), potato ($0.85$), mustard ($0.82$), wheat ($0.66$), sugarcane ($0.46$), maize ($0.11$) and barley ($0.07$) showed positive relationship to the increasing prices, while cotton ($-0.95$), bajra ($-0.69$), gram ($-0.62$), jowar ($-0.55$) and rice ($-0.12$) responded negatively in Ghaziabad district (Table 4.4 and figure 4.4).

i. Foodgrains:

The area under foodgrains which recorded positive correlation with prices were:

(i) Arhar: The prices of arhar has increased by 188.2 per cent while its acreage recorded an increase of 293.6 per cent and almost a perfect positive correlation between price and area was observed. The correlation coefficient was $0.96$, which was significant at all levels of significance. The regression equation was $\log Y = -0.408 + 1.349 \log X$. The graph also shows a high degree of positive relationship.

(ii) Wheat: Prices of wheat has increased by 129.6 per cent while its area increased by 10.6 per cent. Wheat covers 35.85 per cent of the districts gross cropped area and it is the most favoured crop of the district. A positive correlation coefficient ($0.66$) was recorded between price and area, which
<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>$\log Y = 4.119 - 0.084 \log x$</td>
<td>-0.12</td>
<td></td>
</tr>
<tr>
<td>Jowar</td>
<td>$\log Y = 3.926 - 0.354 \log x$</td>
<td>-0.55</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>$\log Y = 4.672 - 0.321 \log x$</td>
<td>-0.69</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>$\log Y = 4.589 + 0.002 \log x$</td>
<td>0.11</td>
<td>No</td>
</tr>
<tr>
<td>Wheat</td>
<td>$\log Y = 4.667 + 0.333 \log x$</td>
<td>0.66</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>$\log Y = 3.287 + 0.077 \log x$</td>
<td>0.07</td>
<td>No</td>
</tr>
<tr>
<td>Gram</td>
<td>$\log Y = 4.962 - 0.635 \log x$</td>
<td>-0.62</td>
<td></td>
</tr>
<tr>
<td>Arnar</td>
<td>$\log Y = -0.408 + 1.349 \log x$</td>
<td>0.96</td>
<td>Yes</td>
</tr>
<tr>
<td>Mustard</td>
<td>$\log Y = 6.743 + 3.745 \log x$</td>
<td>0.82</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>$\log Y = 4.536 + 0.090 \log x$</td>
<td>0.48</td>
<td>Yes</td>
</tr>
<tr>
<td>Potato</td>
<td>$\log Y = 3.256 + 0.257 \log x$</td>
<td>0.85</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>$\log Y = 3.964 - 1.11 \log x$</td>
<td>-0.95</td>
<td></td>
</tr>
</tbody>
</table>
GHAZIABAD DISTRICT
RELATION BETWEEN PRICE AND AREA OF SELECTED CROPS
(1976-77 TO 1990-91)

RICE
\( r = -0.12 \)

JOWAR
\( r = -0.55 \)

BAJRA
\( r = -0.69 \)

MAIZE
\( r = 0.11 \)

WHEAT
\( r = 0.66 \)

BARLEY
\( r = 0.07 \)

GRAM
\( r = -0.62 \)

ARHAR
\( r = 0.96 \)

MUSTARD
\( r = 0.82 \)

SUGARCANE
\( r = 0.48 \)

POTATO
\( r = 0.85 \)

COTTON
\( r = 0.95 \)

FIG. 4.4
was significant at one per cent level. The regression equation was \( \log Y = 4.667 + 0.333 \log X \). The graph also justifies the results.

(iii) Maize: The prices of maize has increased by 176.3 per cent and the area also recorded a marginal increase of 2.5 per cent and a low degree of positive relationship was observed. The correlation coefficient was 0.11 which was not significant. The regression equation was \( \log Y = 4.569 + 0.002 \log X \). The graph also corroborates the results.

(iv) Barley: The prices of barley has increased by 122.5 per cent and its acreage recorded a marginal increase. A low degree of positive correlation coefficient (0.07) was recorded which was not significant. The regression equation was \( \log Y = 3.287 + 0.077 \log X \). The graph also supports the results.

The area under foodgrains which recorded negative relationship with their prices were:

1. Rice: The prices of rice has increased by 213.5 per cent and the area has increased marginally by 6.9 per cent. A low degree of negative correlation coefficient (-0.12) was recorded. The regression equation was \( \log Y = 4.119 - 0.084 \log X \). The graph also justifies the results.

2. Jowar: The prices of jowar has increased by 133.9 per cent while its acreage declined by 6.6 per cent. The correlation coefficient was -0.55 while the regression equation was \( \log Y = 3.926 - 0.354 \log X \). The graph also indicates towards the negative relation between price and area.

3. Gram: The prices of gram has increased by 304.7 per cent but the area has declined by 61.6 per cent. A high degree of
negative correlation was observed. The correlation coefficient was \(-0.62\) and the regression equation was \(\log Y = 4.962 - 0.635 \log X\). The graph also justifies the results.

4. Bajra: The prices of bajra were increased by 97.2 per cent but its acreage declined by 19.7 per cent and a negative correlation was recorded. The correlation coefficient was \(-0.65\) and the regression equation was \(\log Y = 4.872 - 0.321 \log X\). The graph also shows a negative relation between price and area.

2. Non-foodgrains:

The non-foodgrains which recorded positive correlation were:

(i) Potato: The prices of potato have increased by 328.1 per cent, so has its area by 39.2 per cent. A high degree of positive relation was recorded between price and area. The correlation coefficient was 0.85 which was significant at one per cent level. The regression equation was \(\log Y = 3.256 + 0.257 \log X\). The graph also justifies the results.

(ii) Mustard: The prices of mustard have increased by 56.3 per cent and its area has also increased by 749.3 per cent. The correlation coefficient was 0.82 which was significant at one per cent level. The regression equation was \(\log Y = 6.743 + 3.745 \log X\). The graph also shows a high degree of positive relationship.

(iii) Sugarcane: The prices of sugarcane have increased by 183.1 per cent, while the acreage was increased by only 5.1 per cent. The correlation coefficient was 0.48, which was significant at 5 per cent level. The regression equation was
Log \( Y = 4.588 + 0.090 \log X \). The graph also supports the findings.

The only non-food grain which recorded negative correlation was:

**Cotton:** The prices of cotton has increased by 102.1 per cent but its acreage declined by 45.6 per cent. A high degree of negative correlation was recorded. The correlation coefficient was \(-0.75\) and the regression equation was \( \log Y = 5.964 - 1.11 \log X \). The graph also shows a high degree of negative relation between price and area of cotton.

### 4.1.5. Bulandshahr District:

The crops which recorded positive relation between price and area in this district were mustard (0.89), wheat (0.84), arhar (0.72), potato (0.61) and maize (0.44). Negative relations were recorded in jawar (-0.69), cotton (-0.78), bajra (-0.75), gram (-0.71), barley (-0.64), rice (-0.22) and sugarcane (-0.02) (Table 4.5 and Figure 4.5).

#### i. Foodgrains:

The foodgrains which recorded positive relations were:

**Wheat:** The prices of wheat has increased by 252.2 per cent while its acreage recorded an increase of about 92 per cent. It shows a positive influence of increasing prices on wheat acreage. The correlation coefficient was 0.84, which was significant at all levels of significance. The regression equation was \( \log Y = 4.784 + 0.251 \log X \). The graph also shows a high degree of positive relation.
<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>[ \log Y = 4.206 - 0.108 \log X ]</td>
<td>-0.22</td>
<td></td>
</tr>
<tr>
<td>Jowar</td>
<td>[ \log Y = 6.421 - 1.328 \log X ]</td>
<td>-0.80</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>[ \log Y = 5.65 - 0.585 \log X ]</td>
<td>-0.76</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>[ \log Y = 4.764 + 0.174 \log X ]</td>
<td>0.44</td>
<td>Yes</td>
</tr>
<tr>
<td>Wheat</td>
<td>[ \log Y = 4.764 + 0.251 \log X ]</td>
<td>0.64</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>[ \log Y = 5.506 - 0.736 \log X ]</td>
<td>-0.64</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>[ \log Y = 6.051 - 0.866 \log X ]</td>
<td>-0.71</td>
<td></td>
</tr>
<tr>
<td>Arnar</td>
<td>[ \log Y = 2.405 + 0.327 \log X ]</td>
<td>0.72</td>
<td>Yes</td>
</tr>
<tr>
<td>Mustard</td>
<td>[ \log Y = 0.132 + 1.37 \log X ]</td>
<td>0.89</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>[ \log Y = 4.797 - 0.096 \log X ]</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>[ \log Y = 3.085 + 0.406 \log X ]</td>
<td>0.61</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>[ \log Y = 6.067 - 0.996 \log X ]</td>
<td>-0.78</td>
<td></td>
</tr>
</tbody>
</table>
BULANDSHAHAR DISTRICT
RELATION BETWEEN PRICE AND AREA OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
\( r = -0.22 \)

JOWAR
\( r = -0.80 \)

BAJRA
\( r = -0.76 \)

MAIZE
\( r = 0.44 \)

WHEAT
\( r = 0.84 \)

BARLEY
\( r = -0.64 \)

GRAM
\( r = -0.71 \)

ARHAR
\( r = 0.72 \)

MUSTARD
\( r = 0.89 \)

SUGARCANE
\( r = -0.02 \)

POTATO
\( r = 0.61 \)

COTTON
\( r = -0.28 \)

FIG. 4.5
(iii) Arhar: The prices of arhar has increased by 360 per cent and this has influenced its acreage positively, which was increased by 34.6 per cent. The correlation coefficient was 0.72, which was significant at one per cent level. The regression equation was \( \log Y = 2.405 + 0.527 \log X \). The graph also shows a high degree of positive relation.

(iii) Maize: The prices of maize has increased by 183.5 per cent, so is its acreage by 106.4 per cent. The share of area under maize is quite high in Bulandshahar district. It is about 23.35 per cent of the districts gross cropped area, which is second only to wheat. The correlation coefficient was 0.44 which was significant at 5 per cent level. The regression equation was \( \log Y = 4.764 + 0.174 \log X \). The graph also corroborates the results.

The foodgrains which showed negative relation were:

1. Rice: The prices of rice has increased by 280.8 per cent. Its acreage has also increased but it had not changed with the changes in prices. That's why rice acreage was negatively related with its prices. The correlation coefficient was -0.22. The regression equation was \( \log Y = 4.208 - 0.108 \log X \). The graph also supports the results.

2. Barley: The prices of barley has increased by 223.5 per cent but the area has decreased by 49.8 per cent and was negatively correlated with its prices. The correlation coefficient was -0.64. The regression equation was \( \log Y = 5.506 - 0.736 \log X \). The graph also justifies the results.

3. Gram: The prices of gram has increased by 608.4 per cent but the area was declined by about 75 per cent and was negatively related with its prices. The correlation coefficient
was -0.71 and the regression equation was $\log \gamma = 6.051 - 0.866 \log \lambda$. The graph also shows a high degree of negative relation.

4. Jowar: The prices of jowar has increased by 213.4 per cent while its acreage declined by 78.0 per cent and was negatively correlated with its prices. The correlation coefficient was -0.80 and the regression equation was $\log \gamma = 0.421 - 1.328 \log \lambda$. The graph also shows a negative relation.

2. Non-foodgrains:

The non-foodgrains which showed positive relations were:

(ii) Mustard: The prices of mustard has increased by 315 per cent and this increase has positively influenced the area under mustard, which recorded an increase of 674.1 per cent. It covers 3.42 per cent of the districts gross cropped area. The correlation coefficient was 0.69, which was significant at all levels of significance. The regression equation was $\log \gamma = 0.132 + 1.37 \log \lambda$. The graph also shows a high degree of positive relation.

(ii) Potato: The prices of potato has increased by 523.8 per cent, so has the area by 145.3 per cent. The correlation coefficient was 0.61 which was significant at one per cent level. The regression equation was $\log \gamma = 3.063 + 0.406 \log \lambda$. The graph also shows a high degree of positive relation between price and acreage of potato.

The non-foodgrains which showed negative relation were:

1. Sugarcane: The prices of sugarcane has increased by 363.7 per cent out Bulanosnanar was the only district where the sugarcane acreage has decreased. The correlation coefficient
was $-0.82$ and the regression equation was $\log Y = 4.797 - 0.82 \log A$. The graph shows no relation between prices and area of sugarcane.

2. Cotton: The prices of cotton has increased by 424.6 per cent but the area has decreased by 62.6 per cent and is negatively correlated with its prices. The correlation coefficient was $-0.786$ and the regression equation was $\log Y = 0.007 - 0.797 \log A$. The graph also supports the results.

The analysis of responsiveness of prices to area under these twelve selected crops in the districts of the study region, shows that only a few crops responded positively to the increasing prices. The crops which showed a strong positive correlation were wheat and arhar amongst the foodgrains and mustard and potato amongst the non-foodgrains. Sugarcane showed strong positive correlation in the four districts only, except for the district of Bulandshahr. Rice and maize showed a weak positive correlation in few districts only. Rice recorded positive correlation in the two upper districts of Saharanpur and Muzaffarnagar, maize in the two lower districts of Ghaziabad and Bulandshahr in the study region. The crops which showed negative correlation were barley, pujra, gram amongst the foodgrains and cotton amongst the non-foodgrains. There were some crops like rice and maize which showed negative correlation in some of the districts. Rice in Meerut, Ghaziabad and Muzaffarnagar, maize in the districts of Saharanpur, Muzaffarnagar and Meerut.

It is thus seen that the crops which registered an increase in their area mostly showed a positive correlation with prices. mustard, arhar potato, sugarcane and wheat registered significant increases in their area and also showed a strong positive correlation with prices. Other crops like
rice and maize which registered marginal increase in their area showed a weak positive correlation. The crops which did not register any increase in their area showed negative correlation with prices.

The above analysis reveals that prices have helped in bringing about a change in the cropping pattern of the study region. This region is agriculturally very prosperous and from the very beginning, cultivation was the main occupation of the people. Although this region was pioneer in agriculture but even upto sixties the farmers of this region were more or less inclined in subsistence farming but after the successful launch of Green Revolution and later on because of economic factors they gradually switched to commercial farming. Earlier they were growing all kinds of crops but now they are growing only those crops which fetch them more money. In sixties, wheat was first ranking crop followed by sugarcane, rice, maize and gram and a large area was also devoted to coarse cereals like jowar, bajra and barley, but now farmers of this region instead of growing all crops they devote their fertile lands for the cultivation of wheat sugarcane and potato as they are remunerative and in rotation with these crops they sow cash crops like arhar and mustard.

The area under gram, jowar, bajra, maize, barley and cotton has declined significantly. These days jowar and barley are sown more for fodder than rather as a foodgrain. Maize and bajra are also not very favourite crops. Even the rural population prefer wheat to coarse cereals. Although government has increased the prices of gram and cotton considerably to goad the farmers to raise the production of these crops but these two crops are not favoured in this region because of their low yields, non availability of high yielding varieties of seeds, they are also susceptible to pests, diseases and
weather fluctuations and also due to inadequate facilities to store them.

The inferences drawn from these results were that profitability of the crop has emerged as the most important factor. The farmers like to sow those crops which are more profitable. This does not mean that there will be a total switch from foodgrains to cash crops because cash crops are more profitable than the cultivation of foodgrains but instead of that the farmers of the study region devote a significant proportion of their land to raise their own requirement but in sowing their surplus land they look towards the prices.

4.2. INFLUENCE OF CHANGING PRICES ON PRODUCTION OF SELECTED CROPS:

In this part of the chapter, the analysis is related to responsiveness of production of commodities to changes in the prices. Relating production of each year to prices of the previous year, regression equations of the Cobb-Douglas' type are worked out with logarithmic data and the estimated values of the variables in the equations are given in tables 4.6, 4.7, 4.8, 4.9 and 4.10 for all the five districts of the study region from 1965-66 to 1990-91. The values of the correlation coefficients duly tested for their significance are also shown against each equation. Graphs were also drawn with log values of prices on 'X' axis and log values of production on 'Y' axis to show the relationship between these two variables. These were presented in figures 4.6, 4.7, 4.8, 4.9 and 4.10.

Here we discuss the responsiveness of production to change in prices in each district of the study region separately.
4.2.1. Saharanpur District:

The production of mustard ($0.60$), wheat ($0.86$), sugarcane ($0.62$), rice ($0.60$), potato ($0.60$) and arhar ($0.62$) showed a high degree of positive correlation with their respective prices while maize ($0.42$) and jowar ($0.66$) registered a low degree of positive relation. Negative relations were recorded in gram ($-0.52$), bajra ($-0.75$), cotton ($-0.73$) and barley ($-0.43$) in Saharanpur district (Table 4.6 and Figure 4.6).

1. Foodgrains:

The foodgrains which showed positive correlation were:

(i) Wheat: The prices of wheat has increased by 258.7 per cent and its production has also recorded an increase of 198.8 per cent, which is the maximum amongst the foodgrains. The yield has also increased and is about 22.5 quintals per hectare. The correlation coefficient was 0.66 which was significant at one per cent level. The regression equation was \( \log Y = 3.679 + 0.843 \log X \). The graph also shows a high degree of positive relationship between price and production.

(ii) Rice: The prices of rice has increased by 295.8 per cent while its production has increased by 118.4 per cent. The average yield of rice has also increased in this district and is about 20 quintals per hectare. The correlation coefficient was 0.66 between the prices and production which was significant at one per cent level of significance. The regression equation was \( \log Y = 3.700 + 0.628 \log X \). The graph also indicates towards the positive relation.
<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>$\log Y = 3.900 + 0.628 \log X$</td>
<td>0.80</td>
<td>Yes</td>
</tr>
<tr>
<td>Jowar</td>
<td>$\log Y = 0.772 + 0.155 \log X$</td>
<td>0.06</td>
<td>No</td>
</tr>
<tr>
<td>Bajra</td>
<td>$\log Y = 6.083 - 1.926 \log X$</td>
<td>-0.75</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>$\log Y = 4.028 + 0.214 \log X$</td>
<td>0.42</td>
<td>Yes</td>
</tr>
<tr>
<td>Wheat</td>
<td>$\log Y = 3.679 + 0.843 \log X$</td>
<td>0.86</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>$\log Y = 4.082 - 0.433 \log X$</td>
<td>-0.43</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>$\log Y = 6.358 - 1.363 \log X$</td>
<td>-0.82</td>
<td></td>
</tr>
<tr>
<td>Arhar</td>
<td>$\log Y = 2.159 + 0.142 \log X$</td>
<td>0.62</td>
<td>Yes</td>
</tr>
<tr>
<td>Mustard</td>
<td>$\log Y = -0.192 + 1.333 \log X$</td>
<td>0.86</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>$\log Y = 6.220 + 0.436 \log X$</td>
<td>0.82</td>
<td>Yes</td>
</tr>
<tr>
<td>Potato</td>
<td>$\log Y = 2.160 + 1.178 \log X$</td>
<td>0.80</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>$\log Y = 5.814 - 1.158 \log X$</td>
<td>-0.73</td>
<td></td>
</tr>
</tbody>
</table>
SAHARANPUR DISTRICT
RELATION BETWEEN PRICE AND PRODUCTION OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
r = 0.80

JOWAR
r = 0.06

BAJRA
r = -0.75

MAIZE
r = 0.42

WHEAT
r = 0.86

BARLEY
r = -0.43

GRAM
r = -0.82

ARHAR
r = 0.62

MUSTARD
r = 0.86

SUGARCANE
r = 0.82

POTATO
r = 0.80

COTTON
r = -0.73

FIG. 4.6
(iii) Arhar: The prices of arhar has increased by 557 per cent so has its production which has increased by 124.7 per cent. The correlation coefficient was 0.02 which was significant at one per cent level of significance. The regression equation was \( \log Y = 2.157 + 0.142 \log X \). The graph also supports the results.

(iv) Maize: The prices of maize has increased by 201.4 per cent and its production has also increased by 87.7 per cent. The average yield was about 15 quintals per hectare. The correlation coefficient between price and production was 0.42 which was significant at 5 per cent level. The regression equation was \( \log Y = 4.026 + 0.214 \log X \). The graph also corroborates with the results.

(v) Jowar: The prices of jowar has increased by 253.2 per cent but its production declined by 22.7 per cent. The average yield of jowar was about 6.5 quintals per hectare. The correlation coefficient was 0.60 which was not significant. The regression equation was \( \log Y = 0.772 + 0.135 \log X \). The graph also justifies the findings.

The crops which showed negative relation were:

1. Barley: The prices of barley has increased by 207.8 per cent but its production has declined by 51.0 per cent and the production was negatively related to its prices. The correlation coefficient was -0.43 and the regression equation was \( \log Y = 4.062 - 0.435 \log X \). The graph also supports the results.

(vii) Bajra: The prices of bajra has increased by 163.3 per cent but its production has decreased by 68.4 per cent. The correlation coefficient was -0.75. The regression equation was
Log $Y = 6.085 - 1.926 \log X$. The graph also shows a high degree of negative relation between the prices and production.

(iii) Gram: The prices of gram has increased by 604.4 per cent but the production has decreased by 92.2 per cent and a high degree of negative relation was observed. The correlation coefficient was $-0.52$. The regression equation was $\log Y = 0.388 - 1.363 \log X$. The graph also supports the findings.

2. Non-foodgrains:

The non-foodgrains which recorded a positive correlation were:

(i) Mustard: The prices of mustard has increased by 336.1 per cent and the production has also increased by 718.2 per cent. The average yield of mustard in the district was about 6.5 quintals per hectare. There was a strong positive relationship between price and production. The correlation coefficient was $0.86$ which was significant at all levels of significance. The regression equation was $\log Y = -0.192 + 1.335 \log X$. The graph also shows a high degree of positive correlation between prices and production.

(ii) Sugarcane: The prices of sugarcane has increased by 471.4 per cent while its production has also increased by 153.4 per cent. The average yield of sugarcane in the district was about 555 quintals per hectare. A strong positive correlation was recorded between price and production of sugarcane. The correlation coefficient was $0.62$ which was significant at one per cent level. The regression equation was $\log Y = 6.220 + 0.456 \log X$. The graph also shows the high degree of positive relation.
(iii) Potato: The prices of potato has increased by 474.5 per cent and its production has increased by 415.6 per cent. A strong positive response was observed in the production of potato due to its prices. The correlation coefficient was 0.80 which was significant at one per cent level. The regression equation was: \( \log Y = 2.180 + 1.178 \log X \). The graph also supports the results.

The only non-foodgrain which recorded negative correlation was:

Cotton: The prices of cotton has increased by 471.2 per cent but its production has declined by 53.2 per cent and the production was negatively related to its prices. The correlation coefficient was -0.73. The regression equation was: \( \log Y = 3.614 - 1.158 \log X \). The graph also justifies the findings.

4.2.2. Huzaffarnagar District

The production of mustard (0.94), potato (0.93), sugarcane (0.90), rice (0.70), arhar (0.64) and wheat (0.83) responded positively and strongly to their increasing prices. The production of maize (0.05) also showed a very weak positive relation. While cotton (-0.72), gram (-0.71), bajra (-0.45), jowar (-0.32) and barley (-0.05) showed negative correlation (Table 4.7 and Figure 4.7).

1. Foodgrains:

The foodgrains which recorded positive correlation were:

(i) Rice: The prices of rice has increased by 298.1 per cent, so has its production which has increased by 241 per cent. The
TABLE 4.7: RELATION BETWEEN PRICE AND PRODUCTION IN MUZAFFARNAGAR DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Log Y = 3.130 + 0.866 Log X</td>
<td>0.60</td>
<td>Yes</td>
</tr>
<tr>
<td>Jowar</td>
<td>Log Y = 2.610 - 0.539 Log X</td>
<td>-0.32</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>Log Y = 4.201 - 0.747 Log X</td>
<td>-0.45</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Log Y = 4.053 - 0.027 Log X</td>
<td>0.03</td>
<td>No</td>
</tr>
<tr>
<td>Wheat</td>
<td>Log Y = 3.943 + 0.734 Log X</td>
<td>0.63</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>Log Y = 2.81 - 0.173 Log X</td>
<td>-0.05</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>Log Y = 0.903 - 1.492 Log X</td>
<td>-0.72</td>
<td></td>
</tr>
<tr>
<td>Awnar</td>
<td>Log Y = 0.325 + 0.644 Log X</td>
<td>0.84</td>
<td>Yes</td>
</tr>
<tr>
<td>Mustard</td>
<td>Log Y = 0.925 + 0.916 Log X</td>
<td>0.94</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>Log Y = 0.357 + 0.496 Log X</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>Log Y = 2.281 + 1.21 Log X</td>
<td>0.93</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>Log Y = 5.698 - 1.028 Log X</td>
<td>-0.72</td>
<td></td>
</tr>
</tbody>
</table>
MUZAFFARNAGAR DISTRICT
RELATION BETWEEN PRICE AND PRODUCTION OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
$r = 0.90$

MAIZE
$r = 0.03$

WHEAT
$r = 0.83$

BARLEY
$r = 0.05$

GRAM
$r = -0.71$

ARHAR
$r = 0.84$

MUSTARD
$r = 0.94$

SUGARCANE
$r = 0.90$

POTATO
$r = 0.93$

COTTON
$r = 0.72$

FIG 4.7
average yield of rice in this district was maximum in the region which was about 25 quintals per hectare. There was a strong positive correlation between price and production. The correlation coefficient was 0.90 which was significant at all levels of significance. The regression equation was $\log Y = 3.136 + 0.866 \log \lambda$. The graph also shows a high degree of positive relation.

(iii) Arhar: The prices of arhar has increased by 563 per cent and this has influenced positively its production which has increased by 333.6 per cent. The average yield has also increased and it was 16.25 quintals per hectare. The correlation coefficient was 0.84 which was significant at one per cent level. The regression equation was $\log Y = 0.575 + 0.844 \log \lambda$. The graph also supports the results.

(iii) Wheat: The prices of wheat has increased by 252.7 per cent and this has positively influenced its production, which has increased by 150.6 per cent. The average yield has also increased, which is about 25.7 quintals per hectare. The correlation coefficient was 0.83 which was significant at one per cent level. The regression equation was $\log Y = 3.943 + 0.734 \log \lambda$. The graph also shows a high degree of positive relation.

(iv) Maize: The prices of maize has increased by 191.9 per cent and its production has also increased. The average yield was about 15.25 quintals per hectare. A very weak positive correlation was observed between price and production of maize. The correlation coefficient was 0.03 which was not significant. The regression equation was $\log Y = 4.053 - 0.027 \log \lambda$. The graph also supports the results.

The foodgrains which recorded negative correlation were:
1. Barley: The prices of barley has increased by 210.5 per cent but its production has declined by 46.5 per cent. The correlation coefficient was -0.05. The regression equation was \[ \log Y = 2.61 - 0.193 \log X \]. The graph also corroborates the results.

2. Jowar: The prices of jowar has increased by 250 per cent but its production has declined marginally and a negative correlation was observed. The correlation coefficient was -0.32 and the regression equation was \[ \log Y = 2.810 - 0.539 \log X \]. The graph also supports the findings.

3. Bajra: The prices of bajra has increased by 218.5 per cent but its production has declined by 5 per cent. The correlation coefficient was -0.45 and the regression equation was \[ \log Y = 4.201 - 0.747 \log X \].

4. Gram: The prices of gram has increased by 595.4 per cent but its production has decreased by 91.1 per cent and a high degree of negative correlation was observed. The correlation coefficient was -0.72 and the regression equation was \[ \log Y = 5.903 - 1.492 \log X \]. The graph also shows the negative relation.

2. Non-foodgrains:

The non-foodgrains which recorded positive correlation were:

(i) Mustard: The prices of mustard has increased by 339.5 per cent which has influenced its production to increased by 337.7 per cent. The correlation coefficient was 0.94 which was significant at all levels of significance. The regression
equation was \( \log Y = 0.929 + 0.916 \log X \). The graph also shows almost a perfect positive relation.

(iii) Potato: The prices of potato has increased by 495.4 per cent, so has its production by 554 per cent. The correlation coefficient was 0.93 which was significant at one per cent level. The regression equation was \( \log Y = 2.281 + 1.21 \log X \). The graph also shows the positive influence on the production of potato.

(iii) Sugarcane: The prices of sugarcane has increased by 431.7 per cent, its production has also increased by 182.3 per cent. The average yield in this district was maximum of the region, which was about 376 quintal per hectare. The correlation coefficient was 0.90 which was significant at all levels of significance the regression equation was \( \log Y = 6.35 + 0.490 \log X \). The graph also shows the strong positive relation.

Cotton was the only non-food grain which recorded negative correlation.

Cotton: The prices of cotton has increased by 449.2 per cent but its production has declined by 67.5 per cent. The correlation coefficient was -0.72 and the regression equation was \( \log Y = 5.098 -1.026 \log X \). The graph also justifies the results.

4.2.3. Meerut District:

The production of potato (0.94), mustard (0.87), Sugarcane (0.72) and wheat (0.68) were influenced positively and strongly by their increasing prices. Rice (0.30) and gujar (0.30) register low degree of positive response. While gram
(-0.79), cotton (-0.58), barley (-0.43), jowar (-0.45), bajra (-0.37) and maize (-0.33) showed negative correlation between production and prices in Meerut district (Table 4.8 and Figure 4.8).

1. Foodgrains:

The foodgrains which showed positive correlations were:

(i) Wheat: The prices of wheat has increased by 266.5 per cent so has its production, which has increased by 66.7 per cent. The average yield was about 26 quintals per hectare. The correlation coefficient was 0.68, which was significant at one per cent level. The regression equation was \( \log Y = 5.0296 + 0.202 \log X \). The graph also shows the positive influence of prices on the production of wheat.

(ii) Rice: The prices of rice has increased by 275.8 per cent and the production has declined marginally but its yield had increased. The average yield of rice in this district was 18.5 quintals per hectare. The correlation coefficient was 0.30 which was not significant. The regression equation was \( \log Y = 4.154 + 0.145 \log X \). The graph also shows low degree of positive relation.

(iii) Arhar: The prices of arhar has increased by 550 per cent and its production has also increased marginally and a low degree of positive relation was observed. The correlation coefficient was 0.30 which was not significant. The regression equation was \( \log Y = 3.010 + 0.161 \log X \). The graph also justifies the results.

The foodgrains which showed negative relation were:
<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Log Y = 4.154 + 0.143 Log X</td>
<td>0.30</td>
<td>No</td>
</tr>
<tr>
<td>Jowar</td>
<td>Log Y = 3.613 - 0.691 Log X</td>
<td>-0.45</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>Log Y = 4.37 - 0.457 Log X</td>
<td>-0.37</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Log Y = 5.167 - 0.261 Log X</td>
<td>-0.33</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>Log Y = 5.029 + 0.262 Log X</td>
<td>0.78</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>Log Y = 5.163 - 0.935 Log X</td>
<td>-0.43</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>Log Y = 7.339 - 1.539 Log X</td>
<td>-0.79</td>
<td></td>
</tr>
<tr>
<td>Arhar</td>
<td>Log Y = 3.010 + 0.161 Log X</td>
<td>0.30</td>
<td>No</td>
</tr>
<tr>
<td>Mustard</td>
<td>Log Y = 2.164 + 0.528 Log X</td>
<td>0.87</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>Log Y = 6.505 + 0.259 Log X</td>
<td>0.72</td>
<td>Yes</td>
</tr>
<tr>
<td>Potato</td>
<td>Log Y = 3.186 + 0.987 Log X</td>
<td>0.94</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>Log Y = 5.170 - 1.026 Log X</td>
<td>-0.58</td>
<td></td>
</tr>
</tbody>
</table>
MEERUT DISTRICT
RELATION BETWEEN PRICE AND PRODUCTION OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
\[ r = 0.30 \]

JOWAR
\[ r = -0.45 \]

BAJRA
\[ r = -0.37 \]

MAIZE
\[ r = -0.33 \]

WHEAT
\[ r = 0.68 \]

BARLEY
\[ r = -0.43 \]

GRAM
\[ r = -0.79 \]

ARHAR
\[ r = 0.30 \]

MUSTARD
\[ r = 0.87 \]

SUGARCANE
\[ r = 0.72 \]

POTATO
\[ r = 0.94 \]

COTTON
\[ r = -0.58 \]

FIG. 4.8
(i) Maize: The prices of maize has increased by 191.5 per cent. Its production has increased marginally. The correlation coefficient was -0.33 and the regression equation was Log \( Y = 5.105 - 0.261 \log \lambda \).

(ii) Bajra: The prices of bajra has increased by 153.6 per cent but its production has declined by 52.8 per cent. A negative correlation was observed between price and production of bajra. The correlation coefficient was -0.37. The regression equation was Log \( Y = 4.37 - 0.457 \log X \). The graph also supports the results.

(iii) Jowar: The prices of jowar has increased by 201.9 per cent but its production has decreased by 48.7 per cent and a negative relation was observed. The correlation coefficient was -0.45. The regression equation was Log \( Y = 3.613 - 0.691 \log \lambda \). The graph also corroborates the results.

(iv) Barley: The prices of barley has increased by 208.3 per cent but its production has decreased by 81.4 per cent. The correlation coefficient was -0.43. The regression equation was Log \( Y = 5.163 - 0.735 \log \lambda \). The graph also supports the results.

(v) Gram: The prices of gram has increased by 628.4 per cent but its production has declined by 90.9 per cent and a negative correlation was recorded. The correlation coefficient was -0.79 and the regression equation was Log \( Y = 7.339 - 1.539 \log \lambda \). The graph also shows the negative relation between price and production.
2. Non-foodgrains:

The non-foodgrains which showed positive correlation were:

(i) Potato: The prices of potato has increased by 506.4 per cent and its production has also recorded an increase of 355.4 per cent. The average yield was about 264 quintals per hectare in this district. The correlation coefficient was 0.94 which was significant at all levels of significance. The regression equation was \( \log \gamma = 3.166 + 0.989 \log \chi \). The graph also shows a high degree of positive correlation.

(ii) Mustard: The prices of mustard has increased by 330.1 per cent and this has positively influenced its production which has increased by 151.1 per cent. The correlation coefficient was 0.87 which was significant at one per cent level. The regression equation was \( \log \gamma = 2.184 + 0.528 \log \chi \). The graph also shows a high degree of positive correlation between price and production of mustard.

(iii) Sugarcane: The prices of sugarcane has increased by 442.3 per cent so has its production by 74.8 per cent. The correlation coefficient was 0.72, which was significant at one per cent level. The regression equation was \( \log \gamma = 6.505 + 0.259 \log \chi \). The graph also supports the results.

The non-foodgrain which recorded negative correlation was:

Cotton: The prices of cotton has increased by 377.2 per cent but its production has declined by 43 per cent. A negative correlation was observed between price and production of
cotton. The correlation coefficient was \(-0.58\) and the regression equation was \(\log y = 5.176 - 1.020 \log x\). The graph also justifies the results.

4.2.4. \textit{Ghazipur District:}

The production of arhar \((0.93)\), potato \((0.90)\), mustard \((0.69)\), wheat \((0.66)\), paddy \((0.64)\), barley \((0.80)\), rice \((0.70)\), jowar \((0.60)\) and maize \((0.59)\) responded positively and strongly to their increasing prices while sugarcane \((0.35)\) registered a low degree of positive correlation. Negative relation was recorded by cotton \((-0.40)\) and gram \((-0.32)\) in the district (Table 4.9 and Figure 4.9).

1. Foodgrains:

The foodgrains which recorded a positive correlation were:

(i) Arhar: The prices of arhar has increased by 188.2 per cent, so has its production which has increased by 324.2 per cent and a strong positive correlation was observed. The correlation coefficient was 0.93 which was significant at all levels of significance. The regression equation was \(\log Y = -1.562 + 1.562 \log x\). The graph also shows almost a perfect positive correlation between price and production.

(ii) Wheat: The prices of wheat has increased by 129.6 per cent, so is its production by 113.5 per cent. The average yield was about 27.25 quintals per hectare. The correlation coefficient was 0.87, which was significant at one per cent level. The regression equation was \(\log y = 3.921 + 0.69 \log x\). The graph also shows a high degree of positive relation.
### TABLE 4.9 RELATION BETWEEN PRICE AND PRODUCTION IN GHAZIABAD DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>( \log y = 2.038 + 0.676 \log x )</td>
<td>0.78</td>
<td>Yes</td>
</tr>
<tr>
<td>Jowar</td>
<td>( \log Y = 0.631 + 0.944 \log x )</td>
<td>0.60</td>
<td>Yes</td>
</tr>
<tr>
<td>Bajra</td>
<td>( \log y = -0.459 + 2.173 \log x )</td>
<td>0.84</td>
<td>Yes</td>
</tr>
<tr>
<td>maize</td>
<td>( \log y = 3.107 + 0.788 \log x )</td>
<td>0.59</td>
<td>Yes</td>
</tr>
<tr>
<td>Wheat</td>
<td>( \log y = 3.921 + 0.67 \log x )</td>
<td>0.69</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>( \log Y = 1.218 + 1.008 \log x )</td>
<td>0.80</td>
<td>Yes</td>
</tr>
<tr>
<td>Gram</td>
<td>( \log y = 4.101 - 0.254 \log x )</td>
<td>-0.32</td>
<td></td>
</tr>
<tr>
<td>Arhar</td>
<td>( \log Y = -1.562 + 1.800 \log x )</td>
<td>0.93</td>
<td>Yes</td>
</tr>
<tr>
<td>mustard</td>
<td>( \log y = 0.397 + 1.553 \log x )</td>
<td>0.89</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>( \log Y = 6.242 + 0.122 \log x )</td>
<td>0.35</td>
<td>No</td>
</tr>
<tr>
<td>Potato</td>
<td>( \log Y = 4.088 + 0.526 \log x )</td>
<td>0.90</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>( \log Y = 3.256 - 0.416 \log x )</td>
<td>-0.40</td>
<td></td>
</tr>
</tbody>
</table>
GHAZIABAD DISTRICT
RELATION BETWEEN PRICE AND PRODUCTION OF SELECTED CROPS
(1976-77 TO 1990-91)

- **RICE**
  - Log of Production
  - Log of price
  - $r = 0.78$

- **JOWAR**
  - Log of Production
  - Log of price
  - $r = 0.60$

- **BAJRA**
  - Log of Production
  - Log of price
  - $r = 0.84$

- **MAIZE**
  - Log of Production
  - Log of price
  - $r = 0.59$

- **WHEAT**
  - Log of Production
  - Log of price
  - $r = 0.88$

- **BARLEY**
  - Log of Production
  - Log of price
  - $r = 0.80$

- **GRAM**
  - Log of Production
  - Log of price
  - $r = -0.32$

- **ARHAR**
  - Log of Production
  - Log of price
  - $r = 0.93$

- **MUSTARD**
  - Log of Production
  - Log of price
  - $r = 0.89$

- **SUGARCANE**
  - Log of Production
  - Log of price
  - $r = 0.35$

- **POTATO**
  - Log of Production
  - Log of price
  - $r = 0.90$

- **COTTON**
  - Log of Production
  - Log of price
  - $r = -0.40$

**FIG. 4.9.**
Bajra: The prices and production of bajra has increased by 97.2 per cent and 227 per cent respectively. The average yield was also increased and it was about 15 quintals per nectare in this district. The correlation coefficient was 0.84 which was significant at one per cent level. The regression equation as \( \log Y = -0.459 + 2.175 \log X \). The graph also supports the results.

Barley: The prices and production of barley has increased by 122.5 per cent and 166.7 per cent respectively. The correlation coefficient was 0.80 which was significant at one per cent level. The regression equation was \( \log Y = 1.218 + 1.068 \log X \). The graph also corroborates the results.

Rice: The prices of rice has increased by 213.5 per cent and this has influenced its production positively. The production has increased by 40.6 per cent. The average yield of rice was about 13.5 quintals per nectare in the district. The correlation coefficient was 0.78, which was significant at one per cent level. The regression equation was \( \log Y = 2.638 + 0.070 \log X \). The graph also shows the positive relation.

Jowar: The prices of jowar has increased by 133.9 per cent so has its production by 71.4 per cent. The correlation coefficient was 0.80 which was significant at five per cent level. The regression equation was \( \log Y = 0.031 + 0.944 \log X \). The graph also supports the results.

Maize: The prices of maize has increased by 176.3 per cent and the production of maize responded positively to its increased prices. The correlation coefficient was 0.59 which was significant at five per cent level. The regression equation was \( \log Y = 3.167 + 0.788 \log X \). The graph also corroborates the results.
The only foodgrain which showed negative correlation was:

i. **Gram**: The prices of gram has increased by 304.7 per cent but its production declined by 46.6 per cent. The correlation coefficient was -0.32 and the regression equation was \[ \log Y = 4.101 - 0.254 \log X \]. The graph also shows the negative relationship.

2. **Non-foodgrains**:

   The non-foodgrains which recorded positive correlation were:

   (i) **Potato**: The prices and production of potato has increased by 328.1 per cent and 163.4 per cent respectively and a strong positive correlation exists between price and production of potato. The correlation coefficient was 0.90 which was significant at all levels of significance. The regression equation was \[ \log Y = 4.086 + 0.526 \log X \]. The graph also shows a high degree of positive relation.

   (ii) **Mustard**: The prices of mustard has increased by 56.3 per cent and its production has increased by 396.4 per cent. The correlation coefficient was 0.89 which was significant at one per cent level. The regression equation was \[ \log Y = 0.397 + 1.553 \log X \]. The graph also shows a high degree of positive relation.

   (iii) **Sugar cane**: The prices of sugarcane has increased by 163.1 per cent but its production increased marginally by 2.7 per cent and a low degree of positive correlation was recorded. The correlation coefficient was 0.35 which was not significant.
at 5 per cent level. The regression equation was $\log Y = 6.242 + 0.122 \log x$. The graph also corroborates the results.

The only non-foodgrain which showed negative correlation was:

**Cotton:** The prices of cotton has increased by 102.1 per cent but its production declined marginally. The correlation coefficient was $-0.40$. The regression equation was $\log Y = 3.250 - 0.410 \log x$. The graph also justifies the results.

4.2.5. Bulandshahr District:

The production of mustard ($0.96$), wheat ($0.89$), potato ($0.72$), arhar ($0.66$) and maize ($0.60$) responded positively and strongly to their prices while low degree of positive correlation was recorded by barley ($0.48$), sugarcane ($0.41$), bajra ($0.41$), rice ($0.13$) and gram ($0.03$). The production of jowar ($-0.58$) and cotton ($-0.77$) were negatively related to their prices (Table 4.10 and Figure 4.10).

1. Foodgrains:

The foodgrains which recorded positive correlation were:

(i) Wheat: The prices of wheat has increased by 252.2 per cent and this has positively effected its production, which has increased by 151.0 per cent. The average yield of wheat in this district was about 27.5 quintals per hectare. The correlation coefficient was $0.89$, which was significant at one per cent level. The regression equation was $\log Y = 4.084 + 0.738 \log x$. The graph also justifies the results.
TABLE 4.10: RELATION BETWEEN PRICE AND PRODUCTION IN BULANDSHAHIAR DISTRICT

<table>
<thead>
<tr>
<th>Crops</th>
<th>Regression Equation</th>
<th>Correlation Co-efficient</th>
<th>Significant in case of positive relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Log $Y = 3.943 + 0.056 \log X$</td>
<td>0.13</td>
<td>No</td>
</tr>
<tr>
<td>Jowar</td>
<td>Log $Y = 5.111 - 0.971 \log X$</td>
<td>-0.58</td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>Log $Y = 3.75 + 0.239 \log X$</td>
<td>0.41</td>
<td>Yes</td>
</tr>
<tr>
<td>Maize</td>
<td>Log $Y = 3.971 + 0.569 \log X$</td>
<td>0.60</td>
<td>Yes</td>
</tr>
<tr>
<td>Wheat</td>
<td>Log $Y = 4.084 + 0.736 \log X$</td>
<td>0.89</td>
<td>Yes</td>
</tr>
<tr>
<td>Barley</td>
<td>Log $Y = 3.83 + 0.362 \log X$</td>
<td>0.48</td>
<td>Yes</td>
</tr>
<tr>
<td>Gram</td>
<td>Log $Y = 4.665 - 0.246 \log X$</td>
<td>0.03</td>
<td>No</td>
</tr>
<tr>
<td>Arhar</td>
<td>Log $Y = 2.931 + 0.336 \log X$</td>
<td>0.66</td>
<td>Yes</td>
</tr>
<tr>
<td>Mustard</td>
<td>Log $Y = 2.605 + 0.566 \log X$</td>
<td>0.96</td>
<td>Yes</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>Log $Y = 5.971 + 0.310 \log X$</td>
<td>0.41</td>
<td>Yes</td>
</tr>
<tr>
<td>Potato</td>
<td>Log $Y = 3.355 + 0.93 \log X$</td>
<td>0.72</td>
<td>Yes</td>
</tr>
<tr>
<td>Cotton</td>
<td>Log $Y = 6.533 - 1.843 \log X$</td>
<td>-0.77</td>
<td></td>
</tr>
</tbody>
</table>
BULANDSHAHAR DISTRICT
RELATION BETWEEN PRICE AND PRODUCTION OF SELECTED CROPS
(1965-66 TO 1990-91)

RICE
$r = 0.13$

JOVAR
$r = -0.58$

BAJRA
$r = 0.41$

MAIZE
$r = 0.60$

WHEAT
$r = 0.89$

BARLEY
$r = 0.48$

GRAM
$r = 0.03$

ARHAR
$r = 0.66$

MUSTARD
$r = 0.96$

SUGARCANE
$r = 0.41$

POTATO
$r = 0.72$

COTTON
$r = -0.77$

FIG. 4.10
(ii) Arhar: The prices of arhar has increased by 560 per cent while its production also recorded an increase of 137.7 per cent and a positive correlation was observed. The correlation coefficient was 0.66 which was significant at one per cent level. The regression equation was $\log Y = 2.931 + 0.336 \log X$. The graph also shows a positive relation.

(iii) Maize: The prices of maize has increased by 183.5 per cent, its production also recorded an increase of 219.7 per cent. The correlation coefficient was 0.60 which was significant at one per cent level. The regression equation was $\log Y = 3.971 + 0.589 \log X$. The graph also supports the findings.

(iv) Barley: The prices of barley has increased by 223.5 per cent so has its production by 96.8 per cent. The correlation coefficient was 0.46, which was significant at five per cent level. The regression equation was $\log Y = 3.83 + 0.362 \log X$. The graph also supports the results.

(v) Bajra: The prices of bajra has increased by 156.3 per cent so has its production, which also increased by 83.8 per cent. The correlation coefficient was 0.41, which was significant at 5 per cent level. The regression equation was $\log Y = 3.75 + 0.239 \log X$. The graph also justifies the results.

(vi) Rice: The prices and production of rice has recorded increase of 260.6 per cent 14.7 per cent respectively. The correlation coefficient was 0.13 which was not significant at 5 per cent level. The regression equation was $\log Y = 3.943 + 0.056 \log X$. The graph also corroborates the results.

(vii) Gram: The prices of gram has increased by 608.4 per cent. Its production also increased marginally. A very low
degree of positive correlation was observed. The correlation coefficient was 0.03, which was not significant. The regression equation was \( \log Y = 4.685 - 0.246 \log X \). The graph also supports the results.

The only foodgrain which showed negative correlation was:

Jowar: The prices of jowar has increased by 213.4 per cent but its production decreased by 29.5 per cent. The correlation coefficient was -0.56 and the regression equation was \( \log Y = 5.111 - 0.971 \log X \). The graph also corroborates the results.

2. Non-foodgrains:

The non-foodgrains which recorded positive correlation were:

(i) Mustard: The prices of mustard has increased by 315 per cent and this has positively influenced its production which has increased by 142.7 per cent. The correlation coefficient was 0.90 which was significant at all levels of significance. The regression equation was \( \log Y = 2.605 + 0.566 \log X \). The graph also shows almost a perfect positive correlation.

(ii) Potato: The prices of potato has increased by 523.8 per cent, its production has also increased by 397.8 per cent. The correlation coefficient was 0.72 which was significant at one per cent level. The regression equation was \( \log Y = 3.355 + 0.95 \log X \). The graph also supports the results.

(iii) Sugarcane: The prices and production of sugarcane has increased by 363.7 per cent and 167.1 per cent respectively. The correlation coefficient was 0.41 which was significant at
The regression equation was \( \log Y = 5.971 + 0.316 \log \bar{x} \). The graph also justifies the results.

The only non-foodgrain which recorded negative correlation was:

Cotton: The prices of cotton have increased by 424 per cent but its production has decreased by 52.6 per cent. The correlation coefficient was -0.77. The regression equation was \( \log \gamma = 0.333 - 1.643 \log \bar{x} \). The graph also shows high degree of negative correlation between price and production.

The present analysis reveals that in the study region, prices have affected the production pattern. The yield of all the crops have increased because of high yielding variety of seeds, fertilizers, pesticides, better irrigation facilities etc. So now farmers are getting more production from lesser area and this has affected the cropping pattern also.

On the basis of above analysis, we observe that there were two distinct categories of crops. In the first category, wheat and sugarcane are the prominent crops. Arhar, mustard, potato and rice also come in this category. These crops are remunerative and are favoured highly by the farmers. Although wheat is a foodgrain but it is treated like a cash crop because farmer earn the most from this crop in the study region. Sugarcane is another crop which is very popular because of better returns. Rest of the crops like arhar, mustard and potato, gained importance in the last ten years or so and these crops are generally sown either with rotation with wheat or sugarcane. Although rice is also quite remunerative but it needs adequate irrigation so this crop is popular more in the northern part of the region. The significant feature of this category is that these crops are provided with better and
tortile lands, better irrigation, high yielding variety of seeds, adequate doses of fertilizers etc. and much care so that they can get maximum return. The second category consists of coarse grains whose production has declined and naturally the area under these crops have also decreased. In this category coarse grains like jowar, bajra, maize and barley were included. Gram and cotton also come in this category. These were those crops which are not so remunerative and the farmers have to invest more and the returns (in comparison to the crops from first category) are not so high. The farmers sow these crops in only that much of area, from where they can achieve the desired production and because of the improvement in technology they can get the desired production from lesser area that is why the area under these crops have declined since sixties.

On the basis of the above analysis four distinct categories of crops could be made:

1. In the first category we have included those crops which have recorded a high percentage increase in area, production and prices. Mustard, arhar, potato, sugarcane and wheat come under this category. So we observe that in the study region farmers are seen to respond to prices. They like to sow those crops which are more profitable. But this doesn't mean that there will be a total shift from foodgrains to cash crops as cash crops are more remunerative. The farmers of the study region devote a significant portion of their land to raise their own requirements out in sowing the surplus land they look to the market. Crops like mustard, arhar, sugarcane, potato and wheat are primarily produced for money. Wheat is also treated as cash crop and it is an important crop of the region. It is generally the preferred crop because of its price support, massive procurement by the government on farmers door step,
cash payments, technological advancement and sale of wheat straw. Sugarcane is another crop, which is very popular in the study region because of better yield and also because a number of sugar mills are situated in the study region. A shift of cultivation from coarse cereals to mustard because it needs only two waterings and it is high yielding and more remunerative. There was only a marginal area under mustard, arhar and potato in the sixties. These crops have gained importance in the last ten years or so. Arhar and mustard are grown in rotation with wheat. With the introduction of early maturing arhar a change in cropping pattern was witnessed because it can be cultivated in the normal cropping pattern as the bonus crops. The new short duration variety of arhar takes only five months to mature. Thus prices have influenced area under these crops as farmers want to get maximum returns from their land.

In the second category, we have included those crops, which have recorded a marginal increase in area, production and prices. Under this category comes rice and maize. Although rice is also quite remunerative but it needs adequate irrigation, so this crop is more popular in the northern districts while the southern districts prefer maize as it needs less irrigation.

In the third category we have included crops whose area and production has declined while there was marginal increase in prices. In this category jowar, bajra and barley were included. These coarse cereals are mainly grown for self consumption. They depend on rains and can do with out irrigation waters and inputs. Now-a-days even in rural areas people don't like to eat coarse cereals but they prefer eating wheat. These crops are often used as fodder.
In the fourth category, we have included those crops whose area and production have declined but the prices have increased drastically. Under this category gram and cotton were included. Area under gram declined inspite of its soaring prices. The cultivation of gram is not popular because of its low yield, non-availability of high yielding variety of seeds, it is susceptible to pests, diseases and weather fluctuations inadequate facilities of storing, traditional methods of processing, dehusking and milling of dal is carried on. Similarly cotton is also not favoured because it is also very susceptible to pests diseases and weather fluctuations.
CHAPTER FIVE

INFLUENCE OF OTHER IMPORTANT FACTORS ON CROPPING PATTERN
Area under crops are largely governed by physical, cultural, technological and economic factors. Physical factors specify the range of crops that can be grown in a region. It describes the production possibilities of crops and offers many choices but it does not determine as to which crop is most profitable for a particular region. Economic factors have a determining influence on cropping pattern. It determines the particular kind or combination of crops, that are most profitable to be produced on the farm. Generally, cropping pattern followed in India are based on traditional system of subsistence farming. Where farmer tries to produce every thing he needs like cereals, pulses, oilseeds, vegetables etc. The cropping pattern has risen out of necessity of farmer to become self reliant. But after the introduction of technology in agriculture the production possibilities have increased because of the use of costly inputs. The farmers have started to think of maximising their returns from their lands. The price which the farmer gets for the produce became of vital importance for them.

In the previous chapter, it was observed that prices were certainly influencing the cropping pattern of the study region. There was shift in area from the cultivation of coarse cereals like jowar, bajra, barley, pulses like gram and cash crops like cotton to the cultivation of cash crops like mustard, potato and sugarcane and pulses like arhar and fine cereals like wheat and rice. Area under crops like mustard, potato, sugarcane, arhar and wheat had increased tremendously for the last twenty five years basically due to price enhancement. There was also a marginal increase in area under rice and maize. Area under bajra, barley, jowar, gram and cotton had decreased tremendously. Although price is a very important factor influencing the cropping pattern, but there
must be some other factors too which might be responsible for the change.

In this chapter an attempt has been made to examine the influence of important factors on the cropping pattern in the five districts of the Upper Ganges-Yamuna doab from 1966-67 to 1978-79. For the district of Ghaziabad the data were taken from 1977-78 to 1989-90. Twelve important crops namely, rice, jowar, bajra, maize, wheat, barley, gram, arhar, mustard, sugarcane, potato and cotton were taken into consideration. Multiple linear regression model explaining variations in acreage, based on 'Nerlove's Partial Adjustment Model' was applied (Nerlove, M., 1958). The important factors effecting area under different crops considered were:

1. Price of that particular crop in the preceding year,
2. Production of that particular crop in the preceding year,
3. Irrigated area under that particular crop in the preceding year,
4. Area under that crop in the preceding year.

The multiple linear regression model, used in our analysis is:

\[ \hat{A}_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 Q_{t-1} + \beta_3 I_{t-1} + \beta_4 A_{t-1} + \nu_t \]

where \( \hat{A}_t \) = Area under any crop (in hectares) in year \( t \),
\( P_{t-1} \) = Farm harvest price (in Rs. per quintal) of that particular crop in year \( t-1 \)
\( Q_{t-1} \) = Production of that particular crop (in metric tons) in year \( t-1 \).
\( I_{t-1} \) = Irrigated area under that particular crop (in hectares) in year \( t-1 \).
\( A_{t-1} \) = Area under that particular crop (in hectares) in year \( t-1 \).
Now we briefly explain the cause of selecting these variables for this study. Firstly, we selected preceding year prices of a particular crop because in theory, given a free price mechanism, we expect, the supply of a commodity to increase when there is an increase in its prices and to decrease when there is a fall in its prices.

Secondly, we have selected preceding years production of that particular crop as one of the explanatory variable. A higher level of the crop output last year could enable farmers to meet their subsistence needs from the preceding years surplus of the crop. They may, allocate less area to that crop and re-allocate the area to the more remunerative crop or it may induce farmers to go again for that crop if it is relatively profitable to them.

Irrigation is very essential part of agriculture these days, because of fluctuating nature of monsoon. Irrigation is defined as the application of water by human agency to assist the growth of the crop. Our study region is one of the highly irrigated area in the country, so the effect of preceding years irrigated area under that particular crop on its acreage is worth examining and has therefore, been taken as the third factor in the present analysis.

The fourth factor selected is the area under that particular crop in the preceding year, since the traditional cropping pattern is expected to play an important role in the allocation of area under different crops.
Lastly we have included an error term. We agree that our theoretical function is a simplification and we do not expect a perfect relationship between the area under a particular crop and explanatory variables. There were a number of considerations for the inclusion of an error term. First, the inclusion of all explanatory variables is neither possible nor feasible. The quantitative data for all the explanatory variables are not available. Moreover, use of a large number of explanatory variables in the structural equation would reduce the degree of freedom for estimating the parameters with adequate level of confidence. Therefore, we have included only those variables which are considered to be most important. Secondly, there is an element of randomness in human behaviour, which necessitates the inclusion of a random error term. Thirdly, we can never measure acreage response exactly, so we have included measurement error in the error term. Inclusion of an error term allows us to proceed with our next step, which is to estimate statistically the acreage relationship using the data of area and the explanatory variables.

A quantitative estimate is given of the change in acreage that results from a change in each explanatory variable and a test is made to see, if these coefficients differ significantly from zero. In order to assess the ‘Precision’ of the estimates, we have calculated standard errors of the regression coefficients and enclosed them in brackets below their respective estimates. ‘T’ test has been applied to test the significance of each parameter, $R$ (multiple correlation coefficient), $R^2$ (square of multiple correlation coefficient) and $F$-value to test the significance of estimated regression equations have been calculated and presented with the results in tables 5.1, 5.2, 5.3, 5.4 and 5.5.
Still we cannot claim our econometric model to be perfect because they do not and perhaps cannot, encompass all the economic data of the real world. Taking into considerations, all the data and the factors that influence economic decisions of produce would involve minute description and analysis of every economic unit in existence. Consequently, we have singled out what appear to be the most relevant data and from that we have built up an overall structure of acreage response. We have concentrated on the data and assumptions that seem to be most relevant in motivating. In eliminating the less important data and in building up a logical theoretical structure, we lose some contact with reality. But we gain in our understanding of the overall operation of the acreage response phenomenon because the considered factors were reduced to manageable proportions.

Now we will examine the influence of the four important factors on the cropping patterns in the districts of the study region.

5.1. FACTORS ACCOUNTING FOR CHANGES IN AREA UNDER SELECTED CROPS IN SAHARANPUR DISTRICT

Table 5.1 is showing the values of co-eficients in the regression equations for changes in area under the twelve selected crops in Saharanpur district with (i) Price of the particular crop in the previous year, (ii) production of the particular crop in the previous year, (iii) irrigated area under that particular crop in the previous year and (iv) preceding years are under that particular crop respectively, as the explanatory variables. We shall examine the influence of these four factors on area under foodgrains and non-foodgrains in the district.
Table 5.11: Area Response Equation for Selected Crops in Saharanpur District

<table>
<thead>
<tr>
<th>Crops</th>
<th>$F_{t-1}$</th>
<th>$Q_{t-1}$</th>
<th>$I_{t-1}$</th>
<th>$A_{t-1}$</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$F$-value</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>48.7***</td>
<td>0.403**</td>
<td>-0.079</td>
<td>0.318*</td>
<td>0.869</td>
<td>0.755</td>
<td>15.408</td>
<td>5150</td>
</tr>
<tr>
<td></td>
<td>(8.4)</td>
<td>(10.22)</td>
<td>(0.05)</td>
<td>(11.15)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jowar</td>
<td>-0.006</td>
<td>0.614**</td>
<td>-0.351**</td>
<td>0.463***</td>
<td>0.798</td>
<td>0.657</td>
<td>8.774</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.06)</td>
<td>(0.15)</td>
<td>(0.11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>4.948***</td>
<td>-0.214**</td>
<td>-7.277***</td>
<td>1.038***</td>
<td>0.915</td>
<td>0.837</td>
<td>25.675</td>
<td>-681</td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td>(0.1)</td>
<td>(1.39)</td>
<td>(0.27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maize</td>
<td>-43.098***</td>
<td>0.042**</td>
<td>1.077**</td>
<td>0.444**</td>
<td>0.784</td>
<td>0.614</td>
<td>7.953</td>
<td>23.98</td>
</tr>
<tr>
<td></td>
<td>(7.03)</td>
<td>(0.020)</td>
<td>(0.49)</td>
<td>(0.23)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wheat</td>
<td>83.768***</td>
<td>0.083**</td>
<td>-0.09</td>
<td>0.17**</td>
<td>0.946</td>
<td>0.895</td>
<td>42.619</td>
<td>40.54</td>
</tr>
<tr>
<td></td>
<td>(12.09)</td>
<td>(0.04)</td>
<td>(0.07)</td>
<td>(0.069)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>5.620**</td>
<td>-0.419**</td>
<td>0.656**</td>
<td>1.36**</td>
<td>0.769</td>
<td>0.591</td>
<td>7.225</td>
<td>-678</td>
</tr>
<tr>
<td></td>
<td>(2.24)</td>
<td>(0.16)</td>
<td>(0.29)</td>
<td>(0.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>-5.967***</td>
<td>0.156**</td>
<td>-1.365***</td>
<td>0.07</td>
<td>0.925</td>
<td>0.855</td>
<td>28.482</td>
<td>22.44</td>
</tr>
<tr>
<td></td>
<td>(1.17)</td>
<td>(0.06)</td>
<td>(0.27)</td>
<td>(0.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arnar</td>
<td>1.51**</td>
<td>0.407***</td>
<td>0.547***</td>
<td>0.36**</td>
<td>0.851</td>
<td>0.724</td>
<td>13.116</td>
<td>-81</td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td>(0.05)</td>
<td>(0.07)</td>
<td>(0.15)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mustard</td>
<td>1.913***</td>
<td>0.167**</td>
<td>-0.153**</td>
<td>0.808**</td>
<td>0.977</td>
<td>0.954</td>
<td>103.695</td>
<td>-236</td>
</tr>
<tr>
<td></td>
<td>(0.43)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.39)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>152.723***</td>
<td>0.005**</td>
<td>1.036***</td>
<td>-0.495**</td>
<td>0.986</td>
<td>0.972</td>
<td>173.571</td>
<td>43.567</td>
</tr>
<tr>
<td></td>
<td>(21.4)</td>
<td>(0.002)</td>
<td>(0.12)</td>
<td>(0.24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>potato</td>
<td>0.628***</td>
<td>0.607**</td>
<td>0.027***</td>
<td>-0.068**</td>
<td>0.971</td>
<td>0.943</td>
<td>82.719</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.36)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cotton</td>
<td>0.181**</td>
<td>0.028**</td>
<td>-2.028**</td>
<td>0.307***</td>
<td>0.823</td>
<td>0.677</td>
<td>10.479</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.01)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) The asterisk marks on the regression coefficients and on $F$-value indicates as follows:

- ** Significant at 5 per cent
- *** Significant at 1 per cent

(2) Figures in brackets are standard error of regression coefficients.
3.1.1. Foodgrains:

(i) Rice: The estimated regression equation for changes in area under rice is given below:

\[ \hat{a}_t = 5156 + 46.7 P_{t-1} + 0.403 \hat{a}_{t-1} - 0.677 I_{t-1} + 0.318 A_{t-1} \]

\[ R^2 = 0.753 \quad F\text{-value} = 13.408 \]

The coefficients of price, production and area in the previous years were positive and significant while the coefficient of irrigated area was negative but significant. The multiple correlation coefficient was 0.667 and the F-value was 15.408, which was significant.

(ii) Jowar: The estimated regression equation for changes in area under jowar is given below:

\[ \hat{a}_t = 136 - 0.006 P_{t-1} + 0.614 \hat{a}_{t-1} - 0.351 I_{t-1} + 0.463 A_{t-1} \]

\[ R^2 = 0.637 \quad F\text{-value} = 6.774 \]

The coefficient of price and irrigated area under jowar in the previous years were negative but in the case of price, it was not significant. The coefficient of production and area under jowar in the preceding year were positive and were highly significant. The multiple correlation coefficient was 0.798 and the F-value was 6.774, which was also significant.

(iii) Bajra: The calculated regression equation for changes in area under bajra is given below:
The coefficient of price and preceding years area under bajra were positive and highly significant, while the coefficients of production and irrigated area under bajra were negative but significant. The multiple correlation coefficient was 0.915 and the F-value was 25.675 which was also significant.

(iv) Maize: The estimated regression equation for changes in area under maize is given below:

\[ A_t = 23178 - 43.098 \hat{A}_{t-1} - 0.042 \hat{A}_{t-1} + 0.077 \hat{I}_{t-1} + 0.444 A_{t-1} \]

\[ R^2 = 0.614 \quad F-value = 7.953 \]

The coefficients of price and production of maize were negative and significant while the coefficients of irrigated area and maize acreage in the preceding year was positive and significant. The multiple correlation coefficient was 0.784 and the F-value was 7.953 and was significant.

(v) Wheat: The calculated regression equation for variations in area under wheat is given below:

\[ A_t = 40654 + 83.785 \hat{A}_{t-1} + 0.083 \hat{A}_{t-1} - 0.09 \hat{I}_{t-1} + 0.17 A_{t-1} \]

\[ R^2 = 0.675 \quad F-value = 42.619 \]
The coefficient of irrigated area under wheat in the previous year was negative but insignificant, while the coefficients of price, production and area under wheat in the previous year were positive and significant. The multiple correlation coefficient was 0.746 and the F-value was 42.619 and was highly significant.

(vi) Barley: The estimated regression equation for changes in area under barley is given below:

\[ A_t = -676 + 5.626 P_{t-1} - 0.417 Q_{t-1} + 0.656 I_{t-1} + 1.36 A_{t-1} \]

\[ (2.24) \quad (0.18) \quad (0.29) \quad (0.6) \]

\[ R^2 = 0.591 \quad F-value = 7.225 \]

The coefficient of production of barley was negative and significant, rest of the variables showed positive response which were significant. The multiple correlation coefficient was 0.767 and the F-value was 7.225 which was significant.

(vii) Gram: The estimated regression equation for variations in area under gram is given below:

\[ A_t = 2244 - 5.776 P_{t-1} + 0.136 Q_{t-1} - 1.585 I_{t-1} + 0.07 A_{t-1} \]

\[ (1.17) \quad (0.06) \quad (0.27) \quad (0.06) \]

\[ R^2 = 0.835 \quad F-value = 29.482 \]

The coefficients of price and irrigated area under gram were negative and highly significant. While the coefficients of production and area of preceding year were positive of which the coefficient of previous year gram acreage was not significant. The multiple correlation coefficient was 0.925 and the F-value was 29.482, which was significant.
5.1.2. Non-foodgrains:

(i) Mustard: The estimated regression equation for changes in area under mustard is given below:

\[ A_t = -230 + 0.515 P_{t-1} + 0.107 Q_{t-1} - 0.133 I_{t-1} + 0.808 A_{t-1} \]

\[ R^2 = 0.954 \quad F\text{-value} = 103.695 \]

The coefficient of only irrigated area under mustard was negative and significant. While price, production and previous years mustard acreage recorded positive response and were significant. The multiple correlation coefficient was 0.977 and the \( f \)-value was 103.695 which too was highly significant.

(ii) Sugarcane: The calculated regression equation for variations in area under sugarcane is given below:

\[ A_t = 43567 + 152.723 P_{t-1} + 0.005 Q_{t-1} + 1.036 I_{t-1} - 0.495 A_{t-1} \]

\[ R^2 = 0.972 \quad F\text{-value} = 173.571 \]

The coefficients of price, production and irrigated area under sugarcane were positive and significant but previous year area under sugarcane was negative and significant. The multiple correlation coefficient was 0.972 and the \( f \)-value was 173.571 which was highly significant.

(iii) Potato: The estimated regression equation for changes in area under potato is given below:
\[ A_t = 43567 + 152.723 \, P_{t-1} + 0.005 \, Q_{t-1} + 1.036 \, I_{t-1} - 0.495 \, A_{t-1} \]

\[ (Z_{1.4}) \quad (\bar{t}.002) \quad (\bar{t}.12) \quad (\bar{t}.24) \]

\[ R^2 = 0.972 \quad \text{F-value} = 173.571 \]

The coefficients of price, production and irrigated area under sugarcane were positive and significant but previous year area under sugarcane was negative and significant. The multiple correlation coefficient was 0.972 and the F-value was 173.571 which was highly significant.

(iii) Potato: The estimated regression equation for changes in area under potato is given below:

\[ \hat{A}_t = 146 + 0.626 \, P_{t-1} + 0.6076 \, Q_{t-1} + 0.027 \, I_{t-1} - 0.068 \, A_{t-1} \]

\[ (\bar{t}.05) \quad (\bar{t}.29) \quad (\bar{t}.01) \quad (\bar{t}.36) \]

\[ R^2 = 0.943 \quad \text{F-value} = 82.719 \]

Only the coefficient of preceding year area under potato showed negative response while the coefficients of price, production and irrigated area under potato were positive and significant. The multiple correlation coefficient was 0.971 and the F-value was 82.719 which was also significant.

(iv) Cotton: The calculated regression equation for variations in area under cotton is given below:

\[ \hat{A}_t = 145 + 0.181 \, P_{t-1} + 0.028 \, Q_{t-1} - 2.016 \, I_{t-1} + 0.307 \, A_{t-1} \]

\[ (\bar{t}.05) \quad (\bar{t}.01) \quad (\bar{t}.98) \quad (\bar{t}.04) \]

\[ R^2 = 0.677 \quad \text{F-value} = 10.479 \]
Only the coefficient of irrigated area under cotton was negative, while rest of the variables were positive and significant. The multiple correlation coefficient was 0.823 and the $f$-value was 10.479 and it was also significant.

In Saharanpur district, the coefficient of price was positive in rice, bajra, wheat, barley, arhar, mustard, sugarcane, potato and cotton. Of which, bajra and barley are subsistence crops and barley is mostly grown as fodder crop. This shows that even subsistence growers are responsive to price changes. Rice and wheat are the other two fine cereals which are responsive positively to the increasing prices. A possible explanation is that under conditions of rising prices, the farmers would increase the area to provide sufficient food for the farm family because it would be costlier for them to meet their subsistence requirement from market and the surplus production is sold in the market. Pulse crops and cash crops are grown basically for market and any increase in their prices goad the farmers to increase the acreage under these crops.

The coefficient of production was positive in the case of rice, jowar, wheat, gram, arhar, mustard, sugarcane, potato and cotton. Of them, except for jowar rest of the crops are profitable to the farmers and increase in production means more income. This induces farmers to go again for the cultivation of the same crop, which are relatively profitable to them. Jowar, is grown mainly as a fodder crop and its production also influences its acreage positively. Negative response of production was observed in case of bajra, maize and barley. These crops are coarse cereals and are not produced for market. A higher level of production in the last year could enable farmers to meet their subsistence needs from the preceding years surplus of the crop. They may allocate less area to these crops and reallocate the area to more remunerative crops.
The impact of irrigation is one of the important and complex phenomena of agriculture. The coefficient of irrigated area was positive in case of maize, barley, arhar, sugarcane and potato, which means that if these crops are given adequate water supply which will lead to increased production and ultimately their acreage would also increase.

Lastly, the coefficient of preceding years area which is positive in case of rice, jowar, bajra, maize, wheat, barley, gram, arhar, mustard and cotton. This shows that the area under a crop in the preceding year plays an important role in allocation of area during the current year. This suggests that allocation of area under the crop is influenced by the preceding years cropping pattern and farmers hesitate to change the cropping pattern and they stick to the traditional cropping pattern. Sugarcane and potato showed negative response which indicates that for cash crops farmers are taking risk and are going for new crop combinations to get maximum return from their lands.

5.2 FACTORS ACCOUNTING FOR CHANGES IN AREA UNDER SELECTED CROPS IN HUZAFFARNAGAR DISTRICT:

Table 5.2 is showing the values of coefficients in the regression equations for changes in area under the twelve selected crops in Huzaffarnagar district with (i) price of the particular crop in the previous year, (ii) production of the particular crop in the previous year, (iii) preceding years irrigated area under that particular crop and (iv) preceding years area under that particular crop respectively, as the explanatory variables. We shall examine the influence of these four factors on area under foodgrains and non-foodgrains in this district.
<table>
<thead>
<tr>
<th>Crops</th>
<th>( F_{t-1} )</th>
<th>( N_{t-1} )</th>
<th>( I_{t-1} )</th>
<th>( A_{t-1} )</th>
<th>( R )</th>
<th>( R^2 )</th>
<th>F-value</th>
<th>Constant (( n_1, n_2 ))</th>
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<tbody>
<tr>
<td>Rice</td>
<td>13.86**</td>
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<td>(0.12)</td>
<td>(0.33)</td>
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</tr>
<tr>
<td>Jowar</td>
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<td>+2.345**</td>
<td>0.882</td>
<td>0.737</td>
<td>0.543</td>
<td>5.941</td>
<td>1111</td>
</tr>
<tr>
<td></td>
<td>(1.24)</td>
<td>(0.46)</td>
<td>(4.03)</td>
<td>(0.71)</td>
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<td></td>
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<tr>
<td>Bajra</td>
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<td>0.806</td>
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<td>(0.39)</td>
<td>(0.39)</td>
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<tr>
<td>maize</td>
<td>-45.35***</td>
<td>0.077</td>
<td>0.521**</td>
<td>0.306**</td>
<td>0.787</td>
<td>0.619</td>
<td>8.123</td>
<td>12610</td>
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<tr>
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<td>(3.01)</td>
<td>(0.75)</td>
<td>(0.24)</td>
<td>(0.14)</td>
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</tr>
<tr>
<td>Wheat</td>
<td>59.83***</td>
<td>0.041**</td>
<td>-0.537**</td>
<td>+0.195**</td>
<td>0.938</td>
<td>0.879</td>
<td>36.323</td>
<td>60506</td>
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<tr>
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<td>(3.41)</td>
<td>(0.29)</td>
<td>(0.07)</td>
<td></td>
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</tr>
<tr>
<td>Barley</td>
<td>-0.5**</td>
<td>-0.001</td>
<td>0.863***</td>
<td>0.688**</td>
<td>0.729</td>
<td>0.531</td>
<td>5.661</td>
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<td>(0.21)</td>
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<td>(0.33)</td>
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</tr>
<tr>
<td>Gram</td>
<td>-2.514</td>
<td>0.447***</td>
<td>1.425**</td>
<td>-0.042**</td>
<td>0.972</td>
<td>0.945</td>
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<td>Harar</td>
<td>1.73**</td>
<td>0.564**</td>
<td>1.069***</td>
<td>-0.718**</td>
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<td>0.876</td>
<td>35.983</td>
<td>-42</td>
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<tr>
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<td>(0.34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>mustard</td>
<td>0.285***</td>
<td>0.081**</td>
<td>1.40**</td>
<td>-1.283**</td>
<td>0.975</td>
<td>0.95</td>
<td>95</td>
<td>-136</td>
</tr>
<tr>
<td></td>
<td>(1.03)</td>
<td>(0.03)</td>
<td>(0.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>205.25***</td>
<td>0.002**</td>
<td>0.106**</td>
<td>-0.295**</td>
<td>0.994</td>
<td>0.966</td>
<td>411.66</td>
<td>25041</td>
</tr>
<tr>
<td></td>
<td>(14.5)</td>
<td>(0.04)</td>
<td>(0.13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>1.647***</td>
<td>0.077**</td>
<td>-0.007**</td>
<td>-0.58**</td>
<td>0.986</td>
<td>0.972</td>
<td>173.571</td>
<td>453</td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.03)</td>
<td>(0.26)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>0.108**</td>
<td>-1.244**</td>
<td>0.482**</td>
<td>0.338**</td>
<td>0.928</td>
<td>0.841</td>
<td>30.971</td>
<td>1000</td>
</tr>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note: (1) The asterisk marks on the regression coefficients and on F-value indicates as follows:

** Significant at 1 per cent
*** Significant at 3 per cent

(2) Figures in brackets are standard error of regression coefficients.
5.2.1. Foodgrains:

(i) Rice: The estimated regression equation for changes in area under rice is given below:

\[ A_t = 1151 + 13.66 F_{t-1} + 0.654 Q_{t-1} - 0.276 I_{t-1} + 0.738 A_{t-1} \]

\( R^2 = 0.792 \quad F\text{-value} = 19.038 \)

The coefficients of price, production and area under rice in the previous year were positive and significant while the coefficient of irrigated area under rice showed negative response, but was significant. The multiple correlation coefficient was 0.87 and f-value was 19.038 which was also significant.

(ii) Jowar: The calculated regression equation for variations in area under jowar is given below:

\[ A_t = 111 - 0.523 F_{t-1} + 1.023 Q_{t-1} + 2.345 I_{t-1} + 0.882 A_{t-1} \]

\( R^2 = 0.543 \quad F\text{-value} = 5.941 \)

The coefficients of irrigated area and area of the previous year under jowar were positive but only the coefficient of irrigated area was significant. The coefficients of price and production were negative but significant. The multiple correlation coefficient was 0.737 and the f-value was 5.941.

(iii) Bajra: The estimated regression equation for changes in area under bajra is given below:
\[ A_t = 406 + 2.977 P_{t-1} - 0.387 \hat{A}_{t-1} + 0.415 I_{t-1} + 0.855 A_{t-1} \]
\[
(1.06) \quad (0.15) \quad (0.01) \quad (0.39)
\]
\[ R^2 = 0.649 \quad \text{f-value} = 9.245 \]

The coefficient of production was negative and significant, while the coefficients of price, irrigated area and preceding years area under bajra were positive and significant. The multiple correlation coefficient was 0.806 and the f-value was 7.245, which too was significant.

(iv) Maize: The calculated regression equation for changes in area under maize is given below:

\[ A_t = 12616 - 45.33 P_{t-1} + 0.677 \hat{A}_{t-1} + 0.521 I_{t-1} + 0.306 A_{t-1} \]
\[
(3.61) \quad (0.73) \quad (0.24) \quad (0.14)
\]
\[ R^2 = 0.619 \quad \text{F-value} = 8.123 \]

The coefficient of price was negative and highly significant, while the coefficients of production, irrigated area and area under maize in the previous year were positive but the coefficient of production was not significant. The multiple correlation coefficient was 0.787 and the f-value was 8.123, which too was significant.

(v) Wheat: The calculated regression equation for changes in area under wheat is given below:

\[ A_t = 60506 + 59.85 P_{t-1} + 0.041 \hat{A}_{t-1} - 5.39 I_{t-1} + 0.195 A_{t-1} \]
\[
(3.41) \quad (0.02) \quad (0.24) \quad (0.07)
\]
\[ R^2 = 0.679 \quad \text{F-value} = 36.323 \]
The coefficients of price, production and area of the preceding year under wheat were positive and significant, while the coefficient of irrigated area was negative but significant. The multiple correlation coefficient was 0.938 and the $f$-value was 36.323, which too was significant.

(vi) Barley: The estimated regression equation for variations in area under barley is given below:

$$A_t = 54 - 0.5 P_{t-1} - 0.061 Q_{t-1} + 0.663 I_{t-1} + 0.688 A_{t-1}$$  
(0.21)  
(0.05)  
(0.06)  
(0.33)

$R^2 = 0.531$  
$F$-value = 5.661

The coefficients of price and production were negative of which the coefficient of production was not significant. The coefficients of irrigated area and preceding years area under barley were positive and significant. The multiple correlation coefficient was 0.729.

(vii) Gram: The calculated regression equation for changes in area under gram is given below:

$$A_t = 1070 - 2.516 P_{t-1} + 0.449 Q_{t-1} + 1.429 I_{t-1} - 0.042 A_{t-1}$$  
(2.48)  
(0.02)  
(0.69)  
(0.02)

$R^2 = 0.943$  
$F$-value = 85.909

The coefficients of production and irrigated area were positive and significant, while the coefficients of price and preceding years area under gram were negative of which the coefficient of price was insignificant. The multiple correlation coefficient was 0.972 and the $f$-value was 85.909, which too was significant.
(viii) Arhar: The estimated regression equation for changes in area under arhar is given below:

\[ A_t = -42 + 1.73 P_{t-1} + 0.364 Q_{t-1} + 1.689 I_{t-1} - 0.718 A_{t-1} \]

\[ R^2 = 0.878 \quad F-value = 35.983 \]

The coefficients of price, production and irrigated area were positive and significant, while the coefficient of area under arhar in the preceding year was negative but significant. The multiple correlation coefficient was 0.937 and the F-value was 35.983 which was also significant.

5.2.2 Non-foodgrains:

(i) Mustard: The estimated regression equation for variations in area under mustard is given below:

\[ A_t = -136 + 6.265 P_{t-1} + 0.061 Q_{t-1} + 1.46 I_{t-1} - 1.283 A_{t-1} \]

\[ R^2 = 0.93 \quad F-value = 95 \]

The coefficients of price, production and irrigated area were positive and significant, while the coefficient of preceding years area under mustard was negative but significant. The multiple correlation coefficient was 0.975 and the F-value was 95, which too was significant.

(ii) Sugarcane: The calculated regression equation for changes in area under sugarcane is given below:
\[ a_t = 26941 + 205.23 P_{t-1} + 0.002 Q_{t-1} + 0.168 I_{t-1} - 0.295 A_{t-1} \]
\[ (14.3) \quad (0.001) \quad (0.04) \quad (0.13) \]

\[ R^2 = 0.988 \quad F-value = 411.66 \]

The coefficients of price, production and irrigated area were positive and significant while the coefficient of preceding years area under sugarcane was negative but significant. The multiple correlation coefficient was 0.994 and the f-value was 411.66, which was highly significant.

(iii) Potato: The calculated regression equation for changes in area under potato is given below:

\[ A_t = 453 + 1.847 P_{t-1} + 0.079 Q_{t-1} - 0.067 I_{t-1} - 0.56 A_{t-1} \]
\[ (0.25) \quad (0.05) \quad (0.03) \quad (0.26) \]

\[ R^2 = 0.972 \quad F-value = 173.57 \]

The coefficients of price and production were positive and significant, while the coefficients of irrigated area and area under potato in the previous year were negative but significant. The multiple correlation coefficient was 0.986 while the f-value was 173.57, which too was significant.

(iv) Cotton: The estimated regression equation for variations in area under cotton is given below:

\[ A_t = 1060 + 0.106 P_{t-1} - 1.244 Q_{t-1} + 0.482 I_{t-1} + 0.338 A_{t-1} \]
\[ (0.47) \quad (0.02) \quad (0.03) \quad (0.14) \]

\[ R^2 = 0.861 \quad F-value = 30.971 \]
The coefficients of price, irrigated area and preceding year's area under cotton were positive and significant while the coefficient of production was negative but significant. The multiple correlation coefficient was 0.926 and the f-value was 30.971, which was also significant.

In Muzaffarnagar district, the coefficient of price was positive in the case of rice, bajra, wheat, arhar, mustard, sugarcane, potato and cotton. Rice, bajra and wheat are foodgrains, whose area showed positive relations with its prices. These crops are grown for self consumption but their prices also attracts farmers to sow them on more area because the surplus production is sold in the market, rice and wheat are quite remunerative. Rest of the crops which showed positive relation were primarily grown for the market and that's why the coefficients of these crops were positive and shows that an increase in prices attracts farmers to increase the area under these crops.

The coefficient of production was positive in case of rice, maize, wheat, gram, arhar, mustard, sugarcane and potato. Once again most of these crops are remunerative and increase in production means more returns and it induces farmers to allocate more area to these crops. The coefficient of production was negative in case of jowar, bajra, barley and cotton and except for cotton all the other crops are coarse cereals. These crops are not grown for market and a higher level of product of these crops in the previous year could enable farmers to meet their subsistence needs from the preceding year's surplus. They may allocate less area to these crop and reallocate the area to the more remunerative crop.

The coefficient of irrigated area was positive in case of jowar, bajra, maize, barley, gram, arhar, mustard, sugarcane
and cotton, which means that increase in irrigated area will increase the acreage under these crops next year. These crops either are not provided adequate irrigation or they need more irrigation and when they are provided increased irrigation, the production is increased and ultimately their acreage also increases. The coefficient of irrigated area was negative in case of rice, wheat and potato this indicates that these crops are getting adequate irrigation and any increase in irrigation will adversely effect the acreage.

The coefficient of preceding years area was positive in case of rice, jowar, bajra, maize, wheat, barley and cotton. This in a way, suggests that traditional cropping pattern is one of the important factor which accounts for the cultivation of these crops. The coefficient of preceding years area was negative in case of gram, arhar, mustard, sugarcane and potato, these crops are grown largely for the market and for these crops, farmers are taking risk and maximum available lands are devoted to these crops. This shows a change in cropping pattern and also from subsistence farming to commercial farming.

5.3. FACTORS ACCOUNTING FOR CHANGES IN AREA UNDER SELECTED CROPS IN HEERUT DISTRICT

Table 5.3 is showing the values of coefficients in the regression equation for changes in area under the twelve selected crops in Heerut district with (i) the price of the particular crop in the previous year, (ii) production of the particular crop in the preceding year, (iii) preceding years irrigated area under the particular crop and (iv) preceding years area under the particular crop respectively as the explanatory variables. We shall examine the influence of these four factors on area under foodgrains and non-foodgrains in this district.
<table>
<thead>
<tr>
<th>Crops</th>
<th>$F_{t-1}$</th>
<th>$\hat{g}_{t-1}$</th>
<th>$I_{t-1}$</th>
<th>$\hat{A}_{t-1}$</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$F$-value</th>
<th>Constant</th>
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</thead>
<tbody>
<tr>
<td>Rice</td>
<td>17.05***</td>
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<td>Maize</td>
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<td>Gram</td>
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<td></td>
</tr>
<tr>
<td>Arhar</td>
<td>4.462**</td>
<td>0.854**</td>
<td>+0.551**</td>
<td>-1.262**</td>
<td>0.841</td>
<td>0.707</td>
<td>12.065</td>
<td>-704</td>
</tr>
<tr>
<td></td>
<td>(1.93)</td>
<td>(0.38)</td>
<td>(0.24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>0.506**</td>
<td>0.414**</td>
<td>+0.776***</td>
<td>-1.839**</td>
<td>0.974</td>
<td>0.946</td>
<td>91.154</td>
<td>-1021</td>
</tr>
<tr>
<td></td>
<td>(0.33)</td>
<td>(0.19)</td>
<td>(0.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>183.943***</td>
<td>0.212**</td>
<td>0.109**</td>
<td>-0.281**</td>
<td>0.972</td>
<td>0.944</td>
<td>84.285</td>
<td>62996</td>
</tr>
<tr>
<td></td>
<td>(21.61)</td>
<td>(0.105)</td>
<td>(0.047)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>3.265***</td>
<td>0.606**</td>
<td>-0.466**</td>
<td>-0.746**</td>
<td>0.977</td>
<td>0.954</td>
<td>103.695</td>
<td>2053</td>
</tr>
<tr>
<td></td>
<td>(0.9)</td>
<td>(0.30)</td>
<td>(0.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>-1.622**</td>
<td>0.152**</td>
<td>1.146**</td>
<td>-0.271**</td>
<td>0.979</td>
<td>0.958</td>
<td>114.047</td>
<td>1159</td>
</tr>
<tr>
<td></td>
<td>(0.77)</td>
<td>(0.68)</td>
<td>(0.15)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (i) The asterisk marks on the regression coefficients and on $f$-value indicates as follows:

** Significant at 5 per cent
*** Significant at 1 per cent

(2) Figures in brackets are standard error of regression coefficients.
5.3.1. Foodgrains:

(i) Rice: The estimated regression equation for changes in area under rice is given below:

\[ A_t = 7947 + 17.03 F_{t-1} + 0.015 A_{t-1} - 1.009 I_{t-1} + 1.27 A_{t-1} \]

\[ (4.29) \hspace{1cm} (0.61) \hspace{1cm} (0.49) \hspace{1cm} (0.58) \]

\[ R^2 = 0.605 \hspace{5cm} F-value = 7.658 \]

The coefficients of price, production and preceding years area under rice were positive and significant, except for the coefficient of production, which was not significant. The coefficient of irrigated area was negative but significant. The multiple correlation coefficient was 0.775 and the F-value was 7.658.

(ii) Jowar: The estimated regression equation for variations in area under jowar is given below:

\[ A_t = 228 - 1.182 F_{t-1} - 0.753 A_{t-1} + 0.148 I_{t-1} + 0.748 A_{t-1} \]

\[ (0.5) \hspace{1cm} (0.13) \hspace{1cm} (0.66) \hspace{1cm} (0.08) \]

\[ R^2 = 0.779 \hspace{5cm} F-value = 17.624 \]

The coefficients of price and production were negative and significant, while the coefficients of irrigated area and preceding years area under jowar were positive and significant. The multiple correlation coefficient was 0.883 and the F-value was 17.624, which was also significant.

(iii) Bajra: The calculated regression equation for variations in area under bajra is given below:
The coefficients of price, irrigated area and preceding years area under bajra were positive and significant, while the coefficient of production was negative and significant. The multiple correlation coefficient was 0.663 and the f-value was 14.531, which too was significant.

(iv) Maize: The estimated regression equation for changes in area under maize is given below:

$$
A_t = -1127 + 2.659 P_{t-1} - 0.834 O_{t-1} + 1.733 I_{t-1} + 0.853 A_{t-1}
$$

\[ (1.37) \quad (0.39) \quad (0.22) \quad (0.083) \]

$$
R^2 = 0.744 \quad F-value = 14.531
$$

The coefficients of production, irrigated area and preceding years area under maize were positive and significant while the coefficient of price was negative but highly significant. The multiple correlation coefficient was 0.804 and the f-value was 9.124, which was also significant.

(v) Wheat: The calculated regression equation for variations in area under wheat is given below:

$$
A_t = 60754 + 61.1 P_{t-1} + 0.0617 O_{t-1} - 0.675 I_{t-1} + 1.396 A_{t-1}
$$

\[ (5.63) \quad (0.02) \quad (0.33) \quad (0.27) \]

$$
R^2 = 0.874 \quad F-value = 34.68
$$
The coefficient of price, production and preceding years area under wheat were positive and significant. The coefficient of irrigated area was negative but significant. The multiple correlation coefficient was 0.935 and the f-value was 34.68 which was also significant.

(v) Barley: The estimated regression equation for changes in area under barley is given below:

\[ A_t = -986 + 11.357 P_{t-1} - 0.684 \bar{A}_{t-1} + 0.407 I_{t-1} + 1.07 A_{t-1} \]

\[ (2.36) \quad (0.33) \quad (0.198) \quad (0.13) \]

\[ R^2 = 0.944 \quad F\text{-value} = 84.258 \]

The coefficients of price, irrigated area and preceding years area under barley were positive and significant, while the coefficient of production was negative but significant. The multiple correlation coefficient was 0.972 and the f-value was 84.258, which was also significant.

(vii) Gram: The calculated regression equation for variations in area under gram is given below:

\[ A_t = 743 - 1.900 P_{t-1} + 0.211 \bar{A}_{t-1} + 1.036 I_{t-1} + 0.163 A_{t-1} \]

\[ (1.43) \quad (0.11) \quad (0.47) \quad (0.17) \]

\[ R^2 = 0.966 \quad F\text{-value} = 142.059 \]

The coefficients of production, irrigated area and previous years area under gram were positive and significant, while the coefficient of price was negative and was not significant. The multiple correlation coefficient was 0.983 and the f-value was 142.059 which was also significant.
(viii) Arhar: The estimated regression equation for changes in area under arhar is given below:

\[ \hat{A}_t = -704 + 4.462 \hat{P}_{t-1} + 0.634 \hat{Q}_{t-1} + 0.551 \hat{I}_{t-1} - 1.262 A_{t-1} \]

\[ \begin{align*}
(1.93) & & (0.38) & & (0.24) & & (0.61)
\end{align*} \]

\[ R^2 = 0.707 \quad F\text{-value} = 12.065 \]

The coefficients of price, production and irrigated area were positive and significant. The coefficient of preceding years area under arhar was negative but significant. The multiple correlation coefficient was 0.841 and the f-value was 12.065, which too was significant.

3.3.2. non-food grains:

(i) Mustard: The estimated regression equation for changes in area under mustard is given below:

\[ A_t = -1021 + 0.706 P_{t-1} + 0.414 Q_{t-1} + 0.796 I_{t-1} - 1.839 A_{t-1} \]

\[ \begin{align*}
(0.35) & & (0.19) & & (0.06) & & (0.83)
\end{align*} \]

\[ R^2 = 0.948 \quad F\text{-value} = 91.154 \]

The coefficients of price, production and irrigated area were positive and significant while the coefficient of preceding years area under mustard was negative but significant. The multiple correlation coefficient was 0.974 and the f-value was 91.154, which too was significant.

(ii) Sugarcane: The estimated regression equation for changes in area under sugarcane is given below:
\[ A_t = 62996 + 103.943 P_{t-1} + 0.212 Q_{t-1} + 0.109 I_{t-1} - 0.281 A_{t-1} \]

\[ R^2 = 0.944 \quad F\text{-value} = 84.285 \]

The coefficients of price, production and irrigated area were positive and significant while preceding years area under sugarcane was negative but significant. The multiple correlation coefficient was 0.972 and the \( F \)-value was 84.285, which was also significant.

(iii) Potato: The calculated regression equation for changes in area under potato is given below:

\[ A_t = 2053 + 3.265 P_{t-1} + 0.609 Q_{t-1} - 0.408 I_{t-1} - 0.746 A_{t-1} \]

\[ R^2 = 0.954 \quad F\text{-value} = 103.695 \]

The coefficients of price and production were positive and significant, while the coefficients of irrigated area and preceding years area under potato were negative and they too were significant. The multiple correlation coefficient was 0.977 and the \( F \)-value was 103.695, which was also significant.

(iv) Cotton: The estimated regression equation for changes in area under cotton is given below:

\[ A_t = 1159 - 1.622 P_{t-1} + 0.152 Q_{t-1} + 1.146 I_{t-1} - 0.271 A_{t-1} \]

\[ R^2 = 0.958 \quad F\text{-value} = 114.047 \]
The coefficients of price and preceding years area under cotton were negative but significant, while the coefficients of production and irrigated area were positive and significant. The multiple correlation coefficient was 0.979 and the f-value was 114.047, which too was significant.

In Meerut district, the coefficient of price was positive in the case of rice, bajra, wheat, barley, arhar, mustard, sugarcane and potato. Of these crops, bajra and barley are subsistence crops and this shows that even subsistence growers are responsive to price changes. Rice and wheat are fine cereals but they are as remunerative as the cash crops, so these two crops are also responsive to price. The remaining crops are cash crops, which are grown for market and farmers are allocating more area to these crops due to the increase in their prices.

The coefficient of production was positive in case of rice, maize, wheat, gram, arhar, mustard, sugarcane, potato and cotton. Once again except for the coarse cereals the area under all the other crops are responsive to the production. Increase in production means that the farmer can sell more of their production and gain more income. The negative coefficient of production was observed in jowar, bajra and barley. These crops are not grown for market and are used as food and fodder crop. Previous years higher level of production enables the farmers to meet their subsistence requirement from the surplus production and allocate less area to these crops. Thus there is shift in area from the cultivation of coarse cereals to the cultivation of profitable crops.

The coefficient of irrigated area was positive in case of jowar, bajra, maize, barley, gram, arhar, mustard, sugarcane and cotton. Increase in irrigated area under these crops will
lead to increase in production and subsequently increase in their acreage also. Rice, wheat and potato are negatively related to the coefficient of irrigated area, which means that these crops are well irrigated.

The coefficient of preceding years area was positive in case of all the foodgrains. This shows that farmers of this district are still more or less associated with traditional farming. However, the preceding years area under cash crops were negatively related. This shows that for cash crops farmers are allotting land which were earlier devoted to other crops and they are shifting from traditional farming to market oriented farming.

3.4. FACTORS ACCOUNTING FOR CHANGES IN AREA UNDER SELECTED CROPS IN GHAZIABAD DISTRICT

Table 5.4 is showing the values of coefficients in the regression equations for changes in area under the twelve selected crops in Ghaziabad district with (i) price of the particular crop in the previous year, (ii) production of the particular crop in the previous year, (iii) preceding years irrigated area under that particular crop and (iv) preceding years area under that particular crop respectively, as the explanatory variables. We shall examine the influence of these four factors on area under foodgrains and non-foodgrains in this district.

5.4.1. Foodgrains:

(i) Rice: The estimated regression equation for changes in area under rice is given below;
Table 5.4: Area Response Equation for Selected Crops in Bharatpur District

<table>
<thead>
<tr>
<th>Crops</th>
<th>$F_{t-1}$</th>
<th>$Q_{t-1}$</th>
<th>$k_{t-1}$</th>
<th>$A_{t-1}$</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$F$-value</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>-13.45**</td>
<td>0.086**</td>
<td>0.46**</td>
<td>0.429**</td>
<td>0.769</td>
<td>0.591</td>
<td>7.225</td>
<td>2761</td>
</tr>
<tr>
<td>(3.67)</td>
<td>(0.059)</td>
<td>(0.44)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jowar</td>
<td>-2.153**</td>
<td>-0.375***</td>
<td>0.417**</td>
<td>0.295**</td>
<td>0.817</td>
<td>0.667</td>
<td>10.015</td>
<td>1244</td>
</tr>
<tr>
<td>(1.03)</td>
<td>(0.02)</td>
<td>(0.17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>0.035***</td>
<td>-0.158**</td>
<td>0.306**</td>
<td>0.539**</td>
<td>0.898</td>
<td>0.806</td>
<td>20.773</td>
<td>7211</td>
</tr>
<tr>
<td>(1.31)</td>
<td>(0.07)</td>
<td>(0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>-6.651***</td>
<td>0.034**</td>
<td>0.265**</td>
<td>0.243**</td>
<td>0.913</td>
<td>0.833</td>
<td>24.94</td>
<td>22070</td>
</tr>
<tr>
<td>(1.1)</td>
<td>(0.013)</td>
<td>(0.12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>39.741***</td>
<td>+0.058**</td>
<td>-0.094**</td>
<td>0.772***</td>
<td>0.978</td>
<td>0.956</td>
<td>108.636</td>
<td>19230</td>
</tr>
<tr>
<td>(5.61)</td>
<td>(0.013)</td>
<td>(0.044)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>0.726**</td>
<td>-0.146</td>
<td>1.427***</td>
<td>0.078**</td>
<td>0.761</td>
<td>0.575</td>
<td>6.876</td>
<td>533</td>
</tr>
<tr>
<td>(0.35)</td>
<td>(0.15)</td>
<td>(0.11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>-1.325**</td>
<td>0.467**</td>
<td>1.351**</td>
<td>-0.166**</td>
<td>0.798</td>
<td>0.636</td>
<td>8.736</td>
<td>44</td>
</tr>
<tr>
<td>(0.63)</td>
<td>(0.22)</td>
<td>(0.71)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arhar</td>
<td>2.174**</td>
<td>0.132**</td>
<td>0.615**</td>
<td>-0.243**</td>
<td>0.894</td>
<td>0.759</td>
<td>19.875</td>
<td>109</td>
</tr>
<tr>
<td>(1.04)</td>
<td>(0.06)</td>
<td>(0.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>1.882**</td>
<td>0.616**</td>
<td>-1.649**</td>
<td>+1.01**</td>
<td>0.989</td>
<td>0.978</td>
<td>222.27</td>
<td>-1031</td>
</tr>
<tr>
<td>(0.37)</td>
<td>(0.06)</td>
<td>(0.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>142.321***</td>
<td>0.004**</td>
<td>1.841***</td>
<td>-1.576**</td>
<td>0.954</td>
<td>0.91</td>
<td>50.555</td>
<td>28596</td>
</tr>
<tr>
<td>(13.65)</td>
<td>(0.05)</td>
<td>(0.73)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>4.812***</td>
<td>0.005**</td>
<td>0.387***</td>
<td>-0.346**</td>
<td>0.973</td>
<td>0.946</td>
<td>87.592</td>
<td>2341</td>
</tr>
<tr>
<td>(0.24)</td>
<td>(0.03)</td>
<td>(0.16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>+1.762**</td>
<td>0.645***</td>
<td>-0.235**</td>
<td>-0.718**</td>
<td>0.997</td>
<td>0.804</td>
<td>20.51</td>
<td>1493</td>
</tr>
<tr>
<td>(0.78)</td>
<td>(0.06)</td>
<td>(0.34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (i) The asterisk marks on the regression coefficients and on $F$-value indicates as follows:

** Significant at 5 per cent
*** Significant at 1 per cent

(2) Figures in brackets are standard error of regression coefficients.
\[ A_t = 2761 - 13.43 \, P_{t-1} + 0.666 \, Q_{t-1} + 0.46 \, I_{t-1} + 0.425 \, A_{t-1} \]
\[(3.67) \quad (0.033) \quad (0.44) \quad (0.2)\]

\[ R^2 = 0.591 \quad F-value = 7.225 \]

The coefficients of production, irrigated area and preceding years acreage of rice were positive and only the coefficient of irrigated area was not significant. The coefficient of price was negative but it was highly significant. The multiple correlation coefficient was 0.769 and the f-value was 7.225.

(ii) Jowari: The calculated regression equation for changes in area under jowar is given below:

\[ A_t = 1244 - 2.153 \, P_{t-1} - 0.375 \, Q_{t-1} + 0.417 \, I_{t-1} + 0.295 \, A_{t-1} \]
\[(1.03) \quad (0.02) \quad (0.19) \quad (0.13)\]

\[ R^2 = 0.667 \quad F-value = 10.015 \]

The coefficients of price and production were negative but significant, while the coefficients of irrigated area and preceding years jowar acreage were positive and significant. The multiple correlation coefficient was 0.617 and the f-value was 10.015, which too was significant.

(iii) Bajra: The estimated regression equation for variations in area under bajra is given below:

\[ A_t = 7211 + 0.633 \, P_{t-1} - 0.158 \, Q_{t-1} + 0.368 \, I_{t-1} + 0.539 \, A_{t-1} \]
\[(1.31) \quad (0.07) \quad (0.14) \quad (0.2)\]

\[ R^2 = 0.666 \quad F-value = 20.773 \]
The coefficients of price, irrigated area and preceding years area under bajra were positive and significant, while the coefficient of production was negative but it too was significant. The multiple correlation coefficient was 0.898 and the f-value was 20.773, which was also significant.

(iv) Maize: The calculated regression equation for variations in area under maize is given below:

\[ A_t = 22070 - 0.631 P_{t-1} + 0.034 Q_{t-1} + 0.265 I_{t-1} + 0.243 A_{t-1} \]

(0.12) (0.013) (0.12) (0.12)

\[ R^2 = 0.833 \quad F\text{-value} = 24.94 \]

The coefficient of price was negative but significant, while the coefficients of irrigated area, production and preceding years area under maize were positive and also significant. The multiple correlation coefficient was 0.913 and the f-value was 24.94, which was also significant.

(v) Wheat: The estimated regression equation for changes in area under wheat is given below:

\[ A_t = 19230 - 37.741 P_{t-1} + 0.038 Q_{t-1} - 0.074 I_{t-1} + 0.772 A_{t-1} \]

(3.61) (0.013) (0.044) (0.01)

\[ R^2 = 0.956 \quad F\text{-value} = 108.636 \]

The coefficients of price, production and preceding years area under wheat were positive and significant, while the coefficient of irrigated area was negative but significant. The multiple correlation coefficient was 0.978 and the f-value was 108.636, which too was significant.
(vi) Barley: The calculated regression equation for variations in area under barley is given below:

\[ A_t = 935 + 0.726 F_{t-1} - 0.146 Q_{t-1} + 1.429 I_{t-1} + 0.078 A_{t-1} \]

\[ R^2 = 0.579 \quad F-value = 6.876 \]

The coefficients of price, irrigated area and area under barley in the previous year were positive and significant, while the coefficient of production was negative and was also insignificant. The multiple correlation coefficient was 0.761 and the \(f\)-value was 6.876.

(vii) Gram: The calculated regression equation for changes in area under gram is given below:

\[ A_t = 44 - 1.323 F_{t-1} + 0.467 Q_{t-1} + 1.351 I_{t-1} - 0.166 A_{t-1} \]

\[ R^2 = 0.636 \quad F-value = 8.736 \]

The coefficients of price and preceding years area under gram were negative and significant, while the coefficients of production and irrigated area were positive and significant. The multiple correlation coefficient was 0.798 and the \(f\)-value was 8.736.

(viii) Arhar: The estimated regression equation for variations in area under arhar is given below:
The coefficients of price, production and irrigated area were positive and significant while the coefficient of preceding years area under *arhar* was negative but significant. The multiple correlation coefficient was 0.874 and the *f*-value was 19.875, which too was significant.

5.4.2 Non-foodgrains:

(i) Mustard: The calculated regression equation for changes in area under mustard is given below:

\[ A_t = i0.031 + 1.662 P_{t-1} + 8.61 \delta Q_{t-1} + 1.641 I_{t-1} + 1.01 A_{t-1} \]

\( (0.87) \quad (0.06) \quad (0.73) \quad (0.07) \)

\[ R^2 = 0.775 \quad F-value = 222.27 \]

The coefficients of price, production and area of previous year under mustard were positive and significant, while the coefficient of irrigated area was negative but was also significant. The multiple correlation coefficient was 0.989 and the *f*-value was 222.27 which was also significant.

(ii) Sugarcane: The estimated regression equation for changes in area under Sugarcane is given below:

\[ A_t = 26536 + 142.321 P_{t-1} + 0.004 Q_{t-1} + 1.641 I_{t-1} - 1.576 A_{t-1} \]

\( (15.63) \quad (0.002) \quad (0.03) \quad (0.73) \)

\[ R^2 = 0.91 \quad F-value = 50.555 \]
The coefficients of price, production and irrigated area under sugarcane were positive and significant, while the coefficient of preceding years area under sugarcane was negative but it was also significant. The multiple correlation coefficient was 0.954 and the \( f \)-value was 50.555, which too was significant.

(iii) Potato: The estimated regression equation for variations in area under potato is given below:

\[
\Delta_t = 2341 + 4.612 \Delta_{t-1} + 0.005 \Delta_{t-1} + 0.387 I_{t-1} - 0.346 A_{t-1} \\
\text{(0.24) } \text{(0.002) } \text{(0.03) } \text{(0.16)}
\]

\( R^2 = 0.946 \)

\( F \)-value = 87.592

The coefficients of price, production and irrigated area were positive and significant, while the coefficient of area under potato in the previous year was negative but significant. The multiple correlation coefficient was 0.973 and the \( f \)-value was 87.592, which too was significant.

(iv) Cotton: The calculated regression equation for changes in area under cotton is given below:

\[
\Delta_t = 1493 + 1.762 \Delta_{t-1} + 0.845 \Delta_{t-1} + 0.239 I_{t-1} - 0.718 A_{t-1} \\
\text{(0.78) } \text{(0.06) } \text{(0.11) } \text{(0.34)}
\]

\( R^2 = 0.664 \)

\( F \)-value = 20.51

The coefficients of price and production were positive and significant while the coefficients of irrigated area and cotton acreage in the previous year were negative but significant. The multiple correlation coefficient was 0.897 and the \( f \)-value was 20.51, which was also significant.
The coefficient of price was positive in the case of bajra, wheat, barley, arhar, mustard, sugarcane, potato and cotton. It means that the area under these crops are positively influenced by their respective prices. This shows that in this district farmers are influenced by prices but they are allocating their lands both to subsistence crop as well as cash crops.

The coefficient of production was positive in the case of rice, maize, wheat, gram, arhar, mustard, sugarcane, potato and cotton. This shows that increased production in the previous year of these crops influences in increasing the area in the current year. Among these crops, most of them are cash crops so increased production means increase in income. The coefficient of production was negative in case of jowar, bajra and barley. Which shows that the surplus production of the previous year will enable the farmers to meet their requirement and in this way the area under these crops in the current year will be reduced.

The coefficient of irrigated area was positive in case of rice, jowar, bajra, maize, barley, gram, arhar, sugarcane and potato. This shows that if the irrigation to these crops is increased, it will help in increasing their respective acreage. Only wheat, mustard and cotton are adequately irrigated in this district.

The coefficient of preceding years area was positive in case of rice, jowar, bajra, maize, wheat, barley and mustard. This shows that area under these crops in the preceding year bears an important role with changes in the area during the current year. This shows that traditional cropping pattern is still one of the important factors which restrict the changes in cropping pattern. However, the coefficient was negative in
case of gram, arhar, sugarcane, potato and cotton, which indicates that for these crops, farmers are taking risk and are going for new cropping patterns.

5.5. FACTORS ACCOUNTING FOR CHANGES IN AREA UNDER SELECTED CROPS IN BULANDSHAHAR DISTRICT

Table 3.5 is showing the values of coefficients in the regression equations for changes in area under the twelve selected crops in Bulandshahar district with (i) price of the particular crop in the previous year, (ii) production of the particular crop in the previous year, (iii) preceding years irrigated area under that particular crop and (iv) preceding years area under that particular crop respectively, as the explanatory variables. We shall examine the influence of these four factors on area under foodgrains and non-foodgrains in this district.

5.5.1 Foodgrains:

(i) Rice: The estimated regression equation for changes in area under rice is given below:

\[ A_t = 5720 - 25.37 P_{t-1} + 0.117 Q_{t-1} + 1.349 I_{t-1} + 0.164 \ A_{t-1} \]

\[ (3.79) \quad (0.03) \quad (0.68) \quad (0.78) \]

\[ R^2 = 0.662 \quad F\text{-value} = 7.563 \]

The coefficient of price was negative and highly significant, while the coefficients of production, irrigated area and preceding years area under rice were positive and significant. The multiple correlation coefficient was 0.776 and the f-value was 7.563.
Table 5.5: Area Response Equation for Selected Crops in Bulandshahar District

<table>
<thead>
<tr>
<th>Crops</th>
<th>$P_{t-1}$</th>
<th>$q_{t-1}$</th>
<th>$I_{t-1}$</th>
<th>$A_{t-1}$</th>
<th>$R$</th>
<th>$R^2$</th>
<th>F-value</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>-25.37**</td>
<td>0.117**</td>
<td>1.349**</td>
<td>+0.164**</td>
<td>0.776</td>
<td>0.602</td>
<td>7.563</td>
<td>5720</td>
</tr>
<tr>
<td></td>
<td>(3.79)</td>
<td>(0.05)</td>
<td>(0.66)</td>
<td>(0.78)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jowar</td>
<td>-1.287**</td>
<td>-0.073**</td>
<td>1.043**</td>
<td>1.896***</td>
<td>0.854</td>
<td>0.727</td>
<td>13.45</td>
<td>-1281</td>
</tr>
<tr>
<td></td>
<td>(0.57)</td>
<td>(0.03)</td>
<td>(0.47)</td>
<td>(0.11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bajra</td>
<td>7.592***</td>
<td>-0.529**</td>
<td>+1.375**</td>
<td>0.786**</td>
<td>0.806</td>
<td>0.649</td>
<td>9.245</td>
<td>2407</td>
</tr>
<tr>
<td></td>
<td>(1.31)</td>
<td>(0.14)</td>
<td>(0.6)</td>
<td>(0.36)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>-240.2***</td>
<td>+1.005**</td>
<td>+2.504**</td>
<td>+0.054**</td>
<td>0.808</td>
<td>0.652</td>
<td>9.368</td>
<td>20089</td>
</tr>
<tr>
<td></td>
<td>(4.31)</td>
<td>(0.49)</td>
<td>(1.310)</td>
<td>(0.02)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>37.32***</td>
<td>+0.016**</td>
<td>1.008***</td>
<td>-0.308**</td>
<td>0.983</td>
<td>0.966</td>
<td>142.059</td>
<td>60942</td>
</tr>
<tr>
<td></td>
<td>(5.13)</td>
<td>(0.006)</td>
<td>(0.21)</td>
<td>(0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>8.556**</td>
<td>-0.072**</td>
<td>-0.168**</td>
<td>0.806***</td>
<td>0.82</td>
<td>0.672</td>
<td>10.244</td>
<td>1789</td>
</tr>
<tr>
<td></td>
<td>(2.67)</td>
<td>(0.03)</td>
<td>(0.63)</td>
<td>(0.02)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>-5.318**</td>
<td>0.013**</td>
<td>0.954***</td>
<td>0.463**</td>
<td>0.89</td>
<td>0.792</td>
<td>19.038</td>
<td>1266</td>
</tr>
<tr>
<td></td>
<td>(2.25)</td>
<td>(0.006)</td>
<td>(0.01)</td>
<td>(0.21)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arhar</td>
<td>3.619**</td>
<td>0.086**</td>
<td>3.027***</td>
<td>-0.776**</td>
<td>0.861</td>
<td>0.741</td>
<td>14.305</td>
<td>-674</td>
</tr>
<tr>
<td></td>
<td>(1.61)</td>
<td>(0.05)</td>
<td>(0.13)</td>
<td>(0.35)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>6.972***</td>
<td>0.086**</td>
<td>+0.427**</td>
<td>-1.082**</td>
<td>0.978</td>
<td>0.956</td>
<td>108.636</td>
<td>-1400</td>
</tr>
<tr>
<td></td>
<td>(0.67)</td>
<td>(0.039)</td>
<td>(0.19)</td>
<td>(0.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>212.3***</td>
<td>0.007**</td>
<td>0.006**</td>
<td>-0.157**</td>
<td>0.807</td>
<td>0.651</td>
<td>9.326</td>
<td>25682</td>
</tr>
<tr>
<td></td>
<td>(5.31)</td>
<td>(0.002)</td>
<td>(0.005)</td>
<td>(0.86)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>1.362***</td>
<td>0.008**</td>
<td>0.835***</td>
<td>-0.256**</td>
<td>0.985</td>
<td>0.97</td>
<td>161.666</td>
<td>1609</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.003)</td>
<td>(0.01)</td>
<td>(0.11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>0.461**</td>
<td>-0.035**</td>
<td>0.567***</td>
<td>-0.227**</td>
<td>0.974</td>
<td>0.948</td>
<td>91.154</td>
<td>-273</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.01)</td>
<td>(0.09)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) The asterisk marks on the regression coefficients and on f-value indicates as follows:
** Significant at 5 per cent
*** Significant at 1 per cent
(2) Figures in brackets are standard error of regression coefficients.
(ii) Jowar: The calculated regression equation for changes in area under jowar is given below:

\[ A_t = -1281 - 1.287 P_{t-1} - 0.073 Q_{t-1} + 1.043 I_{t-1} + 1.896 A_{t-1} \]

\[ R^2 = 0.729 \quad F\text{-value} = 13.45 \]

The coefficients of price and production were negative and significant while the coefficients of irrigated area and preceding years area under jowar were positive and also significant. The multiple correlation coefficient was 0.854 and the f-value was 13.45, which too was significant.

(iii) Bajra: The calculated regression equation for variations in area under bajra is given below:

\[ A_t = 2407 + 7.592 P_{t-1} - 0.324 Q_{t-1} + 1.399 I_{t-1} + 0.786 A_{t-1} \]

\[ R^2 = 0.649 \quad F\text{-value} = 9.245 \]

The coefficients of price, irrigated area and preceding years area under bajra were positive and significant, while the coefficient of production was negative but it was also significant. The multiple correlation coefficient was 0.806 and the f-value was 9.245.

(iv) Maize: The estimated regression equation for changes in area under maize is given below:

\[ A_t = 20089 - 45.2 P_{t-1} + 1.005 Q_{t-1} + 2.504 I_{t-1} + 0.054 A_{t-1} \]

\[ R^2 = 0.652 \quad F\text{-value} = 9.368 \]
The coefficients of production, irrigated area and preceding years area under maize were positive and were significant, while the coefficient of price was negative but it was also significant. The multiple correlation coefficient was 0.808 and the f-value was 9.368.

(v) Wheat: The calculated regression equation for variations in area under wheat is given below:

\[
A_t = 60942 + 37.32 P_{t-1} + 0.016 Q_{t-1} + 1.008 I_{t-1} - 0.308 A_{t-1}
\]

\[
(3.13) \quad (0.006) \quad (0.21) \quad (0.14)
\]

\[
R^2 = 0.966 \quad \text{F-value} = 142.059
\]

The coefficients of price, production and irrigated area were positive and significant. The coefficient of preceding years area under wheat was negative but was also significant. The multiple correlation coefficient was 0.963 and the f-value was 142.059, which too was highly significant.

(vi) Barley: The calculated regression operation for variations in area under barley is given below:

\[
A_t = 1787 + 5.536 P_{t-1} - 0.072 A_{t-1} - 0.166 I_{t-1} + 0.806 A_{t-1}
\]

\[
(3.67) \quad (0.03) \quad (0.63) \quad (0.02)
\]

\[
R^2 = 0.672 \quad \text{F-value} = 10.244
\]

The coefficients of price and preceding years area under barley were positive and significant, while the coefficients of production and irrigated area were a negative but they too were significant. The multiple correlation coefficient was 0.82 and the f-value was 10.244, which was also significant.
(vii) Gram: The estimated regression equation for changes in area under gram is given below:

\[ A_t = 1250 - 5.318 P_{t-1} + 0.613 \Delta A_{t-1} + 0.754 I_{t-1} + 0.463 A_{t-1} \]

\[ (2.23) \quad \quad (0.660) \quad \quad (0.934) \quad \quad (0.21) \]

\[ R^2 = 0.792 \quad \quad F-value = 19.038 \]

The coefficients of production, irrigated area and preceding years area under gram were positive and significant, while the coefficient of price was negative but it was also significant. The multiple correlation coefficient was 0.89 and the f-value was 19.038, which too was significant.

(viii) Arhar: The calculated regression equation for variations in area under arhar is given below:

\[ A_t = -694 + 3.619 P_{t-1} + 0.686 \Delta A_{t-1} + 3.627 I_{t-1} - 0.776 A_{t-1} \]

\[ (1.61) \quad \quad (0.83) \quad \quad (0.35) \quad \quad (0.21) \]

\[ R^2 = 0.741 \quad \quad F-value = 14.305 \]

The coefficients of price, production and irrigated area were positive and significant, while the coefficient of preceding years area under arhar was negative but significant. The multiple correlation coefficient was 0.861 and the f-value was 14.305, which too was significant.

5.5.2 Non-foodgrains:

(i) Mustard: The estimated regression equation for variations in area under mustard is given below:
The coefficients of price, production and irrigated area were positive and significant while the coefficient of preceding years area under mustard was negative but significant. The multiple correlation coefficient was 0.975 and the f-value was 108.636, which was highly significant.

(ii) Sugarcane: The calculated regression equation for changes in area under sugarcane is given below:

$A_t = 29862 + 212.3 P_{t-1} + 0.007 A_{t-1} + 0.006 I_{t-1} - 0.157 A_{t-1}$

$R^2 = 0.651 \quad F\text{-value} = 9.326$

The coefficients of price, production and irrigated area were positive and only the coefficient of irrigated area was not significant, while the coefficient of preceding years area under sugarcane was negative but significant. The multiple correlation coefficient was 0.807 and the f-value was 9.326.

(iii) Potato: The estimated regression equation for variations in area under potato is given below:

$A_t = 1809 + 1.362 P_{t-1} + 0.008 A_{t-1} + 0.835 I_{t-1} - 0.258 A_{t-1}$

$R^2 = 0.97 \quad F\text{-value} = 161.666$
The coefficients of price, production and irrigated area were positive and significant while the coefficient of preceding years area under potato was negative but it too was significant. The multiple correlation coefficient was 0.985 and the f-value was 161.666 which was highly significant.

(iv) Cotton: The calculated regression equation for changes in area under cotton is given below:

\[ A_t = -273 + 0.461 P_{t-1} - 0.035 Q_{t-1} + 0.869 I_{t-1} - 0.22 A_{t-1} \]

\[ (0.22) \quad (0.06) \quad (0.06) \quad (0.09) \]

\[ R^2 = 0.948 \quad \text{F-value} = 91.154 \]

The coefficients of price and irrigated area were positive and significant while the coefficient of production and preceding years area under cotton were negative but significant. The multiple correlation coefficient was 0.974 and the f-value was 91.154, which was highly significant.

In Bulandshahar district the coefficient of price was positive in the case of bajra, wheat, barley, arhar, mustard, sugarcane, potato and cotton. This shows that these crops are remunerative to the farmers. Significantly among these crops, bajra and barley are coarse cereals and their prices are also influencing positively to their respective acreage. The prices of rice, jowar, maize and gram were negatively influencing their acreage, this is significant because rice and gram are quite remunerative but still it is not making positive impact on their acreage.

The coefficient of production was positive in the case of rice, maize, wheat, gram, arhar, mustard, sugarcane and potato. An increase in their production would definitely give the
farmers more income. Although rice and wheat are consumed by
the farmers themselves but if they get surplus production, they
can sell the surplus in the market and gain vital income as
these two crops are also quite remunerative. This induces the
farmers to increase production and that's why the acreage
under these crops are positively related to their production.
The coefficient of production was negative in case of jowar,
bajra, barley and cotton, except for cotton all the other crops
are subsistence crops and a higher level of production in the
previous year will enable the farmers to meet their subsistence
requirement from the surplus production. This enables them to
shift the area under those crops which are more remunerative.
The coefficient of irrigated area was negative only in
case of barley. This shows that the district is not well
irrigated as the other districts of the study region. The crops
in this district if provided with adequate irrigation will
positively effect their acreage.
The coefficient of preceding years area was positive in
case of rice, jowar, bajra, maize, barley and gram. This shows
that traditional farming is still practiced in the district.
However, the coefficient was negative in case of wheat, arhar,
mustard, Sugarcane, potato and cotton. These crops which are
largely grown for the market are gaining area from other crops
which are not so remunerative. A clear shift from traditional
farming to commercial farming is also observed.
The above results can be summarized in brief as follows:

(i) Prices of crops once again emerged as the most influencing
factor. The crops which showed positive response to prices also
showed positive response to their production. This shows that
profitability of crops is the basic factor for the farmers and
they allocate land keeping these factors in mind. All the
selected cash crops came under this category. Maximum increase in prices were recorded among these crops and subsequently massive increase in area and production have also been witnessed, especially in case of mustard, sugarcane and potato (Fig. 5.1). These crops are basically grown for market and increase in price and production motivate farmers to allocate more land to these crops. They provide these crops with all the necessary inputs to get maximum production which fetch them high returns.

2. Secondly, fine cereals like rice and wheat and arhar also showed positive response to price and production (Fig.5.2). These crops are also as good as cash crops in the study region because of fairly high prices, massive procurement by the government on farmers door-step, cash payments, technological advancement, availability of high yielding variety of seeds and better irrigation facilities. The positive response to increasing prices was also because it would be costlier for the farmers to meet their subsistence requirements from market (Fig.5.3 and Fig. 5.4). The increase in production means that their subsistence need will be fulfilled with lesser area and the surplus production will be sold in the market ensuring good income.

3. The coarse cereals generally showed negative response to prices and production because these crops are not remunerative and a higher level of production in the previous year could enable farmers to meet their subsistence requirements from the previous year's surplus production and instead of allocating area to these crops, they prefer to grow more remunerative crops.

4. The coefficient of irrigation was positive either among those crops, which are not favoured by the farmers like jowar,
Fig. 5.1 Higher prices of mustard have brought a shift in area towards mustard cultivation in the study region.

Fig. 5.2 Early maturing and high yielding variety of arhar has also gained importance in the study region.
Fig. 5.3 The study region is best suited for wheat cultivation, that is why wheat is the most preferred crop.

Fig. 5.4 The sale of wheat straw also brings good income to the farmers.
Pajira, maize, barley and gram etc., because these crops are not provided with adequate or any irrigation and they depend on monsoon rains for their survival and increase in irrigation will definitely increase their production, which ultimately results in increase in their acreage. Secondly, other crops which showed positive response to irrigation were those crops which need higher amount of irrigation water. This includes sugarcane and arhar, although these area are provided with fairly high irrigation but still more irrigation water is desired. Increase in irrigation will positively affect the acreage of sugarcane and arhar. In the southern districts of the study region, the rains are not adequate and more irrigation facility is needed. Crops like rice showed positive response to irrigation in these districts. Generally the favoured crops like wheat, mustard, potato and rice etc. are provided with adequate irrigation and negative response to irrigation was observed.

5. Area of previous year was positively influencing the foodgrains because these crops are grown here for centuries. Previous years acreage plays an important role in allocation of area. The farmers hesitate to make changes and are stuck to the crops which they were growing earlier. However, cash crops like sugarcane, mustard, potato and also arhar showed negative response, which indicates that farmers are taking risk and are venturing for new crop combinations and patterns to get maximum returns from their lands.
CHAPTER SIX

FARMERS' RESPONSE TO PRICE AND IT'S EFFECT ON THE CROPPING PATTERN OF THE SAMPLE FARMS
In a predominantly agricultural economy, the overall rate of economic growth depends to a very large extent, on the rate of growth in agriculture. In India achievement in the agricultural sector will continue to be a determining factor in the achievements of plan targets for many years to come. In the last few years many packages were announced in favour of farmers like subsidies on fertilizers and high yielding variety of seeds etc. and more importantly significant increase in procurement prices of agricultural products. However, the success or failure of programmes of agricultural development depends decisively on the way farmers react to such programmes, since it is ultimately the farmer who makes the final decision concerning the allocation of land and other resources for a particular crop enterprise.

Adoption of agricultural methods and deciding what to grow are based on many socio-economic, physical and even political factors. These factors have a combined impact on the decision making process of the farmers. Any factor can be more influential at any given time depending on the situation. One cannot deny the importance of economic aspect in the decision making process. Agriculture is an economic activity from which farmers earn their livelihood. Therefore, they first look for economic viability of any agricultural method and cropping pattern within their socio-physical and political environment.

In the previous chapter we have discussed the influence of important factors like preceding years price, production, irrigated area and area under a particular crop and their effect on the cropping pattern in the districts of Upper Ganga - Ramuna doab.
In the present chapter, the author is trying to assess the response of the farmers to changing prices and some other important factors and their impact on the cropping pattern in the study region. Data regarding the various socio-economic aspects, factors influencing cropping pattern, area, production, yield of the crops etc. were gathered from a comprehensive and well structured survey. The survey in the study region was conducted during 1990 and 1991. The sample design adopted was of two stage, in the first stage, selection of villages from the five districts of the study region was made and 45 villages were selected. In the second stage, selection of farmers were made and 237 farmers were selected and they were categorised on the basis of their farm sizes. Farm size is defined here as the size of holding under one ownership. This study is based on the data pertaining to the 237 farms selected on 'Stratified Random' basis. A purposeful survey was conducted and not only the farmer but we also tried to gather information about all the family members. It was actually a survey of 237 households. However, our stress was on the farmer who took the entrepreneurial decisions. This chapter has been divided into five parts. In the first part an attempt is made to study the social profile of the sample farmers. Second part assesses the farm practices adopted by the sample farmers. Third part deals with the economic profile of the sample farmers. In the fourth part we will discuss the cropping pattern adopted by the sample farmers and fifth part investigate the various factors which are influencing the cropping pattern of the sample farmers.

6.1. SOCIAL PROFILE OF THE SAMPLE FARMERS:

In this part of the chapter an attempt is made to delineate some of the salient social features of the selected farmers.
### Table 6.1: Area and Number of Holdings Under Different Farm Categories of the Surveyed Farmers in the Upper Ganga-Yamuna Doab (1990-91)

<table>
<thead>
<tr>
<th>Farm categories</th>
<th>Size of holding</th>
<th>Numbers of holdings</th>
<th>Total area (in hectares)</th>
<th>Average area per holding (in hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Large</td>
<td>10 or more</td>
<td>38</td>
<td>710.22</td>
<td>18.69</td>
</tr>
<tr>
<td>2. Medium</td>
<td>4-10</td>
<td>51</td>
<td>318.66</td>
<td>6.25</td>
</tr>
<tr>
<td>3. Semi-Medium</td>
<td>2-4</td>
<td>54</td>
<td>172.63</td>
<td>3.19</td>
</tr>
<tr>
<td>4. Small</td>
<td>1-2</td>
<td>48</td>
<td>67.61</td>
<td>1.41</td>
</tr>
<tr>
<td>5. Marginal</td>
<td>1 or less than one</td>
<td>46</td>
<td>33.46</td>
<td>0.73</td>
</tr>
<tr>
<td>6. Total surveyed Farms</td>
<td>237</td>
<td>1302.80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Figures in brackets are percentage to the total.
Source: Based on field survey

### 6.1.1. Farm Size of the Sample Farmers:

Table 6.1 is showing the size, number, total area and average area per holding under each category in the sample farms. The 237 farms surveyed were spread over 1,302.8 hectares of land. These farms were grouped under five categories on the basis of size of holding namely, large farms having ten hectares or more, medium farms having four to ten hectares, semi-medium farms having two to four hectares, small farms having one to two hectares and marginal farms having less than one hectare. A perusal of Table 6.1 shows that out of the 237 farms surveyed:
38 farms came under the large category which is 16.03 per cent of the total number of holdings. The total area covered by these farms is 710.22 hectares, which is 54.41 per cent of the total surveyed area. Average area per holding is 18.69 hectares.

31 farms came under the medium category which is 21.52 per cent of the total number of holdings. The total area covered by these farms is 318.66 hectares, which is 24.46 per cent of the total surveyed area. Average area per holding is about 0.25 hectares.

34 farms came under the semi-medium category which is 22.78 per cent of the total number of holdings. The total area covered by these farms is 172.63 hectares, which is 13.25 per cent of the total area of the surveyed farms. Average area per holding is 5.19 hectares.

48 farms came under the small category which is 20.25 per cent of the total number of holdings. The total area covered by these farms is 67.81 hectares, which is 5.2 per cent of the total area of the sample farms. Average area per holding is 1.41 hectares.

40 farms came under the marginal category which is 19.41 per cent of the total number of holdings. The total area covered by these farms is 33.46 hectares, which is 2.57 per cent of the total area of the sample farms. Average area per holding is 0.73 hectares.

It is observed that the semi-medium category has the highest number of holdings (34) but it is the large farms which are having the maximum area under them (710.22 hectares). 38 large farms covered more than half of the total surveyed area.
Although, more number of holdings are found in the semi-medium, small and marginal farm categories, but the concentration of land is found under the large and medium category. On the basis of operation of holding, it is the large and medium holdings which predominated with an average area of 18.69 and 6.25 hectares respectively.

6.1.2. Per Capita share of area among the sample farmers:

In this section, our aim is to find out the share of area under each person in different categories of farm sizes. It was found that the per capita share of land in the category of large farmers was 2.07 hectares, medium farmers 1.61 hectares, semi-medium 0.86 hectares, small farmers 0.22 hectares and marginal farmers 0.11 hectares. The survey revealed that the families of marginal and small farmers were big and about 6 to 7 persons were dependent on less than one or two hectares of land. Generally, the family of medium farmers were small, although maximum average area per person among large farmers was more because of their huge holdings.

6.1.3. Caste of the Sample farmers:

A division of the 237 farmers is made on the basis of caste, which is a very important social factor in India.

Of the 237 sample farmers, 47 belonged to the Jat community, 37 were Rajputs, 33 Ioonas, 50 Tyagis, 28 Brahmins, 27 Muslims and 15 were Baniyas, while the remaining 20 belonged to the scheduled castes (underprivileged class of the society) like, Jatavs, Harijans, Cnamars etc. Distribution of the sample farmers by caste in the various farm categories is given in table 6.2.
<table>
<thead>
<tr>
<th>Caste/Farm Categories</th>
<th>Large</th>
<th>Medium</th>
<th>Semi-</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rajput</td>
<td>19(37.63)</td>
<td>13(25.35)</td>
<td>8(16.02)</td>
<td>2(4.04)</td>
<td>-</td>
<td>37(100)</td>
</tr>
<tr>
<td></td>
<td>38.64*</td>
<td>25.49*</td>
<td>14.81*</td>
<td>4.16*</td>
<td></td>
<td>15.61*</td>
</tr>
<tr>
<td>Jat</td>
<td>12(25.35)</td>
<td>15(31.91)</td>
<td>11(23.41)</td>
<td>7(14.69)</td>
<td>2(4.25)</td>
<td>47(100)</td>
</tr>
<tr>
<td></td>
<td>31.57*</td>
<td>29.41*</td>
<td>20.37*</td>
<td>14.56*</td>
<td>4.34*</td>
<td>19.83*</td>
</tr>
<tr>
<td>Brahmin</td>
<td>3(6.25)</td>
<td>7(23)</td>
<td>9(32.14)</td>
<td>5(17.85)</td>
<td>2(7.14)</td>
<td>28(100)</td>
</tr>
<tr>
<td></td>
<td>13.15*</td>
<td>13.72*</td>
<td>10.60*</td>
<td>10.42*</td>
<td>4.34*</td>
<td>11.81*</td>
</tr>
<tr>
<td>Musi11a</td>
<td>5(10)</td>
<td>7(23.33)</td>
<td>11(40.67)</td>
<td>1(3.7)</td>
<td>-</td>
<td>27(100)</td>
</tr>
<tr>
<td></td>
<td>7.69*</td>
<td>9.85*</td>
<td>12.90*</td>
<td>22.91*</td>
<td>2.17*</td>
<td>11.39*</td>
</tr>
<tr>
<td>Tyagi</td>
<td>3(6.25)</td>
<td>0(0)</td>
<td>11(30.60)</td>
<td>7(23.33)</td>
<td>3(10)</td>
<td>30(100)</td>
</tr>
<tr>
<td></td>
<td>7.89*</td>
<td>11.76*</td>
<td>20.37*</td>
<td>14.56*</td>
<td>6.52*</td>
<td>12.65*</td>
</tr>
<tr>
<td>Baniya</td>
<td>1(2.00)</td>
<td>4(20.00)</td>
<td>0(0)</td>
<td>3(15)</td>
<td>1(6.66)</td>
<td>15(100)</td>
</tr>
<tr>
<td></td>
<td>2.03*</td>
<td>7.64*</td>
<td>0.23*</td>
<td>2.17*</td>
<td>6.32*</td>
<td></td>
</tr>
<tr>
<td>Loona</td>
<td>3(6.00)</td>
<td>-</td>
<td>1(3.03)</td>
<td>1(3.03)</td>
<td>10(33.33)</td>
<td>33(100)</td>
</tr>
<tr>
<td></td>
<td>1.19*</td>
<td>1.85*</td>
<td>20.63*</td>
<td>43.65*</td>
<td>13.9*</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>-</td>
<td>3(15)</td>
<td>1(6.00)</td>
<td>20(100)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>1.85*</td>
<td>0.25*</td>
<td>34.78*</td>
<td>8.43*</td>
</tr>
<tr>
<td>Total sample Farms</td>
<td>38</td>
<td>51</td>
<td>34</td>
<td>48</td>
<td>46</td>
<td>237</td>
</tr>
<tr>
<td></td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Figures in brackets are percentages to the total of that variable in the row.

**Note 2:** Figures with asterisk mark are percentages to the total of that particular farm category (in the column).

**Source:** Based on 1990-91 survey

From this table, it is noticed that most of the large and medium farms are owned by upper castes and backward and schedule castes own small and marginal farms.
0.1.4. **Age and duration as decision maker of the sample farmers:**

In the sample farms, decision regarding agricultural practices were mostly made by the elders. 57.38 per cent of the decision makers were in the age group of 50 years or above, 31.22 per cent between 40 and 50 years and only 11.39 per cent were below 40 years. The distribution of sample farmers by age group is given in the table 0.3.

**TABLE 0.3 : AGE OF THE DECISION MAKER IN THE SAMPLE FARMS OF DIFFERENT FARM CATEGORIES IN THE UPPER SANGA-YAHUNA DOAB (1990-91)**

<table>
<thead>
<tr>
<th>Age Group/ Farm Categ.</th>
<th>Large</th>
<th>Medium</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 50</td>
<td>14(40.23)</td>
<td>31(22.79)</td>
<td>31(22.79)</td>
<td>33(24.28)</td>
<td>27(19.85)</td>
</tr>
<tr>
<td></td>
<td>38.69*</td>
<td>60.78*</td>
<td>37.4*</td>
<td>68.73*</td>
<td>58.69*</td>
</tr>
<tr>
<td>Between 40-50</td>
<td>10(21.02)</td>
<td>13(20.27)</td>
<td>14(18.9)</td>
<td>12(18.2)</td>
<td>17(22.97)</td>
</tr>
<tr>
<td></td>
<td>42.41*</td>
<td>29.41*</td>
<td>25.92*</td>
<td>31*</td>
<td>36.95*</td>
</tr>
<tr>
<td>Below 40</td>
<td>6(29.03)</td>
<td>5(18.52)</td>
<td>9(33.33)</td>
<td>3(11.11)</td>
<td>2(7.4)</td>
</tr>
<tr>
<td></td>
<td>21.05*</td>
<td>9.8*</td>
<td>10.06*</td>
<td>0.25*</td>
<td>4.34*</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>31</td>
<td>54</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Farms</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:** Figures in brackets are percentages to the total of that variable (in the row)

(2) Figures with asterisk mark are percentages to the total of that particular farm category (in the column)

**Source:** Based on field survey

Of the 237 sample farmers, only 23 followed some other occupations (other than cultivation) before taking up the present occupation while the remaining 214, had started their career in farming only. Now-a-days due to the lack of employment opportunities both in rural and urban areas, many people resort to agriculture, not by choice but because of
circumstances. 106 out of the 237 sample farmers had been the decision makers for the last 15 years and the remaining 129 had been decision makers for periods ranging from 3 to 14 years. 211 farmers out of the 237 sample, were actively participating in all the farming operations, while 26 were doing only supervision work. Generally, one family member was participating actively in the farm operations through out the year, while other adult members were connected with some subsidiary occupations besides agriculture.

### 0.1.5. Educational Status of the Sample Farmers:

Table 0.4 is showing the educational attainments of the sample farmers.

<table>
<thead>
<tr>
<th>Farm category</th>
<th>Large</th>
<th>Medium</th>
<th>Semi-</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td>9 (36)</td>
<td>12 (48)</td>
<td>3 (12)</td>
<td>1 (4)</td>
<td>-</td>
<td>25 (100)</td>
</tr>
<tr>
<td>and above</td>
<td>23.66*</td>
<td>23.32*</td>
<td>3.35*</td>
<td>1.08*</td>
<td>10.54*</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>17 (27.8)</td>
<td>15 (24.3)</td>
<td>11 (16.0)</td>
<td>14 (22.0)</td>
<td>4 (6.55)</td>
<td>61 (100)</td>
</tr>
<tr>
<td>Rate</td>
<td>44.73*</td>
<td>29.41*</td>
<td>20.37*</td>
<td>24.10*</td>
<td>8.69*</td>
<td>25.73*</td>
</tr>
<tr>
<td>Middle</td>
<td>11 (12.3)</td>
<td>10 (11.6)</td>
<td>24 (27.2)</td>
<td>19 (21.5)</td>
<td>18 (20.4)</td>
<td>88 (100)</td>
</tr>
<tr>
<td></td>
<td>28.94*</td>
<td>31.37*</td>
<td>44.44*</td>
<td>39.36*</td>
<td>39.13*</td>
<td>37.13*</td>
</tr>
<tr>
<td>Total</td>
<td>37 (21.2)</td>
<td>43 (24.7)</td>
<td>38 (21.6)</td>
<td>34 (19.5)</td>
<td>22 (12.6)</td>
<td>174 (100)</td>
</tr>
<tr>
<td>Literates</td>
<td>97.36*</td>
<td>84.3*</td>
<td>70.3*</td>
<td>70.8*</td>
<td>47.8*</td>
<td>73.4*</td>
</tr>
<tr>
<td>Illiterate</td>
<td>2.63*</td>
<td>15.68*</td>
<td>29.62*</td>
<td>29.10*</td>
<td>52.17*</td>
<td>26.6*</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>51</td>
<td>54</td>
<td>46</td>
<td>46</td>
<td>237</td>
</tr>
<tr>
<td>Farms</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Note (1) Figures in brackets are percentages to the total of that variable in the row;

Note (2) Figures with asterisk mark are percentages to the total of that particular farm category in the column.

Source: Based on field survey
Out of the 237 farmers, 174 were literate and of these 23 were graduates, 61 were intermediates and 68 had gone up to the middle (5th class). It was observed that about 97.36 per cent of the large farmers and about 80.31 per cent of medium farmers were educated. These farmers have taken advantage of their improved economic status for getting higher education. It was seen that 7 large farmers and 12 medium farmers have completed graduations. Awareness of education is not only increasing among the large and medium farmers but also among semi-medium farmers. About 70 per cent of the semi-medium farmers are educated and amongst them, one has gone for graduation while a large chunk of these farmers have studied up to the middle level. Not much progress has taken place in the educational attainment of the small and marginal farmers. About 30 to 52 per cent of these farmers are illiterate. Education is not a priority item for these farmers. It is important to educate farmers, so that they may develop proper decision making capacity and will certainly help in commercialization of agriculture and adoption of new technology etc. Education certainly made some impact on the organization of the farming activities and the education of not only the decision maker but other members of the family were also positively influencing the agricultural activities.

6.2. FARM PRACTICES ADOPTED BY THE SAMPLE FARMERS:

Agriculture fulfils the basic needs of the people. Lot of emphasis has been given to develop and increase the agricultural production through the use of modern technology using better farm implements. In this part of the chapter we have included those aspects of the agriculture, which have changed the agricultural scenario of the study region. We have assessed the use of irrigation facilities, consumption of high
yielding variety of seeds, use of chemical fertilizers, mechanization and use of hired and family labourers.

6.2.1. Use of irrigation facilities by the sample farmers:

There is a relationship between farm size, socio-economic status of the farmers and use of irrigation facilities. This region has a vast reservoir of surface and ground water. The development of irrigation facilities had brought agricultural transformation in the study region. Better cropping patterns and intensification of agriculture has resulted in an appreciable increase in crop yields. This has opened new economic possibilities for the farmers (Fig.6.1). Irrigation has played a vital role in transforming the precarious agriculture into productive agriculture over the last few decades (Fig.6.2).

<table>
<thead>
<tr>
<th>Mode of irrigation</th>
<th>Large</th>
<th>Medium</th>
<th>Semi-</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube well (Private)</td>
<td>29(36.72%)</td>
<td>23(31.56%)</td>
<td>18(24.65%)</td>
<td>3(4.11%)</td>
<td>-</td>
<td>73(100%)</td>
</tr>
<tr>
<td>Tube well (Hired)</td>
<td>24(31.48%)</td>
<td>37(50.76%)</td>
<td>44(60.71%)</td>
<td>42(57.59%)</td>
<td>31(77.41%)</td>
<td>178(100%)</td>
</tr>
<tr>
<td>Canal</td>
<td>3(13.04%)</td>
<td>5(21.74%)</td>
<td>4(17.39%)</td>
<td>7(30.43%)</td>
<td>4(17.39%)</td>
<td>23(100%)</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>65</td>
<td>66</td>
<td>52</td>
<td>35</td>
<td>274</td>
</tr>
<tr>
<td>Total surveyed</td>
<td>36</td>
<td>51</td>
<td>54</td>
<td>46</td>
<td>46</td>
<td>237</td>
</tr>
</tbody>
</table>

Note: (i) Figures in brackets are percentages to the total of that variable (in the row).

(ii) Figures with asterisk mark are percentages to the total of irrigation facilities availed by that particular farm category (in the column).

Source: Based on field survey
Fig. 6.1 The availability of high yielding variety seeds and better irrigation facilities has opened new economic possibilities for the farmers.

Fig. 6.2 Irrigation has played vital role in transforming precarious agriculture in to productive agriculture in the study region.
For discussing the mode of irrigation employed by the 237 farmers, the number of farms will exceed because some farmers irrigate their lands from more than one source. From Table 6.5, it is observed that the large and medium farmers are mostly irrigating their farms from private owned tube wells. More than 70 per cent of the large farmers irrigate their fields from their own tube wells, while more than 50 per cent of the medium farmers, more than 60 per cent of semi-medium, more than 80 per cent of the small and nearly 90 per cent of the marginal farmers are taking water on hire from tubewells. Although canal irrigation is cheap but it is also not so popular because of mismanagement and malpractices, timely and adequate supply of water is not certain.

0.2.2. Use of High Yielding Variety of Seeds by the Sample Farmers

A comprehensive field survey of 237 farms revealed that the use of high yielding variety of seeds depends mainly on the irrigation, it also depends on other factors such as the size of holding, economic condition of the farmers, his access to credit facilities and how much he can invest for his farm etc.

Table 6.6 shows that out of the 237 sample farmers, 77.63 per cent farmers were using high yielding variety of seeds and rest of the farmers were using local seeds. About 94.73 per cent of the large farmers, 90.19 per cent of the medium, 83.33 per cent of semi-medium, 68.75 per cent of small and 52.17 per cent of the marginal farmers were using high yielding variety of seeds.
TABLE 6.6: USE OF HIGH YIELDING VARIETY OF SEEDS BY THE SAMPLE FARMERS UNDER DIFFERENT FARM CATEGORIES IN THE UPPER GANGA-YAMUNA DOAB (1990-91)

<table>
<thead>
<tr>
<th>Category</th>
<th>Large</th>
<th>Medium</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Farms/Far.</td>
<td>30(19.5%)</td>
<td>40(25%)</td>
<td>45(24.4%)</td>
<td>33(17.9%)</td>
<td>184(100%)</td>
</tr>
<tr>
<td>Using H. Y. seeds</td>
<td>94.7%</td>
<td>90.19%</td>
<td>85.33%</td>
<td>68.75%</td>
<td>77.63%</td>
</tr>
<tr>
<td>Purchase of seeds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>54</td>
<td>48</td>
<td>46</td>
<td>237</td>
</tr>
<tr>
<td>Sample</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

Note: (1) Figures in brackets are percentages to the total of that variable in the row.
(2) Figures with asterisk mark are percentages to the total of that particular farm category in the column.
Source: Based on field survey

It is observed that there is decrease in the use of these seeds from large to marginal farmers. This is due to differences between their economic status. Timely and adequate supply of water is also a vital factor for the use of these seeds. Purchase of these seeds requires money and although government gives subsidy, but at the time of sowing the seeds are not available at the subsidised rates and the farmers have to purchase them from market at a higher prices. The economically strong farmers have both money and an easy access to credit facilities and the facilities provided by the government are availed mostly by the large, medium and semi-medium farmers.

6.2.3. Use of chemical fertilizers by the sample farmers:

Addition of plant nutrients in the form of fertilizers constitute an essential step in agricultural production. Because of the rapidly declining land-man ratio which would
decline further in coming years, the only hope to fulfil the needs of agricultural produce is by raising the productivity level. One of the important inputs for achieving this objective is the adequate use of chemical fertilizers. Secondly, high yielding variety of seeds gives returns only when they are provided with adequate doses of chemical fertilizers and irrigation (Fig. 6.3 and Fig. 6.4).

The use of chemical fertilizers by the sample farmers under different farm categories is presented in table 6.7.

<table>
<thead>
<tr>
<th>Category</th>
<th>Large</th>
<th>Medium</th>
<th>Semi-Medium</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doses/Farm</td>
<td>500 kg per nectare</td>
<td>78.9%</td>
<td>62.35%</td>
<td>64.8%</td>
<td>18.75%</td>
<td>48.9%</td>
</tr>
<tr>
<td>250 kg per nectare</td>
<td>21.05%</td>
<td>17.64%</td>
<td>35.18%</td>
<td>47.91%</td>
<td>52.17%</td>
<td>35.08%</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>31</td>
<td>34</td>
<td>46</td>
<td>46</td>
<td>237</td>
</tr>
<tr>
<td>Farms</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Notes: (1) Figures in brackets are percentages to the total of that variable in the row.
(2) Figures with asterisk mark are percentages to the total of that particular farm category in the column.
Source: Based on field survey.

It has been noticed that about 48.9 per cent of the farmers are using full dose of chemical fertilizers (which is 500 kg. per nectare, of which 125 kg is urea, 125 kg. potash and 250 kg. super phosphate per hectare). 35 per cent were using 250 kg. per nectare. The large (78.94 per cent), medium (82.35 per cent) and semi-medium (64.8 per cent) farmers were using 500 kg. per hectare of fertilizers judiciously. Marginal farmers were the maximum
Fig. 6.3 Large and medium farmers have their own irrigation facilities.

Fig. 6.4 Availability of irrigation facilities helped the farmers in using high yielding seeds and chemical fertilizers.
Fig. 6.5 Large and medium farmers are in a position to own modern agricultural implements and even maintain a permanent workforce.

Fig. 6.6 Small and marginal farmers are still engaged in traditional style of farming using traditional implements, local seeds and manures.
users of 250 kg. per hectare of chemical fertilizers but none of
the marginal farmers were able to apply full dose of fertilizers.
The sample revealed that small and marginal farmers because of
their poor economic condition and lack of timely and adequate
irrigation facility, could not use adequate doses of chemical
fertilizers. On the other hand large farmers were not applying
full dose because they are not been able to manage their huge
holdings. The study reveals the farmers' awareness towards the use
of chemical fertilizers.

6.2.4. Use of mechanization by the sample farmers:

The sample farmers still follows more or less the
traditional methods of agriculture. The age old methods of
preparing the soil, sowing, harvesting and storing are still
carried on. The recent changes and improvements in agriculture
relate only to the use of better seeds, use of chemical
fertilizers, greater emphasis on irrigation and also co­
operative efforts in the sale of agricultural produce. Only
large farmers use tractors and other small mechanical
appliances (Fig.6.5). Farmers mechanize farm operations when
biological source of energy e.g., human and animal labour,
become costlier than the mechanical sources. With the rise in
the income of the farmers, the desire to lessen the drudgery
and hardwork pushes the farmers to purchase farm machinery. Out
of the 35 large farmers, only 4 had tractors. Farmers who
owned tractor also earn a good amount of money by giving their
tractor on hire for tilling and transportation. Medium, semi­
medium and small farmers apart from tilling and thrashing, for
most of the other agricultural practices are dependent
essentially un manual labour. while marginal and some small
farmers depeno largely on manual labour for all the
agricultural operations (Fig. 6.6).
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6.2.5. Use of hired and family labour by the sample farmers:

Agriculture is still a family business in the study region. Members of the family which form the labour force perform a major part of the field work. On the small farms, where agriculture is largely conventional and the family labour inputs is the highest and forms the basic input. Small and marginal farmers rely mainly on family labour. While large farmers have to rely on hired labour.

<table>
<thead>
<tr>
<th>TABLE 6.8</th>
<th>USE OF HIRED AND FAMILY LABOUR BY THE SAMPLE FARMERS UNDER DIFFERENT FARM CATEGORIES IN THE UPPER GANGLA-YAMUNA DOAB (1990-91)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Large</td>
</tr>
<tr>
<td>Hired Labour</td>
<td>67(57.7)</td>
</tr>
<tr>
<td>Labour</td>
<td>176.3*</td>
</tr>
<tr>
<td>Surveyed Farm</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
</tr>
<tr>
<td>Source: Based on field survey</td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) Figures in brackets are percentages to the total of that variable in the row.

(2) Figures with asterisk mark are percentages to the total of that particular farm category in the column.

Table 6.8 is showing the use of hired and family labour by the sample farmers under different farm categories. From this table, it can be seen that out of the total 116 labourers hired, about 57.7 per cent were hired by large farmers, 28.45 per cent by medium, 12.07 per cent by semi-medium and only 1.72 per cent of small farmers. Marginal farmers did not hire any labour. Apart from 67 labourers hired by the large farmers,
12 others were hired as permanent labourers. They work for the whole year and do every thing except decision making, which is reserved for the owner of that farm. Generally labourers were hired mainly at the seasons peak hours for jobs requiring quick completion of certain farming operations, such as tilling, sowing, harvesting, threshing, irrigation and weeding etc. As far as the family labour is concerned, only 22 family persons were engaged in large farms, 47 in medium, 79 in semi-medium, 103 in small and 108 family members were helping in marginal farms. It was noticed that the large farms are mainly run by hired labourers, while their family members do not prefer to work. While in case of small and marginal farms the family member work in field and hiring is not profitable. Women and children belonging to the small and marginal farmers families are engaged in full time agricultural activities. In practice 6 to 7 members keep themselves occupied on the farm of one hectare for the whole season. The greater intensity of cropping contributes to greater utilization of labour on small and marginal farms. Expansion of irrigation facilities, use of high yielding variety of seeds, use of chemical fertilizers lead to increased labour demand. Mechanization had tended to reduce direct labour demand through its favourable effect on cropping intensity and yields.

The survey reveals that now-a-days, the children of farmers are concentrating more on their studies and are not interested in agriculture, even their parents also encourage this behaviour. That is why the member of family workers is declining and once they get educated, they hesitate to indulge in agriculture and instead of that they prefer to go to city and do whatever job they can get or they just remain unemployed.
6.3. ECONOMIC PROFILE OF THE SAMPLE FARMERS:

In this part of the chapter, an attempt is made to study the various economic aspects of the sample farmers. With the advent of money economy and commercialization of agriculture, these factors became very significant in agriculture. Some crucial economic decisions can lead to massive profits or heavy losses.

6.3.1. Market knowledge of the sample farmers:

The sample farmers had quite a satisfactory market knowledge. They were generally aware of prices of the crops they grow, the cost of inputs, transportation costs and the profit margin etc. It was noticed that educated farmers had excellent market knowledge and large and medium farmers dominated this category. Small and marginal farmers also had satisfactory market knowledge but not as good as large and medium farmers.

6.3.2. Prices which influenced the sample farmers:

As our main objective is to know the influence of prices, so it is very important to know how prices influence the farmers' considerations. Four kinds of prices were generally considered by the farmers in making decisions, these were: (1) farm harvest prices: which are average whole-sale price at which the commodity is sold by the farmers at the village site during the harvesting period, (ii) whole-sale price: which are prevalent in market at any time during the year and a large quantity of commodity are disposed in whole-sale market at these prices, (iii) retail prices: which are prevalent in market and is not related to any particular season, (iv) Trends of prices in the previous few years were also considered by
farmers before making any decision, regarding the crop they grow.

TABLE 6.7: REFERENCES FROM WHICH THE SAMPLE FARMERS GET INFLUENCED UNDER DIFFERENT FARM CATEGORIES IN THE UPPER GANZA-YAMUNA DOAB (1990-91)

<table>
<thead>
<tr>
<th>Prices/ Category</th>
<th>Large</th>
<th>Medium</th>
<th>Semi-Medium</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm harvest</td>
<td>14(15.21)</td>
<td>21(22.82)</td>
<td>21(22.82)</td>
<td>17(18.47)</td>
<td>19(20.85)</td>
<td>92(100)</td>
</tr>
<tr>
<td>Prices</td>
<td>50.84*</td>
<td>41.17*</td>
<td>38.88*</td>
<td>35.41*</td>
<td>41.3*</td>
<td>38.82*</td>
</tr>
<tr>
<td>Whole sale prices</td>
<td>9(24.32)</td>
<td>8(21.62)</td>
<td>9(24.32)</td>
<td>6(16.21)</td>
<td>5(13.51)</td>
<td>37(100)</td>
</tr>
<tr>
<td>Retail prices</td>
<td>3(15.77)</td>
<td>9(17.3)</td>
<td>14(26.9)</td>
<td>13(25)</td>
<td>13(25)</td>
<td>52(100)</td>
</tr>
<tr>
<td>Trend of prices in the previous few years</td>
<td>12(21.43)</td>
<td>13(23.21)</td>
<td>10(17.85)</td>
<td>12(21.43)</td>
<td>9(16.07)</td>
<td>56(100)</td>
</tr>
<tr>
<td>Total surveyed farms</td>
<td>38</td>
<td>31</td>
<td>54</td>
<td>46</td>
<td>46</td>
<td>237</td>
</tr>
</tbody>
</table>

Notes: (1) Figures in brackets are percentages to the total of that variable (in the row)
(2) Figures with asterisk mark are percentages to the total of that particular farm category (in the column)
Source: Based on field survey

The table shows, that out of the total 237 farmers surveyed, 35.82 per cent were influenced by farm harvest prices, 15.61 per cent by whole sale prices, 21.94 per cent by retail prices and 23.63 per cent considered the trends of prices in the previous few years. Farm harvest prices were influencing the farmers from all the categories of farm sizes, more or less equally. Whole-sale prices were considered mostly
by large, medium and semi-medium farmers. Retail prices were considered generally by semi-medium, small and marginal farmers because they store only a small proportion of commodity and they sell it mostly to retail traders. Farmers from all the categories were influenced by trends of prices in the previous few years. Farmers do not change decisions regarding agricultural practices on any sharp fluctuations and they consider the behaviour of the prices in the last few years.

6.3.3. Disposal of production by the sample farmers:

In the sample farms only sugarcane, wheat and vegetables (vegetables for market are grown mostly by small and marginal farmers) are grown for market and rest of the crops are grown mostly for self consumption but surplus production of pulses and fine cereals are also sold in the market which fetch the farmers substantial monetary benefits. Table 6.10 is showing the disposal of production by the sample farmers under different farm categories.

From table 6.10, it is noticed that out of the total 237 farmers sampled, the production of 36.7 per cent farmers was for self consumption. More than 50 per cent of the small and nearly 60 per cent of the marginal farmers grow the crops for only subsistence requirements. Because of their small holdings they can not produce much and whatever they produce, it is for their own consumption. As the farm size increases, there is more production left for the market. 52.32 per cent of the total farmers partly consume and sell of their remaining production to get money for their domestic requirements. About 70 per cent of the medium, 63 per cent large, 59 per cent semi-medium, 45 per cent small and 21 per cent marginal farmers follow this practice. 10.97 per cent of the total sample farmers sell most of the commodity they produce.
TABLE 0.10 : DISPOSAL OF PRODUCTION BY THE SAMPLE FARMERS UNDER DIFFERENT FARM CATEGORIES IN THE UPPER BANGA-YAMUNA DOWAB (1990-91)

<table>
<thead>
<tr>
<th>Disposal of prod.</th>
<th>Large</th>
<th>medium</th>
<th>Semi-</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>of Farm cat.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consume themselves</td>
<td>15.79*</td>
<td>19.0*</td>
<td>29.02*</td>
<td>50*</td>
<td>67.39*</td>
<td>36.7*</td>
</tr>
<tr>
<td>Consume partially</td>
<td>24(17.35)</td>
<td>36(29.03)</td>
<td>52(35.63)</td>
<td>22(17.74)</td>
<td>10(8.06)</td>
<td>124(100)</td>
</tr>
<tr>
<td>Consume solo</td>
<td>63.15*</td>
<td>70.58*</td>
<td>59.23*</td>
<td>43.63*</td>
<td>21.74*</td>
<td>52.32*</td>
</tr>
<tr>
<td>Most of the prod.</td>
<td>21.03*</td>
<td>9.8*</td>
<td>11.1*</td>
<td>4.10*</td>
<td>10.87*</td>
<td>10.97*</td>
</tr>
<tr>
<td>Is solo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total surveyed</td>
<td>38</td>
<td>51</td>
<td>54</td>
<td>46</td>
<td>46</td>
<td>237</td>
</tr>
<tr>
<td>Farms</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: (1) Figures in brackets are percentages to the total of that variable in the row.
(2) Figures with asterisk mark are percentages to the total of that particular farm category in the column.
Source: Based on field survey

These farmers are generally associated with some other occupations. Even the marginal farmers, who are also following this practice, mainly grow vegetables in their small holdings and sell them in the near by town.

0.3.4. Time of selling the products by the sample farmers:

The period when farmer sell his produce is of vital importance, whether he is selling it at the harvest time or by the end of the season or in between these two periods. The price of the crop also varies accordingly. At the time of harvest, the prices are low but it goes increasing as the time passes. The farmers who are financially strong, they store the commodity and sell it when prices are higher, while weaker
section of farmers sell the products at harvest time and get lesser profits.

### Table 6.11: Time of Selling of Products by the Sample Farmers Under Different Categories in the Upper Ganga-Yamuna Doab (1990-91)

<table>
<thead>
<tr>
<th>Time of selling</th>
<th>Large</th>
<th>Medium</th>
<th>Semi-</th>
<th>Small</th>
<th>Marginal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>At harvest</td>
<td>4 (14.04)</td>
<td>13 (13.13)</td>
<td>24 (24.24)</td>
<td>26 (26.26)</td>
<td>32 (32.32)</td>
<td>99 (100)</td>
</tr>
<tr>
<td>time</td>
<td>10.32*</td>
<td>25.5*</td>
<td>44.44*</td>
<td>54.10*</td>
<td>69.56*</td>
<td>41.77*</td>
</tr>
<tr>
<td>Store it</td>
<td>17 (40.47)</td>
<td>16 (35.09)</td>
<td>6 (19.04)</td>
<td>1 (2.38)</td>
<td>-</td>
<td>42 (100)</td>
</tr>
<tr>
<td>till the price increase</td>
<td>44.73*</td>
<td>31.37*</td>
<td>14.81*</td>
<td>2.08*</td>
<td>17.72*</td>
<td></td>
</tr>
<tr>
<td>according to need</td>
<td>17 (17.71)</td>
<td>22 (22.91)</td>
<td>22 (22.91)</td>
<td>21 (21.87)</td>
<td>14 (14.58)</td>
<td>96 (100)</td>
</tr>
<tr>
<td>Total sample</td>
<td>38</td>
<td>51</td>
<td>54</td>
<td>48</td>
<td>46</td>
<td>237</td>
</tr>
<tr>
<td>farmers</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Notes:**

1. Figures in brackets are percentages to the total of that variable in the row.
2. Figures with asterisk mark are percentages to the total of that particular farm category (in the column).

**Source:** Based on field survey

Table 6.11 is showing the time of selling of their products by the sample farmers. It was noticed that out of the 237 farmers surveyed, 41.77 per cent sell their agricultural products at the time of harvest. Most of the marginal, small and semi-medium farmers sell their products during this period. 17.72 per cent of the farmers store their products until the prices are increased and large and medium farmers follow this practice because of their better economic condition. Another category was of those farmers who sell their products according to their need. 40.5 per cent of the total sample farmers sell off their produce at the time of need, like...
marriage, sickness etc. and farmers from all the categories of farm sizes follow this practice.

6.3.3. **Buyer of the product produced by the sample farmers:**

A farmer always needs an efficient market where he can sell his product at a reasonable price. In India, the market of agricultural commodities is generally controlled by buyers rather than by the sellers because of weak economic position of farmers.

<table>
<thead>
<tr>
<th>TABLE 6.12</th>
<th>BUYERS THE PRODUCTS PRODUCED BY THE SAMPLE FARMERS UNDER DIFFERENT FARM CATEGORIES IN THE UPPER GANJHA-YAHUNA DOAB (1990-91)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Buyers of the product</strong></td>
<td>Large</td>
</tr>
<tr>
<td><strong>Farms cat.</strong></td>
<td></td>
</tr>
<tr>
<td>Local traders</td>
<td>5 (7.57)</td>
</tr>
<tr>
<td>Whole sellers</td>
<td>15 (23)</td>
</tr>
<tr>
<td>Government agencies</td>
<td>18 (20.69)</td>
</tr>
<tr>
<td>Others</td>
<td>1 (3.37)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>38</td>
</tr>
<tr>
<td><strong>Surveyed farms</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:**
1. Figures in brackets are percentages to the total of that variable (in the row)
2. Figures with asterisk mark are percentages to the total of that particular farm category (in the column)

**Source:** Based on field survey

In the surveyed villages, generally the production of sugarcane is sold to nearby sugar factories, while other produces are sold either in the mandi or to government agencies.
or through co-operatives (Fig. 6.7 and Fig. 6.8). One more important aspect is that the farmer sell their good quality products either to whole sellers or to the local traders and their inferior products is sold to the governmental agencies.

From table 6.12, it can be seen that out of the 237 sample farmers, 36.71 per cent farmers sell their produce to governmental agencies. There was massive procurement of wheat by government agencies at the time of harvest. The government takes the wheat from the fields and give the farmers cash payments. This is one of the reason for massive wheat cultivation in the region. 27.65 per cent of the total surveyed farmers, sell their commodity to local traders. Marginal and small farmers were mainly selling to the local traders. About 23.02 per cent buyers were the whole-sellers and the large and medium farmers were the main suppliers.

6.3.6. Transportation facilities availed by the sample farmers:

whatever a farmer produces at his farm, he has to sell a certain portion of his produce in the market to obtain money. So an efficient transport system is essential, so that goods can be speedily transported from the producer to the buyer. But of the 237 surveyed farmers, none of them gave much importance to this very vital factor because sugarcane was the only perisnaole item which they were growing and has to be transported quickly after harvesting because the minimum price of the cane is fixed on the basis of its recovery percentage. This crop is generally grown for market by economically well off farmers and others grow it to make Khandsari on the field itself. In the study region, a close network of national, state and district highways exists. None of the 237 farmers use any other kind of transportation apart from using road because they don't send their products far away. The agricultural
Fig. 6.7 The government purchases wheat from the farmers at the farm site.

Fig. 6.8 The farmers sell their products to the government agencies at the procurement centres.
products are transported generally by bullock cart or by tractors to nearby sugar factory, manqi or the traders. Large farmers, which were earlier using bullock carts and cycles etc., now they use tractors, motorcycles and jeeps. Small and marginal farmers used to cover small distances on foot and longer distances by bullock carts or cycles (Fig. 6.9 and Fig.6.10). But now there is significant reduction in the use of bullock carts because of cheap and frequent bus services.

6.4. CROPPING PATTERN ADOPTED BY THE SAMPLE FARMERS:

Field survey revealed that there were vast differences in the cropping pattern of the sample farmers under different farm categories (Table 6.13 and 6.14). The farmers whether small or large always try to make best use of their land according to their own judgement. There are two main agricultural seasons namely, the rabi season and the kharif season. Rabi season pertains to the winter period. It is the main dry crop season, while kharif season pertains to the rainy season. A large variety of food and non-food crops are grown in both the crop seasons. However, the cropping pattern is largely subsistence oriented. Foodgrains accounts for over 75 per cent of the total area during the rabi season and over 70 per cent during the kharif season. During the rabi season, about 60 per cent of the area is under cereals, 16 per cent under pulses and 17 per cent under cash crops. While in the kharif season, cereals accounts for about 60 per cent of area, cash crops 25 per cent and pulses covers about 10 per cent area. Among foodgrains, wheat is the most important crop covering more than 52 per cent of the total area, followed by maize (21.6 per cent), bajra (15.87 per cent) and rice (15.17 per cent). Pulses like peas (10.37 per cent), arhar (6.5 per cent) and gram (7.3 per cent) also form a major crop group. Among non-foodgrains, sugarcane (23.05 per cent), mustard (7.76 per cent) and cotton (6.35 per
Fig. 6.9 The agricultural products are transported generally by bullock carts to the mandi or to the procurement centres.

Fig. 6.10 The small and marginal farmers transport their produce to smaller distance by foot.
<table>
<thead>
<tr>
<th>Farmers Category</th>
<th>Total Area</th>
<th>Total Area under Rabi Crops</th>
<th>Rabi Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area</td>
<td>Wheat</td>
</tr>
<tr>
<td>Large Farmers</td>
<td>710.22</td>
<td>710.22</td>
<td>Rank 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>375.55</td>
</tr>
<tr>
<td></td>
<td>(35.5)</td>
<td>(11.06)</td>
<td>(9.0)</td>
</tr>
<tr>
<td>Medium Farmers</td>
<td>318.00</td>
<td>318.00</td>
<td>Rank 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>159.5</td>
</tr>
<tr>
<td></td>
<td>(14.95)</td>
<td>(11.91)</td>
<td>(10.09)</td>
</tr>
<tr>
<td>Small Farmers</td>
<td>07.81</td>
<td>07.81</td>
<td>Rank 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30.79</td>
</tr>
<tr>
<td></td>
<td>(37.2)</td>
<td>(10.12)</td>
<td>(10.45)</td>
</tr>
<tr>
<td>Marginal Farmers</td>
<td>33.48</td>
<td>33.48</td>
<td>Rank 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30.69</td>
</tr>
<tr>
<td></td>
<td>(32.17)</td>
<td>(10.15)</td>
<td>(10.54)</td>
</tr>
<tr>
<td>Total Surveyed Farmers</td>
<td>1302.8</td>
<td>1302.8</td>
<td>Rank 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>628.36</td>
</tr>
<tr>
<td></td>
<td>(32.37)</td>
<td>(10.37)</td>
<td>(9.76)</td>
</tr>
</tbody>
</table>

Note: 1. Figures in brackets are percentages to the total surveyed area.
2. Area in hectares, Production in metric ton and yield in quintals per hectare.
Source: Based on field survey.
Table 3.14: Cropping Pattern Adopted by the Sample Farmers During Kharif Season Under Different Farm Categories in Upper Ganga-Yamuna Doab (1970-91)

<table>
<thead>
<tr>
<th>Farmers Category</th>
<th>Total Number Surveyed</th>
<th>Area under Kharif Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Crops</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rank</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large Farmers</td>
<td>710.22</td>
<td>681.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium Farmers</td>
<td>516.00</td>
<td>296.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-medium Farmers</td>
<td>172.63</td>
<td>101.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Farmers</td>
<td>67.84</td>
<td>61.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal Farmers</td>
<td>33.45</td>
<td>31.84</td>
</tr>
<tr>
<td></td>
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**NOTE:**
1. Figures in brackets are percentages to the total surveyed area.
2. Area in hectares. Production in metric ton and yield in quintals per hectare.
centres are the important crops. The cultivation of vegetable (16.51 per cent) is also quite popular. The cropping pattern adopted by the sample farmers, though largely dominated by foodgrains but the study reveals certain variations. We will be discussing the cropping pattern adopted by the sample farmers under different farm categories.

6.4.1. Large farmers

It was observed that during the rabi season, every piece of land was under cultivation by the large farmers. They devote more than 60 per cent of their area to foodgrains and about 16 per cent to non-foodgrains during rabi season. Wheat was the most favoured crop accounting for 53.3 per cent of the total area. Peas (6.06 per cent) and mustard (7 per cent) were the other crops which dominate the cropping pattern. Other crops grown in this season area barley (6.01 per cent), gram (7.3 per cent), cotton (6.61 per cent) and vegetables (4.69 per cent).

On comparison amongst the various categories of farmers, it was found that for large farmers, maximum land is devoted to the cultivation of peas. During the kharif season about 96 per cent of the total area was under cultivation, about 70 per cent of the land is devoted to foodgrains and nearly 25 per cent to non-foodgrains. Sugarcane, maize, bajra and rice dominate the kharif cropping pattern. Sugarcane covered 25.44 per cent of the total area, maize covered more than 20 per cent and bajra and rice covered more than 15 per cent. Other crops grown during this season were arhar (9.43 per cent), Jowar (6.02 per cent) and chana (5.27 per cent). So it was seen that the large farmers were devoting substantial area to foodgrains but they also devote a fairly large proportion of their land to the cultivation of cash crops. But there were some differences, as most of the large farmers concentrated more on the cultivation of foodgrains, while some large farmers, who were engaged full
time with the farming activities, devoted significant proportion of their land to cash crops and were earning high income. Although wheat and gram in rabi and rice and arhar in kharif season are grown basically for subsistence requirements but their surplus production is marketed with handsome returns.

6.4.2. Medium farmers:

During the rabi season the entire area was used for cultivation by medium farmers. They devoted about 73 per cent of their land to the cultivation of foodgrains and 19 per cent to non-foodgrains during the rabi season. Wheat followed by mustard and peas dominate the cropping pattern. Wheat was the most favoured crop accounting for 47.7 per cent of the total area. Mustard and peas occupy 11.91 per cent and 10.09 per cent area respectively. Other crops grown in this season were gram (8.03 per cent), vegetables (7.67 per cent), cotton (7.14 per cent) and barley (5.14 per cent). During the kharif season about 94 per cent of the total area was under cultivation. About 71 per cent of the land was under foodgrains and 26 per cent was under non-foodgrains. Sugarcane followed by maize, rice and bajra dominate the cropping pattern. Sugarcane covered about 26 per cent, maize and rice covered more than 20 per cent and bajra covered more than 16 per cent of the total area. Land was also devoted for the cultivation of arhar (7.04 per cent), jowar (4.84 per cent) and chara (2.24 per cent). On comparison among the various categories of farmers, it was found that for medium farmers maximum land is devoted to the cultivation of mustard, gram and cotton during the rabi season and sugarcane and rice during the kharif season. It was also noticed that the medium farmers plan their cropping pattern and each crops is allocated land according to its remunerative nature and its requirements. Amongst the cereals, these farmers highly favoured wheat in rabi and maize,
rice and bajra in kharif season. But significantly the area under rest of the crops are selected in a very calculated manner and returns from the crops grown are considered. Substantial area was devoted to mustard, gram, peas and cotton in rabi season and sugarcane and arhar in kharif season, which are quite remunerative. Although these crops need high inputs and the chances of crop failure is always there but these farmers take risks and in return they get comparatively high profits. Coarse cereals like jowar and barley etc. are the least favoured crop. These crops are grown in less fertile area and are not provided with any modern inputs. These farmers take agriculture seriously and consider it as a business and their economy is based on agriculture. They provide all the necessary inputs, that's why the yield in their farms are higher than others (Fig. 6.11 and Fig. 6.12). The yield of wheat, peas, cotton, sugarcane and rice were highest in the medium farms.

6.4.3. Semi-medium farmers:

The entire area was under cultivation during rabi season. Of the total area, 72.69 per cent was under foodgrains and 17.5 per cent was under non-foodgrains during this season. Wheat is the most favoured crop accounting for about 49.15 per cent followed by mustard (11.21 per cent) and peas (10.94 per cent) dominate the cropping pattern. Other crops grown in this season are vegetables (5.72 per cent), gram (7.42 per cent), cotton (6.35 per cent) and barley (6.18 per cent). During the kharif season about 93.02 per cent of the total area is under cultivation. Of this 77.86 per cent was under foodgrains and 15.63 per cent is under non-foodgrains. Maize (24.41 per cent), sugarcane (22.29 per cent), bajra (17.26 per cent) and rice (14.65 per cent) dominate the cropping pattern. Other crops grown in this season were arhar (10.04 per cent), jowar (7.22 per cent) and chara (3.71 per cent). On comparison among the
Fig. 6.11 Medium farmers consider farming as a business and their economy is based on it. They provide all the necessary inputs to their crops.

Fig. 6.12 Medium farmers give more protection and care to their crops. That's why the yield on their farms are higher.
various categories of farms, it was found that for semi-medium farmers, maximum land is devoted to the cultivation of **arhar**. We observed that the cropping pattern of semi-medium farmers differs a bit from large and medium farmers. These farmers first want to be secure by producing enough foodgrains for their subsistence requirement. Wheat in **rabi** and maize in **kharif** were the first ranking crop among these farmers. Significant area was also devoted to rice and **bajra**. But these farmers prefer to grow only those cereals, which they eat and coarse cereals like **jowar** and barley are not at all favoured. The remaining area is utilized for growing cash crops for money. This shows that semi-medium farmers also plan their cropping pattern intelligently but their first preference is to fulfill their subsistence requirements. These farmers go for intensive farming and give maximum care and importance to their crops but they could not provide the optimum doses of inputs in their farms, so their yield also suffers a bit.

6.4.4. **Small farmers:**

The entire area was under cultivation during **rabi** season. Of this 79.46 per cent was under foodgrains and 10.3 per cent under non-foodgrains. Wheat (57.2 per cent) was the most favoured crop followed by barley (12.06 per cent) and vegetables (10.21 per cent). These three crops dominate the cropping pattern during the **rabi** season. Other crops grown during this season were mustard (7.16 percent), peas (6.16 per cent), gram (4.04 per cent) and cotton (3.14 percent). During the **kharif** season about 90 per cent of the total area was under cultivation. Of this 77.86 per cent was under foodgrains and 25.85 per cent under non-foodgrains. Maize (30.03 per cent) was the most favoured crop, while maize, **bajra**, sugarcane and **jowar** are also quite popular crops. **Bajra** and sugarcane covered more than 15 per cent while **jowar** covered more than 10 per cent
of the total area. Other crops grown in this season were arhar (9.33 per cent), rice (6.66 per cent) and chara (6.6 per cent). We noticed that these farmers grow largely foodgrains for their subsistence requirements. They don't have the resources to invest for costly inputs in their farms, which are required for the cash crops. They also can't take the risk of crop failure, which is associated with these crops. They grow even cash crops for their subsistence requirements. The only crop which they grow for the market, are vegetables. The cropping pattern of small farmers is largely of subsistence type and is characterized by traditional style of farming in which the main aim is to grow cereals.

0.4.5. Marginal farmers:

The entire area was under cultivation during rabi season and of this, 69.05 per cent is under foodgrains and only 2.9 per cent under non-foodgrains. Wheat was the most favoured crop during this season and barley and vegetables are also preferred crops. Wheat covers more than 60 per cent and barley covers about 17 per cent of the total area. Other crops grown in this season are vegetables (7.4 per cent), gram (6.27 per cent) peas (7.66 per cent) and mustard (2.92 per cent). During the kharif season about 33 per cent of the total area was under cultivation, of this 87.73 per cent is devoted to foodgrains and 9 per cent to non-foodgrains. Maize, bajra, jowar and sugarcane dominate the cropping pattern in the kharif season. Maize (58.62 per cent) was the most favoured crop followed by bajra (22.28 per cent), jowar (15.81 per cent), sugarcane (9.05 per cent). Other crops grown were arhar (8.17 per cent), chara (3.17 per cent) and rice (2.79 per cent). On comparison among the various categories of farmers, it was found that for the marginal farmers, maximum land was devoted to the cultivation of wheat and barley during rabi and maize, bajra and jowar.
during the kharif season. It was seen that because of hand to
mouth situation of the marginal farmers, they grow mostly
 cereals to fulfil their subsistence requirements. These farmers
 neither have the resources nor they can take risks of a crop
 failure in growing cash crops. The yield obtained by these
 farmers were the lowest because their cropping pattern is based
 on traditional system of subsistence farming and they rely on
 traditional seeds without providing any modern inputs in their
 farms.

 The cropping pattern adopted by the sample farmers under
different farm categories, though largely dominated by
 foodgrains, reveals certain important variations. During both
 the seasons, the marginal farmers (67.65 per cent) have the
 highest percentage share of area under foodgrains followed by
 the large farmers (79.67 per cent), small farmers (79.46 per
 cent), medium farmers (73.70 per cent) and semi-medium farmers
 (72.09 per cent). The cropping pattern of marginal and small
 farmers was dominated by wheat, barley and vegetables. The
 cropping pattern of large, medium and semi-medium farmers was
 dominated by wheat, which was covering the bulk of the area and
 peas was another major crop among these farmers. During the
 kharif season marginal farmers (67.73 per cent) have the
 maximum share of area under foodgrains followed by small
 farmers (77.50 per cent), semi-medium (73.01 per cent), medium
 (70.67 per cent) and large farmers (67.20 per cent). The main
crop grown by marginal and small farmers were maize, bajra and
 jowar. While maize, bajra and rice dominated the cropping
 pattern of the large, medium and semi-medium farmers. It is
 seen that although foodgrains dominate the cropping pattern
 but it is the large, medium and semi-medium farmers who
 specialize in the cultivation of fine cereals like wheat and
 rice, while the major share of the coarse cereals like maize,
bajra, jowar and barley is grown by the small and marginal farmers.

In case of non-foodgrains, during both the seasons the medium farmers have the highest percentage share of area under it. During the rabi season after the medium farmers (19.05 per cent) came the semi-medium farmers (17.36 per cent), large farmers (13.01 per cent), small (10.3 per cent) and marginal farmers (2.92 per cent). Mustard was the first ranking non-foodgrain crop grown by the large, medium and semi-medium farmers, covering more than 10 per cent of the area. Small and marginal farmers had very little area under this crop. During the kharif season medium farmers (20.03 per cent) had the maximum share of area under non-foodgrains followed by large (23.44) per cent, semi-medium (22.29 per cent), small (15.85 per cent), semi-medium (22.29 per cent), small (15.85 per cent) and marginal farmers (9.05 per cent). Sugarcane was the only non-foodgrain grown during kharif season and the entire area mentioned above is devoted for its cultivation. So among the non-foodgrains sugarcane during the kharif season and mustard during the rabi season dominate the cropping patterns of the sample farmers.

The cultivation of vegetables and chara is also gaining momentum. The percentage share of area under vegetables is highest amongst the semi-medium farmers followed by medium, marginal, small and large farmers. Area under chara is maximum under small farmers followed by large, semi-medium, marginal and medium farmers.

This shows that the degree of commercialization is greater on the medium, large and semi-medium farmers as compared to small and marginal farmers. Large, medium and semi-
medium farmers specialize in wheat and sugarcane. While the marginal and small farmers are largely doing subsistence oriented farming. They only cultivate vegetables and chara for getting quick money.

6.5. FACTORS INFLUENCING THE CROPPING PATTERN OF THE SAMPLE FARMERS:

There are several factors that influence the decision making process in the selection of crops grown by the farmers, such as physical, socio-cultural, economic, political and technology etc. However, some factors may be more dominating than others in a particular region. In the previous part of this chapter, we have discussed about the crops grown by the sample farmers under different farm sizes. In this part of the chapter, we will investigate the major factors influencing the cropping pattern of the sample farmers in the study region. The 237 sample farmers were asked several questions, relating to the various factors influencing them in the selection of crops. We tried to persuade them to point out only one factor, which influenced them most. But most of the farmers insisted that only one factor was not responsible but there were more than one factors. Sometimes two, sometimes three or more factors had influenced their decisions in the selection of crops. We have taken all those factors which were pointed out by the sample farmers. These factors were then arranged in descending order and the top ten factors were taken in to consideration. These ten factors were prices, irrigation facilities, yield, crop prospects, availability of high yielding variety of seeds and chemical fertilizers, financial problems, traditions, physical factors, labour problems and governmental policies (Table 6.1.5).

We discuss below these ten factors, which were effecting the decision making process of the sample farmers:
<table>
<thead>
<tr>
<th>Rank</th>
<th>Factors</th>
<th>Large Farmers</th>
<th>Rank</th>
<th>Factors</th>
<th>Medium Farmers</th>
<th>Rank</th>
<th>Factors</th>
<th>Semi-Med. Farmers</th>
<th>Rank</th>
<th>Factors</th>
<th>Small Farmers</th>
<th>Rank</th>
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<td>Governmental Policies</td>
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<td>Physical Factors</td>
<td>27 (11.39)</td>
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<tr>
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<td>Governmental Policies</td>
<td>3 (5.88)</td>
<td>9</td>
<td>Governmental Policies</td>
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**Note:** Figures in brackets are percentage to the total of that particular farm category.

**Source:** Based on Field Survey
6.3.1. Prices:

Generally, the sample farmers consider farm harvest prices, before making any decision regarding the selection of crops. These prices are the average whole-sale prices at which the commodity is disposed off by the producer to the trader at the village site during the specified marketing period after the commencement of harvest.

Of the total sample farmers, 32.91 per cent were influenced by prices. Large, medium and semi-medium farmers were the most responsive to prices and they gave first preference to it. The small and marginal farmers were also fairly responsive to it. However, the magnitude was not as high as large, medium and semi-medium farmers. The farmers prefer to grow those crops which are profitable to them. Which gave them higher market price and higher the economic benefits, higher the number of farmers who adopted such crops. The economic background of farmer also contributes substantially in the decision making process. Prices of crops are influencing the cropping pattern of mostly those farmers who are socially and economically strong because they can invest on inputs and they can take the risk of changing their cropping pattern. These farmers can invest heavily on crops and in return they get high profits. The large, medium and semi-medium farmers belong to this category while small and marginal farmers can’t afford heavy investments in their farms, which results in low profits and that’s why they are less responsive to prices.

6.3.2. Irrigation facilities:

Availability of irrigation facilities, mode of irrigation, cost of irrigation, timeliness and adequacy of supply of irrigation water etc. were taken into consideration.
Availability of irrigation facility was influencing 27.42 per cent of the total sample farmers. The selection of the crops by the small and the marginal farmers depends to a very large extent upon the availability of irrigation facilities. Irrigation helps in increasing of yield, increase in double cropped area, increase in intensity of cropping and changing cropping patterns, from growing of non-remunerative to remunerative crops. The consumption of high yielding variety seeds and chemical fertilizers depends upon the availability of irrigation waters. The small and marginal farmers could not get as much benefits from irrigation as large and medium farmers because irrigation facility is not in their hands. They have to hire water from large farmers or they depend upon canal irrigation. The mismanagement and malpractices in the distribution of canal water is well known. While the installation of tube well is quite costly and that's why the cropping pattern of marginal and small farmers is adversely affected. This is why for small and marginal farmers irrigation facilities is of such vital importance. On the other hand the large, medium and semi-medium farmers have also given importance to irrigation facilities. But in their case the irrigation water is in their hands and most of them are owner of tube wells. Most of these farmers suffer from labour and management problems because they are not full time associated with agriculture. So they have to keep labour to help in the running of tube wells and watering of the crops etc. Semi-medium farmers are affected by both the sets of problems, that is, non-availability of irrigation facilities and the management problem.

6.5.3. **Yield:**

Yield of the crops, emerged to be the third important factor and influencing the cropping pattern of 25.74 per cent
of the total sample farmers. Farmers from all the categories of farm sizes were equally concerned about the yield of the crop they grow and that's why all of them are influenced by this factor. The farmers prefer to grow those crops which gave them better yield. Crops giving low yields are not favoured. This again shows that farmers first look for economic benefits from a crop. Higher the yield, more will be the production and more will be the income.

6.5.4. Crop prospects

The farmers generally hope that they will get a certain quantity of produce from the crops they grow. But, some crops are more susceptible to pests, diseases and climatic changes and the risk of crop failure in these crops are high. So the farmers prefer growing those crops in which the risk of crop failure is low.

In the selection of crops farmers kept an eye on the prospects of that particular crop and this factor was influencing 23.31 per cent of the total surveyed farmers. Farmers prefer those crops from which they are assured of getting returns in terms of production. Large, medium and semi-medium farmers consider the prospects of a particular crop before selecting it for cultivation. This again shows that these farmers always try to maximise their returns from their land. On the other hand small and marginal farmers with their hand to mouth situation said that they were also concerned about this factor but they could only think about it when other existing problems like the problem of money for investment, availability of irrigation, high yielding variety seeds and chemical fertilizers were solved.
6.3.5. Availability of high yielding variety of seeds and chemical fertilizers:

Timely availability of high yielding variety of seeds and chemical fertilizers was the most important consideration for 17.72 per cent of the total sample farmers. The farmers use high yielding variety of seeds and chemical fertilizers for maximising their profits. The use of these two vital inputs depends upon the availability of irrigation. The small and marginal farmers were very much influenced by this factor. Due to their poor economic condition they can’t purchase these inputs from the market. The government gives subsidies on these inputs but it was observed that almost all these facilities were availed by the large and medium farmers because these farmers are socially, economically and politically strong. So the small and marginal farmers have to rely on local seeds and manures. The result is that they get low returns from their lands.

6.5.6. Financial problems:

These days with the introduction of new technology the cost of production has increased considerably, the inputs are quite expensive and apart from economically well off farmers, it is very difficult for most of the farmers to invest heavily for their crops.

This problem was influencing the cropping pattern of 17.3 per cent of the total sample farmers. The marginal and small farmers were the worst affected by this problem. These farmers came under the category of rural poor. Since they belong to the economically backward class of the society, they don’t have access to subsidies and loan distributing agencies. With the introduction of modern technology in agriculture, the cost
of production has increased considerably. These farmers can not provide necessary inputs in their farms and this led to low yield. They also can't take the risk of a crop failure and all these variables collectively affect the cropping pattern of these farmers and restrict them from going for commercialization of agriculture. Large farmers are not affected by financial problems, while medium and semi-medium and marginally affected by this factor.

6.5.7. Traditions:

The farmers are bound with the age old traditions of farming and they hesitate to make changes in their cropping pattern.

Tradition of past was affecting the cropping pattern of 13.5 per cent of the total sample farmers. Farmers cultivate crops according to their taste and preference. They like to cultivate those crops, which they have been eating traditionally, till some drastic changes come. Their customs and cultural background also play an important role in the selection of crops. Farmers from all the categories of farm sizes are influenced by this factor, but the degree of influence varied. Most of the farmers which were affected by this factor are illiterate and they are bound with the age old traditional pattern of farming and hesitate to make changes in their cropping pattern.

6.5.8. Physical factors:

Physical factors were influencing the cropping pattern of 11.37 per cent of the total surveyed farmers. The crops grown by the farmer depends on the type of soil, climatic conditions, availability of water and topographical conditions.
This region is best suited to agriculture. It has good climatic conditions, flat alluvial plains and fertile soils. But in some surveyed areas, the problem of salinity, alkalinity and water logging was observed. These were adversely effecting the cropping pattern. In the southern part of the region, crops like rice and sugarcane are not favoured because of the lesser amount of rainfall. Wheat is a preferred crop of the region because of alluvial soils and favourable climatic conditions. Changes in climate may compel farmers to change their cropping pattern but due to favourable physical conditions of the study region, the farmers have not given much importance to this aspect.

6.5.9. Labour:

Availability of labour at peak season was a major problem, effecting 10.35 per cent of the total farmers surveyed. Large farmers were the most affected followed by medium and semi-medium farmers. These farmers require hired labour because they themselves are not full time associated with farming activities and their family members also do not work in the field, so to manage their large holdings, they have to depend on hired labour. This also prevents these farmers from cultivating labour oriented crops. On the other hand, small and marginal farmers are not at all affected by this factor. Every working person is engaged in agricultural activities in these farms. In actual practice all the family members keep themselves occupied on the farm of one hectare for the whole season. Women belonging to these families are also engaged in agricultural activities. Employment of hired labour in these farms are almost negligible.
Government policies regarding the distribution of loans, giving of subsidies, fixing and increase in procurement prices of various commodities also influences the cropping pattern. Governmental policies were influencing 9.28 per cent farmers. Small and marginal farmers were more concerned than others. At the time of survey, the 1991 General Elections were going to be held. The farmers were rather sure of getting their loans waived and they were expecting new loans. They were also expecting more subsidies on fertilizers, high yielding variety of seeds and increase in procurement prices of various crops. Irrigation systems, land development policies, land reforms, agricultural schemes for small and marginal farmers, price control and establishment of credit societies are some of the government policies which influences the farmers' decision in selection of crops.

The foregoing analysis of the 237 sample farmers belonging to the various categories of farm size (38 large farmers, 51 medium, 34 semi-medium, 45 small and 46 marginal farmers) shows that there is a close relationship between the socio-economic status of the farmers, farm practices and cropping pattern adopted by them. We will elaborate here the conditions of the sample farmers belonging to various categories.

The large farmers belong to the high and sound economic status. They are strong, wealthy, educated, influential and politically strong. They have a greater capacity to invest their own resources, greater capacity to take risk, better access to information and improved capabilities in terms of education and skills (Fig. 6.13). They have an easy access to
credit facilities. Their better wealth position and political power has biased the distribution of credit towards them (Fig.6.14). This has strengthened their ability to adopt innovation at a faster speed. They are in a position to own tractors, pumpsets, harvesters and other agricultural implements. They apply prescribed doses of fertilizers, use high yielding variety of seeds, purchase the required amount of insecticides and pesticides and even maintain a permanent workforce. Since they are educated, they can acquire information about recent developments and are aware of the prospects of various crops.

The economic background of the large farmers contributes substantially in the decision making process. They can take risk in changing their cropping pattern, they can use inputs like seeds, fertilizer, labour etc., because their cost is within their reach. So they grow those crops which give them higher market price. Their cropping pattern was dominated by foodgrains but they also specialize in the cultivation of non-foodgrains. Wheat was the most favoured foodgrain, which covered the bulk of area during the rabi season, while sugarcane dominated the cropping pattern during kharif season. Wheat was partly grown by these farmers for their own need but it is mostly grown for market. Wheat is considered as a cash crop by these farmers. Wheat is the first ranking crop because of its price support, massive procurement by the government on farmers door step, cash payments, sale of wheat straw and technological developments. Sugarcane is the most preferred non-foodgrain because of the introduction of many sugar factories in the study region, which made available to the farmers an assured market, diffusion of information about its production and this crop gives higher benefits than foodgrains.
Fig. 6.13 Large and medium farmers have better access to information and improved capabilities in terms of education and skills.

Fig. 6.14 Large and medium farmers also have easy access to credit facilities because of their better economic and political position.
The most important factor influencing the cropping pattern of the large farmers was price. This was evident from the two crops i.e. wheat and sugarcane which dominate their cropping pattern. These are highly remunerative crops. The next two important factors influencing their cropping pattern were yield and crop prospects, since these farmers are educated and rich they can collect all the new information about the crops they grow. They have the money to use all the inputs. Usually the remunerative variety of crops require high doses of fertilizers. Since they use all the inputs, they get high yields and more profits. Another factor which has very significantly influenced their cropping pattern is the availability of labour. These farmers still suffer from the some old problem of indifference and uncertainty of hired labour. All the large farmers are not associated full time with the farming activity. So there is heavy reliance on labour and their availability at peak season is very difficult. They require labour for most of the agricultural operations. These farmers hence avoid the cultivation of labour intensive crops.

Like the large farmers, the medium farmers have also great capacity to invest their own resources, great capacity to take risk, better access to credit, information, education and skills and better wealth position (Fig. 6.13 and Fig. 6.14). All this has contributed towards the increase in productivity. But there is slight difference between the large and medium farmers. They are in a position to take advantage on both the counts i.e. greater access to technology and more concentration on their fields (Fig.6.15 and Fig.6.16). The intensity of cropping is highest on these farms. The intensive utilization of land coupled with the intensive use of inputs has resulted in high production.
Fig. 6.15 Medium farmers are in a position to take advantage on both counts, i.e. greater access to technology and more concentration on their farms.

Fig. 6.16 The intensive utilization of land coupled with the intensive use of inputs has resulted in high production in the medium farms.
The cropping pattern of these farmers is also dominated by foodgrains. Wheat during the *rabi* and maize and rice during the *knarif* season were the three important foodgrains grown. Wheat covered about fifty per cent of the cultivated area. These farmers specialize in the cultivation of cash crops like sugarcane and mustard. These crops gave them higher market price. The crops which were grown traditionally were not preferred until it fetches them good income. The most important factor influencing the cropping pattern of the medium farmers was price. As is evident from the above discussion that these farmers prefer growing remunerative crops like wheat, sugarcane and mustard. They devote comparatively more land to cash crops. The degree of commercialization is greater as compared to large or semi-medium farmers.

Conditions of the semi-medium farmers are not very similar to the medium and large farmers. They have smaller land holdings and they are not very economically sound. There is intensive utilization of land and the family members work in fields. They generally do not hire labour. Again the cultivation of foodgrains dominated the cropping pattern. Wheat during the *rabi* season and maize and *pajra* during the *knarif* season were the important foodgrains. Among non-foodgrains sugarcane was the dominating crop grown during the *knarif* season. On these farms the cultivation of coarse grains are gaining importance. The most important factor influencing the cropping pattern of these farmers was price. Cultivation of wheat and sugarcane is giving high returns to them. The next two important factors were crop prospect and irrigation facilities. Amongst this category of farmers, we find that factors like irrigation facilities, availability of high yielding variety of seeds and chemical fertilizers and financial problems are gaining importance which shows the
difference in socio-economic status of these farmers and the large and medium farmers. The role of labour in influencing the cropping pattern is seen declining.

The small and marginal farmers generally belong to the economically underprivileged section of the society. They do not have access to credit, technical know-how, information, education and skills etc. They are socially and economically backward. They belong to the category of rural poor. They do not have their own irrigation facilities. They have to pay high charges for hired water and they depend on canal water, which although is cheap but it is inadequate and is not supplied in time. The results is that these farms are not able to use inputs like high yielding variety of seeds and chemical fertilizers. Since the remunerative variety of crops requires higher dose of fertilizers and irrigation waters, these farmers are unable to cultivate remunerative crops. The cost of inputs are very high and are not within the reach of these farmers. Illiteracy and poverty restrict these farmers even to avail subsidies provided by the government on high yielding variety seeds and chemical fertilizers. They are also deprived of loans etc. because it is taken over by the influential farmers and these farmers rely on private borrowing to a great extent. They also think of getting some returns from their land because they have also to purchase small items of daily needs. But they are engulfed by poverty and it prevents them from the cultivation of remunerative crops. They can not take risk of changing their cropping pattern, so they have a very limited choice of crops. The major handicap on these farms appears to be limited resources and investment capacity. Their cropping pattern is significantly dominated by foodgrains, wheat and barley during the rabi season and maize, bajra and jowar during the kharif season. Wheat covers more than 60 per cent of the total area during rabi season. They grow these foodgrains
basically for self consumption. These farmers prefer growing coarse grains because of low inputs and also because they are growing these crops since long and they can also use the by-products of these crops as fodder and fuel. They do not go for the cultivation of cash crops because of their limited resources. They find it difficult to invest in crops like sugarcane and mustard etc. They cultivate only vegetables for the market which fetches them quick money for their daily needs.

The cropping pattern of small and marginal farmers was influenced mostly by financial problems, irrigation and availability of high yielding variety seeds. All these factors are interrelated and because of poor economic condition they have to think about these factors before choosing the crops they will be growing.

Lastly it can be said that the profit is the driving factor for all the farmers, whether rich or poor.