

IRRIGATION AND CROP PATTERNS IN THE PUNJAB 1887—1947: A PRELIMINARY VIEW

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Irrigation, particularly canal irrigation, has long been recognized to have played an important role in Indian agriculture under British colonial rule. In a way this is clear from the fact that the Indian nationalist spokesmen who were critical of railway construction by the foreign government gave unqualified support to investment in canal-building activities.¹ On the other hand, members of the colonial bureaucracy used a plethora of superlatives to describe the canal system in appreciation of its critical role in augmenting agricultural production. Echoing their sentiment a commentator has recently characterised the canals (along with the railways, laws and civil service) as the “greatest monuments to British rule”.² However, though much has been said about the importance of irrigation on *a priori* considerations, the working of the irrigation system and its impact on the agrarian economy and society has remained under-researched. Till recently the only study of this subject constituted a section of a book on the Uttar Pradesh by Elizabeth Whitcombe.³ As far as Punjab (which had the highest proportion of irrigated area in India) is concerned, there is hardly any publication on the subject even though a wide range of quantitative and qualitative data are available on the working of the irrigation system and related subjects. This paper is an attempt to delineate the broad features of one aspect of the impact of irrigation in the undivided Punjab — changes in the crop-mix over time.

The area of investigation thus selected for this paper derives its importance primarily from three considerations. Firstly, irrigation does not increase crop production only through the expansion of cultivated area and improvement in yield per acre, but also by promoting the transfer of resources to the superior or more valuable

* This paper is based on my current research on Irrigation and Punjab Agriculture (1887-1947). Findings presented in this paper are not for use in any publication.

crops. This explains why inquiry in this latter area is usually regarded as a major aspect, sometimes even the starting-point, in formal benefit-cost analysis. Secondly, the contemporary observers differed in formal benefit-cost analysis. Secondly, the contemporary observers differed in their perception about the specific nature of the changes in the crop production sector likely to follow from canal irrigation. Thus, the nationalist spokesmen believed that irrigation works would increase food production in the country and in this way help prevent famines or scarcity.⁴ Indeed, it was on this assumption that they favoured a diversion of public investment in this field from railway construction. On the other hand, the colonial administrators remained more or less convinced that canal irrigation would (and actually did) promote the increased production of more profitable cash crops.⁵ Many historians have taken the same view. It would then be worth investigating whether cashcrops fared better than the food crops or vice versa. Finally, an inquiry into the changes in crop pattern in response to an assured water-supply is likely to shed some light on the nature of peasant behaviour, a subject which has generated intense debate among the economists and historians.

To begin with, the main developments in respect of the irrigation system in the Punjab province may be mentioned. During the period 1887-1947 sown irrigated area (including double-cropped area and area in which harvest failed) increased at the rate of 1.60 per cent. per annum.⁶ On the other hand, unirrigated area declined by 0.32 per cent and total sown area expanded at the compound rate of 0.45 per cent. In terms of percentage distribution, the proportion of irrigated acreage to total cropped area increased from one-third (33.0%) during the decade 1887-1896 to a little over one-half (52.2%) during the last decade. Thus, by the closing years of the colonial rule Punjab came to possess one of the largest irrigation systems in the world. Rates of change in area irrigated from different sources can not be estimated for the entire period without some major adjustments in the date.⁷ However, the underlying trend is clear enough. Thus, whereas irrigation from government canals expanded at the rate of 1.80 per cent during 1907-1947, area irrigated from wells (all of which were in the private sector) increased by 0.84 per cent per year. This means that at the provincial level irrigation from government canals can not be said

to have replaced well-irrigation. Some substitution did, however, take place in respect of irrigation from private canals, tanks, streams (which declined at 0.23% per annum). The disparity in the performance of canal-irrigation and well-irrigation is shown more clearly by the changes in the percentage distribution of total irrigated area. Thus, the proportion of area irrigated from government canals increased from 35.6 per cent in the first decade to 70.6 per cent in the last. On the other hand, the proportion of well-irrigated area declined by half (from 49.9 to 25.6 per cent).

We propose to indicate the impact of irrigation on crop-combination by comparing trends in total irrigated area with the trends in (irrigated) acreage under individual crops or groups of crops. Of course irrigation is only one of several influences on production decision: population growth, transport development, changes in relative price and institutional factors would impinge upon decision-making to such an extent which would confuse the impact of irrigation on changes in crop mix over time. However, some broad trends can be gleaned from the proposed comparative study. For this purpose 13 crops have been taken into consideration. These are: wheat, gram, barley, bajra, jowar, maize, rice, tobacco, sugarcane, cotton, linseed, sesamum and mustard. The last three crops have been grouped under oilseeds. On the other hand, rice, jowar, maize, barley and bajra have been treated both individually and also as belonging to one group of minor cereals. Finally, estimated rates of change have been presented for (a) all the cereals and pulses and (b) the main cash crops (i.e. cotton, sugarcane, oilseeds and tobacco). While the cash crops were raised primarily for sale, those under (a) were grown partly for sale and partly for domestic consumption.⁸ The relevant statistical data have been drawn from the *Punjab Land Revenue Administration Reports* (for the period up to 1900/01) and the *Season and Crop Reports* (for the subsequent period). Of late the quality of the crop statistics of the Punjab province has come under close scrutiny by several scholars.⁹ We have not concerned ourselves with this question in the present paper. Some adjustments have, however, been made in the data (including those on the different sources of irrigation) for the fact that till 1900/01 the North Western Frontier Province was a part of Punjab. Secondly, data on crop acreage relate to harvested area up to 1905/06 and sown area thereafter.¹⁰

Estimated rates of changes in irrigated and unirrigated acreage under crops are presented in Table I. These show that there was a marked disparity in the performance of the two groups of cash crops and the foodgrains, irrigated acreage under the former group increasing much faster. In other words, all the cash crops taken together increased their share of the total irrigated area over time, from 13.6 per cent in the first decade to 17.9 per cent in the last (Table 2). On the other hand, the shares of the minor cereals and all foodgrains declined over the successive decades. Their share in unirrigated area also declined, but at lower rates. Thus, there was decidedly a trend towards a shift of resources to the cash crops in response to an assured water-supply. The same trend is underlined by two other developments. Firstly, the decline in the proportion of unirrigated area devoted to this group of crops was more marked than in cereals and pulses. Secondly, whereas proportion of unirrigated area under cash crops remained stable during the depression years (1926/27-1935/36), there was a slight increase in the case of irrigated area. Indeed, the proportion of irrigated area under cash crops reached its peak during these years.

It may be argued that as yield per acre may also have been increasing at faster rates and some of the crops in this group (i.e. sugarcane) commanded a higher price annual rates of expansion in irrigated area or its percentage distribution are likely to underestimate the performance of the cash crops or their importance in total crop-mix. Yield figures for almost all the crops considered in this paper are available from 1906/07 onwards. These data suggest that yield per acre of all cash crops taken together was really increasing faster. But the inclusion of the differential in yields and prices do not improve the picture to a significant degree. In other words, the share of cash crops production in total crop production remains about the same as in the distribution of irrigated acreage (Table 3).

Thus, performance at the aggregate level corroborate the view that irrigation would or did promote cash crop production. But when we look at the trend rates of individual crops the picture appears to be more complicated. Acreage under oilseeds declined in absolute terms and that under sugarcane lagged behind the expansion in irrigation. Thus, the fact that as a group cash crops fared better than foodgrains is due to the marked increase in the irrigated acreage under cotton. Among the foodgrains, gram acreage expanded much faster, but expansion rate in irrigated acreage under wheat, the most important food crop, and the minor cereals was

TABLE I
Rates of Change in Crop Acreage and Yield

Crops	Acreage (1887-1947)		Acreage (1907-47)		Yield per acre (1907-47)	
	a	b	a	b	a	b
Total sown area	1.60	-.32	1.39	-.20	.52	—
Wheat	1.18	-.28	.82	.00	.39	.26
Gram	2.79	.56	1.77	-.13	.31	-.35
Maize	-.07	-.96	.71	-.25	.17	-.06
Barley	-1.16	-1.48	-.70	-1.95	1.56	-.32
Jowar	-1.68	-2.05	-1.16	-.98	-1.08	.20
Bajra	2.91	.65	3.34	.77	1.09	-.34
Rice	1.55	1.00	1.72	-.16	1.27	.20
Minor Cereals	.38	-.56	1.04	-.09	.26	-.02
Cotton	3.32	-1.96	2.88	-.26	2.16	1.78
Oilseeds	-.73	-1.15	-.54	-1.00	-.80	-.16
Sugarcane	1.07	-.66	1.18	1.8	.99	.75
Cash crops	2.30	-1.33	1.99	-1.29	1.08	.86
Cereals and pulses	1.05	-.40	0.99	-.10	.31	-.20

Note: (a) Irrigated, (b) Unirrigated, (c) Total

TABLE 2
Changes in Percentage Distribution of irrigated Acreage

Years	Cash	Crops b	Minor a	Cereals b	Cereals & Pulses		Total a	Crops b
	a				a	b		
1887/1896	14	8	27	36	75	89	33	67
1897/1906	14	7	22	27	71	71	40	61
1907/1916	17*	7	17	29	65	83	39	60
1917/1926	20	6	15	29	61	83	45	54
1927/1936	21	5	14	29	58	82	47	52
1937/1946	19	5	15	31	58	83	52	48

Notes: (a) Proportion of irrigated area; (b) Proportion of unirrigated area

* From 1906/1907 *toria* is included

TABLE 3

Percentage Distribution of Output by Groups of Crops

Years	Cash	Crops	Minor	Cereals	Foodgrains	
	a	b	a	b	a	b
1907/1916	17	8	20	28	83	92
1917/1926	21	8	18	28	79	92
1927/1936	21	7	17	26	79	92

Note: (a) Irrigated crops; (b) Unirrigated crops

much lower (Table 1). Decline in the proportion of irrigated area under the foodgrains deserves emphasis because this was accompanied by a decline in unirrigated area in absolute terms and population was growing at the rate of 1.2 per cent per annum.¹¹

The question that now needs to be addressed is: what caused these variations in the performance of the individual crops? According to one view, first propounded by the nationalist spokesmen and subsequently taken up by the Marxist and neo-Marxist historians, is that the production of commercial crops (usually understood as crops raised primarily for sale) was a forced and artificial activity in India. It is presumed that the farmers would have preferred allocating more land to foodgrains to feed growing population, but they were coerced by the landlords and moneylenders to produce cash crops.¹² Interpreted in the context of the subject under study and the trend rates presented earlier on, this would mean that cotton acreage receiving water-supply expanded faster than irrigated foodgrains because of the operation of institutional factors. This view has been challenged by a number of historians and on the basis of positive relationship between the acreage of crop and its yield and price — one author has argued that it was really market forces which led to the expansion of cash crop acreage.¹³ One would be tempted to argue that this will be valid also in the case of Punjab. Firstly, as Raj Krishna has shown, the Punjab farmers responded favourably and significantly to the changes in the relative yields and prices of different crops.¹⁴ Secondly, trends in irrigated acreage under cash crops seem to have been positively related with

those in yields. Thus, while a decline in oilseeds yield was accompanied by an absolute decrease in cropped area, a marked improvement in cotton yield as a result of the introduction of new varieties saw a rapid expansion of sown irrigated area. Between these two extremes a moderate improvement in the yield of sugarcane led to a similar increase in irrigated acreage (Table 1).

It is, however, worth emphasising the point that a positive response to changes in relative yield (and price) of a crop or group of crops may not necessarily have been out of a free choice by all the different section of the farmers. There was a marked disparity in the distribution of agricultural land in Punjab. Thus, the rich farmers who constituted 15.5 per cent of the agricultural population owned 61% of the land. On the other hand, the small peasants owned only 12 per cent of the land though they formed 58 per cent of the population.¹⁵ Moreover, a preliminary survey of the available data indicate that such disparity was more marked in the canal-irrigated than in the rain-fed areas. The view that there was some institutional compulsion on the production of cash crop errs inasmuch as it underestimates the freedom of the surplus farmers in taking their production decision. On the other hand, we seem to get a different picture about the response of the small farmers. Firstly, these farmers were almost perpetually in debt to the moneylenders. Secondly, in Punjab the proportion of land cultivated by the tenants-at-will increased¹⁶ from 32% in 1890 to 48% in 1932. Part of the cost of production in such cases was met by the landlords and their rental demand varied from 25% of the produce.¹⁷ Thus, it would be reasonable to assume that these landlords and the moneylenders (particularly the agricultural ones) intervened in the production decision of the tenants and their intervention was in favour of those crops which were more profitable in terms of higher yield or price. In other words, the response of these small tenants may not have been altogether voluntary.

To turn to the variations in the performance of individual foodgrains, the impact of market forces is likely to be less important given that the larger part of these crops were meant for on-farm consumption. It is also worth mentioning that often the same plot of land was sown with two of the minor cereals, or these were raised along with one of the two main crops in foodgrains category — wheat and gram. Moreover, the minor cereal and gram were

mostly raised in lands which were cropped twice during the same agricultural year. Thus considered, it is not surprising that there were no significant trends in the yield of minor cereals, or any consistent relationship between yield and acreage. As for wheat, the available data do not indicate any significant trend in yield. But it is unlikely that yield did not improve at all, for by the late 1930s the larger part of wheat acreage was sown with wheat acreage. In other words, as in the case of sugarcane or cotton, expansion of irrigated acreage under wheat should also have been partly due to the improvement in yield. Before concluding this part of the discussion it needs to be mentioned that a fuller analysis of the variations in trends in individual crops should also take into consideration the changes in relative price. Reference should also be made to the water-rates in canal irrigation, though these are unlikely to have been a very important factor.

To summarise and conclude, as a group cash crops fared better than cereals and pulses inasmuch as these crops increased their share of irrigated acreage over the successive decades. However, the trends in individual crops reveal sharp variations. In the case of cash crops these variations were clearly related to the changes in yield. The nature and extent of share-cropping tenancy and money-lending operations suggest that there was a certain degree of compulsion in the response of the small and tenant farmers to changes in yield (or price). This element of compulsion should not, however, be overemphasised in the context of the overall pattern, for the substantial farmers who had greater or complete freedom in respect of their production decision cultivated the larger part of land. Moreover, as mentioned earlier on, the expansion in irrigated acreage under wheat is also likely to have been partly due to some improvement in yield. Thus, the view which seems to emerge from this preliminary exercise is that irrigation led to a shift of resources to such crops in the case of which it could cause/permit/facilitate certain improvement in yield per acre.

NOTES

1. For details see Bipan Chandra, *The Rise and Growth of Economic Nationalism in India*, New Delhi, 1966. Ch. V. Bipan Chandra is himself

- critical of the uniformly low expenditure on irrigation alongside that on railways. 'Reinterpretation of Nineteenth Century Indian Economic History', *Indian Economic and Social History Review*, V(1968), pp. 67-68.
2. W.J. MacPherson, 'Economic Development under the British Crown 1858-1947', in A.J. Youngson (ed.), *Economic Development in the Long Run*, London, 1972, pp. 144-145.
 3. E. Whitcombe, *Agrarian Conditions in Northern India*, London, 1972, vol. I, pp. 64-91. There are, however, some works dealing with water-rates; B.D. Kanetkar, 'Pricing of Irrigation Service in India (1854-1959)', *Artha Vijnana* II, 2(1960), and 'The Core of Price Policy for Sale of Canal Waters', *Artha Vijnana* V, 2(1963); N. Ansari, *Economics of Irrigation Rates. A Study in Punjab and Uttar Pradesh*, London, 1968. For a technical cost-benefit analysis see: D.R. Gadgil, *The Economic Effects of Irrigation* (Poona, 1948).
 4. Bipan Chandra, pp. 210-211.
 5. See, for example, Mr. Penny's comments in *Report of the Abiana Committee*, Lahore 1934, Appendix V.
 6. Statistics on irrigated area are available from the *Administration Report of the Punjab Public Works Dept - Irrigation Branch* and also the publications mentioned in connection with the sources of crop statistics. Trend rates have been estimated by fitting equation of the type $y = a + bt$.
 7. Prior to 1906/07 area irrigated from a particular source included double-cropped area. Thereafter double-cropped areas irrigated from different sources were shown separately but these were merged under one heading.
 8. It was estimated in 1930s that the proportions of produce sold in the market were as follow: Wheat 60%; rice 60%; maize 18%; jowar 55%; bajra 12%; the figures for the last term crops relate to the districts included in East Punjab. For details see, *Report on the Marketing of Maize and Millets in India*, Simla, 1954, p. 18; *Report on the Marketing of Rice in India and Burma*, Simla, 1941, p. 12; *Report on the Marketing of Wheat in India*, Delhi, 1937, p. 16.
 9. For details see G. Blyn, *Agricultural Trends in India, 1891-1947: Output, Availability and Productivity*, University of Pennsylvania Press, 1966, Ch. 2; S.C. Misra, 'On the Reliability of Pre-Independence Agricultural Statistics in Bombay and Punjab', *Indian Economic and Social History Review*, XX, 2; Clive Dewey, 'Patwari and Zamindar: Subordinate Officials and the Reliability of India's Agricultural Statistics', in: *The Imperial Impact: Studies in the Economic History of Africa and India*, ed. C. Dewey and A.G. Hopkins, London, 1978.
 10. On an average during 1897-1901 harvest failed in 8% of sown irrigated and 28% of sown unirrigated land. On the other hand in 1900/01 harvested area in the frontier districts accounted for 8% of the harvested area in Punjab and frontier districts taken together. Therefore, *harvested* irrigated area under a crop in Greater Punjab has been assumed to represent *sown* irrigated area in Punjab proper for the period 1897-1901. The harvested irrigated area in Punjab proper for the period 1901/02-1905/06 has been multiplied by 1.08 to obtain sown irrigated area under a crop. In the case of unirrigated crops harvested area in Greater Punjab for the period 1887-1901 has been multiplied by 1.38 to obtain sown area and reduce by 8% for the separation of the frontier districts. For the period 1901/02-

1905/06 harvested non-irrigated area in Punjab has been multiplied by 1.38.

11. Average of growth rates in 7 reference decades beginning 1906/1916 as estimated by Blyn, Appendix Table 5B, p. 332.
12. Rajat K. Ray, 'The crisis of Bengal Agriculture, 1890-1927: The Dynamics of Immobility', *Indian Economic and Social History Review*, X, 2 (1973); Daniel and Alice Thorner, *Land and Labour in India*, Bombay, 1972, p. 55; Bhowani Sen, *Evolution of Agrarian Relations in India*, New Delhi, 1962, p. 87.
13. Akbar Ali Khan, *Some Aspects of Peasant Behaviour in Bengal: A Neo-Classical Analysis*, Dacca, 1982.
14. Raj Krishna, 'Farm supply Response in India-Pakistan: A Case study of the Punjab Region', *Economic Journal*, LXXII.
15. H. Calvert, *The Size and Distribution of Agricultural Holdings in Punjab*, Lahore, 1925, p. 4.
16. Clive J. Dewey, 'The Agricultural Output of an Indian Province: The Punjab, 1870-1940', Paper presented at the Institute of Commonwealth Studies, London.
17. H.R. Stewart, *Some Aspects of Batai cultivation in the Lyallpur district of the Punjab*, Lahore, 1926. Tenancy on share-cropping system was known as Bata'i.