CHAPTER IV

DEVELOPMENT OF WATER RESOURCES

Irrigation is the application of water or method of supplying additional water to crops in the areas where the rainfall is scanty or irregular. Irrigation water may be comes from (1) natural flow of streams (2) obtained by damming or otherwise regulating the flow of streams (3) pumped from underground sources by means of tube wells. It may be applied to the crop by flooding, by channels or by spray. Water resources are the pre-requisite condition for agricultural development and one of the essential bases and the foundation of farming in dry lands. With a poor water supply the otherwise productive dry lands tilled by assiduous farmers have only an inferior and subsistence farming and a low standard of living for the peasantry. With sufficient and assured water supply to the same the farming is superior, stable, diversified, and commercially profitable and the standard of living of a peasant proprietor is improved. Water resources are categorized as surface water resources and ground water resources. Surface water resources may be natural or man-made resources. Several water resources may be utilized pump from ponds, lakes, wells, canals, embankments and rivers; basin systems and dams hold back larger streams and annual floods, to meet the same requirements. The chapter is divided into six sections. The first section is a brief historical background of irrigation. Second section deals with the survey of water resources in colonial India. The development of irrigation in colonial Punjab, discuss in third section. The fourth section focuses on south-east Punjab with different sources, projection of irrigation schemes. In the fifth section, the irrigated area and district wise development of water resources were focused. The last section is of an overview of irrigation development and problems.

1 Water resources may be defined as different means, which provide water for usefulness for agricultural output, and is a part of the earth’s water circulatory system. In India and the U.S.A. vast areas of land, hitherto worthless, have been put to useful account, while in Egypt depends almost entirely upon irrigation. Sir John Hammer (ed.), The New Universal Encyclopedia, Vol. 8, The Government Book Company Limited, London, n.d., 4583.
Irrigation has not only proved beneficial for increasing produce from the land but it forms the datum line for successful sustained agriculture.² It alleviates suffering, preserves life, averts famines and advances the material prosperity of the country. In fact, as pointed out by Sir Charles Trevelyan, an administrator, "Irrigation is everything in India. Water is more valuable than land, because, when water is applied to land it increases its productiveness at least six fold and renders great expansion of land productivity, which other wise would produce nothing or next to nothing."³

Successful cultivation cannot be assured for any considerable period unless irrigation facilities are available. The success, however, as remarked by Royal Commission of Indian Agriculture, depends in a very large measure upon adequate and regular water supply. It was because of this realization of the supreme importance of irrigation in India that several irrigation schemes were initiated by the colonial rulers.⁴ Mufakharul Islam is of the opinion that "irrigation works have the same value to our great agricultural province as the coal and iron mines to Britain and gold mines to the Transvaal."⁵

In the colonial period, the irrigated area in India increased from about less than a million hectares in 1800 to about 5 million hectares in 1900 and 17 million hectares in 1925. At the beginning of the Plan period (1951), the area under irrigation was 22.6 million hectares.⁶ Consequently, the yield of major crops increased 49.8 million tons in 1913-14 to 52.3 million tons in 1927-28.⁷ The area under irrigation in modern India is larger than the area irrigated in any other country of the world, two and a half times the area irrigated in U.S.A.; and

⁴ Royal Commission of Indian Agriculture, 1928, 325.
⁵ Mufakharul Islam, Irrigation, Agriculture and the Raj: Punjab, 1887-1947, Manohar, 1907, 21; according to the view, other monuments were railways, law and civil service; Ibid., 22-22.
⁶ C.B. Mamoria, Agricultural Problems of India, 189.
it exceeds the combined acreage under irrigation in U.S.A.; U.S.S.R.; Japan; Italy; Egypt; and Mexico. These five countries occupied roughly ten times the area of the Indian Union. Even then in India the acreage under irrigation was very inadequate before 1950. Only 17 percent of the land was under irrigation as against 55 percent in Japan, 48 percent in Pakistan, 46 percent in China, 30 percent each in Indonesia and Malaya.  

Irrigation had been extensively practiced from the time immemorial and has helped in the success of agriculture. It has been recognized as an important element even in the Chalcolithic period, when irrigated farming was developed. Hence, Chalcolithic age is also called the ‘age of irrigated farming’. In the Vedic age, land in northern India was well watered and had seven rivers. There is a reference to craftsmen (ribhus) who led forth the rivers (R.G. IV, 4.1.7); the reference was to irrigation by channels taken from the rivers. In the Mauryan period, too irrigation by channels was carried out. The Arthashastra enjoined, ‘those who irrigate land by manual labour shall pay 1/5th of the produce as water rate Udakabhagan; by carrying water on shoulders, ¼ of the produce. The most important development of the period 1. A.D. to A.D.300 was the spread of irrigation. In the irrigation systems of the Cholas, ‘anicuts’ were built across rivers, and chains of tanks along the courses of small streams were the proud achievements of southern India. The Chola king, Karikala (C.A.D.190) and his successors constructed the canals, Vennara and Arabic, which took off from the Cauvery for irrigation.  

Archaeological remains testify to the great antiquity of irrigation tanks in peninsular India. Many remains of the pre-colonial system of south India dams anicuts, tanks and canals are described in Buchanan’s great survey of south-India in 1800-01. In the Dakhin the practice of leading off some canals from rivers and streams was, like that of making reservoirs, an ancient one. Irrigation was also a major concern of the rulers in the medieval times. The principal means employed for the artificial irrigation has been the construction of wells,

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10 Rigveda, IV, 4.1.7, Ibid.
tanks and canals. In the upper Gangetic plains, as also the parts of Dakhin, wells must have provided the chief source of irrigation. The ‘Persian wheel’ (arhat, or rahat) was also used in the west Punjab. Around Agra and further east, the charas, or leather bucket lifted out of water by yoked oxen, pulling a rope thrown over a pulley was most common. An extensive system of irrigation by canals was set up for the first time by Firuz Shah Tughlak during the second half of the 14th century. The canal was originally cut by Firuz Shah Tughlak (1351-88). Essentially, Firuz Shah's canal was designed to force water from the Yamuna (Jumuna) into the Chitang River. According to Afif in Tariikh-i-Firuz Shahi, Firuz Shah had dug two canals to bring a continuous supply of water to the newly built town of Hissar Firuza, but by the sixteenth century his canal seems to have silted up. After this, Shihabuddin, the Governor of Delhi about the year 1560 repaired this canal. Shahjahhan also made a great effort for canal building, for which he has yet to receive due credit. He cut two canals from the Jamuna, and one each from Sutlej and Ghaggar. These mainly benefited the areas around Hissar in modern Haryana. Other smaller canals were also mentioned in Sindh and the Punjab. An important aspect of Indian agriculture in Mughal times was artificial irrigation to supplement the natural bounty of the monsoons. The principal means employed for this purpose was again the construction on wells, tanks and canals. Abul Fazal's account suggests that the crops depended mostly upon rainfall and only partly of wells, giving thus a small contribution of the role of irrigation in agricultural activity to human efforts.

In pre-colonial times rainfall was not the only factor, which affected agricultural production. The flow of water and its fluctuation in rivers and streams was no less important. Agriculture based on inundation (sailaba), for example, was only less precarious than agriculture based on rainfall (barani). Perennial rivers, canals, wells, and streams also provided limited irrigation. In

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14 Satish Chandra, Medieval Indian History, 1206-1526, Har-Anand, New Delhi, 2003, 146.
cases where the river rose and inundated the field seasonally every year, both the irrigation and fertilization, if a layer of the sub-soil is left behind, were purely natural.\footnote{Irfan Habib, \textit{Agrarian System of Mughals}, Oxford, New Delhi, 2003, 31-32.}

\section*{II}

Striking evidence of zeal, and sophistication, of its predecessors in the building of irrigation works confronted the East India Company in 1803 in the kingdoms of Delhi and Tanjore. The East India Company took over and repaired the great irrigation systems of Delhi and Tanjore, which fell to its lot by conquest and cession.\footnote{Dharma Kumar ed., \textit{The Cambridge Economic History of India}, Vol. 2, C. 1757-C.1957, Orient Longman, New Delhi, 1982, 678.} In the north, canals of some hundreds of miles in length took off from the Jumna near its debouchment's into the Gangetic plain to run west and east of the river as far south as the confines of Delhi itself. In the south a very ancient system of anicuts or weirs controlled the movement of water through an intricate network of channels winding through Cauvery Delta. However, in the early nineteenth century, both systems were falling into disrepair.\footnote{\textit{The Cambridge Economic History of India}, 677.} The first professional survey was carried out in 1804 for the Cauvery works. In 1820 the Western Jumna Canal was rebuilt and repaired. Major Cotton's reconstruction of the Grand Anicut at Trichinopoloy in 1836-8 inaugurated the development of modern, large scale irrigation in the Madras Presidency.\footnote{\textit{Ibid.}, 682-83.}

Under the East India Company rule, all irrigation works were the responsibility of the military engineers of the three Engineers corps of the Armies of the East India Company. Thus, the military engineers laid the foundation of modern irrigation system in India. One of these distinguished engineers was Major Proby T. Cautley, of the Bengal Artillery, who constructed the Ganga Canal. Lord Auckland commenced this work when he had to deal with the famine which ravaged northern India in 1837-38. His successor, Lord Ellenborough, however, suspended this work. In 1841, Lord Hardinge sanctioned this project. The Court of Directors, encouraged by the financial results of the East and West Jumna canals, consented to the expenditure of over a million pound sterling over this great enterprise.
In 1842 canal operations were commenced between Kankhal and Hardwar, and though stopped for a time on account of various doubts that had risen with respect to the results of the canal; they were resumed shortly after, permission being given to spend 20 lakhs rupees annually. The canal was opened on 8 April 1854. This was followed by other canals like the Lower Ganga, the Agra, and the Betwa Canals in United Provinces, the Sirhind Canal in Punjab, Muthra canal in Bombay and the Periyar canal in south India. Other notable works were the weirs across the river Godawari near 'Rajmahendry', and across the river Krishna near Vijaiwada. Deoband Branch was completed in 1881, and the Ganga Canal head works made in 1913.\textsuperscript{20}

The appointment of the Irrigation Commission of 1901 by Lord Curzon was to facilitate feasible irrigation projects and deal with the famines that ravaged the country towards the end of the nineteenth century and affected the Deccan with particular severity. The Commission consisting of irrigation and revenue experts who toured the country in 1901 and 1902, and presented a Report in 1903 laying down a definite policy regarding the selection, financing and maintenance of canal works. They, however, added that these works should be developed as soon as possible, because they would be profitable to the government and would increase the total food supply of the country.\textsuperscript{21} To evaluate the utility of such irrigation and the Indian Irrigation Commission (1903) was appointed to deliberate upon the question. In the twentieth century, investment was concentrated on the provinces with the best prospects, Punjab, United Provinces, Sindh and Madras. By the 1920s and 30s attempts were made to diversify the use of India's water resources. By the 1940s the Hydro-electric project trend slowed down and irrigation settled back into its old remunerative ways in most parts of the country.\textsuperscript{22}

The comment of Sir William Willcocks, a leading hydraulic engineer, on the aspects of irrigation in the Deccan is not less striking: He had investigated the conditions in Bengal and discovered that innumerable small destructive rivers

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\textsuperscript{22} \textit{Ibid.}, 679.
of the delta region, which were originally canals constantly, changed their course. Under British rule they were allowed to escape from their channels and run wild. Formerly, these canals distributed the flood waters of the Ganges and provided for proper drainage of the land, undoubtedly accounting for that prosperity of Bengal which lured the rapacious East India merchants there in the early days of the eighteenth century—

"Not only was nothing done to utilize and improve the original canal system, but railway embankments were subsequently thrown up, entirely destroying it. Some areas cut off from the supply of loam-bearing Ganges water, have gradually became sterile and non-productive, others improperly drained, show an accompaniment of malaria. No attempt been made to construct proper embankments for the Ganges in its low course, to prevent the enourmous erosion by which villages and groves and cultivated fields are swallowed up each year." Sir William Willcocks severely criticized the modern administrators and officials, who, with every opportunity to call in expert technical assistance, had hitherto done nothing to remedy the disastrous situation, which was growing worse from decade to decade.23

In the middle of the nineteenth century, a properly organized irrigation department was set up by Captain Napier from the Public Works Department for carrying out public works.24 This department remained under the control of all military works until 1854.25 The canal branch was at the same time put under a Director of Canals. The designation Director of Canals was changed to ‘Chief Engineer of Irrigation Works’ in September 1854. The branches of the PWD, Buildings and Roads and Irrigation, were organized separately in 1868. In 1892, the Government of India agreed to Chief Engineers of both the

25 When all engineering works in the Punjab, Civil, Military or Public, were placed under one department with Colonel Napier as the Chief Engineer. In 1851, Napier was of the opinion that the movable nature of the banks of the Satlej would always be a bar to any permanent works at the heads of these inundation canals. The inundation canals were highly vulnerable to the fluctuating behaviour of the Indus River and so was agriculture dependent on those canals.
branches being designated as Secretaries for their respective branches.\textsuperscript{26} By 1895, the Public Works Department had become a purely Civil Department and was responsible only for Civil Works including irrigation. The administrative changes reflected the growing significance of irrigation works for the colonial government.

In the land revenue system of British India, the Settlement Officer determined the different classes of soil distinguishing not only by the chemical constitution and texture but also by irrigation facilities. In most assessment circles the differences in chemical constitution and texture were much less important than those of water supply, and it is the latter that determined the average productivity of the harvest. Hence, in most Assessment Reports, the soil classification is on the lines of well-land, canal land, flood land, rain land. If rain-lands are further differentiated, the distinction is sometimes between fields, which have a catchment-area, and those, which rely entirely on direct rainfall; more rarely between soils in which clay or sand were predominant. On the whole, the classification depended more on water than on land.\textsuperscript{27} The Settlement Commissioner sanctioned the following soil classification.\textsuperscript{28}

\begin{itemize}
\item[Irrigated]  
1. Chahi \textendash\textendash Intrigated by wells.
2. Nahri \textendash\textendash Irrigated by canals.
3. Abi \textendash\textendash Irrigated by tanks.

\item[Unirrigated]  
4. Sailab \textendash\textendash Watered by inundation.
5. Barani \textendash\textendash Depend of rainfall.
6. Bhur \textendash\textendash Sandy.
7. Tibbi \textendash\textendash Mountaneous land.
8. Dahr \textendash\textendash Naturally irrigated.
\end{itemize}

\textsuperscript{26} Haryana State Gazetteers, Vol. II, Agriculture and Irrigation, Gazetteers Organization, Revenue Department, Chandigarh, 2005, 367-69.

\textsuperscript{27} Land Revenue Settlements in the Punjab, Lahore, 1863, 10-11.

\textsuperscript{28} Punjab District Gazetteers, Vol. VI B, Karnal District, (Statistical Tables), Civil and Military Gazette, Lahore, 1912, 12; and also see, Report on Settlement of the Gurgaon District, Central Jail Press, Lahore, 1888, 120-25.
The main interest of the colonial government was the *abiana* (water tax); out of the total revenues from cultivation, 53.99 crores, 12.5 crores or 23 percent were from *abiana* and well irrigation.\textsuperscript{29} The effort of initiating the canals system was in fact directly linked to the economic requirements of the colonial state. The colonial rulers were predetermined in then concern for canalization in India. They wanted only the maximum revenue through *abiana* with minimum effort. They initiated several schemes in irrigation, so that the agriculture improved from which they could realize the maximum land revenue.

**III**

In the early nineteenth century Punjab, Maharaja Ranjit Singh made efforts to use canal water on a larger scale than any of his predecessors, since no single ruler before him controlled territories large enough to cover a whole canal. In the pre-British times the region had known several means of man-made irrigation system like canals, wells, *jhallars*, embankments, water cuts and river inlets, streams; even *sailaba* or autumnal river flood could be used at least for sowing. There were two perennial canals: Firuzshah’s canal and Shah Nahr. The former was dug in the fourteenth century and latter in the seventeenth century. However, these canals were not continuously in operation. The fate of these canals was intimately linked with the political structures, which created and maintained them. When the supporting political structures collapsed, the canals fell into disuse. They were not functional by the mid-eighteenth century. The Shah Nahar known as Hasli under Ranjit Singh was partially revived in 1806 and it gave some stability to agriculture in the Upper Bari Doab. The Firuzshah Canal had been revived and expanded by Akbar and Shahjahan.\textsuperscript{30}

Between Madhopur and Dinanagar the Hasli Canal irrigated 18,787 acres by 1849. Considerable amount of water from the Ravi was also diverted into the stream dug by constructing a canal near Shahdara. Wazirabad-Jammu area

\textsuperscript{29} Brij Narayan, *Indian Economic Life*, 45.

too had many canals. In taaluqa Narot of Gurdaspur district canals irrigated area was 48 per cent.31

The British conquerors of the Punjab lost no time in carefully surveying the economic possibilities of the newly acquired territory in the 'land of five rivers'. One of the first features noted was the presence of the various irrigation schemes dating from earlier times in the territory. The new government was interested in the possibilities of utilization and improvement of existing irrigation works and the projection of new schemes to tap the potentials of the region.32

The chief irrigation works which the British found operating upon annexation of the Punjab were the inundation canals along the Jumna River, inundation works along the Indus and the lower Chenab Rivers, and the Hasli Canal which was so constructed as to provide a perennial flow of waters from the River Ravi to the city of Lahore and to the holy city of the Sikhs, Amritsar.33

The early British administrators were eager to make the best use of the fertile thirsty plains, under utilized rivers and hard working peasantry. In 1852, Lieutenant Colonel Trenmenheire referred in his paper on 'Agriculture in the Punjab' to its unquestionable capabilities which were more valuable than the discovery of the richest mines,' there were springs of wealth at the feet of British which required but well directed skill to bring them to the light of the day. The prosperity of the people and the interests of the government alike in the Punjab could be served by the progress of agriculture, which was the greatest, the simplest and the most obvious of its resources. Broadly speaking, two complementary processes were needed to turn this dream into a reality. The Government was required to take the initiative by proving technological

breakthrough. Of all the provinces of British India, the Punjab was best suited for extensive irrigation by perennial canals. The constant supplies of its snow-fed rivers and even surface of its arid plains rendered it possible to construct the vast network of canals at a comparatively viable cost. In the view of the Indian Irrigation Commission, the conditions of soil and climate, throughout the Punjab plains were such as to ensure a constant and sustained extensive irrigation system and in none was it more urgently necessary or more keenly appreciated. Thus, the Punjab was the only province where the direct profits of irrigation were so high that the new projects could be proposed with confidence for their remunerativeness as financial invests. Consequently, as seen the state charged 29 percent as canal water rates to increase revenues and make up for the investments in the canal systems.

During the first year of British occupation of the Punjab the ‘Baree Doab’ Canal was projected and re-construction began. The ‘Huslee’ Canal was operated next in this line by permission of government to survey and examine the line. These local inquiries were interrupted by the Mooltan insurrection but not until a considerable portion of both Upper Baree and Rachna Doabs has been roughly, but scientifically, examined. When all engineering works in the Punjab, Civil, Military or Public, were placed under one department with Colonel Napier as the Chief Engineer. In 1851, Napier was of the opinion that the movable nature of the banks of the Satlej would always be a bar to any permanent works at the heads of these inundation canals. The inundation canals were highly vulnerable to the fluctuating behaviour of the Indus River and so was agriculture dependent on those canals. Colonel Napier had devised schemes for two great canals, one from the Ravee and the other from the Chenab River.

37 Ibid., 26-28.
Thus, the process of agricultural colonization was commenced in the Western Punjab from 1885 and it continued into the final years of British rule. The nine canal colonies developed in this period were situated in the interfluves west of the Beas-Sutlej and east of the Jhelum rivers. These canal colonies of west Punjab, also known as the bars, were the ‘breadbasket of India’ before partition. Embracing an area of 5.5 million acres (225773 Hectares), they were developed in the districts of Lyallpur, Sargodha (Shahpur), Montgomery and Multan. The Lyallpur colony was started in 1892 and one of the oldest. The lower Chenab Canal irrigated it. The Sargodha colony was started in 1897, when the lower Jhelam Canal extended irrigation to it. It was followed by the development of Montgomery colony also called Nilli Bar. Its irrigation was rendered possible by the famous Triple Project (1905-17), which was conceived by the Sir Thomas Benton, the great canal engineer. Three canals were made. The first on the Upper Jhelum, took the spare water of the Jhelum and poured it into the Chenab, irrigating 35000 acres (263046 hectares). On its way Chenab and the Ravi were then linked together by a second canal, the upper Chenab, which irrigated another 650000 acres (263046 Hectares) in Gujranwala and Sheikhpura, and third canal, the Lower Bari Doab, took it another 134 miles (216 meters) through Montgomery into the heart of Multan. The lower Bari Doab Canal colony, the Montgomery Bar, the third of the great colonies, was the result. Consequently, a tremendous increase in the cultivated area took place in canal colonies, which experienced there by the great expansion in agricultural production unequalled in any part of South-Asia even the world. Mufakharul Islam, Himadri Bnerjee and Imran Ali considered the canalization as an example is neither in India nor in South-Asia. M L Darling also remarked: “The irrigation colonies in fact, opened an era prosperity undreamt of the past.”

The colonial State exploited the latent potential of the Punjab by initiated several irrigation schemes to meet the economic requirements. The State’s

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38 The Lyallpur colony named after Sir James Lyall, the Lieutenant Governor of Punjab.
41 M.L Darling, Wisdom and Waste in the Punjab Villages, 1934, 3.
main concern was the water taxes through abiana. In the Punjab 30 percent the total revenue came from irrigation as compared to 23 percent from India as a whole.42

IV

The south-eastern region of the province was bereft of this spectacular scheme of canalization and ensuing agricultural expansion of the western Punjab. The means of irrigation in the south-eastern tract were canals, wells, ponds and tanks. The land of this region was largely dependent upon the natural factor of irrigation i.e. rainfall. This is amply reflected in local adages, and folk songs on the theme of rain, in this area:43

‘Jab Chamke Pachcham Uttar Ke or, Jab Jano Pani Ka Jor’.
(Such as the lightening flashes in the north-western direction and a partridge feather shaped cloud indicates the certainty of down pour), and;

‘Sad do Sawan nit, Bahadon Char or Asaj Ek’.
(Two falls of rain in ‘sarh’, daily falls in ‘sawan’, four in ‘Bhadon’, and one in ‘Asoj’ constitute the ideal rainfall of the summers).

The inadequate degree of water was no security against drought and famine in the south-east Punjab, and rain was scanty and did not assure an increased yield, as brought out in folk songs; a young girl had to cherish a desire with expectation from clouds:

‘Upra Babilra Upra kyon ja’,
Barse Te kyon na Mahare desh’.
(Oh clouds! why are you going from our area and why are you not raining in our region).44

The rainfall however, in this region, was low and erratic and moreover, it varied area to area and time-to-time as well.

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42 For detail see, Paul Paustian, *Canal Irrigation in the Punjab*, 128.
Table 4.1
Average Rainfall in Major Rain Gauge Station of South-East Punjab, 1901-04.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Rain Gauge Station</th>
<th>Rainfall in Inches in 1883-84</th>
<th>Rainfall in Inches in 1901-04</th>
</tr>
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<tr>
<td>1</td>
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<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Bhiwani</td>
<td>16.3</td>
<td>16</td>
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<td>3</td>
<td>Fatehabad</td>
<td>15.7</td>
<td>15</td>
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<tr>
<td>4</td>
<td>Gohana</td>
<td>20.1</td>
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<td>5</td>
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<td>26.5</td>
<td>23</td>
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<tr>
<td>6</td>
<td>Hansi</td>
<td>16.2</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>Hissar</td>
<td>16.3</td>
<td>16</td>
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<td>Nuh</td>
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<td>18</td>
<td>Sampla</td>
<td>20.8</td>
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</tbody>
</table>

The table is based on, *Punjab District Gazetteers*, Vol. VII B, Ambala District and Kalsia State, Statistical Tables, 1912, Gula Singh and Sons, Lahore, 1913, IV; *PAR*, 1901-02, 111; *DG Gurgaon*, 1910-A, 17; *DG Rohtak*, 1910-A, 21; *DG Ambala*, 1904-B, Table IV; *DG Karnal*, 1904-B, Table N; *DG Hissar*, 1904-B, Table III.
Information on rainfall shows that Naraingarh (40) had the maximum rainfall in the tract 1883-84, as well as in 1901-04, whereas Fatehabad (15) had the lowest. Rainfall was higher in the sub-mountainous station like Nariangarh and Jagadhri than the plain area; in all the districts as a whole, we find the Ambala had the maximum whereas the Rohtak the minimum rain. We have comparative figures of the Punjab regions of 1888-89. The south-eastern region had 24 percent an average of all five districts, as compare to around 30 percent in central Punjab and only 15 percent in rest of the Punjab. More than eighty percent of the annual rainfall received was during the rainy months of July, August and September. More importantly, rainfall over most of the region was unreliable. The importance of sufficient and timely rainfall could be well imagined. When the rainfall was sufficient, the land produced most luxuriant crops and sometimes most astounding ones. Therefore, the productivity of land hovered around the rainfall.

In addition to rainfall, several rivers and streams provided water to the south-eastern tract. The only perennial river in the region was the Yamuna, which arose in the Tehri (Uttar Pardesh) hills and entered Ambala district. From there it flowed on through Kurukshtetra, Karnal, Panipat, Sonepat and Faridabad below Delhi, from where it entered western Uttar Pardesh area just past Hasanpur in Faridabad. Another river/rivulet was the Saraswati which had no defined bed; it was only after the Chautang, another small stream, joined it at Bhaini village that it acquired a continuous channel and was worthy

47 S R Rohtak District, 1873-74, 87.
48 For details, See, DG Ambala, 1883, 11-13; DG Karka., 1883, 4-5; DG Rohtak 1883, 6; .G Gurgaon 1883, 3; and K.C. Yadav, Modern Haryana, History and Culture, 1803-1966, 16.
49 General Cunningham in this archaeological report of 1863-64 gives, the following account of river: ‘Saraswati (in Sanskrit Saraswati) is too well known to require more than a mere notice. Its name is derived from Saros a lake or a pool, and Vati which means like-that is, the ‘river of lakes or pools’, a character which is still bears as it partially drives up early in the year and becomes a mere succession of pools, without any visible stream’. For details, See, D.C. Verma, Haryana, 6-8.
of being called a stream. The Ghaggar rose in the outer Himalyan ranges between the Yamuna and the Sutlej, and enters the plains as a rapid and variable mountain torrent and passing near Ambala and a south-westerly course of about 110 K.M.50

There was another rivulet or stream near the Ghaggar- the Markanda.51 It also rose in the outer Himalyan ranges and, like the Saraswati, entered the south-east Punjab near Nahan, then flowed across the Ambala, and Karnal districts as a rainy stream. It was a much more important stream than any of those yet described. In the first twenty miles of its course in the plains, it was joined by two other torrents. The first, which rose in the hill to the north of Sadhaura, bears the name ‘Sadadaini’ or ‘the constant plague,’ the second, which united with the Markanda lower down, was called the Begna.52

The Rakshi stream took its rise near Bilaspur, five or six miles below the hills. In Jagadhri, it was a very insignificant stream, flowing after heavy rain in a ditch like channel. It entered the Pipli Tehsil at Jagadri and flowed south-west to Ladwa. To the west of Ladwa the larger Chautang approached the Rakshi stream and formed the Sarusti (to be distinguished from the river described in the earlier) and the Adawa, which ran below Balchpur.53

The stream named Indori, which rose in Alwar, some 12 or 15 miles south of Gurgaon used to flow through the Taur plateau and after collecting all the Tauru

51 DG Ambala, 1883, 6.
53 The last Sikh chief wishing to save his town from the risk of inundation dug a channel to connect the two streams, and divert the former into the latter. Report on Revenue and Rates, From Ibbetson to Commissioner, 1878, 20-21.
drainage, spread over the south-west corner of Gurgaon tehsil. In the Gurgaon district, there was also an important stream named Sahibi. It was a powerful stream, which arose in the Aravali hills in Rajasthan about 150 km. north of Jaipur. Gathering volumes of water from a hundred petty tributaries, it entered Rewari above Kot Qasim, and joined the Najafgarh Jhil and joined the Yamuna through a channel. Besides these, there were Dohan, and Kasavati in the Gurgaon district.

Besides these rivers, and streams/rivulet, the south-eastern districts were irrigated by wells and ponds through Persian Wheels and leather buckets (charas).

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54 Some natural drainage, embankments (private as well as government), and wells irrigation were amongst the irrigation system, but well irrigation was of considerable importance in most parts of the Gurgaon district but especially in Rewari and part of Gurgaon. *Final Report of the Third Settlement, (1903-09) of the Gurgaon District*, 1910, Lahore, I.

55 The Sahibi identified with the rasa of the Rig Veda, and believed that to be a big, perennial river in ancient times: M.L. Bhargava, *The Geography of Rig Vedic India*, 53-61.


58 A charas well consisted of a buffalo hide bag rope (laaj) or san fiber, and passing over a small strong wheel (bhon or chak) fixed over the well. Water was drawn up from the wells by a charas (leather bucket) worked by four men and four bullocks. One end of a strong rope was attached to the bucket and the other to a yoke of oxen. The bullocks drew the rope down a ramp until the bucket reached the pulley at the top of the well; the oxen were then unhitched and the bucket, after being emptied, went down again, the rope having been fastened meantime to another pair of bullocks standing ready, which went down the ramp as the first pair came up. One man stood at the well to empty the bucket, two men drove the two pairs of bullocks, and a fourth directed the water to the fields. With a charas, four bullocks and four men were able to irrigate only two bighas (0.4 acres) within twenty four hours, if the wells were worked continuously, though as already mentioned, they ran dry after being worked about two hours. It was a cumbersome and wasteful process and needed to be replaced by the Persian wheel only two bullocks were required, a boy to drive them and a man to control the water. It watered 3 acres of land in five days i.e. 0.6 acre per day, and a good deal less, if the soil was sandy. The labor of the Persian wheel was much easier as expressed by saying"Harat ek ankh se chalta", "one eye is enough for a harat"; for the driver (gadriya), to sit on the beam to which the Yoke was tied, may be blind and paniara only needs one eye. See the *BEIP, Village Surveys-7, An Economic Survey of Bhadas, A Village in Gurgaon District of the Punjab*, Civil
Another important device was *dhenki* by which the water to be raised came up in a vessel suspended from a long arm of a lever of the balance kind and its weight was overcome by the weight of a block of hard earth or stone piled on the other hand of the lever. This device required much manual labour and could irrigate only a small portion of land. The Jhalar system of irrigation was found on the lands near the rivers, streams or *jhils*. It was merely a variety of a Persian wheel with larger water buckets.

A district wise review of the available sources of irrigation tells us that in Ambala District irrigation was possible through the Yamuna and Saraswati rivers; Western Jumna Canal, Ghaggar, Markanda, Rakhshi and Chautang streams, wells and tanks. Karnal district had Yamuna and Saraswati rivers; Rakhshi and Chautang streams; wells, tanks; charsa and Persian wheels and Western Jumna Canal. The main sources of irrigation in Rohtak district were only *Western* Jumna Canal, and wells with Persian wheels. In Hissar, there was the Western Jumna Canal, Sirhind and Ghaggar canal, and wells. Gurgaon district had the Yamuna River as well as the *Agra* Canal; Sahibi, Indori, Dohan, and Kasawati streams; wells and embankments.

The British, who took over the south-eastern Punjab areas in 1803, had clear ideas on the importance of the provision of additional water for agriculture but did not initiate any major irrigation work till 1858, when the region was transferred to the Punjab province for the purpose of administration. From the very beginning the British were of the firm conviction that the investment required for the remodeling and re-opening of the existing indigenous projects like Western Jumna Canal would be low. At the same time, it was clear that they should be able to get rich dividends in the form of *abiana*. At that time it was estimated that an amount of Re. 1 Lakh annually for three years would be sufficient to cover the expenses of the scheme, the result of which, it was...
hoped, would bring under cultivation vast deserted tracts and the consequent huge returns in the form of abiana. It is also evident from the contemporary and near contemporary official and unofficial evidence that, from the economic point of view, the remodeling of the Western Jumna Canal was considered much more profitable, and several persons interested in the contract to carry out the excavation and clearing work necessary for this purpose. The government however, did not want huge profits and benefits that would accrue from the project should not fall into the hands of anyone other than the Government. Needless to say, the offers of Mercer and others were rejected and, in accordance with the instructions of the Government, a survey of the work was done and Lieutenant Macartney submitted a detailed report for consideration in 1810. In canals, Western Jumna canal was among the important canal in the region. It was the oldest of the great canals in the province of Punjab. Taking off the Western side of the river-Jumna, it provided irrigation to Karnal, Rohtak, Delhi, Hissar and Amabala districts. In 1820, it irrigated 1255 acres, which increased to 561480 acres in 1901-02 and further increased to 745197 (excluding Patiala state) in 1932-33 to 1934-35, i.e a 33 percent increase between 1901-1932.

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62 The Western Jumna Canal was taken over in the early half of the nineteenth century without the expenditure of any capital; there had therefore never been any arrears of interest, and the sum at charge had never been greater than the capital. In 1900-01, it would be seen that the whole capital had been repaired, and about 194 lakhs in addition was clear gain. Report on the Administration of Irrigation Department, Punjab, 1909-10, Lahore, 1910, 6.

63 Major Colvin laid down: 'I have understood the first suggestion of a gentleman (Mr. Mercer) to reopen the Delhi canal at his own expense, under the management having secured to him the whole benefits resulting for a period of twenty years'.


66 See appendix B, for detail of Western Jumna Canal regarding history, irrigated area and capital outlay.
In the second half of the nineteenth century, the British took up some canal works to improve the irrigation system in the Gurgaon, Hissar and Sirsa. The Agra canal, a main canal in the United Provinces, was introduced in 1875. Emerging out of the Jumna River at Okhla near Delhi, it provided irrigation to the parts of Delhi and Gurgaon districts. Canal irrigation was extremely popular, and had entirely displaced well irrigation of the commanded zone. The Sirhind canal also contributed to irrigation of Hissar and Sirsa. The British Government in collaboration with the Native States of Patiala, Nabha and Jind, constructed it. The work of construction began in 1876 and by November 1882 the canal started working. The effective irrigation was started from 1885. The acreage of irrigated land in Hissar district was 17300 acres (5.7 percent area). The British Government had undertaken the project with a view to the economic requirements. Ghaggar canal started irrigation from 1897. Its inundation channels increased the availability of water to the arid regions of Hissar and Sirsa. It irrigated 16600 acres (5.5 per cent.) in Hissar district. Out of all the south-eastern areas therefore, Hissar district benefited the most from canal irrigation which reflected in agricultural output.

The canal irrigation was very popular among agriculturists. Zamindars of these tracts as well as small farmers demanded nahri (canal) lands to increase

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68 Ibid., I.
70 (i) Affording employment opportunities for the disbanded Sikh soldiers; (ii) earning a profit in the form of abiana (water tax); and (iii) increasing the security of the cash crops such as cotton and sugar-cane. P.W. Paustian, Canal Irrigation in the Punjab, New York, 1930, 38-39; N.A.I. Department of Revenue and Agriculture, Land Revenue-A, August 1896, Progs No. 44; P.A.R. for 1911-12, 7-8; HSA, Ambala Division, Revenue Department, Canal Revenue Establishment and Distribution and Economy of Water, File no. 27, Accession No. 1865, 1863; Dipak Chattaraj, ‘Curse Amidst Blessings’, 126.
72 See chapter on Agricultural Growth.
produce for the market. It is, therefore, obvious that the life was very uncertain in the rain fed villages during drought and famine years. It was very difficult for them to pay even the land revenue. They grumbled before the revenue officials: ‘Ogahi re sey’ i.e. land revenue was very harsh. However, the people having canal irrigation facilities were better of and they had the privilege of having good support for agricultural activities. A folk song testifies the above fact:

Unka bairi kya kare jin ke mit diwan,
Unka bairi kya kare jin ke khet niwan.

(In the song, it is said that” What can the enemy do to the man whose friend is the Magistrate or whose fields are low lying having canal facilities”).

Well irrigation made further contribution to the south-eastern tract. The British also tried to promote it by advancing taccavi and other loans almost every year, particularly at the time of famine and drought. In Karnal and Delhi, moderate taccavi advances were made with favourable results. In Gurgaon, the advances were made more liberally, as this district was far more dependent on well irrigation than Delhi and Karnal. Out of total advances, around 55 percent were given for wells in both districts of Delhi and Karnal whereas for Gurgaon, it was only 19 percent. Except in Gurgaon, no attempts were made to improve the means of irrigation through wells before 1863. Mr. Jacob, Deputy Collector of Gurgaon took up the activity of encouraging the sinking of

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73 Many contemporary folk songs refer to it and a few of their lines may be quoted here from Rohtak Settlement Report, 1880, 49- ‘Mere babehe naddio par dharti dedehe, Mere bhaiyne nahron par dharti bai yobe ‘. Oh! Sisters gives one some canal land, oh! Brother sows some land on the canal.


75 Financial Commissioner to Secretary, Punjab Government No. 576, dated 17, November 1866.

76 Financial Commissioner to Secretary, Punjab Government No. 576, dated 17, November 1866.
wells, which was likely to produce beneficial effects in that district.\textsuperscript{77} Among half of the total \textit{taccavi} advances were meant for the construction or repair of the wells.\textsuperscript{78} This amount led to the construction and commencement of 441 wells in Delhi division, 453 in Hissar division and 170 in Ambala division.\textsuperscript{79} One thing is noticeable that where the government advanced the \textit{taccavi}, there was far more wells in existence than the remaining areas, and were mostly successful. It is seen that \textit{taccavi} advances were made mainly in Gurgaon, Delhi, and Karnal because water table was easily available and was easily accessible in this area. The wells were also dominant in these districts. In 1915, out of 55 bores, 45 were successful in Gurgaon and Delhi, 7 out of 12 in Karnal, 6 out of 13 in Ambala and in 1 out of 1 Hissar.\textsuperscript{80}

In the early twentieth century, a scheme for extension of the south-eastern region was supported with the important Bhakra Dam Project in which was initiated by the colonial state supposedly only as a reward for the region's massive contribution to the war effort.\textsuperscript{81} The statement reported in the press and made by the Punjab legislators during the twenties and thirties of the twentieth century had created confusion regarding the origin of the scheme.\textsuperscript{82}

\textsuperscript{77} \textit{Punjab Land Revenue Administration Reports, 1862-63, Appended in table No. XIX; Cited hereafter, PLRAR.}
\textsuperscript{78} \textit{PLRAR, 1869-70, 28.}
\textsuperscript{79} \textit{PLRAR, 1869-70, 28.}
\textsuperscript{80} \textit{PSA, Department of Agriculture, Punjab, for the year Ending 30\textsuperscript{th} June, 1915, Printed by the Superintendent, Government Printing, Punjab, Lahore, 1915, 15.}
\textsuperscript{81} \textit{The Jat Gazette, weekly newspaper in Urdu published from Rohtak, private collection; now with Nehru memorial Museum Library, see issue of 20 April 1927, 5. Regarding the origin, nature and association of this paper with British officials, see Prem Chowdhry's Punjab Politics: The Role of Sir Chhotu Ram, New Delhi, 1984, chapter II, cited in Prem Chowdhry, 'The Advantages of Backwardness: Colonial Policy and Agriculture in Haryana' vol. II, IESHR, Vol. XXII, No. 3, Sage, Delhi 1986, 267.}
\textsuperscript{82} \textit{The present reasons for early execution of this project can be summarized as follows: (i) The south-east Punjab, especially the districts of Hissar, Gurgaon, and Rohtak being a famine drought prone area, crop and cattle loss was enormous for instance, in a single famine during 1900, 1243000 cattle perished in Ambala division of them 448000 died in Hissar district alone. Frequent famines were responsible for the economic distress of the people of this region.}
The British made with determined efforts to retain this as a 'cattle producing zone' and 'draught animal suppliers' had doubts regarding the 'detrimental' and 'adverse' effects of irrigation on the existing economy of these parts which made the officials hesitant. The delay process in this project from 1914-15 to 1945 was the evidence of a determined British policy and the effort of the official report of 1935 which revealed; 'It is almost certain that if the Bhakra Dam Scheme matures cattle breeding will receive a serious set back and production of draught bullocks in Haryana tract may discontinue'.

Sir Chhotu Ram's one of the prominent Unionist leaders had a broad based irrigational policy was in mind. On the one hand, he wanted to execute a number of major and minor irrigational projects ranging from tube well irrigation, non-perennial canals to Hydro-electric projects like Bhakra Dam Scheme and on the other he wanted to bring down the water charges by rationalizing these in accordance with agricultural process, and removing corruption and inefficiency in the irrigation department. The Bhakra Project was the most

(ii) Due to the acute scarcity of irrigational facilities the otherwise fertile land could not meet even the fodder demand for its livestock.
(iii) Irrigation by wells was not feasible for the presence of brackish water even at a depth of 120 feet, in the said region.
(iv) Existing irrigation facilities by canals were restricted to a very small area. Thus, keeping view the above mentioned factors, the prosperity and economic welfare of the people was dependent on creation of such facilities as Bhakra Dam which could provide irrigation facilities with in turn changes the deplorable conditions of this region. Gazetteer of India, *Agriculture and irrigation*, Gazetteer’s Organisation, Chandigarh, 2005-533.


84 The Punjab officials involved in various surveys of the Haryana region had for a long time been declaring that any extension of irrigation to this region would prove to be injurious to cattle breeding. See, H.T. Pease, *Breeds of Indian Cattle*, Punjab, Calcutta, 1903, 47; A.M. Stow, *Cattle and Dairying in the Punjab*, 6-7.
ambitious irrigational project pursued by Sir Chhotu Ram and seen as a solution for relief to the famine prone areas.\textsuperscript{85}

The Bhakra Dam was originally conceived as simply a water storage project without any idea of generating hydroelectric power from it. The dam derives its name from the village Bhakra situated in the erstwhile state of Bilaspur. High rocks around it formed a natural sloping lake by with a narrow passage of about 200 to 300 yards. The original plan was to block this passage and then to reutilize the arrested water for irrigating the south-eastern Punjab.\textsuperscript{86}

In 1915, the Punjab government appointed a special officer to find out the ways through which irrigation could be provided to the dry lands of the districts of Hissar, Rohtak, and Karnal. The special officer the Punjab Government after completing a survey of the proposed site during 1915-18 and submitted his report to the Government in 1919. The Lieutenant Governor of the Punjab, Sir Michael O’Dwyer referred to this project many times in his speeches during 1916-19. For instance, he declared at the Rohtak Darbar held in his honour in January 1919 that the forests of Hissar and Rohtak would be turned into smiling fields. In that year itself a detailed Report of the project was prepared, but thereafter nothing was heard about it till 1924.\textsuperscript{87} Only Rai Bahadur Chhotu Ram who considering it the first charge on his public welfare efforts, re-opened the issue of the Bhakra Dam Scheme in 1924.

In three years from 1925 to 1927, many ministers from the Unionist Party visited the dry area of south-east Punjab. In 1925, Sunder Singh Majithia, who was a revenue member in Unionist Government, in 1926, Fazal-E-Husain (Revenue member) and in 1927, Firoz Khan Noon and Joginder Singh (both ministers) visited Rohtak. The agriculturists of the area emphasized in the

\textsuperscript{85} Whose birth name was Ram Richhpal, but this name was entered as Chhotu Ram in the School register and became famous later on.

\textsuperscript{86} Ibid., 534.

\textsuperscript{87} Yash Pal Bajaj, ‘Genesis of the Bhakra Dam Scheme 1914-18; the Panjab Past and Present, Vol. Xi-I, April, 1977, 150.
demands presented to them that the execution of the Bhakra Project should be taken up immediately.\textsuperscript{88}

In 1926, the Punjab Government brought in an American expert who after studying the site with the assistance of two officers of the Government of India and one of the provincial Government, he submitted a detailed report to the Punjab Government in January 1928. In 1929-31, however, the economic viability of the project was being challenged even by those who had supported the scheme earlier. Sikandar Hyat Khan and Muhammad Hyat Qureshi opposed the project in their speeches of 11 November 1932 and 27 March 1933 respectively.\textsuperscript{89}

In spite of approval of the site, the work on the project could not be undertaken because of the objections raised by the Governments of Bombay and Sindh, the ruler of Bilaspur and the Punjab States as well as the indifferent attitude of the Central and the Provincial Governments. Despite the objections, hindrances and delaying tactics on one or the other pretexts by the concerned government, Sir Chhotu Ram continued making zealous efforts to realize his aim and dismissed all the objections as flimsy.\textsuperscript{90} As a result of his persistent efforts some spadework was done, when Unionist Party assumed power in 1937. Sir Chhotu Ram after becoming the Agriculture Minister started his efforts with added force.

A High Dam circle was created in 1939 to prepare the designs and revise the estimates of the Bhakra Dam. By 1942, surveys were completed and the project was revised with a view to generate hydroelectric power too. Rs. 2 Crores were paid as compensation to the Sindh Government to avoid prolongation in the implementation of the project. On Sir Chhotu Ram’s persuasion, the ruler of Bilaspur changed his attitude and agreed to allow the raising of the Dam on its original site. Between November 1944 and January 9,

\textsuperscript{88} Yash Pal Bajaj, ‘Genesis of the Bhakra Dam Scheme 1914-18; the Panjab Past and Present, Vol. Xi-I, April, 1977,151.
\textsuperscript{89} Yash Pal Bajaj, ‘Genesis of the Bhakra Dam Scheme 1914-18; the Panjab Past and Present, Vol. Xi-I, April, 1977, 154-55.
\textsuperscript{90} Gazetteer of Haryana, Agriculture and irrigation, 535.
1945 he signed the agreement on Bhakra Dam with the Punjab government. Sir Chhotu Ram, on behalf of Punjab Government, put his signature (incidentally his last) on the file for the approval of Bhakra Dam Project on 8.1.1945, only a day before his death. Sir Chhotu Ram had wanted an early execution of the Bhakra Dam Project, which could not materialize. In the meantime to bring irrigation water to regions of the south-east Punjab, he proposed the tube well irrigation scheme in Karnal district to which the government had agreed to in 1936. This scheme was proposed as a stopgap arrangement till the Bhakra Dam Project was given a practical shape. Under this scheme the water of the Western Yamuna Canal could be utilized for irrigating the drier districts of Rohtak and Hissar districts. However, necessary machinery for this could not be imported owing to Second World War. The scheme was thus, stalled.

V

In the 1880s only about 9 percent of cultivated area was irrigated by all the sources of irrigation available in south-east Punjab. In a review of the district wise situation in the third quarter of the nineteenth century, we find that in Gurgaon, the cultivated area was utilizing the maximum irrigational water, followed by Karnal, then Rohtak and Hissar, lastly Ambala. Gurgaon had an almost equal share of areas under wells (53 percent) and canals (47 percent). In Karnal, the maximum area was served by wells (70 percent) followed by canal (28 percent) and tank (2 percent). In the Rohtak district, canals provided main share in irrigation at 50 percent while, well and other source had almost at equal share at 26 and 25 percent respectively. In Hissar, 97 percent of the water was provided by canal water and only 3 percent by wells. In Ambala, wells were utilized to provide an additional water to 53 percent area and canal to only 5 percent. On the whole, this proportion was 41 percent by canals, 49 percent by wells, 2 percent by tanks and 6 percent by other sources.

Gazetteer of Haryana, Agriculture and Irrigation, 536-37.
### Table 4.2
**System of irrigation (1886-87)**

<table>
<thead>
<tr>
<th>District</th>
<th>Total Crops Area</th>
<th>Canals Acres</th>
<th>Wells Acres</th>
<th>Tanks Acres</th>
<th>Other Acres</th>
<th>Total Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambala</td>
<td>1001513</td>
<td>2378</td>
<td>25863</td>
<td>6479</td>
<td>13739</td>
<td>48459</td>
</tr>
<tr>
<td>Delhi</td>
<td>563442</td>
<td>27597</td>
<td>58880</td>
<td>-</td>
<td>-</td>
<td>86477</td>
</tr>
<tr>
<td>Karnal</td>
<td>697635</td>
<td>35475</td>
<td>86392</td>
<td>2700</td>
<td>-</td>
<td>124567</td>
</tr>
<tr>
<td>Hissar</td>
<td>1860821</td>
<td>55780</td>
<td>1874</td>
<td>-</td>
<td>-</td>
<td>57654</td>
</tr>
<tr>
<td>Rohtak</td>
<td>920633</td>
<td>36288</td>
<td>18263</td>
<td>-</td>
<td>17998</td>
<td>072549</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>934372</td>
<td>63937</td>
<td>68770</td>
<td>-</td>
<td>-</td>
<td>132707</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5978416</strong></td>
<td><strong>221455</strong></td>
<td><strong>260042</strong></td>
<td><strong>9179</strong></td>
<td><strong>31737</strong></td>
<td><strong>532423</strong></td>
</tr>
</tbody>
</table>

(41%) (49%) (1.72) (5.95) (8.90)

93 PAR, 1886-87, Appendix Table No. 43.

### Table 4.3
**System of Irrigation (1935-36)**

<table>
<thead>
<tr>
<th>District</th>
<th>Total Crops Area</th>
<th>Canals Acres</th>
<th>Wells Acres</th>
<th>Tanks Acres</th>
<th>Other Acres</th>
<th>Total Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambala</td>
<td>879720</td>
<td>1940/-</td>
<td>3810</td>
<td>1531</td>
<td>11202</td>
<td>52774</td>
</tr>
<tr>
<td>Karnal</td>
<td>1280825</td>
<td>186961/22055</td>
<td>119499</td>
<td>1857</td>
<td>17</td>
<td>330389</td>
</tr>
<tr>
<td>Hissar</td>
<td>2744789</td>
<td>281743/19644</td>
<td>165</td>
<td>19</td>
<td>4097</td>
<td>305668</td>
</tr>
<tr>
<td>Rohtak</td>
<td>1467955</td>
<td>264747/-</td>
<td>76378</td>
<td>382</td>
<td>97</td>
<td>341604</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>1139901</td>
<td>46425/-</td>
<td>73102</td>
<td>16</td>
<td>3105</td>
<td>122648</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7513190</strong></td>
<td><strong>823515</strong></td>
<td><strong>307245</strong></td>
<td><strong>3805</strong></td>
<td><strong>18518</strong></td>
<td><strong>1153083</strong></td>
</tr>
</tbody>
</table>

(71%) (27%) (0.32%) (1.06) (15.34)

93 PAR, 1886-87, Appendix Table No. 43.
Changing Percentage of Irrigation, 1886-87 to 1939-40

YEAR 1886-87 (AVERAGE = 9.9)

YEAR 1901 (AVERAGE = 23)

YEAR 1939-40 (AVERAGE = 15.3)
Canal irrigation was found in all five districts. The main acreage irrigated by canals was in Hissar (97 percent), followed by Gurgaon (47 percent); Rohtak had, 50 and Karnal (28) percent by canals. Ambala had the minimum canal irrigated acreage of 5 percent only.

The irrigated area rose to over 23 percent by the turn of the century and to 27 percent by the early 1940s. Irrigated area however, fluctuated considerably, falling to less than 14 percent in 1911, recovering to about 22 percent by 1921, marginally improving in 1931-32\(^{94}\), before falling under 15 percent by 1948.\(^{95}\) The position of the districts also fluctuated during this period.

The available statistics on irrigation shows that wells were dominant (49 percent) in 1886-87, whereas in 1935-36, the canals were dominant (71 percent). The overall irrigated area increased from 8.9 percent to 15.34 percent in the 1930s. The irrigated area by wells was concentrated in Rohtak in 1886-87 whereas in 1935-36 it was replaced by Karnal.

In the districts of south-east Punjab, Karnal maintained maximum irrigated area throughout the period i.e. 1901 to 1951, while the minimum was in Ambala. Rohtak was at the second, and Gurgaon was at the 3rd position in the 1951.\(^{96}\) Therefore, the regional disparity in irrigation pattern of this region was rather marked. Karnal increased from 38 percent irrigated areas in 1901 to almost 45 percent in 1951. Second was Rohtak from nearly 25 percent to 37 percent during the same time. In the other districts, there was a decline in the


\(^{95}\) Calculated from Punjab District Hand Book, 1961.

\(^{96}\) Table: 4.4 Percentage of Net Irrigated Area in the South-East Punjab.

(Derived from the quinquennial figures)
irrigated area from 20 percent to 17 percent in the case of Hissar, from over 24 percent to about 14 percent in Gurgaon, while Ambala remained the same proportion of about 8 percent throughout this period.

In a comparison of all sources of irrigation between the south-east and other areas of the Punjab province, we find that there was an inequality and imbalance. In 1920-21, the proportion of the area irrigated by all sources in the south-eastern districts ranged from 4-28 percent while that of canals only from 4-16 percent. In the central districts of the province, the proportion of irrigated area from all sources ranged from 50-82 percent while, from canal alone ranged 34-63 (table 4.5). The area under matured crops through irrigation at the same time ranged from 6-36 percent in south-east Punjab while it was 54-98 percent in the western and central Punjab. An obvious disparity shows the south-eastern districts at a clear disadvantage, where water resources were concerned.

<table>
<thead>
<tr>
<th>South-Eastern District</th>
<th>Percentages of Area Irrigated</th>
<th>Central &amp; Western Punjab District</th>
<th>Percentages of Area Irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Sources</td>
<td>Canals</td>
<td>All Sources</td>
</tr>
<tr>
<td>Ambala</td>
<td>04</td>
<td>-</td>
<td>Amritsar</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>12</td>
<td>04</td>
<td>Ferozpur</td>
</tr>
<tr>
<td>Hissar</td>
<td>12</td>
<td>11</td>
<td>Jullundur</td>
</tr>
<tr>
<td>Karnal</td>
<td>28</td>
<td>16</td>
<td>Lahore</td>
</tr>
<tr>
<td>Hissar</td>
<td>18</td>
<td>14</td>
<td>Shahpur</td>
</tr>
</tbody>
</table>

Table 4.6
Comparison of Areas of Matured through Irrigation Crops in 1921.

<table>
<thead>
<tr>
<th>South-East Punjab</th>
<th>Percentage</th>
<th>Central and Western Punjab</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karnal</td>
<td>36</td>
<td>Lyallpur</td>
<td>98</td>
</tr>
<tr>
<td>Rohtak</td>
<td>27</td>
<td>Montogany</td>
<td>87</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>17</td>
<td>Jullundur</td>
<td>78</td>
</tr>
<tr>
<td>Hissar</td>
<td>16</td>
<td>Lahore</td>
<td>70</td>
</tr>
<tr>
<td>Ambala</td>
<td>6</td>
<td>Amritsar</td>
<td>54</td>
</tr>
</tbody>
</table>

The progress of irrigation in south-eastern region as compared to the central and western Punjab can in no way be considered satisfactory, as evident from the figures from *Punjab Agriculture Facts and Figures* from 1939-48. The area irrigated over the gross cultivated area in the Punjab rose from 28 percent in 1868 to 33 percent in 1901 to 41 percent by 1903-04, and to 52 percent in 1940. In the south-eastern region however, the irrigated area however, fluctuated considerably, this proportion was 9 percent in 1866-87, increased to 14 percent in 1911, recovered to over 21 percent by 1921 reached a high of 27 percent in 1940s but declined to 24 percent in 1948. The following table will show that Ambala was the only district where the irrigated area increased by 5 percent otherwise in all districts of the south-eastern tract, there was a decrease which ranged from 5 to 18 percent. In the central districts, these percentages ranged from 5 to 8. The difference lay in the fact that the average irrigated area in south-east was 26 percent and in central part 53 percent in 1939-40, which decreased to 18 percent in south-east and 47 percent in central districts in 1947-48. The south-eastern region was therefore, more seriously impacted by this decline.


100 The proportion of the Punjab was included south-east Punjab; if we excluded this region, the proportion would automatically increase.
### Table 4.7
Comparison Irrigated Areas in South-East and Central Punjab 1939-48.

<table>
<thead>
<tr>
<th>Districts</th>
<th>1939-40</th>
<th>1947-48</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hissar</td>
<td>20.0</td>
<td>14.6</td>
<td>-5</td>
</tr>
<tr>
<td>Rohtak</td>
<td>44.9</td>
<td>28.8</td>
<td>-15</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>15.5</td>
<td>8.6</td>
<td>-6</td>
</tr>
<tr>
<td>Karnal</td>
<td>52.0</td>
<td>34.3</td>
<td>-18</td>
</tr>
<tr>
<td>Ambala</td>
<td>0.7</td>
<td>5.3</td>
<td>+5</td>
</tr>
<tr>
<td>Hoshiarpur</td>
<td>13.5</td>
<td>7.6</td>
<td>-5</td>
</tr>
<tr>
<td>Jullandur</td>
<td>61.8</td>
<td>53.3</td>
<td>-8</td>
</tr>
<tr>
<td>Ludhiana</td>
<td>57.1</td>
<td>52.6</td>
<td>-5</td>
</tr>
<tr>
<td>Ferozpur</td>
<td>67.3</td>
<td>56.2</td>
<td>-11</td>
</tr>
<tr>
<td>Amritsar</td>
<td>77.2</td>
<td>82.4</td>
<td>-5</td>
</tr>
<tr>
<td>Gurdaspur</td>
<td>42.2</td>
<td>34.5</td>
<td>-8</td>
</tr>
</tbody>
</table>

VI

During the colonial period, the availability and utilization of water resources of the south-eastern region underwent several changes. These changes took place both in terms of natural, as well as man made irrigation systems, since the rainfall was low, erratic and inadequate, other water resources became essential for the region.

The overall irrigation was only 9 percent in the last quarter in the nineteenth century, which marginal increased to 15 percent in the mid twentieth century. The intervening period showed increase to 23 percent in 1900 and 22 percent on 1921 but this level of irrigational facilities could not be sustained long. The irrigation by canals and wells was dominant in south-east Punjab. In 1886-87, the irrigated area by canal was only 4 percent to total sown area, which increased to 11 percent in 1935-36. The total acreage under wells was the same as canal in 1886-87 i.e 4 percent, and almost the same in 1935-36 also at the district level the percentage of canal irrigated area, during 1886-87 was Gurgaon(7), Rohtak (4), Karnal (5), Hissar (3), and Ambala was 0.23 percent only. The area under wells was 12 percent in Karnal, 7 percent in Gurgaon, percent in Ambala, 2 in Rohtak, and only 0.3 in Hissar district during the same
time. In the mid twentieth century, the area under canals was 18 percent in Rohtak, 16 percent in Karnal, 11 in Hissar, 4 each in Gurgaon and Ambala respectively.

Wells helped a great deal to compensate for the deficiency of rainfall. But interestingly, the well irrigation decreased from 47 to 27 percent by the 1930s. One of the major causes behind this was the increase of canal irrigation, despite the fact that it involved much more labour and cost of operating than well irrigation. The British also tried to promote wells by advancing taccavi (agricultural loans). Well irrigation was not extended to any appreciable degree because the canal-irrigated area in total irrigated area was 41 percent in the late nineteenth century which rose to 71 percent in 1930s. Although, there was a marked variation within all districts. Another change in the actual proportion related to the water resources, which we have seen that Karnal and Hissar district emerged as dominant districts where irrigated area was higher than the earlier century.

Tanks were an additional source of irrigation and in the late nineteenth century, providing nearly 2 percent of water resources, which decreased to half percent in 1930s. Interestingly, tank irrigated area which earlier was confined to Ambala and Karnal had also extended to Hissar, Gurgaon and Rohtak, despite the overall decline in its use.

The cultivated area correspondingly fluctuated over the period. The cultivated area increased to 48 lakh acres between 1867-68 and 1886-87. By the turn of the century it further increased to 65 lakh acres. The cultivated area of this tract had increased 11.8 percent by 1886-87, by 21.8 percent between 1887 and 1907, by 1.6 from 1907-22 but then decreased by 11.5 percent in 1940. Therefore, the overall growth of the cultivated area increased by a moderate 23 percent between 1867 to 1940, with the contribution of additional water resources during this time.

With the extension of irrigation by canals, there was a shift in the system of land utilization and change in the cropping pattern of the south-eastern

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tracts. What really happened was that rice and indigo cultivation had decreased and consequently, more cotton was grown to fill this gap. The following figures will give an idea about the cultivation of nahri crops in the Hansi Canal Circle:

Table 4.8

Figures for nahri crops in the Hansi Canal Circle.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Average 4 years ending 1888-89</th>
<th>Average 5 years ending 1901-02</th>
<th>1902-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>15</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Cotton</td>
<td>25</td>
<td>44</td>
<td>45</td>
</tr>
<tr>
<td>Indigo</td>
<td>18</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Cane</td>
<td>-</td>
<td>2.5</td>
<td>1</td>
</tr>
<tr>
<td>Jawar, bazra</td>
<td>2.5</td>
<td>7.5</td>
<td>4</td>
</tr>
<tr>
<td>Other crops</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Kharif</strong></td>
<td><strong>61.5</strong></td>
<td><strong>60</strong></td>
<td><strong>53</strong></td>
</tr>
<tr>
<td>Wheat</td>
<td>17.5</td>
<td>18.5</td>
<td>22.5</td>
</tr>
<tr>
<td>Gochni</td>
<td>12.5</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Barley &amp; Barley</td>
<td>2</td>
<td>5.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Mixed with Gram</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>7</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other crops</td>
<td>2.5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Rabi</strong></td>
<td><strong>41.5</strong></td>
<td><strong>40</strong></td>
<td><strong>47</strong></td>
</tr>
</tbody>
</table>


The commercial crops received more water, which are wheat, sugarcane and cotton of the all irrigated crops. In Rohtak, cotton received 38 percent of the canal water, wheat, 21, and sugarcane, 11; the remaining 30 percent was
In the district of Delhi, this allocation was wheat 40; cotton, 15; and sugarcane, 15. Commercial crops thus, received 70 percent share of irrigation in Rohtak, and same in Delhi areas. The water supplied by the Agra canal had gone in support of sugarcane and cotton cultivation in Gurgaon district. The agriculturists gave priority to the spring crops than the autumn crops, for example in Delhi district.

Table: 4.9

<table>
<thead>
<tr>
<th>Autumn</th>
<th>Percent</th>
<th>Spring</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane</td>
<td>15</td>
<td>Wheat</td>
<td>40</td>
</tr>
<tr>
<td>Cotton</td>
<td>15</td>
<td>Pulses (gram)</td>
<td>8</td>
</tr>
<tr>
<td>Millets</td>
<td>4</td>
<td>Barley</td>
<td>1</td>
</tr>
<tr>
<td>Pulses</td>
<td>1</td>
<td>Oil seeds</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
<td>Others</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>Total</td>
<td>57</td>
</tr>
</tbody>
</table>

Source: - Punjab District Gazetteer (Delhi, 1912), 131.

Of the 43 percent of canal water which was available for the autumn crops, 30 was devoted to cotton and sugarcane and the remaining 13 percent had gone in favour of the miscellaneous crops. Thus, none could deny that during the British period, the autumn crops, such as jawar, bajra, maize and pulses, and the food grains of the agriculturists, were relegated to the position of the neglected crops. Government policy ensured that the water rates for Western Jumna Canal of nearly commercial crops were increased.

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105 Punjab District Gazetteer, Gurgaon-1910, Lahore, 1911, 96.
Table: 4.10
Showing the Enhancement of Rates of Different Crops in South-East Punjab, 1905-06 to 1924-25.

<table>
<thead>
<tr>
<th>Crops</th>
<th>1905-06</th>
<th>1910-11</th>
<th>1916-17</th>
<th>1924-25</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rs. A. P.</td>
<td>Rs. A. P.</td>
<td>Rs. A. P.</td>
<td>Rs. A. P.</td>
</tr>
<tr>
<td>1 Sugarcane</td>
<td>5 10 0</td>
<td>9 0 0</td>
<td>10 0 0</td>
<td>12 0 0</td>
</tr>
<tr>
<td>2 Rice</td>
<td>4 2 0</td>
<td>6 8 0</td>
<td>6 8 0</td>
<td>7 8 0</td>
</tr>
<tr>
<td>3 Cotton</td>
<td>2 8 0</td>
<td>4 0 0</td>
<td>4 0 0</td>
<td>5 8 0</td>
</tr>
<tr>
<td>4 Wheat</td>
<td>2 8 0</td>
<td>4 0 0</td>
<td>5 0 0</td>
<td>5 4 0</td>
</tr>
<tr>
<td>5 Rapeseed</td>
<td>2 8 0</td>
<td>4 0 0</td>
<td>4 0 0</td>
<td>4 4 0</td>
</tr>
<tr>
<td>6 Bajra</td>
<td>1 12 0</td>
<td>2 8 0</td>
<td>3 0 0</td>
<td>3 4 0</td>
</tr>
<tr>
<td>Total</td>
<td>18 0 0</td>
<td>30 0 0</td>
<td>32 0 0</td>
<td>37 12 0</td>
</tr>
</tbody>
</table>

The table reveals that the rates increased continuously to almost twice from 1905-06 to 1924-25, whereas sugarcane and cotton rose by exactly two and a half times. Consequently, the rise in canal water rates in many cases, contributed to the indebtedness of the peasantry. The increasing water advantage rate, of course, appeared before them as an extra burden with fixed, rigid and inflexible revenue demands of the government.

The development of water resources, particularly canal irrigation, had both positive as well as negative impact on the agricultural economy and rural life. Increase in the cultivated area, agricultural production, introduction of new crops, and market orientation of crops was the positive impact. On the other hand, development of irrigation also had negative implications for agriculture; which at times outweighed the positive results where the shrinkage of cultivation due to over irrigation and higher incidence of disease and epidemics, which was linked to the development of irrigation facilities were the base of some parts in the south-eastern districts. Rural society benefited from upward agricultural production and a market economy but at the same time, there the

107 One thing which is noticeable here that waribandi was not legally binding. It was only due to the mutual understanding among the irrigators.
opposite effect in certain areas such as Karnal, Ambala and Delhi. Besides the exhaustion of soil by over-cropping, the land of nahri area was afflicted by several other problems such as (i); reh (saline efflorescence), (ii) over-saturation of the soil due to excessive irrigation (iii) percolation from the water channels; (iv) the spring levels being unduly raised by the action of any or all of the above; (v) intercepted drainage and swamps. The first three were more or less interdependent and together served as the contributing factor of the fourth.

The agriculture in the south-eastern Punjab was affected by alarming extent of reh, which was developed in lands of once flourishing villages which had been almost entirely destroyed as a result of reh. Numerous official reports during the colonial period underlined this problem. According to Ibbetson, Settlement Officer, Karnal, 89 villages of Bangar in the Panipat tehsil had also come under the reh in 1879. From the report of Oliver, Engineer, Delhi Division, it was evident that several villages in that area had been severely affected. A group of five canal villages in the Sonepat tehsil – Juah, Jaki, Machri, Rahama and Sitauli – covering a total area 7521 acres, lost 432 acres due to reh, the land having deteriorated so much as to become waste. In Delhi tehsil of 82 canal villages, 47 were affected as early as 1880. However, in Rohtak district, the picture was not so bad as pointed out in District gazetteer: "Reh efflorescence, called shor, was unfortunately not unknown, although it has not developed along the canals in Rohtak to the same degree as in Delhi and Karnal: it occurred chiefly in Mahmudpur and a few other villages above Mahmudpur in the north-east of Gohana tahsil, rounded Kharkhaudah, and above the town of Rohtak". It led to appearance of kaller or reh, which devastated the vegetative qualities of land. Indeed, reh continuously threatened the cultivated area till the 1930s, becoming increasingly distressing and the members of Royal Commission on Agriculture

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110 DG, Rohtak District, 1883-84, 7.
111 Where the bed of the canal was high above the sea level.
were compelled to give serious attention to this problem during its study of agricultural problems in the Punjab in 1926.\textsuperscript{112}

The second problem in the south-eastern areas was over saturation of soil. The Settlement Report of Karnal district also remarked that there was a still larger area on which, after a heavy rain, the water stands some inches deep for three or four days at a time and causes great injury to the crop. No means existed of carrying off the water, for as the Chief Engineer reported in 1867,'the level of the water in the canal can very seldom is reduced in the rainy season, even if the supply at the heads was shut off.'\textsuperscript{113}

The problem of water-logging also existed in this sub-region. This was one of the serious problems confronted by the Irrigation Department in the Punjab and received increasing attention on the part of the government. Since its first inclusion was in the Report on the Administration of Irrigation in the Punjab in 1869.\textsuperscript{114} The worst instance of water logging was perhaps that related in the district gazetteer of Karnal (1892) on the Western Jumna Canal. The combined result of faulty alignment of the canal was that the whole country was waterlogged by the canal water which was forced into it from below, while the cultivator drenched it from above. When heavy rain came it fell upon a country already saturated with water. Cultivated land was turned into swamps, and *kallar* soon appeared.\textsuperscript{115} This problem had been created by the excessive canal irrigation or faulty alignment of canals. B.T. Gibson, Settlement officer, Gurgaon, in his report remarked," The natural drainage of the tract has been seriously interfered with by the construction of the main canal and its network of subsidiary branches and channels and in years of heavy rainfall large areas are submerged for a long period as happened in 1908-09."\textsuperscript{116} T.E. Dempster, Army


\textsuperscript{113} \textit{ibid.}, 66.


\textsuperscript{115} See, in detail, \textit{DG, Karnal District, 1892}, appendix, x; and Brij Narayan, \textit{Indian Economic Life}, 389-91.

\textsuperscript{116} \textit{First Report of the Third Regular Settlement of the Gurgaon District, 1903-09}, Lahore, 1910, 7.
Surgeon, H. Yule, Military Engineer, and R. Maconachie, Deputy Commissioner, Gurgaon, reportedly urged the government to recognize this problem and find solutions as far as possible.\textsuperscript{117}

The problem of water-logging was related to faulty alignments with canal system and its use. The headwork of the canals, main lines, branches and distributaries were constructed and maintained by the Irrigation Department. But the field channels or water courses by means of which water was finally supplied on to the fields were usually constructed and invariably maintained by irrigators themselves. In the winter, water supply was insufficient to keep the canal running continuously and, therefore, the distributaries had to be closed on a system of rotational turns.\textsuperscript{118} To facilitate distribution and utilize water use each acre or \textit{killa} was required to be divided into a number of compartments or \textit{kiaris} (eight, according to the regulation of the Irrigation Department). The irrigators were expected to arrange matters in such a manner that they had, for each compartment, water supply for 20 to 30 minutes. The irrigators however, were not favorably disposed to this rule requiring the divisions of a field into \textit{kiaris} or small beds and in some cases the rule remained a “dead letter”.\textsuperscript{119} Consequently, it resulted in the emergence of water-logging issues.

Over saturation of soil also led to serious effects upon health. A committee appointed by the Government to investigate the matter and published their report in 1847. In 1867, Surgeon – Major Adam Taylor was appointed to make a further inquiry; and his report was published as Selection No. VI of 1870 from Records of Government, Punjab.

\textsuperscript{117} T.E. Demster and H. Yule in their report suggested that, ‘Irrigation be prohibited as thin five miles of a military station and within one or two miles of a large town.’ Also, ‘irrigation be altogether prohibited in localities which appear naturally to possess a malarious character.’ \textit{Records of Malaria Survey of India, Vol. I}, No. 2 Cited in Dipak Chattaraj, Canal Irrigation the South-East Punjab, 138, Calcutta, 1930, 53.
\textsuperscript{118} Called waribandi. For this purpose the day was divided into eight pahras of their hours each and the practice was to allow each holding a turn (wari) of two to four pahras.
Dr. Taylor showed that 60 to 80 percent of the inhabitants in many of the Bangar villages were suffering from enlarged spleen and yearly attacks of fever. He speaks of the 'languor and depression of manner, and stunted and shrunken forms of the inhabitants of the villages in close proximity to the swamps; and of the absence of 'the strength to repair damages or to preserve comfort.' The heavy rains of 1871-76 rendered the sanitary condition of the canal villages worse than ever. In fact, the fever (malaria)\textsuperscript{121} increasingly

\textsuperscript{120} Settlement Report of Karnal District, 1872-80, 66-68.

became a frequent illness in almost all the nahri villages in Delhi, Gurgaon, Karnal and Rohtak districts.\textsuperscript{122}

In south-east Punjab, there was the growing incidence of sleeping sickness due to the stagnant surface water. In many canal irrigated villages, of course, nearly three-fourths of the dwellers suffered from spleen disease.\textsuperscript{123} The report by Dr. Adam Taylor, Civil Surgeon, Delhi, clearly indicates that spleen disease was closely connected with canal irrigation and degrees of swampness. By restricting the impact of water-logging due to canals, a reduction in the incidence of spleen disease, could have been achieved.\textsuperscript{124}

Irrigation thus, in the south-eastern region was limited. The development can be seen only in some pockets and overall development was almost nil. Irrigation was a blessing and a curse because it stimulated unhealthy effects on rural life. The major problems included swamps, saline – efflorescence, and water-logging. The epidemic Malaria fever and large spleen affected the life of people, who lived specially with the boundary of canals. This was only one of the major changes in the life of the people. The overall impact of the colonial rule brought about several other implications for agrarian society and agrarian relations in the sub-region.

\textsuperscript{122} The people were also aware that canal with a high water level was a source of sickness; as proceeds in saying:

\begin{quote}
Jahan Jawe pani nahr,  
Wahan Jawe bimari bahar.
\end{quote}

(Were flows the canal water there go sickness). \textit{Punjab District Gazetteer, Rohtak, 1910}, 53.

\textsuperscript{123} In Delhi, in 1912, the spleen rates in certain wards reached neighbouring villages. See, R.A. Senior White, ‘Malaria at Delhi: its incidence and causation,’ \textit{Records of Malaria Survey of India}, Vol. I, No. 3, 293.

\textsuperscript{124} Dipak Chattaraj, ‘Irrigation in the South-East Punjab’, 140.