The spatio-temporal analysis of major elements of agricultural land use and their regional synthesis have been attempted in the previous chapters of this study. A number of physical, economic and social variables were pressed in for explaining regional variations in specific elements as well as in total agricultural character. The entire focus in the preceding discussion was kept on areal and regional variations, assuming areas and regions to be uniform from within. This, however, is not true. Spatial variations do exist within these areas and regions if viewed at micro level. A different set of variables determine the spatial order of agricultural activity at this level. Out of a host of variables operating at this scale, 'distance' is the most important and the most investigated one. Therefore, it has been taken for exploring spatial location of agriculture at meso and micro levels, in the present chapter.

The role of distance in spatial organization of agriculture was first recognized by von Thunen in 1826. Under certain preconditions, he postulated a model of the location of agricultural activity with respect to market city. The concept of an 'Isolated State' forwarded by him is well known. It is an assumed countryside with specific characteristics. It is considered to be a circular, uniformly fertile and featureless plain, having a single city market in its centre.
The central city depends for its needs on the surrounding countryside and vice versa. The farmers living in the State travel directly from their farms to the city and back by horse-cart for transporting farm produce and the needed inputs. It means, the cost of transport per unit of weight and per unit of distance for a commodity is uniform all over the plain. It decreases with increase in distance from the city. The State is inhabited by economically rational people (economic man) who always try to maximize their profits. It is surrounded by wilderness into which it can expand with the increase in demand for farm produce in the central city. Von Thunen postulated that in such an area, net revenue earned by a farmer is the function of distance at which his farm is located from the city and the resultant cost of transport of farm produce to the market. The farther is a farm, the greater will be the transport cost and lower will be his income. This net income will determine the location of agricultural activity. He deduced that agricultural activity will organize itself in the form of concentric circular zones around the market. His theory has two components: (i) the theory of intensity, and (ii) the theory of crop location. His intensity theory states that agricultural intensity decreases with increase in distance from the market. This is because economic rent is high near the market due to less expenditure on transportation. Thus, the farmers located near the city have more money to invest. The intensity falls with distance. Thunen's crop theory deals with the location of crops in relation to the
market. It states that intensive, more paying, bulkier and perishable crops are located near the market and others are pushed to far off locations.

His model may not hold valid in the contemporary world situations because of the absence of rigorous assumptions of the Isolated State. Nonetheless, it provides a different approach to analyse spatial order of agriculture. Many geographers utilized Thünen's concept to study the spatial organization of agriculture at different scales in a variety of environments.

The work of Jonasson (1925) in this regard is noteworthy. An attempt was made by him to study the location of agriculture in the whole world considering it as one region. He regarded Northwest Europe as the centre of consumption as well as market facilities for most of the agricultural production in the world. Jonasson found strong similarity with Thünen's model, especially in terms of the production and consumption of horticultural and perishable commodities around the market centre of Northwest Europe. Similar study at world scale was conducted by Peet (1969). He treated Great Britain, Western Europe and Northeastern North America as the central city and studied the expansion of commercial agriculture into the vacant or little used continental interiors, which took place during the nineteenth century, due to increase in demand for food and raw materials in his world city.
At meso level too, many people based their studies on distance-cost concept. Horvath (1969) took the city of Addis Ababa (Ethiopia), for testing Thunen's idea. He confirmed the validity of the theory at a limited scale. Similar attempts were made in India also. Sharma and Archana (1980) used the concept to identify the zones of influence of the Sagar city on its surrounding agricultural land use. They proved that distance does play a significant role in the location of agriculture around the city since most of the land near Sagar was under horticultural crops. Other crops too were influenced by this variable. The work done by Shafi (1977) in this direction needs special mention. He assessed Thunen's theory in Indian conditions. On the basis of the study of cropping pattern in 35 villages of Koil tahsil in Aligarh district of Uttar Pradesh (India) he concluded that intensity of land use does not decrease with increase in distance from market city. Rather it is affected more by distance from the source of irrigation. His idea was strongly supported by Fakhrudin and Khan (1981) in their locational analysis of agricultural land use in case of Unnao tahsil of Unnao district (Uttar Pradesh, India). They also proved that Thunen's model has little relevance in Indian conditions.

Not only at the macro and meso scales, the model was tested by many at micro level too. Most important work in this regard was done by Chisholm (1962). He cited many examples from different parts
of the world, where this concept replicates at village and farm levels. In case of Indian agriculture, a work of repute was done by Blaikie (1971). Keeping in view Thunen’s theory of crop location, he studied the spatial organization of agriculture in four selected villages of northwestern India. He found that under conditions of limited irrigation, fragmented holdings and extensive agriculture, the per hectare use of inputs decreases with increase in distance from village settlement. The amount of fallow land too showed a negative relationship with distance from the settlement. But in the case of irrigated villages, cropping pattern and application of inputs were found controlled by spatial variations in irrigation facility. Singh (1983) developed a model of the spatial organization of crops in a north Indian village. He analysed the location of crops with respect to village settlement, source of water and the approach roads. This study concluded that all those crops which are intensive in water and labour are concentrated near the source of water. Similarly, fodder tends to be as near the settlement and approach roads as possible.

A modest attempt in this chapter has been made to analyse the role of distance in spatial organization of agriculture at meso and micro scales. It deals with the study of spatial location of agriculture at three different levels (i) city and its region; (ii) the village settlement and its production territory; and (iii) the source of irrigation (tube-well, pumping set) and its catchment area.
Accordingly, this chapter has been divided into the following three sections:

I. Distance from market city and agricultural location;
II. Distance from village settlement and agricultural location; and
III. Distance from source of irrigation and agricultural location.

I. Distance from Market City and Agricultural Location

The role of distance from the market in the location of agricultural activity in the Bist Doab has been investigated by taking all those towns of the region which had population of over 50,000 in 1981. Jalandhar (441,552), Hoshiarpur (85,648), Phagwara (75,961) and Kapurthala (50,300) towns fall in this category. Of these, Jalandhar is the largest and has the status of a city. It has developed a strong relationship with the surrounding countryside mainly due to its very long history. The city remained the capital of the northern and most important portion of Jalandhar Doab under Mughal emperors. It also was the capital of the possessions of the Lahore state under the rule of Sikhs till 1845-46. After that, it became the headquarters of the commissionership of the Trans-Sutlej states. A cantonment was established by the side of this city in 1846. At present it is the headquarter of the Jalandhar district and Jalandhar division of the state. Not only that, the city is

* District Census Handbook, Jalandhar District, 1951, p. iii and iv.
an important industrial centre of Punjab. It is very well linked with its countryside through a dense net of roads. Also the city is connected with other parts of the state and with neighbouring states through highways and railways. Because of being located in a flat, fertile plain, the city and its surrounding area form an isotropic surface. Thus, it furnishes a good case for testing von Thunen's model. That is why a special emphasis has been placed on this city and its surrounding area for testing the role of distance in the location of agricultural activity. The following four hypotheses have been tested for this purpose:

1. (a) The villages falling closer to the market centres recorded higher increase in the cultivation of vegetables as compared to those located away.

   (b) Vegetable cultivation decreases with increase in distance from the market.

2. Cultivation of fodder is inversely related with distance from the market.

3. (a) Villages located near urban centres recorded higher increase in irrigation.

   (b) Irrigation decreases with increase in distance from the market.

4. (a) Increase in intensity of cropping in a village during 1951-80, is indirectly related with its distance from the urban centre.

   (b) Villages located near urban centres display higher intensity of cropping as compared to their counterparts located away.

Methodology for testing the hypotheses:

As already stated, market towns of Jalandhar, Hoshiarpur,
Phagwara and Kapurthala have been selected for exploring the role of distance in the spatial organization of agriculture. An approximate sphere of influence regarding agricultural linkages in case of Jalandhar city was earmarked on the bases of field enquiries and empirical observations. The same was arbitrarily divided into thirteen concentric zones of equal width. The width of successive zones thus drawn came out to be 1.27 kilometres. Taking this width, concentric zones were drawn around other three towns upto the distance their zones of influence approximately stretch. These zones, more or less, are proportionate to their population sizes in 1981. Thereafter, villages from each zone drawn around various towns, were randomly selected. The villages thus picked up, were from different directions of their respective towns. A total of 49 villages were chosen. Out of these, 27 were from Jalandhar region alone (Map 6.1). Requisite data concerning irrigation, land use, cropping pattern etc., for various villages were noted from their respective revenue records (lal kitabs). Only those crops and aspects of agriculture which are sensitive to distance were taken up for the analysis. Each hypothesis was tested in two ways: (i) by examining the zone-wise position of a crop or an element of agriculture and (ii) by computing correlation coefficient between the two variables stated in a hypothesis. In the first case, average of a phenomenon was calculated for each zone drawn around the four towns. This was done by adding various values of the phenomenon pertaining to all the villages falling in a zone and dividing the sum by the number of villages in that zone. The zone-wise values...
BIST DOAB
Location of Villages Selected From Different Zones of Major Market Towns

1 Garau Wohudan
2 Khugra
3 Khurla
4 Khimbria
5 Bulandpur
6 Jihi
7 Mirpur
8 Nangal Purial
9 Damokdipur
10 Basti Ilahkahlan
11 Gazipur
12 Mador
13 Toiwara
14 Seem
15 Khajuria (Phagwara)
16 Lariwala
17 Patgar Kahan
18 Rahimpur
19 Rasulpur Brahman
20 Jaurampur
21 Ram Bhatti
22 Bhaqwanpur
23 Masikwara (Phallour)
24 Chawal (Phallour)
25 Kotil Jamat Singh

HOSHIARPUR
1 Chohal
2 Kotla Manut Jhoari
3 Dogani Khurd
4 Bassi Nau
5 Sutehri
6 Kajpur
7 Atalgarh
8 Haiderwal
9 Karangna
10 Badal

PHAGWARA
1 Hajiopur
2 Mehli (Nawanshahr)
3 Kripalpur
4 Jhanki (Nawanshahr)
5 Chak Prima
6 Parwa

KAPURTHALA
1 Nurpur Dora
2 Manurwala Dora
3 Nawam Pad
4 Nurpur Rajpur
5 Parvez Nagar
6 Bibri

H - HOSHIARPUR
J - JALANDHAR
P - PHAGWARA
K - KAPURTHALA
thus obtained for each town were used to analyse the spatial organization of agriculture in its surroundings. In the second case, the correlation coefficients were calculated only in the case of Jalandhar region where 27 sample villages formed fairly reasonable number of observations for the purpose. To do so, distance of each village was measured from the centre of Jalandhar city. Correlation coefficients were calculated by taking distance as one variable and change in or existing position of a crop or an element of agriculture for the same village as the other variable.

Hypothesis - 1.
(a) First part of this hypothesis relates increase in area under vegetables with distance from the market. The demand for vegetables by the urban dwellers has increased manifold since 1951, due to the increase in their population, improvement in living standards and change in their dietary habits. A large part of this demand is likely to be fulfilled by the neighbouring villages because these crops are perishable in nature and require quick disposal at the market. They cannot stand long haulage and greater time between the harvest and disposal. As a matter of fact, they are supplied more conveniently at a cheaper transport cost from the villages falling closer to urban centres. Thus, increase in vegetable hectarage is expected to be higher in the villages located near towns as compared to their counterparts located away.
At the first instance, this hypothesis was tested by noting the increase in percentage area under vegetables in different zones of the four selected towns (Table 6.1). This table clearly reveals that as one moves from inner to outer zones (except in the case of Hoshiarpur), the magnitude of positive change in percentage area under vegetables decreases. It portrays a negative association between the two variables. However, this is a rough test. A better and more rigorous test was applied to establish its validity. This was done through the calculation of coefficient of correlation. Since such calculations need data for sufficiently large number of units (villages), it was feasible only in the case of Jalandhar. The value of correlation

Table 6.1

Bist Doab: Distance from Market and Location of Vegetables

<table>
<thead>
<tr>
<th>Town City</th>
<th>Zone</th>
<th>Increase in area under vegetables during 1951-80 (per cent)</th>
<th>Area under vegetables in 1980 (per cent)</th>
<th>Town City</th>
<th>Zone</th>
<th>Increase in area under vegetables during 1951-80 (per cent)</th>
<th>Area under vegetables in 1980 (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalandhar</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>Hoshiarpur</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>3.17</td>
<td>5.64</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-</td>
<td>20.93</td>
<td></td>
<td>3</td>
<td>3.92</td>
<td>3.92</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>16.23</td>
<td>17.20</td>
<td></td>
<td>4</td>
<td>6.77</td>
<td>8.57</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>15.65</td>
<td>16.15</td>
<td></td>
<td>5</td>
<td>3.77</td>
<td>3.77</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>15.20</td>
<td>15.48</td>
<td></td>
<td>6</td>
<td>1.83</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>12.78</td>
<td>12.82</td>
<td>Phagwara</td>
<td>1</td>
<td>2.20</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>12.79</td>
<td>13.29</td>
<td></td>
<td>2</td>
<td>1.45</td>
<td>1.87</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>9.50</td>
<td>9.50</td>
<td></td>
<td>3</td>
<td>0.11</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3.79</td>
<td>6.25</td>
<td></td>
<td>4</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>4.84</td>
<td>5.08</td>
<td>Kapurthala</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>1.15</td>
<td>1.25</td>
<td></td>
<td>2</td>
<td>0.78</td>
<td>4.56</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>2.02</td>
<td>2.47</td>
<td></td>
<td>3</td>
<td>0.05</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Source: Field work.
coefficient between distance of a village from Jalandhar and increase in area under vegetables during 1951-80 was computed. It came out to be -0.766, which clearly established a strong negative relationship between the two. Thus the hypothesis proposed in the beginning stands valid.

(b) Second part of the proposition intends to test the role of distance from urban market in the location of vegetables. The cultivation of vegetable crops is expected to decrease with increase in distance from the market centre. Due to their perishable nature, vegetables require quick transport to the market. The same is convenient at a cheaper transport cost from the nearby villages. Therefore, villages located near urban centres are likely to lay more emphasis on cultivation of vegetables, as compared to those falling away.

The zone-wise position of area under vegetables around Jalandhar and other towns, clearly shows that these crops occupy higher proportion of the cropland in inner zones (Table 6.1). Their percentage area decreases from inner to outer zones. However, the trend is slightly disturbed in case of Hoshiarpur town. Correlation coefficient between distance and percentage area under vegetables in 27 villages lying at different distances from Jalandhar came out to be '-0.764', which is very strong and significant. Thus, this part of the hypothesis is also accepted.
In brief, the increase in and the existing proportion of area under vegetables decreases with increase in distance from towns. It clearly establishes that distance from urban centres plays an important role in the location of vegetables in the study region.

**Hypothesis – 2 :**

The second hypothesis postulates an inverse relationship between distance from the market and area under fodder. Fodder cultivation is associated largely with the production of milk. It is required to meet the needs of dairy cattle. Since cities and towns furnish market for milk and milk is a perishable commodity, it is raised as near them as possible. It means, dairy cattle are reared in large number in and around towns and cities. The space within the municipal limits is too limited to fulfill the needs of the milch cattle kept there. Therefore, these animals depend on fodder produced mainly in the surrounding villages. Like milk, fodder too is perishable. Also it is bulky in nature. A large part of the fodder produced in areas near urban centres is marketed in the cities and towns as such. Some of it is fed to the cattle kept in the villages around and thus enters the market indirectly in the form of milk. In the light of these facts, fodder is likely to concentrate in areas falling near urban centres. Its cultivation will decrease with increase in distance from them.

The impact of distance from urban centre on the location of fodder has been ascertained firstly by examining the zone-wise
position of fodder around the selected towns. Table 6.2 shows that in case of Jalandhar, cultivation of fodder decreases towards the outer zones. It covers 32.69 per cent of the total cropped area.

<table>
<thead>
<tr>
<th>Town/City</th>
<th>Zone</th>
<th>Area under fodder in 1980 (per cent)</th>
<th>Town/City</th>
<th>Zone</th>
<th>Area under fodder in 1980 (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalandhar</td>
<td>1</td>
<td>-</td>
<td>Hoshiarpur</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-</td>
<td></td>
<td>2</td>
<td>31.59</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>32.69</td>
<td></td>
<td>3</td>
<td>23.53</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>19.0</td>
<td></td>
<td>4</td>
<td>34.06</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>21.05</td>
<td></td>
<td>5</td>
<td>15.04</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>14.81</td>
<td></td>
<td>6</td>
<td>10.83</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>12.50</td>
<td>Phagwara</td>
<td>1</td>
<td>11.81</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>10.42</td>
<td></td>
<td>2</td>
<td>15.44</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>17.18</td>
<td></td>
<td>3</td>
<td>14.26</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10.58</td>
<td></td>
<td>4</td>
<td>9.82</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>11.80</td>
<td>Kapurthala</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>8.43</td>
<td></td>
<td>2</td>
<td>9.30</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>11.57</td>
<td></td>
<td>3</td>
<td>19.0</td>
</tr>
</tbody>
</table>

Source: Field work.
in the first zone and falls to 11.57 per cent in the last zone. The decline, however, is not uniform. In case of Hoshiarpur and Phagwara, the proportion of fodder, although is higher in the innermost zones than in the outermost ones, but it is highest in the intermediate zones. This is largely an outcome of the chance factor in sampling. The relationship is difficult to be ascertained in case of Kapurthala due mainly to the limited number of zones. As already stated, zone-wise position gives only a rough idea of the relationship. The computation of correlation coefficient between the two parameters is a more stern test. In case of Jalandhar, the correlation between distance and area under fodder, comes out to be 0.516. It is fairly strong and amply proves the proposed hypothesis.

Hypothesis - 3 :

(a) The third hypothesis relates distance to increase in irrigation during 1951-80. Villages falling closer to urban centres recorded higher increase in (minor) irrigation, firstly because they experienced greater increase in the cultivation of vegetables which are more intensive of water. Secondly, vegetables bring higher returns to the growers. Increase in their cultivation will increase the income of the farmers. The same is likely to be used for installing more and more tube-wells and pumping sets. Therefore, the increase in irrigation is expected to be higher in areas located near towns and cities.
It is quite clear from Table 6.3 that expansion of tube-well irrigation during 1951-80 does not decrease with increase in distance from the towns. The increase is of almost equal magnitude.

### Table 6.3

**Bist Doab: Distance from Market and Net Irrigated Area**

(as per cent of Net Area Sown)

<table>
<thead>
<tr>
<th>Town/City</th>
<th>Zone</th>
<th>Increase in net irrigated area during 1951-80 (per cent)</th>
<th>Net irrigated area in 1980 (per cent)</th>
<th>Town/City</th>
<th>Zone</th>
<th>Increase in net irrigated area during 1951-80 (per cent)</th>
<th>Net irrigated area in 1980 (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalandhar 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Hoshiarpur 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2 36.06</td>
<td>48.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>96.20</td>
<td>3</td>
<td>2.70</td>
<td>2.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>38.43</td>
<td>98.93</td>
<td>4</td>
<td>79.99</td>
<td>90.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>39.30</td>
<td>99.91</td>
<td>5</td>
<td>38.33</td>
<td>41.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>29.79</td>
<td>69.55</td>
<td>6</td>
<td>27.08</td>
<td>36.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>43.67</td>
<td>76.22</td>
<td>Phagwara 1</td>
<td>-16.25</td>
<td>59.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>22.21</td>
<td>69.30</td>
<td>2</td>
<td>0.61</td>
<td>93.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>39.36</td>
<td>85.03</td>
<td>3</td>
<td>-7.13</td>
<td>81.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>23.33</td>
<td>70.15</td>
<td>4</td>
<td>3.17</td>
<td>89.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>44.93</td>
<td>93.47</td>
<td>Kapurthala 1</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>26.14</td>
<td>67.25</td>
<td>2</td>
<td>44.16</td>
<td>89.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>43.31</td>
<td>79.01</td>
<td>3</td>
<td>29.96</td>
<td>94.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Field work.
in the inner and other zones of all the four selected towns. The value of correlation coefficient computed between distance of various villages selected from different zones of Jalandhar and increase in their tube-well irrigation came out to be -0.073. It is an extremely weak relationship, and is not significant even at 5 per cent level. Therefore, the present hypothesis is refuted, due basically to (i) most of the villages falling near towns had an already higher base of irrigation over which the scope for further expansion was limited; (ii) with the implementation of Green Revolution technology in the form of high yielding seeds, chemical fertilizers and other bio-chemical inputs, assured irrigation was necessitated over all farms located far and near towns. The practice of intensive cropping became common almost everywhere. As a result, higher development in minor irrigation was recorded by almost all villages irrespective of their distance from market; (iii) the government provided loans to the farmers for installing new tube-wells and pumping sets irrespective of their distance from towns; (iv) power connections were given at flat rates to farmers of nearer as well as far off areas; (v) this innovation was adopted by all farmers without regard to their distance from the urban centres.

(b) Second part of the hypothesis associates distance with existing position of irrigation. The intensity of irrigation is likely to decrease with increase in distance from the towns, due largely to the fact that villages located near them devote higher proportion of their cropland to more water intensive crops, such
as vegetables and fodder (clover). However, Table 6.3 shows that irrigation is equally developed in nearer as well as in farther zones. The value of \( r = -0.171 \) worked out between the two in case of Jalandhar too invalidates the same. The relationship is very weak and is not significant even at 5 per cent level. It implies that the differentials in irrigation of nearer and farther areas are not wide. This is attributed mainly to its development in all areas, located far or near towns, through Green Revolution technology and through certain special policies adopted by the government.

Thus, increase in irrigation has a little association with distance from urban markets. The existing position of irrigation too is not influenced by distance from an urban centre. Instead, nature of crops, availability of capital, size of farm, availability of good quality water at suitable depths, favourable relief etc., are more important in this regard.

**Hypothesis - 4 :**

(a) The association between increase in cropping intensity (total cropped area as percentage of net area sown) during 1951-80 and distance from market has been explored in this hypothesis. The relationship between these two variables seems to be indirect due largely to the fact that the villages falling near markets recorded higher increase in cultivation of vegetables and fodder in response to ever growing demand for these commodities in the towns. These
are short duration crops and are raised throughout the year in order to keep their supply perennial. Therefore, number of crops produced over the same field must have increased more fastly in nearby areas as compared to the farther ones.

Similar to the previous ones, this hypothesis too has been tested by noting zone-wise increase in cropping intensity around four selected towns (Table 6.4). Higher increase in crop intensity is a feature not only of the villages located in the inner zones, but also of the villages falling in the outer zones. This is further

Table 6.4

<table>
<thead>
<tr>
<th>Town/City</th>
<th>Zone</th>
<th>Increase in cropping intensity during 1951-80 (per cent)</th>
<th>Cropping intensity in 1980 (per cent)</th>
<th>Town/City</th>
<th>Zone</th>
<th>Increase in cropping intensity during 1951-80 (per cent)</th>
<th>Cropping intensity in 1980 (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalandhar</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>Hoshiarpur</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
<td>2</td>
<td>48.90</td>
<td>151.20</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-</td>
<td>181.14</td>
<td></td>
<td>3</td>
<td>32.44</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>46.80</td>
<td>176.60</td>
<td></td>
<td>4</td>
<td>80.95</td>
<td>196.45</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>26.85</td>
<td>177.60</td>
<td></td>
<td>5</td>
<td>37.98</td>
<td>153.80</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>29.42</td>
<td>172.50</td>
<td></td>
<td>6</td>
<td>37.98</td>
<td>118.20</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>63.90</td>
<td>169.67</td>
<td>Phagwara</td>
<td>1</td>
<td>73.29</td>
<td>190.49</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>29.85</td>
<td>155.50</td>
<td></td>
<td>2</td>
<td>54.30</td>
<td>190.10</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>88.17</td>
<td>194.70</td>
<td></td>
<td>3</td>
<td>51.08</td>
<td>175.28</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>49.70</td>
<td>142.65</td>
<td></td>
<td>4</td>
<td>20.22</td>
<td>193.59</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>52.91</td>
<td>177.91</td>
<td>Kapurthala</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>53.53</td>
<td>152.63</td>
<td></td>
<td>2</td>
<td>51.77</td>
<td>180.07</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>69.01</td>
<td>178.43</td>
<td></td>
<td>3</td>
<td>46.82</td>
<td>188.83</td>
</tr>
</tbody>
</table>

Source: Field work.
supported by the value of 'r' (0.303) calculated between distance of villages selected from around Jalandhar and increase in their cropping intensities during 1951-80. The relationship turns out to be direct but weak and insignificant. It clearly renunciates the proposed hypothesis. This is mainly because (i) cropping intensity is strongly associated with irrigation (r=0.504) which has increased equally even in the far off villages; (ii) the practice of intensive crop rotations (like of wheat and rice) has become common in almost all villages irrespective of their distance from the urban centres due largely to the increase in the application of modern technology; and (iii) size of farms is small and pressure of population is high in all the villages, which compel the intensive use of land everywhere.

(b) The intensity of cropping is likely to manifest a negative relationship with distance from market centre. It has been proved that areas falling near towns emphasize more on cultivation of vegetables and fodder. These crops are of short durations and are required in the cities and towns throughout the year. To some extent, such areas are in a better position to get city manures, fertilizers etc., at lower transport costs. Their soils are relatively fertile and can withstand repetitive cropping. Therefore, the intensity of cropping in these villages would be higher as compared to their counterparts located at a distance.

Table 6.4 clearly reveals that such a relationship does not exist between the said variables. Not only in the nearer zones,
intensity of cropping is high in the farther zones too. Very weak
direct relationship (r=0.05) between the two in case of Jalandhar
also supports the same. This is ascribed mainly to the availability
of dependable irrigation in all villages without regard to their
distance from towns and cities. Besides, smaller size of landholdings
and intense pressure of population compel the people to use their
land as intensively as possible in all villages located far and
near towns. Modern farm inputs are available to all the farmers
irrespective of their location.

In sum, distance from the market influences the spatial
location of agriculture in the Bist Doab. This is especially true
in case of vegetables and fodder. The closer is a village located
to the market centre, the greater has been the increase in vegetable
cultivation and higher has been the percentage area under these
crops. The same is true of fodder crops. Being bulky and perishable,
fodder crops are grown over larger area in the villages located near
towns to cater to the fodder needs of milch cattle kept in and around
urban places. Distance from an urban centre, however, does not show
any relationship with the increase in and existing intensity of
irrigation as well as the intensity of cropping.

II. Distance from Village Settlement and Agricultural Location

It has already been mentioned that distance affects the
location of agriculture to a great extent, not only in the surroundings
of a city or a town but also around individual village settlements.
A number of studies have been conducted by scholars to examine the role of this variable at the village level (Chisholm, 1962; Blaikie, 1971; Symons, 1972; Singh and Singh, 1976; Singh, 1979; Stevens and Lee, 1979; Singh, 1982 and 1983). In this section too, an attempt has been made to investigate the role of distance from the village settlement in the spatial organization of agriculture. For this purpose, six villages have been selected randomly from the study region. A care has been taken to select at least one village from each agricultural region arrived at in the preceding chapter. The role of distance has been investigated only in terms of the intensity of cultivation and the location of crops. The following two hypotheses have been postulated for the purpose:

1. Intensity of cultivation in a village decreases with increase in distance from its settlement.

2. All those crops which are more remunerative, require constant care and are bulkier in nature, are raised near the settlement.

Hypothesis - 1:

First hypothesis relates intensity of cultivation with distance from the village settlement. Intensity of cultivation for the purpose of this study refers to the input per unit area. Village settlement is a place where a farmer lives and from where he operates daily to his fields for work. Various inputs such as manures, fertilizers, seeds, etc., are stored in the settlement and are carried to the fields whenever required. Also labour, may be these are family workers or hired personnels, move daily from the settlement to the fields.
Most of the farm produce too is taken to the settlement either for consumption or for further disposal to the market. The cost of movement of men and materials, in terms of time and energy, from the settlement to the fields and back increases with distance. Under this situation, the application of inputs such as manures, fertilizers, labour etc., is likely to be higher in the nearer fields since it is economical and physiologically convenient to put them in larger amount over there. Therefore, the intensity of cultivation is expected to be higher in the fields located near the settlement in comparison to the ones falling away.

This hypothesis has been tested by computing correlation coefficient between distance and intensity of cultivation for each of the six villages (Chak Guru, Bolina, Badial, Bhoyapur, Mustfapur and Kaimpur) selected from the Bist Doab (Map. 5.2). Intensity was calculated indirectly through inputs needed by various crops. The input costs (per acre) of various crops raised in Punjab were obtained from the Economics and Sociology Department of the Punjab Agricultural University at Ludhiana. These costs are not the averages for the state but simply are the recommendations of the University to achieve maximum returns under normal weather conditions. In order to calculate intensity of inputs, each village was divided into squares (normally murabas of 25 acres each). Total area (in acres) occupied by a crop in each square was multiplied by its per acre inputs. In this way total input cost for the square was calculated in rupees by adding
inputs required by each crop grown in the square. The total input cost for the square was divided by the cultivated area of the square to get per acre intensity (Map 6.2). Direct distance from the centre of the village settlement to the centre of each square was measured. The product-moment correlation between the two variables (intensity and distance) was calculated for each sample village and was taken as a measure of their linearity. Scatter diagrams were also prepared for further elaboration of the relationships thus obtained.

The correlation coefficient between distance from settlement and cropping intensity in each sample village turns out to be very weak (Table 6.5). In none of the study villages, the relationship is significant even at five per cent level. The scatter of points in each case also manifests the same (Figs 6.1 to 6.6). The postulated statement thus is invalid. It proves without any doubt that intensity of cultivation has no relationship with distance from a village settlement. Instead of distance, the intensity is influenced by a number of other variables.

The most important among

<table>
<thead>
<tr>
<th>Name of the Village</th>
<th>Value of 'r'</th>
<th>Level of significance 1 per cent</th>
<th>Level of significance 5 per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chak Guru (26)</td>
<td>-0.0320</td>
<td>Not significant</td>
<td>Not significant</td>
</tr>
<tr>
<td>Bolina (32)</td>
<td>0.2078</td>
<td>Not significant</td>
<td>Not significant</td>
</tr>
<tr>
<td>Badial (68)</td>
<td>-0.1862</td>
<td>Not significant</td>
<td>Not significant</td>
</tr>
<tr>
<td>Bhoyapur (19)</td>
<td>0.1135</td>
<td>Not significant</td>
<td>Not significant</td>
</tr>
<tr>
<td>Mustfapur (18)</td>
<td>-0.0313</td>
<td>Not significant</td>
<td>Not significant</td>
</tr>
<tr>
<td>Kaimpur (30)</td>
<td>-0.0836</td>
<td>Not significant</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

Source: Field work.
Note: Figures in brackets are the degrees of freedom for each village.
Village Chak Guru

Block-wise Intensity of Cultivation (in rupees per acre)

1980

---

MAP 6-2
Fig. 6-1
Village Chak Guru
RELATIONSHIP BETWEEN DISTANCE FROM SETTLEMENT AND INTENSITY OF CULTIVATION: 1980

\[ r = -0.0232 \]
Village Bolina

RELATIONSHIP BETWEEN DISTANCE FROM SETTLEMENT AND INTENSITY OF CULTIVATION: 1980

$r = +0.2078$
Village Badial

RELATIONSHIP BETWEEN DISTANCE FROM SETTLEMENT AND INTENSITY OF CULTIVATION 1980

\[ r = -0.1862 \]
Village Bhoyapur

RELATIONSHIP BETWEEN DISTANCE FROM SETTLEMENT AND INTENSITY OF CULTIVATION: 1980

\[ r = +0.1135 \]
Village Mustapuran

RELATIONSHIP BETWEEN DISTANCE FROM SETTLEMENT AND INTENSITY OF CULTIVATION: 1980

$r = 0.0313$
Village Kaimpur

RELATIONSHIP BETWEEN DISTANCE FROM SETTLEMENT AND INTENSITY OF CULTIVATION: 1980

$r = -0.0836$
these is assured irrigation which is available at all distances in most of the selected villages. Without irrigation, no piece of land, however nearer it may be to the settlement, can be brought under intensive cultivation. Intensive crops are tied with water and not with distance. And tube-wells have been installed over individual pieces of landholdings located far and near. Such a spatial arrangement of farms and tube-wells have diluted the role of distance in this regard. Secondly, some farmers have built their farmhouses over their farms away from the original settlement. Some others have a structure of at least one single room, which besides protecting the tube-well, is also used to store farm machinery and inputs. Such farmhouses and structures have become a common feature of the rural landscape not only in the Bist Doab but in the state as a whole. Consolidation of landholdings and security against banditry have played a special role in this dispersal. Thirdly, greater use of chemical fertilizers during the post-Green Revolution period has increased the fertility of the soils located far and near. Intensive crop rotations are widely practised in nearer as well as in farther fields. Fourthly, the role of this variable has been diluted with the mechanization of agriculture. In most of the selected villages, tractor trollies and rubber wheeled carts are commonly used for moving the goods to and from the settlement. Linked with this is a system of straight, fairly wide roads and tracks leading to almost every farm in a village. Under such conditions, movement becomes easy and cheaper and, therefore, the concept of nearness to settlement loses its importance.
Apart from the aforesaid factors, heavy pressure of population, high land values and better returns from farming are some other variables which encourage the farmer to cultivate each bit of land available with him, as intensively as possible. Thus, the role of distance from the settlement in determining intensity is negated.

**Hypothesis-2**:

Second hypothesis builds an association between distance from the settlement and location of crops. It is hypothesized that intensive and more precious crops such as vegetables are raised closer to a village settlement, because these require greater inputs (both labour and capital), constant care and are to be protected against pilferage. These crops can be looked after more carefully if grown near home. Likewise, fodder which is bulkier and is transported daily to the settlement for feeding the cattle, is likely to be raised closer to the settlement in order to economize on transport.

The same six villages have again been taken for testing this hypothesis. The test is based on relative dispersion of various crops with respect to the settlement. Relative dispersion is a refined form of standard distance. Its computation pre-requires the calculation of standard distance. The standard distance is a measure of dispersion in spatial context. It is defined as equivalent of statistician's standard deviation and is given by the formula (Taylor, 1977):
S.D. = \sqrt{\frac{\sum d^2}{n}}

where,

S.D.- standard distance;
d-distance of an observation from the mean centre;
n-number of observations.

The following hypothetical example demonstrates the working of this formula. It relates to the cultivation of vegetables in 10 fields in a village A:

<table>
<thead>
<tr>
<th>Field number in which vegetables are grown</th>
<th>Distance of the field from village settlement (in metres) (d)</th>
<th>Square of distance (d^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>49</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>81</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>121</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>144</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
<td>196</td>
</tr>
</tbody>
</table>

\(\sum d^2 = 720\)

\(n = 10\)

Standard distance of vegetable fields in village A = \(\sqrt{\frac{720}{10}} = 8.48\) metres.
Using this method, standard distances of individual rabi and kharif crops raised in the selected villages in 1980 were calculated. However, the crops which appeared in one or two fields and covered very small area in a village, were omitted. It should be mentioned that the centre of the village settlement was taken as reference point with respect to which dispersion was measured. The standard distances thus calculated could be used for comparing the dispersal of crops vis-a-vis each other within a particular village. But it does not enable inter-village comparison of the location of a particular crop. This is because, standard distance is not simply a function of the location distances of fields devoted to a crop with respect to settlement centre but also depends upon the areal size of a village. The standard distance of a crop will be larger in the case of bigger villages than that in the smaller ones. Therefore, inter-village comparison of the location of various crops is not possible with this method. Such an objective can be achieved by calculating relative dispersion, which neutralizes the size factor. Relative dispersion of a crop in a village can be worked out by using the following formula:

\[
R.D._c = \frac{S.D._c}{S.D._v} \]

Where,

- \( R.D._c \) - relative dispersion of the crop;
- \( S.D._c \) - standard distance of the crop in a village;
S.D.\textsubscript{v} - standard distance of the village area (viz., square root of the sum of squared distances of farthest corners of the village land from its settlement centre; divided by the number of farthest corners).

This method is illustrated below by giving an example of wheat in village Chak Guru.

S.D. of wheat in Chak Guru = 941.78 metres
S.D. of the village itself = 1176.67 metres
Therefore, R.D. of wheat in Chak Guru = \frac{941.87}{1176.67} = 0.8004

The relative dispersion of wheat thus calculated for all the selected villages is given below:

<table>
<thead>
<tr>
<th>Village</th>
<th>Relative dispersion R.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chak Guru</td>
<td>0.8004</td>
</tr>
<tr>
<td>Bolina</td>
<td>0.9625</td>
</tr>
<tr>
<td>Badial</td>
<td>0.6291</td>
</tr>
<tr>
<td>Bhoypaur</td>
<td>0.7788</td>
</tr>
<tr>
<td>Mustfapur</td>
<td>0.9252</td>
</tr>
<tr>
<td>Kaimpur</td>
<td>0.8430</td>
</tr>
</tbody>
</table>

\( n = 6 \) \hspace{1cm} \£ R.D. = 4.9390

Source: Field work.
No doubt relative dispersion neutralizes the size factor and enables inter-village comparison of location of different crops but it does not give a common index of the dispersal. This can be obtained by resorting to the calculation of average relative dispersion. This calculation is elaborated in the following example:

\[
\text{Average relative dispersion of wheat} = \frac{\text{R.D. of wheat}}{n} \text{ (number of villages)}
\]

\[
= \frac{4.9390}{6} = 0.8232
\]

In this way, relative dispersion for each crop raised in the six villages has been averaged and given in Table 6.6. This table is being used for testing the proposed hypothesis. The higher the value of average relative dispersion, the farther is the crop located from the village settlement.

Table 6.6
Bist Doab: Average Relative Dispersion of Crops with respect to Village Settlement

<table>
<thead>
<tr>
<th>Crop</th>
<th>Relative dispersion</th>
<th>Crop</th>
<th>Relative dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabi Season</td>
<td>Kharif season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clover</td>
<td>0.5826</td>
<td>Rice</td>
<td>0.6370</td>
</tr>
<tr>
<td>Gram</td>
<td>0.6537</td>
<td>Sesamum</td>
<td>0.6423</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>0.6594</td>
<td>Cotton</td>
<td>0.6532</td>
</tr>
<tr>
<td>Wheat-gram</td>
<td>0.6941</td>
<td>Fodder</td>
<td>0.7005</td>
</tr>
<tr>
<td>Masar</td>
<td>0.7166</td>
<td>Vegetables</td>
<td>0.7159</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.7330</td>
<td>Maize</td>
<td>0.7230</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.8232</td>
<td>Sugarcane</td>
<td>0.8753</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mash</td>
<td>0.8840</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundnut</td>
<td>0.9807</td>
</tr>
</tbody>
</table>

Source: Field work
far and near the settlements. Due to this, a farmer who has his land far from the settlement has no other option except to raise the intensive, precious or bulkier crops over there; (ii) the fact that the means of transport in the sample villages are fairly developed and each farm is connected to the settlement with a road or track, due to which any crop, howsoever care demanding or bulkier it may be, can be looked after properly or can be easily transported even from the distant fields.

Thus, neither the intensity of cultivation nor the location of crops are influenced by the variable of distance, as far as the village settlement and its production territory are concerned.

III. Distance from Source of Irrigation and Agricultural Location

An attempt, in this section, has been made to analyse the spatial arrangement of crops around tube-wells and pumping sets. Due to inadequate, uncertain and seasonally concentrated rainfall in the Bist Doab, irrigation water plays an important role in the success and location of crops. Sub-soil water in most of the study region is available at favourable depths and is of good quality. As a result, irrigation by tube-wells and pumping sets is a common practice. Nearly 93 per cent of the total irrigated area of the Bist Doab is served by tube-wells and pumping sets. They affect the spatial order of crops within their catchment areas. In order
were taken for analysing the spatial order of agriculture in the preceding section of this chapter. Locations of rabi and kharif crops

Table 6.7

Punjab: Water Requirements of Crops (per acre), 1980

<table>
<thead>
<tr>
<th>Rabi Season</th>
<th>Diesel engine-hours</th>
<th>Crop</th>
<th>Diesel engine-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>30.0</td>
<td>Rice</td>
<td>75.0</td>
</tr>
<tr>
<td>Clover</td>
<td>100.0</td>
<td>Maize</td>
<td>30.0</td>
</tr>
<tr>
<td>Gram (irrigated)</td>
<td>10.0</td>
<td>Groundnut (irrigated)</td>
<td>30.0</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>10.0</td>
<td>Sugarcane</td>
<td>107.5</td>
</tr>
<tr>
<td>Lentil</td>
<td>10.0</td>
<td>Cotton</td>
<td>27.5</td>
</tr>
<tr>
<td>Barley</td>
<td>23.0</td>
<td>Bajra</td>
<td>15.0</td>
</tr>
<tr>
<td>Vegetables</td>
<td>56.0*</td>
<td>Vegetables</td>
<td>75.0*</td>
</tr>
</tbody>
</table>


* In the case of vegetables, water requirements were given in electric units in the aforesaid data obtained from the P.A.U., Ludhiana. The same were converted into diesel engine-hours by treating 4 electric units of 5 H.P. motor equal to one diesel engine-hour.
water. Less water demanding crops are raised in the farther fields (Map 6.3). Thus, the proposed hypothesis is proved to a great extent in case of rabi crops.

**Kharif Crops:**

Kharif crops are also expected to display locational preferences with respect to the tube-well, despite the fact that a part of their water need is fulfilled by the monsoon rains. This is because, irrigation is essential for most of the kharif crops too, due to the uncertain and unreliable nature of monsoon rains. This is more true of the high yielding and improved varieties of crops for which irrigation is necessary input. Depending upon their variable need for water, these crops are likely to organize themselves in a particular order around tube-well.

Maize, rice, vegetables, fodder (bajra, jowar), sugarcane and cotton are the major crops raised over the sample farms during this season. Besides, sesame, groundnut, mash, moong, arhar, etc., are also produced in small proportions over some farms. Rice and maize, however, are the most important. Together, these constitute nearly 70 per cent (35 per cent of total cropped area) of the kharif cropland of the selected farms.

Out of the various crops produced during this season, vegetables display minimum relative dispersion. On an average they are grown closest to the source of irrigation. As already mentioned, constant care and water are their basic requirements which are provided better near the tube-well.
VILLAGE CHAK GURU
Location of Crops in a Farm: 1980

Rabi Crops

Wheat
Clover
Vegetables
Gram
Mosar
Oil seeds
Fallow

Kharif Crops

Rice
Fodder
Sugarcane
Maize
Cotton
Mash
Fallow
The fodder crops (bajra, jowar, guara etc.) of this season are also located near the source of irrigation. They are next to vegetables in this regard. In spite of the relatively less demand for water they are raised closer to the tube-well for the reasons already explained in the case of rabi fodder. Sugarcane comes next to fodder in locational order. It is an annual crop and stands in the fields throughout the year. That is why, its demand for water is relatively high. Secondly, a number of the cane growing farms have a sugarcane crusher attached with their respective tube-wells. Thus, a tube-well site acts as a collection centre for sugarcane where it is crushed and processed into brown sugar.

Sugarcane is followed by sesameum and maize. Sesamum covers limited area and is not common to all the farms. Many a times it is produced in mixture with maize. Their location in the farther fields is justified by their very little demand for water. Outer location of maize is also ascribed to its greater areal spread and relatively less demand for water. Despite being more water intensive than many crops of the season, rice is raised in the fields located farther from the source of water. In fact it is the second most important crop produced over different farms. Its greater areal coverage, similar to wheat and maize explains its distant location with respect to the tube-well. Cotton and maah, because of their limited water requirements, are produced in most distant fields from a tube-well. Thus, with the exception of rice, the average
dispersion of various crops of the kharif season is in consonance with their demand for water. Therefore, the proposed hypothesis is proved to a great extent.

Conclusion

Distance plays an important role in the spatial organization of agriculture in the city-region context. This is particularly true of the perishable and bulkier crops. The expansion of area under vegetable crops (during the study period) and the prevailing position of cropland devoted to them is substantially higher in the villages located near cities and towns. Similarly, cultivation of fodder crops decreases with increase in distance from the urban centre. These are bulkier and perishable, and are in considerable and constant demand in and around the city. Increase in and the existing position of the intensity of irrigation and cropping, however, do not display any relationship with distance from market city.

Distance plays no role in the spatial organization of agriculture in the context of village settlement and its production territory. Neither the intensity of cultivation, nor the location of crops are influenced by this variables at the village level. Availability of assured irrigation at all distances, shift of residence at least temporarily during peak seasons by some farmers to their farms; application of science and technology without regard to distance of farms from the settlement; small size of villages; location of farms in
consolidated blocks far and near the settlement; good connectivity between farms and the settlement along with fairly developed modes of transport, neutralize the role of distance in the intensity of farming and the location of crops at the village level.

At the farm level, distance does affect the spatial location of crops. In this case, tube-well or pumping set forms the node. Crops arrange themselves around it in an order. More water demanding crops, which are generally more intensive and paying, are grown closer to the tube-well, whereas the less water demanding ones occupy the farther fields.