International Journal of Cultural Inheritance & Social Sciences (IJCISS)
Vol. 8 Issue 16, Sep 2026, ISSN: 2632-7597 Impact Factor: 6.985
Journal Homepage: http://ijciss.com/, Email: journal.ijciss@gmail.com
Double-Blind, Peer Reviewed, Refereed & Open Access International Journal

Engineering the Agrarian Landscape: Canal Irrigation, Colonial Intervention and Agricultural Transformation in Punjab, 1849–1947

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Abstract

The expansion of canal irrigation under British rule transformed Punjab from a region of uncertain rainfall and agricultural production into one of the most extensively irrigated regions of colonial India. Beginning with the annexation of Punjab in 1849, this paper examines how colonial irrigation projects reshaped the physical landscape, agricultural production and rural society. The expansion of irrigated land from fewer than five million acres in 1868–69 to nearly 15.6 million acres by 1936–37 demonstrates the scale of this transformation. It traces the development of major canal systems, including the Western Yamuna and Sirhind canals in present-day Haryana, and the Chenab, Jhelum and Bari Doab canals in western Punjab. Particular attention is given to the canal colonies, where extensive grazing lands, known as *bars*, were converted into organised agricultural settlements. The paper explores how colonial policies promoted peasant settlement, military horse breeding and land disposal through auctions. It argues that canal irrigation increased agricultural production, land revenue and protection against rainfall failure, but also served the political and administrative interests of the colonial state. Access to land and water became a means of rewarding loyalty and strengthening colonial authority. However, this transformation also resulted in the marginalisation of nomadic *jangli* communities and disadvantages for cultivators at the tail ends of canal networks. The paper thus examines canal irrigation not merely as an agricultural development programme but also as an instrument of colonial governance, agrarian restructuring and rural inequality in British Punjab.

Keywords: *canal irrigation, canal colonies, Punjab, Western Yamuna Canal, Sirhind Canal, Lower Chenab, historical geography, colonial agriculture*

1. Introduction

Few changes in South Asia under British rule were as visible on the ground as the spread of canals across the Punjab. A traveller who crossed the Chenab–Ravi plain in 1880 would have seen open scrub, a few camel-herders and little else. Twenty-five years later the same plain held straight roads, brick-built market towns, villages laid out on a grid, and wheat fields that ran to the horizon. The change was the result of decisions taken in Lahore, Simla and London, and it altered where people lived, what they grew, and who held power over land and water.

This paper looks at that change from the viewpoint of historical geography, which asks how human action reshapes a place over time. Three questions run through it. First, how much did irrigation expand, and where? Second, how were the canals and the colonies planned, financed and settled, and with what motives? Third, who gained and who lost? The paper gives special space to the eastern plains, the part of the province

that is now Haryana, because the history of the Western Yamuna and Sirhind canals is closely tied to the history of the districts of Karnal, Rohtak, Hisar and Ambala.[1]

2. A Land of Uncertain Rain

The reason for canals lay in the climate. The Punjab lies at the dry north-western edge of the monsoon. Rainfall fell steeply from the north-east to the south-west: Kangra in the foothills received about 1,500 mm in an average year, while Multan averaged only about 148 mm and in some years received barely 20 mm.[2] About three-quarters of the rain came in the summer monsoon between June and mid-September, and a smaller share in winter. In many places the rain was also very irregular. The study notes that in the years between 1901–02 and 1935–36, whenever a year had rain of around 900 mm, the next year tended to be much drier, often with about half as much.[3] Before the canals, as the thesis puts it, farming in most of the province was a gamble on the weather.

Table 1 gives the annual averages for some stations. The figures bring out how close the south-eastern plains were to the dry side. Hisar, with only about 388 mm, had less than half the rain of Ambala and was nearer to Firozpur than to Karnal. Rohtak and Gurgaon, at 502 and 561 mm, lay between the two. This is the setting in which the Western Yamuna and Sirhind canals were first dug and in which the people of these districts lived.

Table 1. Average annual rainfall at selected stations (mm)

Station	Rainfall	Station	Rainfall
Kangra	1,508	Karnal	703
Shimla	1,167	Gurgaon	561
Ambala	870	Rohtak	502
Ludhiana	628	Hisar	388
Amritsar	553	Firozpur	377
Lahore	414	Montgomery	243
Multan	148	Dera Ghazi Khan	137

Source: Trevaskis (1928), p. 354.

3. How Irrigation Grew, 1868–1937

3.1 The overall picture

Wells, small canals fed by river floods ("inundation canals"), tanks and hill channels had irrigated parts of the Punjab for centuries, and the British at first built on these. The first reliable count for 1868–69, when the districts under British rule had about 4.75 million acres under irrigation, or 26.8 per cent of the net sown area. By 1936–37 the figure was 15.6 million acres, or 55.9 per cent. Taken together with the princely states, which had another 3.3 million acres, the Punjab had about 18.9 million acres under irrigation, and the thesis estimates this at some 37 per cent of all irrigated land in India including Burma.[4]

[1] Singh, D. (2004). *Historical geography of the colonial Punjab: 1849–1947* [Unpublished doctoral dissertation]. Panjab University, Chandigarh.
[2] Trevaskis, H. K. (1928). *The land of the five rivers*. Oxford University Press, p. 354.
[3] Rai, G. (1937). *Agricultural statistics of the Punjab, 1901–02 to 1935–36*. Board of Economic Inquiry, p. 7.
[4] Master, H. S. (1983). *Agrarian scene in British Punjab*. People's Publishing House, Vol. 2, p. 109.

Table 2. Irrigated area in British Punjab, 1868–69 to 1936–37

Year	Irrigated area (million acres)	Per cent of net sown area	Index (1868–69 = 100)
1868–69	4.75	26.8	100
1878–79	5.74	29.9	121
1890–91	6.61	31.5	139
1894–95	5.88	31.1	124
1900–01	8.41	40.2	177
1905–06	9.98	41.4	210
1910–11	10.02	41.2	211
1915–16	11.68	52.2	246
1920–21	12.95	59.5	273
1925–26	13.82	53.1	291
1930–31	14.81	55.5	312
1936–37	15.60	55.9	329

Source: District Gazetteers of the Punjab and Agricultural Statistics of British India, as compiled in Singh (2004), Table 5.4. Acreage rounded to two decimals. The compiled text gives slightly different figures for some years (for example, 6.53 million acres in 1890–91); the table is followed here.

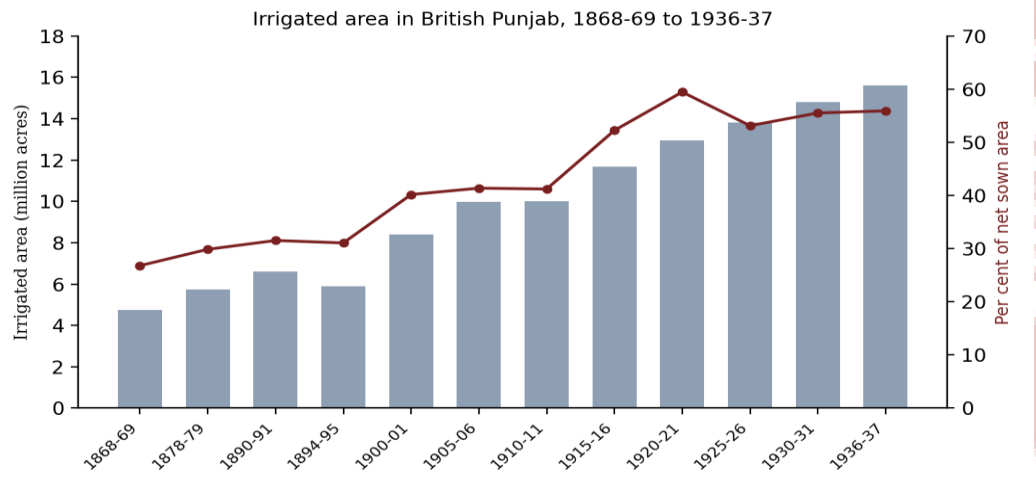

Figure 1. Irrigated area and its share of net sown area in British Punjab (drawn from Table 2).

The growth was not smooth. The slow decades before 1890 saw only small additions, and in 1894–95 the irrigated area actually fell by about 11 per cent. The failure of the winter rains, which hit the tracts of the Western Yamuna and Sirhind canals especially hard.[1] After that came a sharp rise. Between 1894–95 and 1905–06 the irrigated area went up by more than 4 million acres. The decade from 1910–11 to 1920–21 added another 2.9 million, as the great canals of the west were finished, and a further 2.7 million followed in the next sixteen years. In terms of share, the proportion irrigated more than doubled in seventy years.

3.2 Wells and canals

Table 3 shows the source of irrigation in 1936–37. In British districts nearly 70 per cent of irrigated land was watered by government canals, a little over 26 per cent by wells, and the rest by private canals, tanks and other means. The pattern in the princely states was similar. Wells had not disappeared, and the counts

[1]Rai (1937), p. 50.

about three lakh wells in 1906 and 3.4 lakh in 1938–39, but their numbers hardly grew while canals took over almost all the new acreage.

Table 3. Sources of irrigation, 1936–37 (acres)

Source	British Punjab	Per cent	Princely states	Per cent
Government canals	1,08,85,910	69.8	23,06,861	70.5
Private canals	4,66,288	3.0	1,59,559	4.9
Wells	40,86,756	26.2	7,70,805	23.5
Tanks	33,760	0.2	30	0.0
Other sources	1,31,993	0.8	35,873	1.1
Total	**1,56,04,707**	**100.0**	**32,73,128**	**100.0**

Source: Agricultural Statistics of British India, 1936–37, as compiled in Singh (2004), Table 5.3. Percentages recalculated from the acreage.

There was a difference between the British districts and the states. In 1900–01, about 39 per cent of the net sown area was irrigated in the British districts and about 19.5 per cent in the states; by 1936–37 the shares were 56 and 46 per cent. The gap narrowed, mainly because the Sirhind and Western Yamuna canals carried water to the Phulkian states, but the British districts always had the larger share of the best-served land.

3.3 The regional pattern, with Haryana in view

Irrigation was never evenly spread. In 1868–69 the highest shares were in the south-west, where inundation canals watered Multan and Muzaffargarh, and in a few central districts where wells were common. The studies lists Multan at about 81 per cent and Dera Ghazi Khan at about 73 per cent that year, whereas in the eastern plains the percentages were low. Even by 1890–91, when the provincial average was about 31.6 per cent, the south-eastern districts lay at the lower end. Gurgaon, Rohtak and Shimla had only 10 to 20 per cent of their area irrigated, Hisar and Hoshiarpur were under 10 per cent, and Ambala had the lowest figure in the province at about 5 per cent. Karnal, Firozpur, Kangra and Gurdaspur stood in the 20 to 40 per cent range. The contrast with the south-west, where Jhang had risen from about 5 per cent in 1878–79 to about 78 per cent in 1890–91, shows how the new canals were changing the western districts first.

What is interesting for the eastern plains is the way canal-making there differed from the west. The Western Yamuna and Sirhind canals mostly served villages that were already settled and had their own wells, whereas the western canals opened empty land. This point is made in the study itself in a comparison with the United Provinces, where canals also ran through old, settled tracts.[1] The consequences, for good and ill, followed from this difference.

4. The Canal System

The Punjab's canals fall into two groups. Inundation canals, found mainly in the south-west, ran only when the rivers were high and were cheap and small. Perennial canals drew water through weirs and headworks all through the year and could be run on a large scale. Government-owned canals watered nearly all the irrigated land, and private canals added only a small acreage. Table 4 sets out the main perennial systems and the facts the thesis gives for each.

[1]Ali, I. (1988). *The Punjab under imperialism, 1885–1947*. Princeton University Press, p. 8.

Table 4. The principal perennial canal systems

Canal	River	Key facts
Western Yamuna	Yamuna	Old canal of the Tughluq and Mughal periods; British restoration begun 1817; Delhi branch opened 1819, Hansi branch 1825; remodelled 1872–82; Sirsa branch built 1889–95; remodelled again 1940–43
Sirhind	Satluj (Ropar)	Surveyed 1867, sanctioned 1873, opened 1882; cost about Rs 40.7 million; costs shared 64:36 between British Punjab and the princely states
Upper Bari Doab	Ravi	Based on the older Hasli canal; irrigation from 1860–61; net return 12.7 per cent by 1903–04
Bist Doab	Satluj	Built 1853–54; the only canal of the Jalandhar Doab; about 103 km long
Lower Chenab	Chenab (Khinki)	Opened as inundation canal 1887; converted to perennial 1889; weir built 1890–92; about 3.3 million acres commanded
Lower Jhelum	Jhelum	Opened 30 October 1901; cost about Rs 18.2 million
Triple Canal (Upper Jhelum, Upper Chenab, Lower Bari Doab)	Jhelum, Chenab, Ravi	Constructed 1905–17; carried surplus Jhelum water to the Chenab and Chenab water to the Ravi, to feed the Lower Bari Doab canal (completed 1913)

Source: Imperial Gazetteer of India, Punjab (1908); Census of India, Punjab (1931); Uppal (1978); Randhawa (1983).

4.1 The Western Yamuna Canal

The Western Yamuna Canal is the oldest and, for Haryana, the most important of these works. The thesis traces it to the time of Firoz Shah Tughluq in the fourteenth century, when a channel from the Chautang torrent watered the royal gardens at Hansi and Hisar, and notes that it was dug afresh under Akbar in the sixteenth century.[1] Neglect followed, and in 1817 the British began to restore it. The Delhi branch was ready in 1819 and the Hansi branch in 1825. After the famine of 1832–33 the system was enlarged, and by 1837–38 it was watering about 400,000 acres.[2] Even in these early years the canal earned money: by 1847 the water revenue came to about 13 per cent of the capital spent on it.

The same canal also shows the dangers of badly planned irrigation. The original alignment blocked the natural drainage of the country it crossed, and waterlogging appeared in the districts it served. Between 1872 and 1882 the canal was therefore remodelled, with a permanent weir at Tajewala and cross-drainage works at Datarpur.[3] The Sirsa branch, built between 1889 and 1895, carried water into the dry districts of Karnal and Hisar and the Patiala state, and watered about 200,000 acres.[4] By the 1940s the canal system, remodelled once more in 1940–43, had a gross command of about 3.2 million acres, of which about 2.6

[1]Government of India. (1908). *Imperial gazetteer of India, Provincial series, Punjab* (Vols. 1–2). Superintendent of Government Printing, Vol. 1, p. 202.
[2]Douie, J. (1916). *The Panjab, North-West Frontier Province and Kashmir*. Cambridge University Press, p. 135.
[3]Dhillon, G. S. (1992). *Canal system of Punjab region*. Punjab Agricultural University, p. 7.
[4]Government of India (1908), Vol. 1, pp. 203–204.

million acres could be cultivated, in Karnal, Rohtak and Hisar. It is a record of nearly a hundred and thirty years of repair, extension and correction.

4.2 The Sirhind Canal

The Sirhind Canal was born out of famine. Famine in the 1860s and 1870s that affected the Punjab, the Central Provinces and the Upper Provinces and killed about a million people. Surveys began in 1867, the project was sanctioned in 1873, and the canal was opened by Lord Ripon in November 1882 in front of the chiefs of the Phulkian states. It took water from the Satluj at Ropar and ran southwards through Ludhiana and the territory of Patiala, Nabha, Jind and other states, as far as the borders of Rajputana and Bahawalpur.[1] The cost to the opening was about Rs 40.7 million. Because several princely states contributed, the cost and upkeep were divided between the British Punjab and the states in the ratio of 64 to 36. The Patiala feeder, which served the states, shared its water among Patiala (83 per cent), Nabha (9 per cent) and Jind (8 per cent).[2]

Two points about its construction deserve attention. About 1,800 convicts and several thousand free labourers, among them 15,000 famine relief workers from Sirsa and Bikaner, were camped along the line while the final scheme of 1879 was carried out, and calls it the first large-scale use of convict labour on public works in India.[3] Forced labour (*begar*) and the ready availability of London loans made such big projects possible. The canal also paid. In 1897–98 the return on the British capital outlay was 10.8 per cent, and it averaged about 8 per cent in 1897–1903, while the states' share averaged about 5.3 per cent. The Paper describes it as a commercial success that also protected a large tract from famine.

4.3 The western canals

The great canals of the west were of a different order. The Upper Bari Doab Canal, based on a plan to improve the older Hasli canal, began to irrigate in 1860–61. One reason for pressing the work after annexation, the thesis notes, was to find employment for the disbanded Sikh soldiers.[4] By 1903–04 it had cost 197 lakh rupees and returned a net profit of about 12.7 per cent. The Lower Chenab Canal, begun as a small inundation canal in 1887 and converted to a perennial canal in 1889, became one of the largest irrigation works of its time, commanding some 3.3 million acres. The study says its average revenue between 1907–08 and 1911–12 was 28 per cent of the capital invested, and that interest charges were cleared in 1894.[5] It was the Lower Chenab, more than any other work, that made the colonies possible.

The Lower Jhelum Canal, opened on 30 October 1901, and the Triple Canal Project completed by 1917 extended the pattern. The Triple Canal was a piece of engineering planning that tied three rivers together: the Upper Jhelum Canal moved surplus Jhelum water into the Chenab, the Upper Chenab Canal passed Chenab water into the Ravi at Balloki, and the Lower Bari Doab Canal then used this water to irrigate Montgomery and Multan. The Ravi alone did not have enough water in winter to supply the Lower Bari

[1]Randhawa, M. S. (1983). *A history of agriculture in India* (Vol. 3). Indian Council of Agricultural Research, p. 198; Thorburn (1970, p. 266).
[2]Punjab State Gazetteer (1908, p. 105).
[3]Thorburn (1970, p. 266).
[4]Gazetteer of Gurdaspur District (1914, p. 16); Punjab Administration Report, 1897–98 (p. 225).
[5]Douie (1916), p. 136.

Doab. The Balloki crossing as a remarkable engineering feat.[1] Thus the water of one river was routed hundreds of kilometres to serve land that did not touch it.

5. The Canal Colonies

5.1 The bars before colonisation

A canal colony was a settlement created on newly irrigated "crown waste" land and peopled by chosen immigrants. The land lay in the interior of the doabs, the great ridges between the rivers, which local people called *bars*. A Deputy Commissioner of Lyallpur who knew the Sandal Bar before settlement described it as an extremely flat and nearly treeless upland with rainfall in the interior of seldom more than four inches, swept by dust storms like those of the Rajputana desert.[2] Yet the flatness helped the planners, for the canal engineers could lay out the canals and distributaries across the whole area without obstacles, and surveyors could mark the land in squares. Each square (*murabba*) measured about 28 acres, and the colony villages were planned around these regular blocks.

The people of the bars were the *janglis*, pastoral nomads with camels and cattle. The Paper cites an estimate of 50,000 janglis in 1892 and a census count of 57,829 in the Chenab colony in 1906.[3] Because the land was officially "crown waste", the Government declined to recognise any claims by these people and was free to dispose of it as it wished. The Study observes that the Government held authority over the land and over the water at the same time, which let the settlement proceed with very little interference. In this paper's reading, that double control is the key to the whole colonisation scheme: whoever received a square also received a place on a water-course controlled by the state.

5.2 The aims

Official aims changed over time. The first colonies had two purposes. One was to relieve the pressure of population in the crowded central districts, where holdings were shrinking. The other was to build villages that were better planned and better equipped than any in the older Punjab.[4] A third aim was added after the South African War, when officers worried that the army would not find enough horses, mules and camels. In the Lower Jhelum and Lower Bari Doab colonies, land was therefore granted on condition that the grantee breed remounts for the army, and about 200,000 acres were allotted on this basis in the first two. Other aims were to raise surplus wheat, cotton and sugarcane for export and for provinces in need, and to give land for experiments in seed, cattle breeding and farm machinery.

5.3 The colonies one by one

Table 5 lists the nine colonies of the colonial punjab in the order in which they were settled. The first, Sidhani and Sohagpara, were small and were settled in 1886–88 on canals that supplied only seasonal water. The government therefore kept the holdings large, about 55.5 acres, so that settlers would be wealthy enough to dig brick-lined wells for the second harvest, and it avoided creating very big estates.[5] Chunian

[1]Uppal, H. L. (1978). Hydrological balance of the Indus Basin. In *Land and water management in Indus Basin (India)* (Vol. 1). Indian Ecological Society, Punjab Agricultural University, pp. 22–25.
[2]The Chenab Colony (1904, p. 31).
[3]Randhawa (1982, p. 284).
[4]Darling, M. L. (1928). *The Punjab peasant in prosperity and debt* (2nd ed.). Oxford University Press, p. 134.
[5]Ali (1988), p. 14.

(1896–98 and 1904–06) followed on an extension of the Upper Bari Doab. The big colonies came after 1892.

Table 5. The canal colonies of the Punjab

Colony	Settled	Districts	Area (acres)	Cost (Rs million)
Sidhani	1886–88	Multan	250,000	1.3
Sohagpara	1886–88	Montgomery	86,300	1.8
Chunian	1896–98, 1904–06	Lahore	102,500	2.0
Lower Chenab	1892–1905, 1926–30	Gujranwala, Jhang, Lyallpur, Lahore, Sheikhupura	2,034,235	53.1
Lower Jhelum	1902–06	Shahpur, Jhang	1,531,000	43.6
Lower Bari Doab	1914–24	Montgomery, Multan	1,635,000	25.1
Upper Chenab	1915–19	Gujranwala, Sialkot, Sheikhupura	72,000	43.6
Upper Jhelum	1916–21	Gujrat	42,300	49.8
Nili Bar	1926–40	Montgomery, Multan	1,154,000	—

Source: Punjab Colony Manual, 1945–46, and the Punjab Public Works Department (Irrigation Branch) Administration Report, 1945–46, as compiled in Singh (2004), Table 7.1. The printed area for the Lower Bari Doab includes some private land, and the cost for the Nili Bar is printed unclearly and is left blank.

5.4 The Lower Chenab Colony

The Lower Chenab colony, begun in 1892, was the largest and the model for the rest. Its first allotments were made in the area of the Rakh and Mian Ali branches and then extended to the Jhang, Gugera and Buraia branches by 1902. The Government wished it to be a colony of small farmers, and the final distribution bears this out: of the total crown land, about 75 per cent went to peasant grantees, 9.6 per cent to yeomen, 8.5 per cent to capitalists and about 6.9 per cent to others.[1] On the Gugera and Buraia branches alone, about 78 per cent was given to peasants, to nomads and to the owners of the river-side villages.

The grantees came in classes. A peasant grantee received from half a square to two squares, a yeoman several squares, and a capitalist from six squares up to twenty. There were also pensioners of the army and police, and other categories. Peasants were at first given only the status of occupancy tenants and not full ownership, because the Government wished to stop the land from passing into the hands of money-lenders, as had happened in the old districts. The colonists, however, resented the restrictions, and the thesis says that within a few years a political agitation started. A commission was appointed and the Government gave in to the demands. This episode is a reminder that the planners had to bargain with the people they settled.

Where did the colonists come from? The study shows that about 80 per cent of the land that went to immigrants was allotted to people from seven central districts: Ambala, Hoshiarpur, Jalandhar, Gurdaspur, Amritsar, Ludhiana and Sialkot.[2] Amritsar received the largest share, about 250,000 acres, Gurdaspur and Sialkot about 150,000 acres each, and the others, except Ambala, about 100,000 acres each. The greatest

[1] Ali (1988), p. 22.
[2] Ali (1988), pp. 347–348.

part of the immigrant land, some 675,000 acres, went to Jats, of whom about 230,000 acres went to Muslims and about 445,000 to Hindu and Sikh Jats. The Arains, all Muslims, came next with about 200,000 acres. Kambohs, Sainis and some Rajputs also received land. Where possible, people of the same clan were placed in one village, and they took their service castes with them, so that the old structure of the village was reproduced in the new ones. Ambala is worth noticing: it was among the districts of recruitment, but its share of land was smaller than that of the other central districts, which says something about how the officers rated its agricultural population.

Life in the first years was hard. The thesis repeats the recollection of a farmer from Gill village in Ludhiana district who had moved to Lyallpur in 1891 and found only four families in his *chak*. As more families came, barbers, carpenters, blacksmiths, water-carriers and priests followed and singers and acrobats toured the new villages. But the official gazetteer records the other side. There was no railway or market at the first harvest, labour was scarce, so that thousands of acres of cotton remained unpicked, cattle were stolen, the climate was fierce and cholera broke out. Some colonists gave up and went home.[1]

5.5 Horses, soldiers and auctions: the later colonies

In the Lower Jhelum colony (1902–06) the horse-breeding condition changed the whole plan. A peasant grantee now had to keep a branded mare, and the size of the grant was raised to two squares, or about 55.5 acres, to make this possible. Official reports showed how scarce such animals were. In the Rawalpindi commissionership there were only 7,000 branded mares when 10,000 were needed, and in the whole of the Punjab only 13,000, against 22,000 in all British India.[2] Because the mare was out of reach of most local candidates, grantees were drawn from the northern districts of Sialkot, Gujrat and Gujranwala, and the share of Sikhs rose. About 74 per cent of the allotable land of 540,000 acres was reserved for peasant grantees, and eight stud farms were granted to landlords, seven of whom belonged to local landed families.

The Lower Bari Doab colony (1914–24) went further in the same direction. The 1914 scheme planned to allot about 1.19 million acres but the land finally given out was about 958,000 acres, a result of shrinking availability and other claims. The largest single category, about 57 per cent, went to horse-breeding peasants and war veterans, and the military received a further large share.[3] Some land also went to private experiments. A European cotton expert received 3,000 acres on condition that he supply seed to the Agriculture Department, and the British Cotton Growing Association of Manchester was given 7,220 acres in the Lower Bari Doab, and later, on temporary lease in the Nili Bar, acquired about 70,000 acres, which the thesis calls the largest holding in the colonies.[4] The Government thus used land grants to get private firms to do the work of agricultural research.

The last colony, the Nili Bar (1926–40), marked a break. It was made on the Satluj Valley Project and had about 804,600 acres of crown land under perennial irrigation. There was no horse-breeding condition. About 45 per cent of the land was reserved for sale by auction at market prices, and the peasant grants dropped to about 31 per cent.[5] Table 6 compares the share of land in the colonies. The picture is clear. At

[1]Gazetteer of the Chenab Colony (1904, p. 31); Darling, M. L. (1947). *The Punjab peasant in prosperity and debt* (4th ed.). Oxford University Press, p. 133.
[2]Report of the Rawalpindi Commissioner (January 1902), quoted in Ali (1988), p. 26.
[3]Punjab Revenue and Agricultural Proceedings (Irrigation), March 1914 and December 1916.
[4]Darling (1946, p. 35).
[5]Punjab Revenue Administration Papers, No. 4 (1927).

first the colonies were planned as settlements of small peasants, then as sources of horses and soldiers for the army, and at the end as a way to raise money from land sales.

Table 6. Changing pattern of land allotment in four colonies (per cent of allotted land)

Colony	Peasant grants	Horse-breeding	Sale by auction	Other
Lower Chenab (final)	About 75	—	Small share	About 25
Lower Jhelum (planned)	74.4	Included in peasant grants	—	About 25
Lower Bari Doab (final)	—	56.9	7.8	About 35
Nili Bar (perennial)	31.2	Not required	45.0	About 24

Source: compiled from the allotment figures in Singh (2004), drawing on Ali (1988). The shares are for different categories and are not strictly comparable; "Other" is the remainder. For the Lower Chenab, yeomen received 9.6 per cent, capitalists 8.5 per cent and others 6.9 per cent.

6. Effects on Land Use and Farming

The effects on land use were large. For the whole province the thesis reports that net sown area rose from 41.7 per cent of the total in 1900–01 to 46.4 per cent in 1936–37, cultivable waste fell from 30.6 to 23.5 per cent, and forest from 7.5 to 3.2 per cent. The area given over to roads, railways, canals and towns grew from 8 to 13 million acres. The pattern in space was easy to read: the fall in forest was in the hills, the rise in sown area and fall in waste was in the canal colonies, and the rise in land not available for cultivation was around new settlements and works.

The crops changed too. The thesis estimates that the area under wheat in British Punjab rose from 4.8 million acres in 1873–74 to 9.4 million acres in 1936–37, an increase of nearly 97 per cent, and that the canal colonies and the well-irrigated parts of the central districts were the main wheat-growing areas.[1] Wheat had become a commercial crop. About 24 per cent of the wheat harvest of 2.6 million tons in 1906–07 was available for export, and in 1916–17 about 34 per cent was exported, of which about 29 per cent went overseas. Cotton, sugarcane and fodder crops also benefited from perennial water, although the thesis notes that sugarcane had its home in the northern and central districts and cotton had a small base in the early years (3.3 per cent of the cropped area in 1873–74). The shift to export crops tied the farmer more closely to world prices and the railway.

7. Costs and Limits

The study is warm in its praise of the canals, but it records several costs. The first was ecological. Canal irrigation caused waterlogging and salinity, that the boom in farming in some places began to fall away, and that falling output led to some out-migration from the affected areas. The story of the Western Yamuna Canal, already noted, shows that this problem was known in the Haryana plains as early as the 1830s and 1870s, when the canal's alignment had to be altered because it disturbed natural drainage.

The second cost was social. The janglis were pushed from their pastures, and their resentment was recorded. They were given only a small portion of the land at the end (about 67,000 acres in the Lower Chenab

[1]Rai (1937), p. 61; Malik, R. (1974). Changes in the land use pattern in Indus Basin during the British period. *Pakistan Geographical Review, 29*, p. 8.

extension), and later grants were made only to those who owned cattle or camels. The capitalist and yeoman grantees often did not live on their land. Some never visited their estates, and many were absentee, so that the Government's expectation that they would lead the new colonies was not met. The peasants were to be the backbone of the colonies, and in most cases they were, but this was by selection: the Government picked good farmers from the central districts, and the landless labourers of those districts, who made up the poorest part of the old villages, mostly had no part in the colonies.

The third cost was political. Water and land became instruments of policy. Grants were used to reward soldiers, to bind the Sikh peasantry to the army, to supply remounts, and to draw capital from private firms and from the princely states. The Government had to give way when peasant colonists protested at their tenant status, which shows that dependence on state grants also produced grievances. For this paper, the lesson is that the colonies were as much instruments of rule as of development.

8. Discussion

Three points emerge when the evidence is put together. First, the canals were a real success in the narrow sense. The area irrigated more than trebled in seventy years, the main canals paid well on their capital, and the colonies became a granary for the empire. The study calls the Punjab a "bread basket", and several of its numbers, such as the 28 per cent return on the Lower Chenab in some years, support this. The success came partly from the careful engineering, such as the Triple Canal, and partly from the fact that the state was the owner of both the land and the water.

Second, the benefits were not spread equally across space. The western doabs, which had been empty, were transformed in a few decades, while the eastern plains received canals that watered land already settled and farmed, and these districts, even in 1890, had only 5 to 20 per cent of their land irrigated. Haryana's canals were made in the nineteenth century and improved piecemeal, whereas Lyallpur and Montgomery were created by design in about thirty years. The Phulkian states, as partners, did get a share in the water, but the control was in British hands, and the Sirhind canal's two largest branches served British territory and gave the revenue to the Government. This difference is one of the reasons why the western Punjab was richer than the east by 1947.

Third, official gazetteers and on writers such as Darling, who admired the colonies. It describes Lyallpur as the richest tract in India and perhaps in Asia, which is a judgment that few of the janglis would have shared.[1] Nor does it say much about the colonists' debts or about women, who are almost absent from the evidence.

9. Conclusion

Canal irrigation was the biggest change made by the British to the geography of the Punjab. It raised the irrigated share of cultivation from about 27 per cent in 1868–69 to about 56 per cent in 1936–37, created new districts and towns, and made wheat a major export. In the eastern plains it renewed and extended old canals, with the Western Yamuna and Sirhind systems at the centre, and carried water to the dry lands of Karnal, Rohtak, Hisar and the Phulkian states. In the west it created the canal colonies, which were planned as small-farmer settlements but changed in time into places that served the army and the treasury.

[1]Darling (1946, p. 32).

The gains were large and the costs were real. The nomads of the bars lost their grazing, the early over-irrigation led to waterlogging, and the benefits depended on whether a person was chosen as a colonist. Looking at canals through geography shows both sides: the pattern of water tells us who received land, and the pattern of land tells us what the Government wanted from the people. The story is a reminder that irrigation in the colonial Punjab was a matter of power as much as of engineering.

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