CHAPTER V

IRRIGATION

In tropical areas dry farming is possible with 20 to 30 inches of rainfall but it is precarious and the production is meagre. Where rainfall ranges between 12 and 20 inches farming without irrigation is very limited and if it decreases to less than 12 inches, agriculture is impossible without irrigation.

The eastern one-third of the Malwa receives 20 to 30 inches of total annual rainfall and over the western two-thirds of the tract, it is between 10 and 20 inches (Fig.7). This rainfall is small in amount, seasonal in character and is highly variable.

Table 9

Amount and Variability of Rainfall at Selected Stations of the Malwa.
(Normal Figures)

<table>
<thead>
<tr>
<th></th>
<th>Kharar</th>
<th>Ludhiana</th>
<th>Moga</th>
<th>Fazilka</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Rainfall</td>
<td>28.28&quot;</td>
<td>25.58&quot;</td>
<td>17.47&quot;</td>
<td>9.76&quot;</td>
</tr>
<tr>
<td>Summer Rainfall</td>
<td>22.46&quot;</td>
<td>19.93&quot;</td>
<td>13.46&quot;</td>
<td>7.21&quot;</td>
</tr>
<tr>
<td>Winter Rainfall</td>
<td>4.29&quot;</td>
<td>3.51&quot;</td>
<td>2.67&quot;</td>
<td>1.80&quot;</td>
</tr>
<tr>
<td>Annual Rainfall Variability</td>
<td>22.1%</td>
<td>24.5%</td>
<td>29.6%</td>
<td>34.7%</td>
</tr>
<tr>
<td>Summer Rainfall Variability</td>
<td>29.3%</td>
<td>35.8%</td>
<td>46.1%</td>
<td>55.7%</td>
</tr>
<tr>
<td>Winter Rainfall Variability</td>
<td>60.9%</td>
<td>68.1%</td>
<td>75.2%</td>
<td>91.0%</td>
</tr>
</tbody>
</table>

Source: Compiled and worked out from the rainfall data available in the Office of the Director of Land Records, Jullundur.

Table 9 indicates that the lesser the amount of rainfall the higher is its variability. The amount and character of rainfall in most of the region is thus such that need of additional water supply for successful cropping has always been felt and some sort of irrigation has always been practised in the area since ancient times.

The development of present irrigation facilities started during the latter half of the nineteenth century when shortage of food for the rapidly growing population was realized by the British Government which by that time had established itself firmly. The first practical step was the construction of Sirhind Canal and the water supply from this canal transformed the so called 'jungle' into a most productive region of the Punjab. The irrigation facilities have steadily been increasing since then and at present about 55 per cent of the total cropped area of the region is irrigated.

The table given below indicates the irrigated area and its relation to the amount of rainfall in different districts of the region. The acreage of irrigated area in different districts increases with the decrease in the amount of rainfall.

Table 10
Rainfall and Irrigation in the Malwa Tract.
(Average 1952-57)

<table>
<thead>
<tr>
<th>District</th>
<th>Cropped Area</th>
<th>Irrigation (Acres)</th>
<th>Percentage of Rainfall (In creped area, inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambala</td>
<td>2,80,067</td>
<td>52,315</td>
<td>18.69</td>
</tr>
<tr>
<td>Patiala</td>
<td>8,41,538</td>
<td>3,95,520</td>
<td>47.11</td>
</tr>
<tr>
<td>Ludhiana</td>
<td>7,98,684</td>
<td>4,87,091</td>
<td>60.99</td>
</tr>
<tr>
<td>Sangrur</td>
<td>11,33,547</td>
<td>6,64,972</td>
<td>58.66</td>
</tr>
<tr>
<td>Bathinda</td>
<td>16,21,611</td>
<td>8,01,966</td>
<td>49.45</td>
</tr>
<tr>
<td>Ferozepur</td>
<td>20,56,690</td>
<td>13,01,277</td>
<td>63.27</td>
</tr>
<tr>
<td>Malwa</td>
<td>67,32,137</td>
<td>37,04,141</td>
<td>55.02</td>
</tr>
</tbody>
</table>

Source: Compiled from the revenue records available at the headquarters of the tahsils of the Malwa Tract.
MALWA TRACT (PUNJAB)

WATER-TABLE

OCT. 1957

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DEPTH OF WATER-TABLE
FACTORS FAVOURING THE DEVELOPMENT OF IRRIGATION.

The region forms a part of the extensive Indo-Gangetic Plain which slopes very gently from the east to the west. Before the introduction of canal irrigation it was ascertained that water of the Sutlej can be spread over an immense area to the south and south-west. Moreover, as the sediments are very soft and the region is plain with a favourable slope, the digging of canals is very easy and cheap and water can be distributed over the region without much expense.

The sub-surface of the region consists of alternate layers of sand and clay; therefore, the water-table is not very low (Fig. 20).

The porous soil of the region absorbs large quantities of rain water and adds to the underground reservoir. Moreover, the percolation of this water along with the water from the Sutlej and various other channels is instrumental in keeping the water-table high. The construction of wells and tube-wells, in areas where water-table is not deep and where water-bearing strata are thick enough, is cheap and economical.

The soil in this region is an important factor which has given an impetus to the development of irrigation. Nature of the soils of the region is such that they are neither excessively porous nor too heavy to retard the percolation of water. They vary from sandy loams to clayey loams, best suited for irrigation. Further, the soils are deep enough and there is no hard rock near the surface which can make the shallow soil water-logged.

MALWA TRACT (PUNJAB)
IRRIGATION METHODS
AVERAGE 1952–57
Fig. 21

20 MILES
10
0
Nature has been benevolent enough to this region by providing it rivers the water of which compensates the dearth of rainfall. Fed from the snow-clad Himalayas, the Sutlej flows along the northern border of the Malwa and is a perennial source of water.

In some tracts where canal water cannot be taken, the underground quantity of water is quite enough and lies near the surface and can be tapped very economically. This is the case in the flood plain of the Sutlej and the north-central part of the Malwa.

**MAIN SOURCES OF IRRIGATION.**

Canals, wells, tube-wells and 'kuls' are the sources of irrigation in the area. Out of these canals and wells are the major two sources of irrigation. The 'kuls' being taken out from the small and seasonal rivers, are restricted to a small area. The tube-well irrigation holds promise for future irrigation development.

The sources of irrigation vary within the region in accordance with variations of topography and water-table. In the vicinity of the Siwalik hills, the land is comparatively high and is also dissected by numerous streams making it unfit for canal irrigation. On the other hand low and reliefless plain towards the west and the south-west is most suited for this type of irrigation. Water-table all along the Sutlej and over most of the eastern half of the Malwa is very near the surface making well-irrigation more feasible.

Thus towards the Siwalik hills canals are absent and the whole of the irrigation is done by wells. On the other
hand in western Bhatinda and southern Ferozepur wells are totally absent and the whole of the irrigation is done by canals. In the central tracts conditions are favourable for both types of irrigation (Fig. 21).

Canals: Canals are by far the biggest source of irrigation and 68 per cent of the total irrigated area receives water from them.

Only Kharar and Rupar tahsils and the 'Bet' circles of Ludhiana district are without canals (Fig. 22) because topography does not favour their development in the former and the presence of enough moisture in the soil and high water-table in the latter. In the rest of the region canal irrigation is practised.

Three big canals take out from the Sutlej irrigating the Malwa. The whole of the central and south-western region is irrigated by the Sirhind Canal whose branches and distributaries have reached the farthest points of the area (Fig. 22). In the extreme north-west along the Sutlej, a narrow tract of Ferozepur district is irrigated from the Eastern Canal. In the east and south-east (the eastern section of Patiala district and parts of Samrala tahsil) a similar small tract is irrigated by the Bhakra Nangal Canal. In the Ferozepur district the distributaries of Sirhind Canal are supplied additional water from the newly constructed Sirhind Feeder with head-works at Harike.

The Sutlej is a perennial river but its flow is very irregular. The maximum discharge is recorded during the hot and monsoons period, i.e., from March to August. The volume
of water begins to shrink from September onwards and the minimum is in December. As a result, the river supplies maximum amount of water to the canals during the summer season, i.e., from April to September, and the supply is very small during the winter season. Table 11 shows the mean discharge in different canals during the different seasons. The seasonal variations of water in the Sutlej (mean discharge of the Sutlej is about 20 times more in summer than in winter) determine the amount of water supplied to the canals. After the completion of Bhakra Dam all the excessive water of the summer season will be stored so as to supply more and regular water during the winter season.

Previously, the Eastern and the Grey Canals were the non-perennial canals which irrigated the land adjoining the Sutlej. Now the Eastern Canal has water throughout the year and the Grey Canals which used to flow for four months between May and October in a year, have regular water supply from May to the end of October. These canals are now fed by the Sidhwan Branch of Sirhind Canal and they supply water

### Table 11

Mean Discharge of the Various Canals in the Malwa (In Cubic Meters) 
(1956-57)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sirhind Canal</td>
<td>8333</td>
<td>6671</td>
<td>4116</td>
<td>5408</td>
</tr>
<tr>
<td>Bhakra Nangal</td>
<td>4090</td>
<td>1428</td>
<td>651</td>
<td>1044</td>
</tr>
<tr>
<td>Canal</td>
<td>1661</td>
<td>348</td>
<td>223</td>
<td>286</td>
</tr>
</tbody>
</table>

far sawing both the 'kharif' and the 'rabi' crops.

The distribution of water supply in the canal-irrigated area is not the same in tracts which they cover. The canal water-supply is more in the western than in the eastern districts. In the western side, i.e., Bhatinda and southern Ferozepur districts, more canal water has to be supplied in order to meet the deficiency in rainfall and underground water.

Table 12

<table>
<thead>
<tr>
<th>District</th>
<th>Irrigated area as per cent of the annually cropped area</th>
<th>Percentage of cropped area irrigated by canals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ludhiana</td>
<td>60.99</td>
<td>17.32</td>
</tr>
<tr>
<td>Patiala</td>
<td>47.11</td>
<td>8.02</td>
</tr>
<tr>
<td>Sangrur</td>
<td>58.66</td>
<td>36.38</td>
</tr>
<tr>
<td>Bhatinda</td>
<td>49.45</td>
<td>48.42</td>
</tr>
<tr>
<td>Ferozepur</td>
<td>63.27</td>
<td>56.88</td>
</tr>
</tbody>
</table>

Source: Compiled from the revenue records available at the headquarters of the tahsils of the Malwa Tract.

Wells: The practice of irrigation from the wells is very old in the region and unlike canal irrigation its development is due to the initiative of the individual farmers. At present about 30 per cent of the total irrigation in the Malwa region is done by wells.

The distribution of wells in the region is very uneven and is governed mainly by the depth of water-table. Other factors which affect the development of wells are the thickness of water-bearing strata, the quality of underground water
and the amount of rainfall. The depth of water-table is by far the most potent factor which limits the construction of wells for irrigation. Roughly speaking, in areas where the depth of water is more than 30 feet (Fig. 20) wells for irrigation are very few. More than 99 per cent of the wells are found in areas where the depth of water-table is less than 30 feet (Fig. 20 and 23).

There is a greater concentration of wells in the north-eastern side of the region, i.e., in western Sirhind, eastern Upper Dhaial circles of Ludhiana, Nabha and the adjoining portions of Malerkotla and Patiala tahsils. In this area water-table lies 10 to 25 feet and the underground water reservoir is very thick. Each well can irrigate more than 15 acres of land. Two sets of persian wheels fitted on one well are frequently found. The number of wells in proportion to the cultivated area is very high in this area. From this region of concentration, the number of wells decreases in all directions. Fig. 23 indicates that the decrease towards the south-west and west is very rapid as compared to the eastern and south-eastern parts of the Malwa. The steep downward gradient of water-table along the eastern side of Bhatinda district (Fig. 20), restricts the construction of wells for irrigation. In western Bhatinda and south-western Ferozepur districts water-table is more than 50 feet deep. In addition to the depth of water-table the quantity of underground water is meagre and

* Actual figure is not possible to be calculated from the available data because well and tube-well irrigation is recorded together and there is no area where tube-wells are not present.
Table 13
Land for which one well is available for irrigation in the Well Irrigated Areas of the Malwa.
(Average 1952-57)

<table>
<thead>
<tr>
<th>S.W. Region</th>
<th>Central Region</th>
<th>E.&amp; S.E. Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land for which a well is available for irrigation</td>
<td>Land for which a well is available for irrigation</td>
<td>Land for which a well is available for irrigation</td>
</tr>
<tr>
<td>Acres</td>
<td>Acres</td>
<td>Acres</td>
</tr>
<tr>
<td>Malerkotla</td>
<td>50</td>
<td>Sirhind</td>
</tr>
<tr>
<td>Sangrur</td>
<td>61</td>
<td>Nabha</td>
</tr>
<tr>
<td>Barnala</td>
<td>158</td>
<td>D.U. Samrala.</td>
</tr>
<tr>
<td>Mansa</td>
<td>1000</td>
<td>D.U. Ludhiana.</td>
</tr>
<tr>
<td>Bhatinda</td>
<td>1962</td>
<td>Powadh Ludhiana.</td>
</tr>
</tbody>
</table>

Source: Compiled from the revenue records available at the headquarters of the tahsils of the Malwa Tract.

contains too much of salts. Thus in this region wells for irrigation are totally absent.

Towards southern Patiala and Rajpura tahsils water-table lies 20 to 25 feet deep. The thickness of water bearing stratum is comparatively thin. But the main hindrance in the construction of wells is the presence of a peculiar mud, locally known as 'lehli', through which the wells cannot be sunk deep. In area which adjoins Sirhind and Nabha tahsils about 15 acres are irrigated by each well but in 'Neli' of Patiala less than

10 acres are irrigated by a single well.4

Towards the Siwalik hills the water-table is near the surface but the water bearing stratum is very thin and whatever underground water is available it is found in a fine mud which gushes out along with water and chokes the well in a short period. All along the Siwalik hills each well irrigates less than five acres of land. People prefer to rely upon rainfall, which is fair enough, rather than to spend so much upon this uneconomic venture. Throughout the 'Bet', wells for irrigation are important because the water-table is kept near the surface by the percolation from the Sutlej. The intensity is, however, less especially towards the two ends of the flood plain. In Eastern 'Bet' the high water-table combined with fair amount of rainfall keeps the soil moist throughout the year requiring little extra water. In the western 'Bet' the water from the canals is also available which is cheaper than the water from the wells consequently the development of wells for irrigation is restricted. The wells are used more in the rabi than in the kharif season. During the kharif season the eastern half of the halwa has considerable amount of rainfall and many crops can mature without irrigation. In the western half though the rainfall is small yet the canals have ample water; therefore, in both sides wells are not much in use. In north-western Ferozepur district 75 per cent of total

♦Rabi is the winter season and Kharif is the summer season.
irrigation from the wells is during the rabi due to the restricted canal water. During the kharif, Eastern Canal supplies ample water thus sparing the working of wells. In the eastern side, i.e., in Ludhiana district, Rupar, Kharar, Rajpura and Patiala tahsils, 50 to 60 per cent of total irrigation is in the rabi season while it is 60 to 75 per cent in the central parts of the Malwa. The comparatively more irrigation during the kharif in eastern parts is because wells are the only or the major source of irrigation.

**Tube-wells:** Though a recent introduction, the scope of irrigation from tube-wells is bright over most of the eastern Malwa. The favouring factors are the high water-table, good rainfall and abundant water in the substratum. The water-bearing stratum which is the deciding factor for the tube-wells, is sufficiently thick over most of the region. The area being comparatively near the mountains receives more rainfall, large quantities of which percolate to the underground reservoir eliminating the chances of its exhaustion, unless excessively exploited. The economic consequences of tube-well irrigation also favour the development of tube-wells. The canal water so spared from this area can be better utilized in western parts of the state where the rainfall is meagre and water-table very deep. Much time and labour which is now spent in working the wells, can be saved and utilized in other pursuits. More land can be brought under irrigation which is at present not commanded by the existing wells and also that of poor farmers who can not afford to sink wells on their own.

The individual ventures by the farmers in the
construction of tube-wells have met with a partial success. The main causes are the initial high cost of sinking and the prevailing high fuel prices. At the present time there are very few tube-wells which are owned by the farmers. The wells have been mainly constructed with the loans and grants advanced by the government.

The main hindrance is still the non-availability of finance, but now the government has planned tube-well irrigation for this area. Finance, technical assistance and equipment are coming under the T.C.A. and Green More Food Schemes and the electric power supply from Bhakra Nangal Project.

Of course, an extensive tract is suitable for the sinking of the tube-wells, only most favoured as well as deserving areas have been chosen in the first phase, mainly because of limited financial resources. Fig. 24 shows areas where tube-wells have been sunk during the First Five Year Plan, and areas where tube-wells are proposed up to the end of the Third Five Year Plan period. In all 558 tube-wells have been sunk during the First Plan period, 303 in Malerkotla Deraha area, 55 in Samrala-Rupar area and 159 in Rajpura-Banur area. On an average 650 acres are proposed to be irrigated by a tube-well for which it has to run for 5640 hours a year.

Inspite of all the favourable conditions the first phase of the extension of tube-well irrigation has not been upto the mark, the reason for this being the high-rates

of water supplied from these tube-wells. The farmers who had wells of their own in the commanded area of a tube-well preferred to irrigate their crops from the wells rather than to buy this costly water. The irrigation from the wells does not take anything from their pockets because the labour and draught animals are already there at their disposal and can be used without any additional expenditure. The second reason has been the very slow development of water courses and much of the water remained unutilized. However, now all the impediments have been removed. Cost of the tube-well water has been reduced to 50 per cent of the original water, channels have been constructed throughout their commanded areas and more and more people are tempted now to utilize the tube-well water.

'Kuls'- These are the narrow and small channels of water taken out from seasonal streams for irrigation and are notified under the Minor Canals Act. This source is used in two submountaneous tracts of Ambala district; Ghar Bet circle of Bupar tahsil and Neli circle of Kharar. In the former 'kuls' are taken out from the Sirsa river while in the latter from the Ghaggar. In Neli circle of Kharar this is the only and most important source irrigating annually about 68 per cent of the total cropped area.

Though the bulk supply of water in the 'kuls' is only during the monsoons yet some water is available in winter also as whatever the amount of water is present in the Ghaggar, during this season, is diverted into these 'kuls'.

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This tract has, therefore, 'kul' irrigation both in the kharif and in the rabi seasons.

Over the rest of the region this source is totally absent.

DISTRIBUTION OF IRRIGATED AREA.

The percentage of cropped area under irrigation from all sources in the region increases from east to west; or in other words meagre rainfall is compensated with greater intensity of irrigation. It also varies with the type of the source employed for irrigation. Thus in areas where wells are the only source, less acreage is irrigated because of a physical limit imposed on the lifting of water. On the other hand, where canal is the main source there is no such limit provided the water supply in the canal is adequate. Comparing the maps showing rainfall, canals, number of wells and total irrigated land, it is clear that irrigation is small where rainfall is considerable and wells are the only source of irrigation. Irrigation is more in areas where rainfall is inadequate and where canals are the only source of irrigation. Again it is more in areas where restricted canal development is compensated by the wells (Fig. 25).

Tracts with less than 15 per cent of land under irrigation are termed as the areas of very low proportion of irrigated land. Those with 15 to 30 per cent are the areas of low proportion. Medium proportion of irrigated land is from 30 to 45 per cent and the high proportion areas are with 45 to 60 per cent of the land under irrigation. The areas of very high proportion of irrigated land are these
where more than 60 per cent of the land is irrigated.

**Areas of Very Low Proportion of Irrigated Lands:** Areas with this proportion form a small region in the extreme eastern side of the Malwa and covers Rajpura, Kharar (except Neli) and Rupar (except Dhaia) tahsils and the Bet and Lower Dhaia circle of Samrala tahsil. Towards the northern side, the percentage of cropped land under irrigation varies between 10 to 15 while towards the east and southeast it is less than 5. The main reasons are the physical handicaps in the development of irrigational facilities. The canal irrigation is non-existent except in a few villages of Rajpura tahsil because of higher and dissected nature of the land. The only source is the wells which also are limited because the underground water-bearing stratum is thin as well as less suited for the construction of wells. Adequate amount of moisture present in the soil also restricts the construction of wells especially in the 'Bet' where land remains moist for many months in a year partially because of high water-table and rainfall and partially due to the frequent floods in the Sutlej.

**Areas of Low and Medium Proportion of Irrigated Lands:** These two categories are taken together as the area coming in this range is very small. One is the Dhaia circle of Rupar, the second one is the 'Bet' and Lower Dhaia circles of Ludhiana and Jagraon tahsils and the third, which lies in extreme west, comprises of the Rohi circle of Ferozepur and Hithar and Guru Harshahai circles of Muktsar tahsil.

In the Dhaia circle of Rupar, canal irrigation is almost absent and wells are the only source of irrigation.
Conditions for the development of irrigation are better here than in the extreme eastern tract. The scope of extension of well irrigation is there. Canal irrigation is also possible but is denied because of the potentialities of underground reservoir and irrigation from the tube-wells has already been introduced in this tract.

In the 'Bett' circle of Ludhiana and Jagraon, conditions are similar to those of Samrala and Rupar areas, and comparatively high percentage of irrigated area is due to the fact that rainfall is somewhat less and the underground water conditions for the development of wells are better.

In the Rohi circle of Ferozepur, Hithar Kot Kapura and Guru Harshahi tracts the amount of irrigation is small as compared to the surrounding areas. This is due to the fact that irrigation both from wells and canals is little developed here as compared to that in the adjoining tracts. The number of wells on account of deep water-table and limited availability of underground water is not so large which can command huge acreage. This area again lies at the tail of the Grey Canals where limited and uncertain amount of water is available for irrigation.

Areas of High Proportion of Irrigated Lands: Areas where 45 to 60 per cent of total cropped acreage is irrigated are found in two extensive belts and several scattered pockets. Sirhind and Patiala tahsils constitute the eastern belt where about 50 per cent of the cropped area is irrigated. The abrupt increase in this tract from the Kharar - Rajpura region is due to the fact that both canal and well irrigation
facilities are present. Only in these areas which are adjacent to Kharar and Rajpura tahsil's canal irrigation is absent and the number of wells for irrigation is also limited. So it is only because of these small areas that the proportion of irrigation of the whole block is kept somewhat lower, otherwise western side of this block has the maximum development of irrigation, contributed both by wells and canals. In Sirhind tahsil the increase in irrigated acreage is a recent one which has become possible with the commissioning of Bhakra Canal. Patiala tahsil has also started receiving additional water from the Narwana Branch of the same canal.

The second belt covers Mansa, Bhatinda, Nathana, Paridkot, and Barnala tahsils. The region is irrigated from Abohar, Bhatinda, Kotla and Ghaggar branches of the Sirhind canal. This area is surrounded on all sides by comparatively more-intensively irrigated areas. There are two reasons for less irrigation in this area. Firstly, this area was formerly in the Native Princely States having a smaller share of canal water. The same proportion of water supply is existing in this area. Secondly, leaving aside the north-eastern side irrigation from wells is completely absent, thus there is no other source which would supplement the limited canal water supply.

Western 'Bet' of Ludhiana, Bet Mamdot and Hithar of Fazilka have also similar intensity of irrigation. In the former tract this proportion is higher as compared to that in its counterparts of Jagraon and Samrala tahsils mainly because of better underground water facilities. In addition to the wells, tube-wells also irrigate a considerable acreage
of this tract. In the latter two tracts, irrigation is less when compared to the surrounding tracts mainly because of seasonal supply of canal water and limited development of wells for irrigation.

Areas of Very High Proportion of Irrigated Land: In this category fall the areas where more than 60 per cent of cropped land is irrigated. A vast area covering most of Ferozepur district (except a few patches), upper Dhaia circles of Ludhiana district and Nabha, Malerkotla and Sangrur tahsils constitutes this category. Over most of the western and southwestern part of the Malwa, i.e., Rohi of Fazilka and Rohi and Uttar of Muktsar, excellent canal irrigational facilities are available. Though the tract lies at the tail of the distributaries of Abohar and Bhatinda branches even then an adequate amount of water is supplied because rainfall is very meagre and wells are totally absent. So cropping is possible only with ample water supply from the canals. At the present time additional supplies are available to this area from the Sirhind Feeder.

In spite of the fact that the canals are seasonal, irrigation throughout the 'Bet' of Ferozepore district is enough. This is because of the regime of the Eastern and the Grey Canals that water is available for sowing of both rabi and kharif crops. Again, canal water is considerably supplemented by the wells especially in Zira tahsil where they contribute about 50 per cent of total irrigation.

In upper Dhaia circles of Ludhiana and in Moga, Nabha, and Malerkotla, the intensity of irrigation is high
in spite of the limited availability of canal water. It is mainly due to the excellent development of well irrigation which contributes one-half to two-thirds of the total irrigation. In Dhaia circle and Nabha tahsil there is one well for every 30 acres of cultivated land. The water supply in the wells is also sufficient and each well can irrigate 15 to 20 acres of land. Towards the south, i.e., in Sangrur tahsil the importance of wells decreases but the water from canal increases keeping the same proportion of irrigation as is found in Nabha tahsil.

In the extreme eastern side of the Malwa is a small pocket of land with highly developed irrigational facilities. It lies between the Ghaggar and the Sukhna and is known as 'Neli'. It is covered by the 'kuls' taken out from the Ghaggar irrigating about 65 per cent of annually cropped acreage.

SEASONAL DISTRIBUTION OF IRRIGATED AREA.

The proportion of irrigated land is not the same in the two harvests, nor is the relative importance within each harvest equal. This is because climatic conditions, moisture requirements and the amount of water available for irrigation differ during the kharif and the rabi crop seasons. During the kharif season, June to September, temperature is very high. Consequently the rate of evapotranspiration is high. On the other hand during the rabi season as the temperature is low the evapotranspiration is also less. As a result more of water is required during the kharif than in the rabi season. But the regime of rainfall
MALWA TRACT (PUNJAB)
KHARIF IRRIGATED ACREAGE
PER CENT OF KHARIF CROP AVERAGE 1952-57

Fig. 26
is such that 75 per cent of the annual amount of rainfall coincides with the Kharif crops season, meeting most of the water requirements, especially in areas where it is more than 20 inches. In such areas little additional water is required. It is only in the western Malwa, Ferozepur and Bhatinda districts where the rainfall is very small, that an additional supply of water is essential. During the rabi season evaporation is small but at the same time rainfall is also meagre. Again, not only the growing season stretches over a longer period but sowing and maturing periods of the rabi crops have comparatively high temperatures, making irrigation as important as in the Kharif.

In the Malwa as a whole, the amount of irrigated area is almost equally distributed among the Rabi and the Kharif crops. But the position differs from the eastern to the western side. Over the eastern two-thirds of the Malwa, irrigated acreage in the rabi is slightly greater than in the kharif season, but in the extreme west, i.e., in Fazilka, Muktsar and Faridkot tahsils irrigated acreage in the kharif

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Table 14

Acreage Irrigated in the Rabi and the Kharif Seasons. (Average 1952-57)

<table>
<thead>
<tr>
<th>Area</th>
<th>'Annual Irrigated in Kharif'</th>
<th>% of % of</th>
<th>'Annual In Rabi'</th>
<th>% of % of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malwa Tract.</td>
<td>3704141</td>
<td>1832570</td>
<td>187151</td>
<td>49.43</td>
</tr>
</tbody>
</table>

Source: Compiled from the revenue records available at the headquarters of the tahsils of the Malwa Tract.

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is more than in the rabi. In the former tract because of better rainfall in kharif season much cropping is done without irrigation and most of the water is supplied to those crops which require greater amount of water. A comparatively large irrigated acreage in the rabi season is because of the fact that most of the crops require less water and few waterings, thus a smaller quantity of water is spread over larger area. Moreover, the canal water in this season is supplemented from the wells.

In Fazilka, Muktsar and Faridkot tahsils, because of meagre rainfall, cropping without irrigation during the kharif is impossible. Secondly, adequate water is available in the canals so that more than 75 per cent of the crops during the kharif are sown with irrigation (Fig. 26). In comparison to kharif, irrigated acreage is less in rabi because of limited canal water supply during the winter and complete absence of well irrigation. Thus in the whole of Faridkot tahsil and southern circles of Fazilka and Mukhtsar tahsils less than 50 per cent of the rabi crops are grown with irrigation.

**CONCLUSION**

The amount of rainfall over most of the region is not enough for a profitable farming and at present more than half of the cropped area receives additional water from canals, wells, tube-wells and 'kuls'. 'Kul' irrigation is small and is confined to the eastern-most side of the Malwa immediately in the foot of the hills. About one-third of total irrigation is from the wells and tube-wells, mainly
in the north-eastern side of the region. Well irrigation is also important all along the Sutlej. In both these areas under-ground water is tapped quite economically. About two-thirds of the total irrigation is from the canals and south-western parts of the Malwa are most important for it. It is an area where the rainfall is small and where wells are either absent or are insignificant. The proportion of irrigated area increases with a decrease in the amount of rainfall. However, it is also affected by the source of irrigation employed in different areas. The maximum is in Ludhiana, western Patiala and Sangrur districts because both wells and canals supply water for irrigation. The intensity is again high in south-western parts of the region; irrigation here is from the canals alone. It is the eastern and south-eastern sides of the region - Kharar, Rajpura and eastern Rupar - where the amount of irrigation is very small because of the various physical limitations.