CHAPTER III

CHANGES IN IRRIGATION PATTERNS

In a state like Punjab where rainfall is not only inadequate but also highly variable in time and space, the indispensability of irrigation for the success of farming needs no emphasis. Irrigation, in fact, has played a key role in transforming the state's agriculture. Improvement in irrigation has broadened the extent of cultivation, increased multiple cropping, enhanced crop yields and has tended to rationalize cropping patterns on commercial lines. Thus, to have a comprehensive understanding of the changes in agricultural land-use in the state, a detailed investigation into recent trends and existing patterns of irrigation is inescapable.

With 52.9 per cent (5,033,181 acres) of its net area sown under irrigation in 1966 (as against the Indian average of 19.5 per cent), Punjab ranked first in the country in the development of irrigation. (Table 2). Its unique position in this regard, is not an achievement of a decade or two, rather it is the outcome of concerted efforts of the people and the government through the entire history of its settlement.

Because of deficient rains, their concentration in a short period of the year and high variability within that
<table>
<thead>
<tr>
<th>State</th>
<th>Net Irrigated Area As Per Cent of Net Area Sown</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIA</td>
<td>19.5</td>
</tr>
<tr>
<td>Punjab</td>
<td>52.9</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>42.9</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>40.4</td>
</tr>
<tr>
<td>Haryana</td>
<td>37.8</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>33.8</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>27.2</td>
</tr>
<tr>
<td>West Bengal</td>
<td>27.1</td>
</tr>
<tr>
<td>Nagaland</td>
<td>25.5</td>
</tr>
<tr>
<td>Bihar</td>
<td>23.9</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>23.5</td>
</tr>
<tr>
<td>Kerala</td>
<td>17.5</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>12.4</td>
</tr>
<tr>
<td>Karnataka</td>
<td>9.7</td>
</tr>
<tr>
<td>Gujarat</td>
<td>8.8</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>6.8</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>DNA</td>
</tr>
<tr>
<td>Assam</td>
<td>DNA</td>
</tr>
<tr>
<td>Orissa</td>
<td>DNA</td>
</tr>
<tr>
<td>Other Centrally administered areas</td>
<td>23.2</td>
</tr>
</tbody>
</table>

SOURCE: Calculated from *Statistical Abstract of Punjab, 1968*

DNA : Stands for Data Not Available.

period in not only Punjab but also in all plain areas of northwestern India, the necessity of irrigation for stable agriculture has always been strongly felt by the farmers. Till the middle of the 19th century, irrigation in Punjab
was either confined to the river valleys through the use of flood waters or was in the form of wells in areas (Hoshiarpur, Jullundur, Ludhiana and Amritsar districts) where sub-soil water conditions were favourable. Limited irrigation of this type in a few tracts was mostly the result of the individual or collective efforts of the people. However, the role of the government in developing irrigation became prominent only after the annexation of Punjab by the British in 1849. The extension of the British rule, in fact, proved to be a turning point in the history of the state's irrigation. Large irrigation projects, such as the Upper Bari Doab Canal System (1859) with its headworks at Madhopur on the Ravi and the Sirhind Canal System (1882) with its headworks at Ropar on the Sutlej were executed by the then British

---


2 The work on this project was started by the British Government in 1854 and the canals were opened for irrigation in 1859. See Census of India, 1961, District Census Handbook: Gurdaspur District, Census Operations, Punjab, Chandigarh, 1969, p. 23.

3 The Sirhind Canal Project was a joint venture of the British government and the Princely States of Patiala, Nabha and Jind. The construction on this project was started in 1873 and canals were opened for the flow of water in 1882 (Imperial Gazetteer of India: Provincial Series: Punjab, Superintendent of Government Printing, Calcutta, 1908, p. 205).
Government during the latter half of the 19th century (Map 35). A few medium irrigation projects such as the Grey Canal (1875–1885) from Harike headworks and Bikaner Canal from Hussainiwala headworks both on the Sutlej river and Shah Nehar from the Beas river in Hoshiarpur district were also completed during the same period. Well irrigation also recorded notable improvement during this period. Loans were distributed by the government for installing new wells and for replacing wooden Persian wheels with more efficient and durable steel wheels and buckets. As a result, irrigation was extended to many new areas of the state during this period. However, the first half of the 20th century recorded slow development in this field. No large irrigation project was undertaken within the limits of the present Punjab state either by the British Government or by the Princely States since 1900 till the Independence of the country in 1947. Whatever limited increase in irrigation took place during this period was mostly due to the extension of well irrigation. Independence of the country marks the beginning of another era for the speedy development of irrigation in the state. Realising the importance of water for the improvement of agriculture as also for expanding the cultivated area, the State Government took up the task of systematic development of irrigation through the Five Year Plans. The Bhakra-Nangal
Multipurpose River Valley Project on the Sutlej (the biggest of its kind in the country), aiming mainly at the extension of irrigation facilities, generation of hydroelectric power and control of floods, was executed during the first two Five-Year-Plan period. This project enabled the diversion of the Sutlej water into a dense network of canals operating in southern Punjab and adjoining areas of Haryana and Rajasthan states. Besides bringing new areas under irrigation, it augmented water supply in the Sirhind Canal System already operating in the Malwa region. Sirhind Feeder from Harike Headworks on the Sutlej was also built in the early sixties for increasing water supply in the old Sirhind Canal System. The Bist Doab Canal System (1954), another large irrigation project, with its headworks at Ropar is also a post-Independence development. The extension of

---

This project consists of 740 feet high dam across the Sutlej at Bhakra to store and regulate water supply the year round; two power houses at the foot of the dam with an installed capacity of 1050 MW; 90 feet high Nangal dam about 9 miles down-stream; Nangal-Hydel channel and the two power houses on the Hydel-channel; one at Ganguwal and another at Kotla, each with an installed capacity of 77 MW. The project was started in 1948, canals were opened for irrigation in 1954 and Bhakra reservoir started giving storage facilities in 1958-59. Concreting of Bhakra dam was completed in October, 1963. It helped feeding 685 miles of canals and 2083 miles of distributaries spread in Punjab, Haryana and Rajasthan. The project, with a financial outlay of about 175 crores of rupees, was financed by the Centre Government. Its benefits are shared by Punjab, Haryana, Rajasthan, Himachal Pradesh and Delhi.
all these large canal irrigation systems was facilitated, among other factors, by the alluvial plain topography of the state. Although, the soft alluvial strata expedited the digging of canals, yet its percolatory nature resulted in considerable loss of water through seepage which reduced the irrigation potential. This is more true of semi-arid southwestern parts of the state. None the less, excessive percolation of water from canal beds raised the groundwater level and lessened the brackishness of the sub-soil water along the main canals, particularly in the southwest. The rise in water-table enhanced the possibility of tubewell irrigation in such zones. On the other hand, considerable seepage from canals over a long period of time in association with poor drainage due to faulty construction of roads and canals without adequate number of syphons and bridges obstructing the natural flow of rainwater, resulted in a serious problem of water-logging at many places in northern and eastern Punjab.

Apart from the large irrigation schemes, due attention was also given to the exploitation of the state's vast groundwater resources. Advancement of liberal loans to the farmers on easy instalments for energizing wells and tubewells, distribution of cement, bricks and steel at subsidized rates for the purpose, increasing commercialization in agriculture and consequent wealth with the farmers to invest in this
Punjab
Irrigation by different Modes
1966
DATA BY TAHSLS

Source of Data: Unpublished Revenue Records
(Lai Kitabs)
field stimulated the development of minor irrigation works (wells/tubewells). The consolidation of fragmented landholdings completed for the second time during this period played an exceedingly important role in creating the necessary conditions for the development of well and tubewell irrigation wherever otherwise possible throughout the state. This measure brought together the scattered fields of a landholding sometimes from as many as 15 different locations to a maximum of four. As a result of the execution of large as well as small irrigation schemes, nearly 0.7 million acres (0.32 million acres by wells/tubewells and 0.38 millions acres by canals) of additional land was brought under net irrigation in the state during the period of the first three Five-Year-Plans. Besides, the intensity of irrigation in already irrigated areas was also considerably improved.

In 1966, 57.8 per cent of the state’s net irrigated area was served by canals; 39.5 per cent by wells and tubewells; and the remaining 2.7 per cent was either served by both or by other miscellaneous means such as tanks, ponds, jhalars (lifting water from natural water bodies by persian wheels) and dhinelies (lever irrigation). It clearly shows that canals and wells/tubewells are the two major modes of irrigation practised in Punjab. The relative importance of each, however, varies areally (Map 36). Canals dominate the irrigation scene
Punjab
Distribution of Wells
1966

Each Dot Represents 200 Wells

Source of Data: Unpublished Revenue Records (Lal Kitabs)
in the western Malwa tract and the southwestern Upper Bari Doab. These are the areas of the state where sub-soil water is deep and brackish as a result of which well and tubewell irrigation could not make much headway. The prominence of Kuhl irrigation (local diversion of small streams) in Pathankot tahsil is associated with hilly terrain. Wells and tubewells have an upper edge over canals in (i) the whole of the Bist Doab, northeastern Malwa and northern Upper Bari Doab where a large reservoir of sub-soil water close to the surface offers a vast potential for the development of small irrigation schemes and (ii) phe-infested foothill plain where canal irrigation failed to make any progress due to the physical handicaps (Map 37).

The proportion of net irrigated area to net area sown shows striking areal variations in the state, ranging from barani cultivation (absence of irrigation) in Bit Mansowal assessment circle of Garhshankar tahsil to 97.8 per cent in Nehri assessment circle of Ajnala tahsil (Map 39). With 60 to 97.8 per cent of its net area sown under irrigation, the southern half of the Upper Bari Doab, comprising the whole of the Amritsar district and parts of the Batala tahsil of neighbouring Gurdaspur district, is the most intensively irrigated part of Punjab. Within this region as many as 12 assessment circles, out of a total of 12, have more than 80 per cent of their net area sown under irrigation. Early
introduction of the Upper Bari Doab Canal System (1859) and considerable development of well and tubewell irrigation mainly account for the outstanding position of this region in this respect. The development of supplementary tubewell irrigation is largely associated with its exclusively dependable nature both in terms of time and quantity. Even if irrigation from canals is delayed or reduced, the tubewells provide readily available water to the fields. This is true of all the canal irrigated areas of Punjab provided groundwater conditions are favourable.

Southcentral Bist Doab is another tract where proportion of irrigation is very high. Here percentage of net irrigated area to net area sown ranges between 60 and 90. Favourable groundwater conditions (sub-soil water depths range from 5 to 15 feet), ample and good quality water in the aquifers, emphasis of the state government on the development of small irrigation schemes by distributing loans to the farmers and remittance of money by a large number of emigrants to their relations (a substantial portion of which has been spent on the farms) mainly account for the extensive development of well and tubewell irrigation in this tract. Canals irrigate only a small part of the irrigated area of this region.

In the southwestern section of Ferozepur district where 62 to 85 per cent of the net area sown is irrigated, however, canal is the main source of irrigation. Canal
irrigation in this area is about a century old. Here, because of deep and brackish groundwater, irrigation by wells/tubewells is not possible. With 62 to 66 per cent of their net area sown under irrigation, the whole of the Moga and Nabha tahsils, southern parts of Ludhiana district and Daha circle of Ropar tahsil forms another tract where the percentage of net irrigation is high. Canals and wells/tubewells, the two major means of irrigation, complement each other here. The selection of Ludhiana district for the intensive agricultural development programme made its own impact on the extension of irrigation from all possible sources in that district.\(^5\)

In sharp contrast to the areas described above, the Siwalik hills and the adjoining cho-infested foothill plain are the least (below 30 per cent) irrigated parts of the state. A majority of the assessment circles in this tract have less than 15 per cent of their area under net irrigation. Canals in this zone could not be extended due to the hilly and dissected terrain. The development of well and tubewell irrigation also failed to make much

---

\(^5\) Package programme also known as Intensive Agricultural District Programme was initiated in 1960-61, in all states of India, selecting one district from each state. In Punjab it was introduced in Ludhiana district. See Agricultural Development and Perspective, Ministry of Food and Agriculture, Government of India, New Delhi, 1965.
headway due to the deep and inadequate sub-soil water and the limited resources of the small landholders to go in for the installation of deep tubewells. The upper sections of the flood plains of the Sutlej, the Beas and the Ravi also have low (20 to 30 per cent) proportion of their net area sown under irrigation. Occasional floods and consequent waterlogging in these tracts largely restricted the development of irrigation. A small tract in the southwestern Punjab, comprising Hathar circles of Muktsar, Fazilka and Ferozepur tahsils also remained less (15 to 36 per cent) irrigated. Very high intensity of sand dunes and irregular relief are mainly responsible for such a state of affairs. Excessive loss of water through seepage from the canals and brackish groundwater are the other limiting factors. Similarly, dune infested Dona Circles of Jullundur, Nakodar and Kapurthala tahsils also remained less irrigated. Relatively low (35.5 per cent) percentage of irrigation in Patiala tahsil is largely attributable to the inadequate supply of canal water, uneven nature of the recently reclaimed lands and frequent floods in the flood plain of the Ghaggar and its tributaries.

An extensive tract in the southcentral Malwa, where net irrigated area varies from 43 to 59 per cent, falls in between the two types of areas discussed above. Inadequate supply of canal water, excessive loss of water through seepage in this area of porous soils and occasional occurrence
of dunes standing higher than the canal water level have stood in the way of extension of irrigation in this zone. Moderate degree of irrigation is also a feature of the western half of Kapurthala tahsil where waterlogging is a serious problem and the northern Upper Bari Doab where relatively heavy (40 to 50 inches) rainfall reduces its need.

In sum, higher proportion of irrigation has been a feature of those areas of the state where (i) canals were introduced at an early date; (ii) traditional well irrigation has been replaced by tubewell irrigation; and (iii) where both canal and well/tubewell irrigation supplement each other. On the other hand, areas of hilly and dissected terrain, zones infested with sand dunes, and those menaced by floods remained backward in this regard.

**Changes in Net Irrigated Area**

Net irrigated area in Punjab increased from 49.9 per cent (4,317,688 acres) in 1951 to 52.9 per cent (5,018,181 acres) in 1966 (Maps 38 to 41). Out of this increase of about 0.7 million acres, nearly 0.38 million acres (53.0 per cent) was due to the extension of large irrigation schemes such as Bhakra Canal System, Bist Doab Canal System and increase in the supply of the Sirhind Canal System, while the remaining 0.32 million acres
(46 per cent) resulted from the extension of small irrigation schemes. However, increase in percentage difference in percentage of 1951 and 1966\(^6\) net irrigated

6 For the study of changes in irrigation three different methods can be used:

1. **Absolute acreage change in irrigation**
   In this method increase or decrease in area under irrigation in the absolute sense during 1951-66 is computed. For example, if area under irrigation in a unit in 1951 is 1000 acres and in 1966 is 1500 acres, the absolute acreage change is plus 500. Although, this method clearly depicts the actual increase or decrease in area under irrigation, yet it fails to portray effectively the comparative picture of change in different areas, especially when the basic units under study are not of the same size. Larger units are expected to show greater magnitude of change in absolute terms than the smaller ones.

2. **Percentage change in irrigation**
   In this method, absolute acreage change in irrigation in any unit is computed as percentage of the data on the base year. For example, if area under irrigation in a unit in 1951 was 1000 acres and in 1966 it was 1500 acres, absolute acreage change comes out to be 500. This change taken as percentage on the figure for the base year (1951) i.e. on 1000, gives the required percentage change. In this case it comes out to be 50 per cent. This method suffers from two serious drawbacks:
   
a) It has a tendency of exaggerating the percentages in case of low figures. For example, if area under irrigation in any unit increases from 10,000 to 20,000 acres during 1951-66, percentage change is plus 100. On the other hand if area under irrigation in a unit increases from 1 to 4 acres the percentage change is plus 400. In the second case, although actual area involved in change is only 3 acres as compared to 10,000 acres in the first case, yet change in the second case is much higher.

b) It has a tendency to exaggerate the positive and negative changes by differing rates even if the actual acreage change is the same. For example, if area under irrigation in a unit increases from 0 (zero) acres in 1951 to 10 acres in 1966, the percentage change in irrigation is plus infinite. On the
area, by only 3 (from 49.9 to 52.9 per cent) despite notable increase in absolute acreage under irrigation is largely attributable to the parallel increase in net area sown.

Continued:-

6 other hand, if area under irrigation decreases from 10 acres in 1951 to 0 (zero) acres in 1966, percentage change in irrigation comes out to be minus 100. These are the extreme limits within which other percentages fluctuate. It is evident from this example that the negative change by this method will never be more than 100 but positive change can be as high as infinity. Changes of two different scales if plotted on the same map give somewhat deceptive picture.

3. Change in percentage of irrigation (differences in percentage of area under irrigation in 1951 and 1966; i.e. percentage for 1966 minus percentage for 1951). In this method, difference in percentage of net irrigated area to net area sown in 1951 and 1966 is used as an index of change. For example, if net irrigated area as percentage of net area sown in 1951 is 60 and the corresponding figure for 1966 is 70, the change in percentage is plus 10. This method, in fact, depicts the change in relative position in the area under irrigation in 1951 and 1966. In this case, the change in percentage is not only a function of change in area under net irrigation but also of the change in net area sown (net area sown, with which percentages of net irrigation have been calculated, also change with time). For the illustration of this fact, the following examples may be noted:-

<table>
<thead>
<tr>
<th>Example I</th>
<th>(Area in acres)</th>
<th>Change in % (Difference in % of Net Area Sown)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Net Area</td>
<td>Net irrigated area as % of Net Sown area.</td>
</tr>
<tr>
<td>1951</td>
<td>1000</td>
<td>50</td>
</tr>
<tr>
<td>1966</td>
<td>2000</td>
<td>50</td>
</tr>
</tbody>
</table>

In this example, despite an absolute increase of 500 acres in net irrigated area during 1951-66, the change in percentage i.e. percentage for 1966 minus percentage for 1951, comes out to be zero. It is because of the fact that net area sown has witnessed a parallel increase of the same proportion, as that of net irrigated area.
The changes in percentage net irrigated area, however, strikingly vary in different parts of Punjab ranging from

Continued:

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Area Sown (Area in acres)</th>
<th>Net irrigated Area (Area in acres)</th>
<th>Change in %age (Difference in %age of Net Area Sown 1951 and 1966)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>1000</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>1966</td>
<td>2000</td>
<td>600</td>
<td>(-) 20</td>
</tr>
</tbody>
</table>

In this case, despite an actual increase in net irrigated area by 100 acres, the change in percentage is negative 20. It is because of relatively faster increase in net area sown vis-a-vis net irrigated area.

Example III

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Area Sown (Area in acres)</th>
<th>Net irrigated Area (Area in acres)</th>
<th>Change in %age (Difference in %age of Net Area Sown 1951 and 1966)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>1000</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>1966</td>
<td>1500</td>
<td>1000</td>
<td>(+) 25</td>
</tr>
</tbody>
</table>

In this case the increase in area under irrigation is 500 acres i.e. the same as in Example I, but the change in percentage here is plus 25, while in the first example it is 0 (zero). This is mainly because of relatively high increase in net irrigated area vis-a-vis net area sown.

Although none of the three methods discussed above is free from criticism, yet the last one i.e. change in percentage in irrigation (difference in percentages of 1951 and 1966) is decidedly better than the first two and thus, has been adopted in this study for analysing the changes. However, the other two methods have also been used wherever necessary.
an increase of 29.4 per cent in Daha circle of Ropar tahsil to a decline in percentage by 18.0 in Patiala tahsil (Map 40). For the purpose of analysing spatial variations in changes, the state may be broadly divided into the following three types of areas:

A. Areas where increase in percentage of net irrigation is more than 5.
B. Areas where increase in percentage of net irrigation is less than 5.
C. Areas with decline in net irrigation.

A. Areas Where Increase in Percentage of Net Irrigation is More Than 5.

Most of the northern and northwestern Malwa, northern, central and southwestern Bist Doab and a few isolated assessment circles in Upper Bari Doab recorded increase in the percentage of net irrigated area by more than 5.

An extensive contiguous tract covering most of the northern and northwestern Malwa registered an increase in the percentage of net irrigated area by 5.7 to 29.4. Such a great increase in net irrigation is largely associated with the extension of the Bhakra Canal System to its eastern sections in the mid-fifties, augmentation of water supply in the Sirhind Canal System which was already operating in
Punjab
Percentage Change in
Net Irrigated Area
1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lai Kitabs)
the remaining parts of this tract, and development of tubewell irrigation in all its sections. This apart, the apparently large increase in percentage of net irrigated area is also associated with negligible change in net area sown during this period. On the other hand, percentage change i.e. absolute acreage change taken as percentage on the base year of 1951, is relatively small in this tract. For a measure of this type of percentage change, please see map 42. Northern, central and southwestern Bist Doab is another tract where irrigation has substantially improved. Gain in percentage of net irrigated area here ranges between 6.4 and 20.7 per cent. Greater emphasis on well and tubewell irrigation by the people and the state, aided by the favourable physical setting, and the extension of the Bist Doab Canal System largely account for the notable improvement in irrigation here. Net area sown in this tract, similar to the one discussed above, remained almost unchanged. Bet Bangar assessment circle to which new canal distributary has been extended recently and parts of the southern Upper Bari Doab where canal water supply has been augmented, also recorded high increase.

Map No. 42 showing the absolute acreage change as percentage on the base year of 1951 and map No. 40 depicting difference in percentage of net irrigated area to net area sown in 1951 and 1966 are, in fact, complementary to each other.
Thus, larger increase in percentage of net irrigated area has been a characteristic of only those areas of the state where net area sown has not changed much but net irrigated area has substantially gained in acreage either due to the extension of new canals and augmentation of water supply in the old canals or due to substantial improvement in well and tubewell irrigation, or where both the developments have been witnessed simultaneously.

B. Areas Where Increase in Percentage of Net Irrigation is Less Than 5.

Southcentral Malwa, parts of the Siwalik hills and cho-infested foothill plain, old flood plain of the Sutlej in Ludhiana district and a few isolated units in Upper Bari Doab are the areas which recorded an increase of less than 5 per cent.

Southcentral Malwa registered an increase ranging from 0.4 to 4 in the percentage of net irrigated area. Well and tubewell irrigation in this region could not gain much ground due to the deep and brackish groundwater. Nevertheless, considerable new areas were brought under irrigation in this part of the state with the augmentation of water supply in the canals. However, a parallel increase in net area sown has reduced the figure for percentage gain in irrigation.

Areas associated with the Siwalik hills and cho-infested foothill plain too displayed sluggish growth in this regard. Undulating and dissected topography, deep and inadequate
groundwater, low investment capacity of the farmers associated with their small (average farm size ranges from 5 to 10 acres) and less productive landholdings continue to impede seriously the development of irrigation in this zone. The old flood plain of the Sutlej in Ludhiana district by recording a gain in percentage varying from 0.4 to 3.6 also falls in this category. Occasional floods and consequent waterlogging in most of its parts continuously discouraged the extension of irrigation here. A few units in Upper Bari Doab, where percentage of irrigation was already very high offering a limited scope for further expansion also recorded small increase. The increase in these units would have been even smaller but for the decline in net area sown.

Thus, small increase in percentage net irrigated area has been a feature of those areas of Punjab where (i) physiography restricted the development of irrigation; (ii) the expansion of net area sown vis-a-vis net irrigated area has been considerable; and where (iii) the extent of irrigation had achieved its near saturation level by 1951.

C. Areas with Decline in Net Irrigation

As many as 15 assessment circles covering about 11.0 per cent of the total area of the state registered decline in net irrigated area. Decrease in almost all of
them has been only marginal (Map 41). Emergence of waterlogging in a few assessment circles in the plains and continuing dissection of land in a few other units in the hills largely account for this downward trend.

On the other hand, decline in percentage of irrigated area in the state has been larger in magnitude and wider in areal coverage than absolute decrease in irrigated acreage referred to above. As many as 40 assessment circles covering nearly one-third of the total area of the state recorded decline ranging between 0.1 and 18.0 in percentage of net irrigated area. This is largely the function of greater increase in net area sown vis-a-vis net irrigated area. Southeastern Punjab comprising Patiala, Sangrur and Rajpura tahsils, parts of the flood plains, Rohi circle of Fazilka tahsil and a few assessment circles in the Upper Bari Doab are the areas which registered decline in percentage irrigated area. Actual area under irrigation in almost all these tracts increased by a substantial amount. The increase in net area sown in all of them, however, has been still greater causing relative decrease in percentage of net irrigated acreage. Varying degree of decline in these parts has been the outcome of the differential rates of increase in net area sown and net irrigated area.

Thus, decline in percentage of net irrigated area
in the state has been largely a feature of two types of areas; (i) where absolute acreage under net irrigation has decreased and (ii) where development of irrigation has failed to keep pace with the expansion of cultivation.

CONCLUSIONS

With more than half (52.9 per cent) of its net area sown receiving irrigation in 1966, Punjab was the most irrigated state of the country. Alluvial plain topography, favourable sub-soil water conditions in most of its parts, presence of three large perennial rivers which feed irrigation channels the year round, consolidated landholdings, better economic conditions of the farmers and determined efforts of the people and the government largely explain the superior position of the state in this regard. The scope for further expansion of irrigation, however, is still wide. Accounting for nearly the whole of the irrigated area, canals and wells/tubewells are almost the exclusive means of irrigation. With advancements in technology and increase in the availability of power, traditional persian wheel irrigation has been replaced to a considerable extent by more efficient tubewell irrigation.

Practice of irrigation cultivation is common in almost all parts of the state. Larger development in this field, however, has been a feature of only those areas of the
state where irrigation (may be through canals, wells and tubewells or both) was introduced at an early date. Most of the Upper Bari Doab, southcentral Bist Doab, southwestern Ferozepur district and northern Malwa are the areas of the state where irrigation has a long history. As such, these parts of Punjab enjoy maximum irrigation. By comparison, the sub-montane zone, the flood plains, a few dune infested tracts in the semi-dry southwest and the Dona belt of the Bist Doab, which suffer from one physical handicap or the other, have remained considerably backward in this regard.

Excepting a few assessment circles where waterlogging and dissection of land has become serious during recent years, Punjab recorded an increase in absolute acreage under net irrigation. Increase, however, was considerably high in the Malwa where new canals have been recently extended, and old ones were renovated and supplemented with more water; southcentral Bist Doab where well and tubewell irrigation was given a great fillip and the Bist Doab Canal System was introduced since 1954. On the other hand, the sub-montane zone due to its dissected hilly terrain, and the flood plains where waterlogging continues to impede the progress of irrigation experienced low increase. Most of the Upper Bari Doab, where proportion of irrigation was already high in 1951, thereby offering limited scope for further expansion, also falls among the areas of low increase. The decline in
percentage of net irrigation in a larger number of assessment circles in the state is mainly the function of faster increase in net area sown vis-a-vis area under net irrigation.

Associated with these changes is the dynamics of cropping patterns in the state which is being taken up for detailed investigation in the next chapter.