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Local Consequences of a Large-Scale Irrigation System in India

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Irrigation projects have often formed a part of development programs aimed at economic and social change in rural India. A major irrigation development project in southern Fatehabad tehsil, Hissar District, Haryana, initiated important changes in the spatial pattern of agricultural land use in the area. Certain design and operational features of the irrigation system tended to concentrate the advantages of irrigation at specific locations within the area it serves, and the resulting patterns of agriculture substantially reflect the differential access of farmers to the advantages and benefits of irrigation. Moreover, differential access to irrigation water has had important implications for the various social groups resident in villages in the area, particularly when examined within the context of governmental action to implement a land-reform program intended to have major social and economic benefits.

The temporal coincidence of perennial irrigation from the Bhakra-Nangal project and the application of the Punjab Occupancy Tenants and Security of Land Tenures Act, 1953, and Rules, 1956, may have been accidental. The general success of the Bhakra-Nangal project in bringing water to agricultural lands in Punjab and Haryana is widely acknowledged. Yet the general failure of land-reform legislation to alter significantly the concentration of land-

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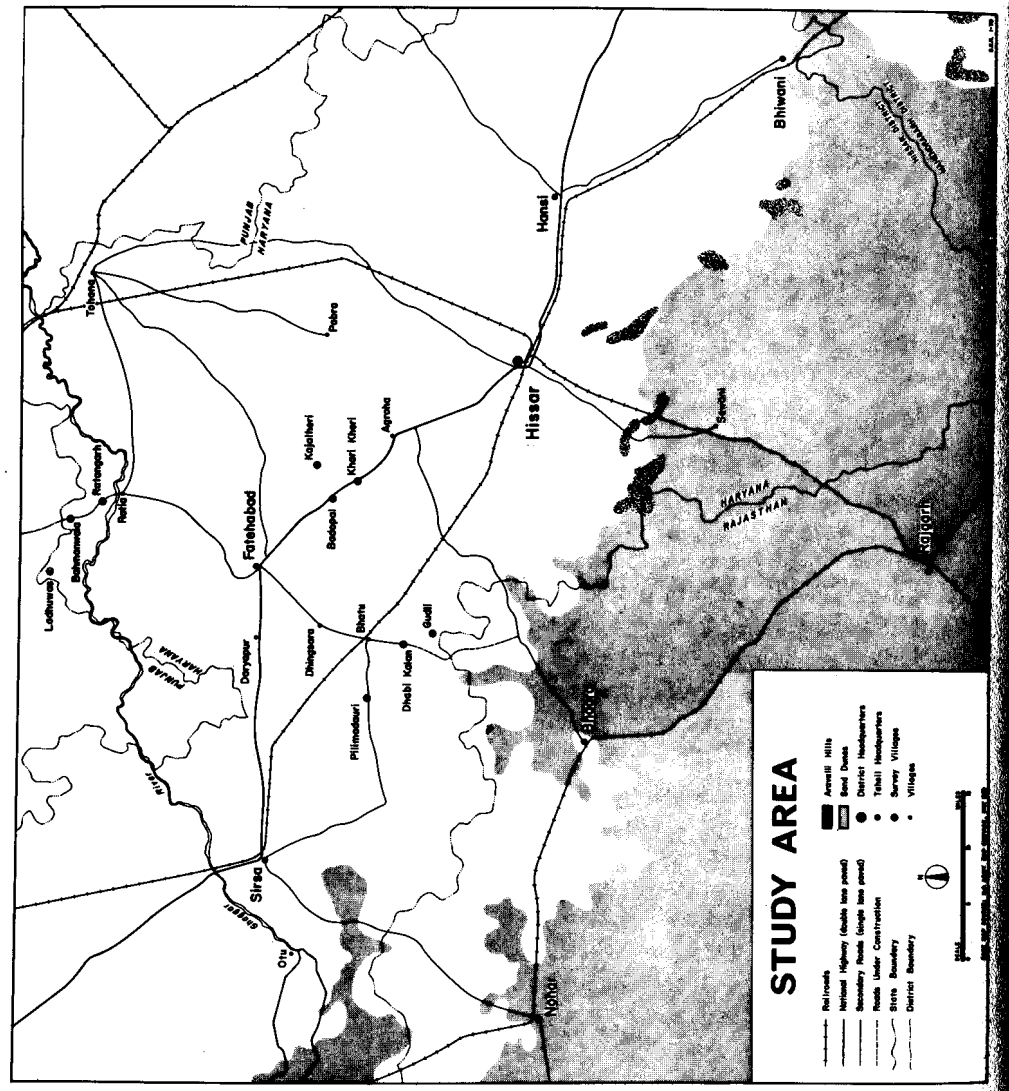

ownership in the hands of rural elites within the environment of rapid technological change in agriculture facilitated by the Bhakra-Nangal project appears to have substantially frustrated efforts to redress the severe social and economic inequalities of rural life in this region.[1]

The Research Area

The Bagar region of Haryana, in which the survey village for this study, Dhabi Kalan, is located, was long recognized as one of the least productive agricultural areas in India (Fig. 14.1.).[2] Recurring famine conditions dramatically emphasized the environmental severity and agricultural marginality of Hissar District, particularly its southern and western parts. Occasionally entire village populations would temporarily emigrate for the wetter and agriculturally more prosperous districts of Punjab and Uttar Pradesh, to the north and east, where they searched for work as daily or seasonal agricultural labor and for fodder supplies for their animals. Many also sought and found work as casual laborers in the Delhi urban area or in the other towns and cities north and east of Hissar District.[3]

This region and the bordering area of Rajasthan have an average rainfall of only sixteen inches, and it varies substantially annually, seasonally, and monthly. Most of the annual rainfall comes during the July-August monsoon season, when evapotranspiration rates are close to maximum. Highest temperatures occur in May and June, but especially in June, when mean daily maximums often exceed 105° F. The coldest month is January, when mean daily minima in the low forties are common; frost occurs occasionally in January and February. The rates of evapotranspiration in the winter months partially offset the low probability of significant rainfall during that period.[4]

1. The Punjab Occupancy Tenants and Security of Land Tenures Acts, 1953, and Rules, 1956, were applicable throughout the former Punjab. See Government of Punjab, Legislative Department, *Land Code* (Chandigarh: Controller of Printing and Stationery, Punjab, 1963), vol. 2.

2. "Bagar" is the indigenous term for the sandy portion of western and southern Haryana.

3. As recently as 1965–66, such conditions prevailed in parts of southern Haryana, including Hissar District. See "Famished Villages Cry for Water," *The Tribune* (Ambala), November 16, 1965, p. 3. See also R. Humphreys, "Report on the Famine in the Hissar District," in Punjab Government, *The Punjab Famine of 1899–1900* (Lahore: The "Civil and Military Gazette" Press, 1901), vol. 4; Punjab Government, *Final Report on the Operations for the Relief of Distress in the Hissar District (Ambala Division), during the Year 1932–33* (Lahore: Superintendent of Government Printing, Punjab, 1934), pp. 2–15; Punjab Government, *Reports on the Famine Relief Operations in the Southeast Punjab (Hissar, Rhotak, and Gurgaon), 1938–1940* (Lahore: Superintendent of Government Printing, Punjab, 1946); Sir Malcolm Darling, *The Punjab Peasant in Prosperity and Debt* (London: Oxford University Press, 1947), pp. 82–88.

4. Annual rainfall at Hissar for the past seventy years has ranged from 34.3 inches in 1917–18 to 5.4 inches in 1951–52. The erratic seasonal distribution of rainfall is well illustrated by the fact that in 1965 the monsoon "average" for the study area came in two forty-eight-hour periods separated by nearly a month of rainless weather. L. Labroue, P. Legris, and M. Viart ("Bioclimats du Sous-Continent Indien," *Travaux de la Section Scientifique et Technique* (In-

The soils in the Bagar region are alluvial in origin, potentially very fertile, but sandy in many places and highly permeable.[5] Shifting sand dunes are scattered throughout the area, and it is plagued by severe dust storms from April until the onset of the monsoon. Groundwater is found at depths commonly exceeding 100 feet, but often it is too brackish for humans, beasts, or crops. The occasional tank or pond has been and remains a major focal point for settlement in this area.

Before the completion of the Bhakra-Nangal project, farmers in the Bagar region depended on the scanty and variable rainfall, except in small areas in the northwest and in the east-northeast where limited irrigation was possible from the seasonal Ghaggar River and the Western Jumna and Sirhind Canal systems, respectively. Thus cereals and pulses with low moisture requirements and a high tolerance for drought were the predominant crops. Bajra (*Pennisetum typhoideum*) was the principal summer season (*kharif*) crop, and gram (*Cicer arietinum*) was the most widely grown crop in the winter season (*rabi*). If soil moisture conditions were favorable, a less drought-resistant but better yielding and more remunerative crop such as jowar (*Sorghum vulgare*) in *kharif* or wheat in *rabi* was sown intermixed with bajra or gram.

To counter the low yields usually produced under these conditions, large holdings under cultivation were necessary; 15 to 20 acres was a common holding for a family of the dominant, landowning Jat caste, and holdings that exceeded 50 or even 100 acres were not unusual.[6] In the one good year in five that might normally be expected, these holdings would produce large, marketable surpluses of gram, bajra, or wheat as well as abundant fodders to support the extensive livestock production of the region. The more persistent pattern of pre-irrigation agriculture, however, was bare subsistence, punctuated by a year or two of genuine famine.

Haryana first received irrigation though the Bhakra system during the summer of 1952; supplies were gradually increased as Bhakra Dam and the network of irrigation channels were constructed. In the agricultural year 1961–62, the Bhakra irrigation system was finally capable of supplying water on a year-round basis to a large portion of the *barani* or dry crop tract in

stitut Français de Pondichery) 3, no. 3 [1965], p. 25) classify Hissar as "tropical dry," calculating 237 physiologically dry days. See also S. L. Duggal, *Agricultural Atlas of Punjab* (Ludhiana: Punjab Agricultural University, 1966), pp. 30–31 (Plate 14).

5. The pre-irrigation soil survey of the area south of Fatehabad and Sirsa, which includes the research area, found that 29 percent of the soils surveyed were "excessively sandy," and as a consequence, recommended that canal irrigation be carefully controlled to avoid water losses through excessive seepage. This important conclusion has proved to be prophetic. See C. L. Dhawan and others, "Pre-irrigation Soil Survey of Some Districts of the Punjab," *Indian Journal of Agricultural Science* 27, no. 4 (1957): 375–94.

6. Large holdings still prevail; 32 percent of all landowning households in Hissar District own 15 to 30 acres, and 21 percent own in excess of 30 acres (Census of India, 1961, *Hissar District, Punjab,* District Census Handbook no. 1 [Chandigarh: Government of Punjab, 1966], p. 32).

Hissar, Fatehabad, and Sirsa tehsils in Hissar District. The arrival of fairly regular perennial irrigation fundamentally altered the resource base of agriculture for a considerable area of cropland in the study area. Wheat quickly became the most important winter crop for many farmers, though gram remained a significant crop in unirrigated fields. The cultivation of profitable cash crops such as cotton and sugarcane also spread rapidly throughout the area served by the Bhakra Canal system. Most significant, however, wherever it was available, year-round irrigation sharply reduced the dependence upon rainfall and brought to the agriculture of many farmers a degree of dependability and security previously unknown in this region.[7]

Western and central Hissar District is the very core of the region comprised of parts of Punjab, Haryana, and Rajasthan in which the Jat community is numerically dominant. In the 1931 census, the last census to enumerate caste populations, the Jats constituted over 24 percent of the population of Hissar District. In a more recent study, the geographer Joseph Schwartzberg found that the Jat population in villages in Hissar District typically exceeded that of the next most numerous caste in the village by over 150 percent.[8]

Dhabi Kalan, the research village, is fifteen miles southwest of Fatehabad, the headquarters of tehsil and subdivisional administration, and five miles south of the large village of Bhatu, a station on the narrow-gauge railway line between Hissar and Bhatinda. A single-lane tarmac road connects Bhatu and Dhabi Kalan, and continues on to the Haryana–Rajasthan border, six miles further south; regular bus service along this route between Fatehabad and Bhadra, Rajasthan, facilitates travel through the region.

Dhabi Kalan was colonized by Jats of the Beniwal clan (*got*) immigrating from neighboring Rajasthan about 150 years ago, and many cultural links persist between the village and that region. Numerous families in the Jat community still maintain close relations with the parent Rajasthan villages by exchanging daughters in marriage with families there. Although it is a multicaste village, Dhabi Kalan is numerically dominated by the Jats, who make up nearly 50 percent of the population, more than double the population of the next largest caste, the Kumhars (Table 14.1).

Dhabi Kalan has an area of 4,222 acres or about 6.6 square miles (Fig.

7. See Economic and Statistical Organisation, *Effects of Bhakra Dam Irrigation on the Economy of Barani Villages in the Hissar District, 1964–65* (Chandigarh: Government of Haryana, 1967), for a partial account of the cropping pattern changes associated with the supply of Bhakra Dam irrigation to Hissar District since 1952–53. The Board of Economic Inquiry, Punjab, *Report on Cropping Pattern of Hissar District* (Chandigarh: Economic and Statistical Organisation, Government of Punjab, 1965), is another useful though occasionally inaccurate source of data concerning the shifts in the cropping pattern of Hissar District. Duggal, *Agricultural Atlas of Punjab*, is a convenient reference for the spatial distribution and relative significance of various crops grown in this region.

8. Joseph E. Schwartzberg, "The Distribution of Selected Castes in the North Indian Plain," *Geographical Review* 55, no. 4 (1965): 477–95 and map; Census of India, 1931, *Punjab*, vol. 17, pt. 1 (Lahore: The "Civil and Military Gazette" Press, 1933), pp. 339–42.

Table 14.1.

Dhabi Kalan: Caste population and households, 1966[a]

Caste	Population	Households	Percent of Population
Jats			
Beniwal	479	53	28.4%
Dhindwal	40	6	2.4
Jakhar	149	18	8.8
Lamba	32	3	1.9
Netar	10	3	0.6
Puniya	23	3	1.4
Other *gots*	82	12	4.9
All Jats	8.15	98	48.4
Caste Hindus			
Brahmin	21	4	1.2
Aggarwal	19	4	1.1
Sunar	9	1	0.5
Kumhar	369	48	21.8
Khati	26	5	1.5
Nai	44	6	2.6
Gujar	3	1	0.2
"Refugee"	2	2	0.1
All caste Hindus	493	71	29.0
Other castes			
"Muslim"	10	1	0.6
Lohar	28	5	1.7
All other castes	38	6	2.3
Harijans			
Chamar	141	23	8.3
Dhanak	171	25	10.1
Other	31	5	1.9
All Harijans	343	53	20.3
Total population	1689	228	100.0%

[a]Excluding Patwaris and their families.

14.2), of which only 6 percent is uncultivable. Of the 3,958 acres of cultivable land, 2,065 acres are officially classified as irrigable and the remainder as nonirrigable. Irrigation is supplied from the Dhabi Minor Canal, which traverses the village area from northeast to southwest for a distance of about three miles. The headworks of Dhabi Minor are on Kheri Distributary, and the last outlets of the Minor irrigate fields of the neighboring village of Dhabi Khurd.

Before the completion of the Bhakra irrigation system, agriculture in Dhabi Kalan was totally dependent upon the capricious rainfall. Consequently, drought-resistant gram was by far the most widely grown winter crop and bajra dominated agriculture in the summer season. Sowing mixed crops was the usual method of diversifying agriculture to meet environmental uncertainty; bajra-jowar-pulse, bajra-pulse, and bajra-guar (*Cyamopsis psoraloides*) were frequent summer crops mixes, and gram-wheat, gram-

Table 14.2.

Dhabi Kalan: agricultural land ownership by caste (acres)

Caste	All land	Classed Nehri	Classed Barani	Acres of cultivated area per household
Jats				
Beniwal	2152.0	1282.5	869.5	40.6
Dhindwal	84.6	37.5	47.1	14.1
Jakhar	403.0	201.0	202.0	22.4
Lamba	207.1	134.1	73.0	69.0
Netar	4.7	1.9	2.8	1.6
Puniya	55.1	9.9	45.2	18.4
Other *gots*	159.4	52.0	107.4	13.3
All Jats	3065.9	1718.9	1347.0	31.2
Caste Hindus				7.6
Brahmin	27.0	8.4	18.6	6.8
Aggarwal	85.4	56.2	29.2	21.4
Kumhar	319.8	133.7	186.1	6.7
Khati	20.8	20.8	0.0	4.2
Nai	69.7	16.9	52.8	11.6
All caste Hindus	522.7	236.0	286.7	7.4
Other castes				
Lohar	21.1	16.8	4.3	4.2
Harijans				
Chamar	75.0	41.4	33.6	3.3
Dhanak	51.5	16.9	34.6	2.1
All Harijans	126.5	58.3	68.2	2.4
Other owners				
Panchayat	87.6	6.8	80.8	
Temple	20.7	0.5	20.2	
Reside outside	113.0	27.3	85.7	
All other owners	221.3	34.6	186.7	
All owners	3957.5	2064.6	1892.9	16.7

mustard, and barley-wheat were often planted in winter. Nevertheless, partial crop failures were common, and occasionally crops failed totally, irrespective of the location of the field within the village area, the caste of the farmer, or the tenure of the cultivation unit.[9] Since the perennial operation of Dhabi Minor in 1960–61, agriculture in Dhabi Kalan has ceased to depend exclusively on rainfall, and crop failures have been reduced—perhaps more accurately, confined—to those areas of the village lands that remain outside the area served by the irrigation system.

Jat households own over three-quarters of the agricultural land in Dhabi

9. In two consecutive winter seasons, 1938–39 and 1939–40, all sown acreage failed to mature, and in the winter season 1965–66 the rate of failure of rainfall-dependent crops exceeded 50 percent; rain-fed agriculture remains risky (*Lal Kitab, Mauza Dhabi Kalan*, Tehsil Records Office, Fatehabad, Hissar District, n.d., and personal communication, District Commissioner, Hissar, August 1966).

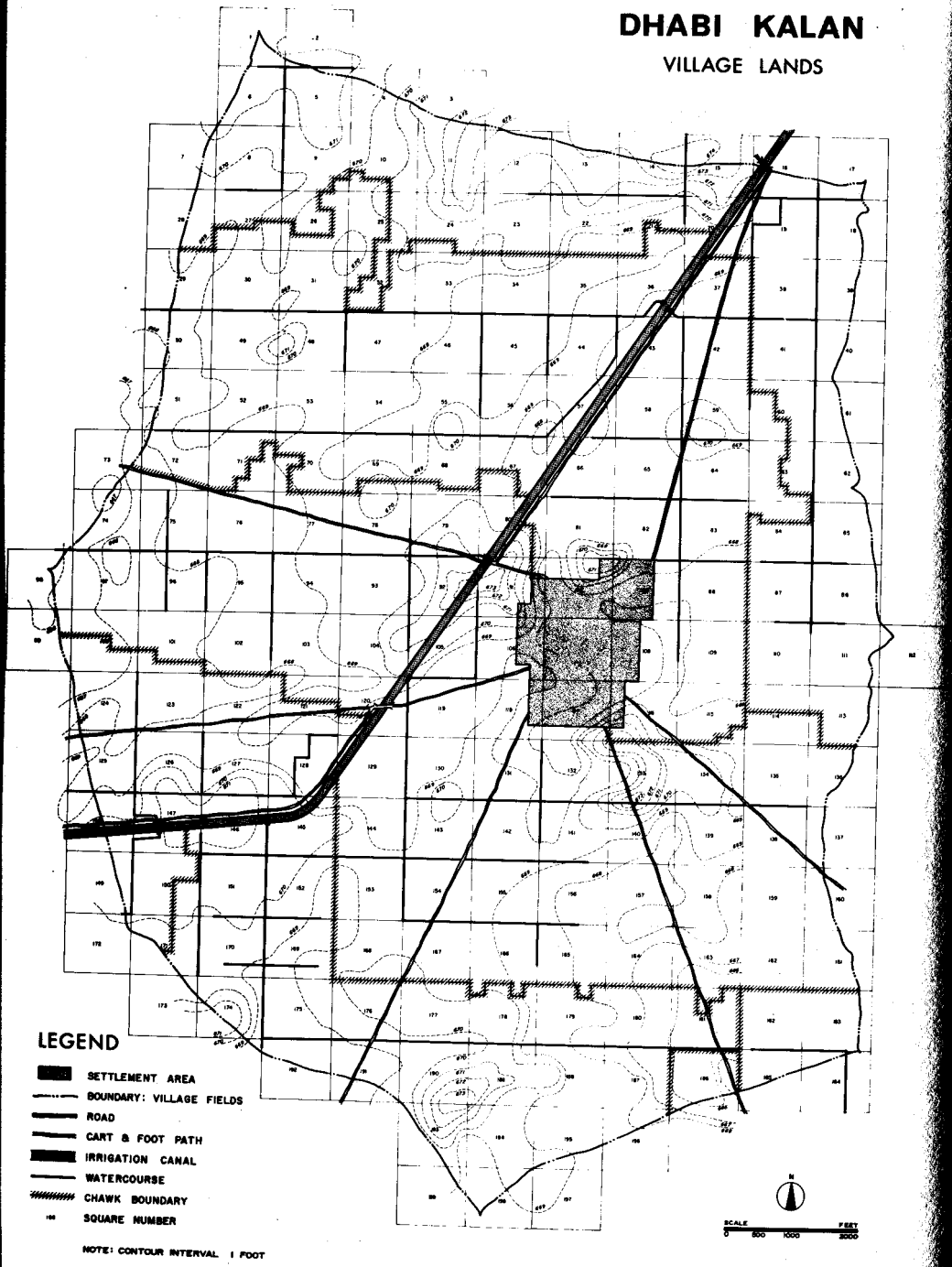

Figure 14.2.

Kalan and, significantly, 83 percent of all irrigable land (Table 14.2).[10] The amount of land owned by most Jat households exceeds 30 acres and holdings larger than 50 acres are common. All of these landholdings contain variable amounts of irrigable and nonirrigable land, and they are usually located at two or three sites within the village area. Most Jat landowners have always tried to maximize their ownership or control over agricultural land, and now their competition for control over more irrigable land or for additional water rights is the principal cause of the feuds and faction fights that erupt from time to time within the Jat community of Dhabi Kalan.

Although it is true that most households in Dhabi Kalan own at least a bit of land, only the Jats, and a few other families ranking immediately below them in the social hierarchy, own enough land to support the individual households. Thus, the basis of the Jat dominance of all important levels of society in Dhabi Kalan is not simply their numerical superiority but their extensive control of the agricultural base of the village economy.[11]

The Irrigation System

Dhabi Minor and the network of field watercourses it sustains are but a small part of the Second Bhakra Main Line Circle, a major component of the Bhakra canal system built as a part of the multipurpose Bhakra-Nangal project (Fig. 14.3).[12] The planned intensity of irrigation for Dhabi Minor, as for all perennial Bhakra canals, was 62 percent of the cultivable commanded area (CCA),

10. In all, fourteen Jat *gots* are represented in Dhabi Kalan. Following the Beniwal *got* in both numbers and importance is the Jakhar *got*. The population and caste data for Dhabi Kalan used here were compiled from a census conducted by the author in 1965 and a resurvey in 1966. Two sources are of particular value in any analysis of the tribes and castes of this region of Haryana: J. Wilson, *General Code of Tribal Costume in the Sirsa District of the Punjab* (Calcutta: Superintendent of Government Printing, India, 1883), especially pp. 1–66; and Sir Denzil Ibbetson, *Panjab Castes* (Lahore: Superintendent of Government Printing, Punjab, 1916), a reprint of the chapter, "The Races, Castes, and Tribes of the People" in his *Report* on the Census of the Punjab, 1881.

11. Although caste hierarchies and caste dominance have been studied extensively by anthropologists, frequently in villages in the North Indian plain, the spatial context of caste hierarchy and dominance has yet to attract much systematic attention by geographers. Kashi N. Singh, "The Territorial Basis of Medieval Town and Village Settlement in Eastern Uttar Pradesh," *Annals of the Association of American Geographers* 58, no. 2 (1968): 203–20, and Joseph E. Schwartzberg, "Caste Regions of the North Indian Plain," in *Structure and Change in Indian Society*, ed. Milton Singer and Bernard S. Cohn (Chicago: Aldine Press, 1968), pp. 81–113, are important exceptions to this criticism. See Ralph W. Nicholas, "Structures of Politics in the Villages of Southern Asia," in ibid., pp. 243–84, for definitions of caste dominance by an anthropologist.

12. The Second Bhakra Main Line Circle is comprised of nearly 2,000 miles of large and small irrigation channels providing perennial irrigation to a cultivable commanded area of 1.9 million acres in Hissar District, Haryana, and Bhatinda and Sangrur districts, Punjab. The system was declared perennially operational beginning in the winter season of 1961–62 (Superintending Engineer, Second Bhakra Main Line Circle, Hissar, "Note on the Development of Irrigation in Second Bhakra Main Line Circle, Hissar" [Hissar, 1964], typescript).

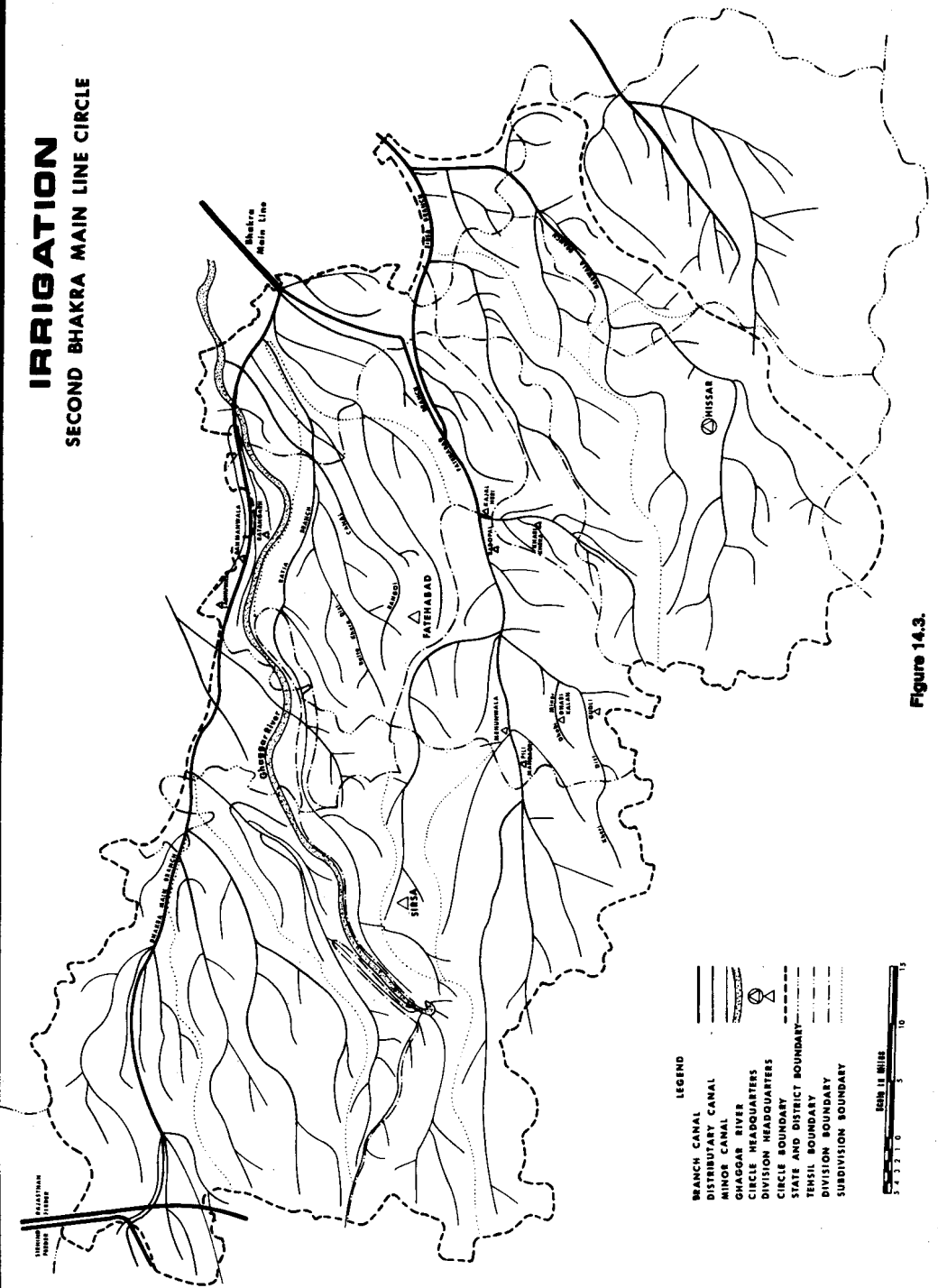

Figure 14.3.

divided between 28 percent in the summer season and 34 percent in the winter.[13] The acreage actually irrigated in the command of Dhabi Minor, however, has consistently fallen well short of this target, as it has for the entire area supplied by Kheri Distributary in the Fatehabad irrigation subdivision and in many other areas irrigated by the channels in the Second Bhakra Main Line Circle.[14]

Part of this failure is doubtless due to large water losses through seepage in the unlined channels traversing the sandy and highly permeable soils of the Haryana Bagar region and the high rates of evaporation that are common in the region. Part of the failure, however, also rests with certain weaknesses in the design of the project itself. When the irrigated and highly productive areas of western Punjab were lost to Pakistan in 1947, the Bhakra irrigation system was conceived as a way to offset this loss by supplying water to the semiarid areas of the southeastern Punjab plains. Simply put, the project was planned to cover too large an area given the supplies of water that would be available. Apparently the desire to expand agricultural production and at the same time to reduce the risk faced by the farmer in the sparsely populated and potentially productive Bagar region led to an overly optimistic assessment of project capability.[15] In the operations of Dhabi Minor during the first six years of perennial water supplies, this design weakness led to annual deliveries as low as 56 percent of the promised amount (Fig. 14.4). The shortages of water supplies have been particularly acute in the winter crop season.

A second weakness of the Bhakra project was that the water allowance was predetermined and rigidly fixed, and the new crop patterns then had to be worked out within those limits.[16] This arrangement had major implications for

13. Intensity of irrigation is the ratio of the area actually irrigated by the canal to the total cultivable commanded area of the canal.

14. The mean annual intensity of irrigation for the period 1961–62 to 1966–67 in the area served by Dhabi Minor was 35.5 percent, 15 percent in the summer season and 20.5 percent in the winter season (Edward J. Vander Velde, Jr., "The Distribution of Irrigation Benefits: A Study in Haryana, India," unpublished Ph. D. dissertation, University of Michigan, 1971, pp. 102–12). Robert C. Repetto (*Time in India's Development Programmes* [Cambridge: Harvard University Press, 1971], pp. 73–80) reports a similar pattern in other areas of Hissar District served by Bhakra canals.

15. K. N. Raj, *Some Economic Aspects of the Bhakra Nangal Project* (New York: Asia Publishing House, 1960), p. 53, notes that in 1953 it was recognized that "there will be a shortage of 9% even in years when the reservoir is full, and about 25% on an average over a longer period," in relation to the requirements of the Bhakra irrigation system. See his discussion, pp. 36–37, for a fuller exposition of the technical implications of the Bhakra project design.

16. Ibid., p. 92. The water allowance or duty of water is the relation between the area to be irrigated and the quantity of water available or required to irrigate it, often expressed in cusec per unit area. The Bhakra-Nangal project design set a water allowance of 2.75 cusecs of capacity at the head per 1,000 acres of CCA in the unrestricted perennial irrigation area of Zone III, in which the study area is located. Dhabi Minor's full supply discharge at the head per 1,000 acres CCA is 0.35 cusecs less than the duty of water established for this area. Thus, at full supply, this canal carries 3.65 cusecs *less* than it should for its assigned CCA; functionally, this has meant that the duty of water in the CCA of Dhabi Minor is even greater than planned for channels providing perennial irrigation (Sub-Divisional Officer [Irrigation], Fatehabad, personal communication, August 1966).

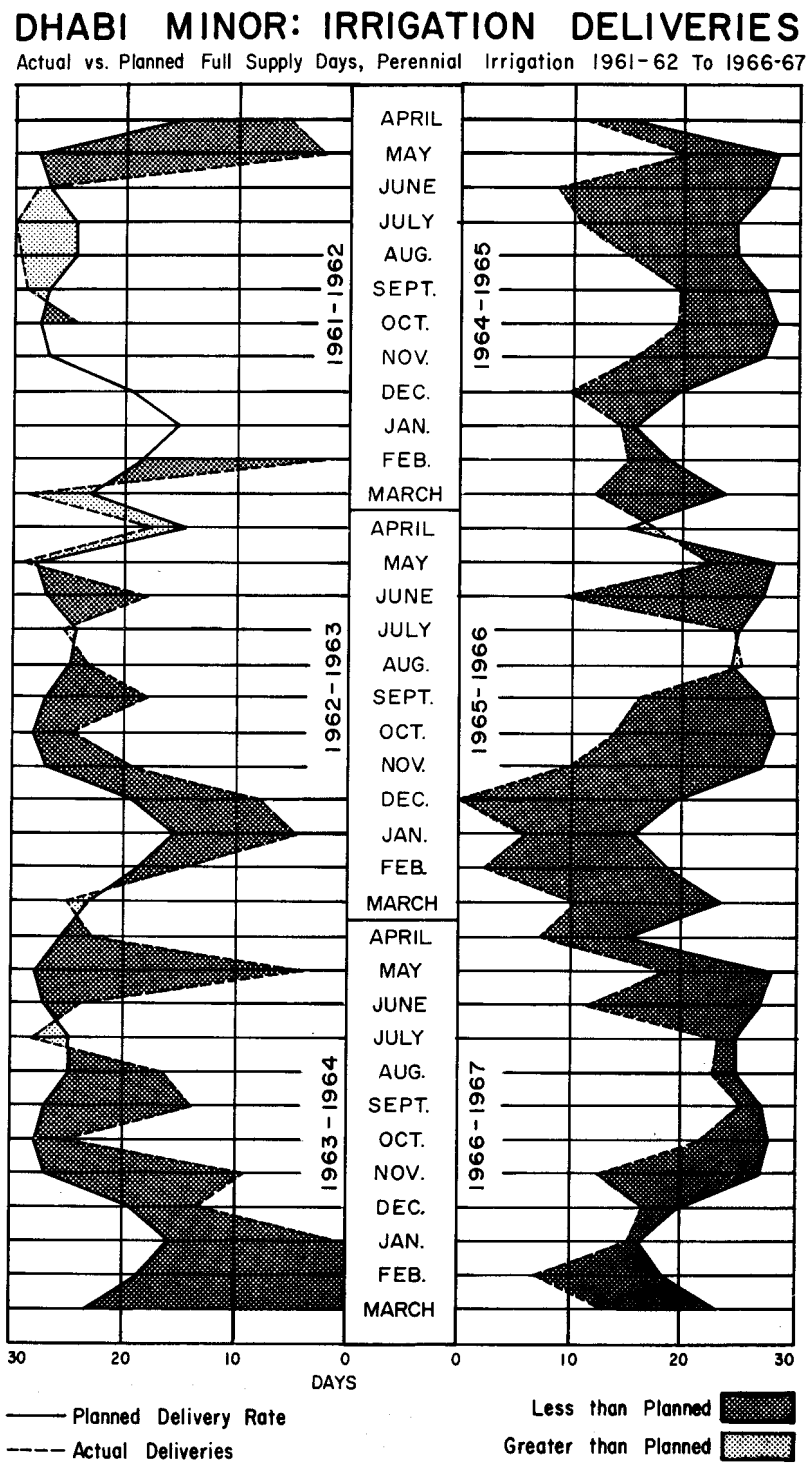

Figure 14.4.

the resulting patterns of agricultural land use in the area served by the Bhakra irrigation system. If maximizing agricultural productivity per volume of water provided by the system had been the goal, the water allowance for particular areas would have been adopted on the basis of water requirements per crop, the seasonal ratio of irrigation, and the area planted to each crop per 1000 acres CCA. Under such a plan, the effects of particular environmental factors in an area, primarily relief and soils, on a planned crop pattern would have been minimized. Adoption of a fixed water allowance *regardless* of areal differences, however, magnified the significance of relief and soils, as well as field location with respect to the water distribution system, as factors in the resulting patterns of land use in the command of the Bhakra project.

The irrigation allowance for each cultivable acre in the command or *chak* of an outlet on the canal is determined by dividing the total amount of water that an outlet can deliver at full supply for a week by the total cultivable acres in the *chak*. The resulting irrigation allowance of so many minutes per acre is then multiplied by the number of acres in a farmer's cultivation unit in the *chak* to determine the total length of his irrigation turn during the rotation of turns in an irrigation week. Again, a fixed water allowance has been established irrespective of environmental variation and field location in the *chak*.

Seen in this context, the implicit goal in the perennial irrigation area of the Bhakra project surely was to *protect* agriculture from the effects of a failure of the monsoon rains and subsequent drought, a common occurrence in the Haryana Bagar. The duty of water was set to ensure that a maximum amount of CCA would be established and supplied with water, but the productivity of irrigated lands would not be maximized in these areas.[17] Presumably, most farmers would perceive the irrigation system as providing a "floor" below which their productivity would not fall and they would adjust their cropping patterns accordingly. That a few farmers would shift to growing higher yielding, more profitable, *and* more water-consumptive crops must have been anticipated. In view of the weaknesses in the final project design, however—known at the time of its adoption—and the methods adopted to determine water allowances and farmers' irrigation turns, the Bhakra system obviously could supply water in sufficient amounts and at suitable times over only a small portion of the total CCA to sustain these highly water-consumptive crops.[18] The subsequent pattern of concentration of such crops at specific

17. Others have concluded similarly. For example, Hari Lal Sally has noted that the objective in distributing irrigation supplies on the Bhakra canals was to provide irrigation to the maximum area *regardless of the adequacy of supplies for essential crops*. . . . The available supplies have been utilized to the full and on the maximum area by reducing the water allowances to the barest minimum and without adjusting them on the basis of rainfall, soil and other characteristics of the tracts concerned" (emphasis mine) (Hari Lal Sally, *Irrigation Planning for Intensive Cultivation* [New York: Asia Publishing House, 1968], p. 85).

18. Using officially supplied data and other published studies, Raj (*Some Economic Aspects*, pp. 94–102) attempted to assess the likely impact of Bhakra irrigation on agricultural production

locations in the irrigation system less obviously conflicted with developmental policies and goals.

Irrigation and Agriculture in Dhabi Kalan

As previously noted, irrigation opened up new agricultural options for farmers in Dhabi Kalan. In so doing, however, it also produced an unintended concentration of benefits by creating a pattern of differential access to the water essential for the cultivation of the new crops. The spatial pattern of irrigated and dry crops as well as fallows and crop failures in Dhabi Kalan suggests that local relief is a significant land-use variable. The 670-foot contour is a frequent barrier to irrigation, occurring throughout the lands of the village. Seldom are fields at this height or higher actually irrigated, even though they may adjoin frequently irrigated fields, and then only with difficulty in this gravity flow system. Increasing distance from the head of irrigation and correspondingly lower volumes of flow in the watercourse network also means that the maximum elevation of fields sown to irrigated crops diminishes.[19]

Often minor fluctuations in field and watercourse elevations pose substantial problems for the irrigation farmer in a gravity-flow irrigation system. Leveling fields, improving the layout of field channels, and maintaining these improvements are not readily and easily accomplished tasks, and many farmers in Dhabi Kalan had not eliminated such obstacles to more efficient and effective delivery of water to their crops.

Much more significant in determining the spatial pattern of irrigation agriculture in the various *chaks* of Dhabi Minor are the rates of water loss through seepage, rates that increase with increasing distance from the watercourse outlets. Throughout Dhabi Kalan, soils are sandy and permeability is high. Progressive losses through seepage in the unlined watercourses considerably reduce the velocity of water flow in the more distant reaches; generally poor levels of watercourse maintenance, siltation of the watercourses, and the varying dimensions of the channels from place to place combine to reduce further the velocity of flow in the watercourses, while raising seepage losses.

In *chak* 16000 Left, Dhabi Minor (Fig. 14.5), the average rate of water loss in the first 2000 feet of watercourse was 20 percent; it increased to 40

throughout the commanded area; at the time, no specific field studies had been conducted for such a purpose.

19. This problem was anticipated by the irrigation engineers. The formula used to determine the area designated in the CCA of an outlet reduces the maximum elevation at which a field is classified as irrigable by 0.2 feet per 1,000 feet from the head of irrigation.

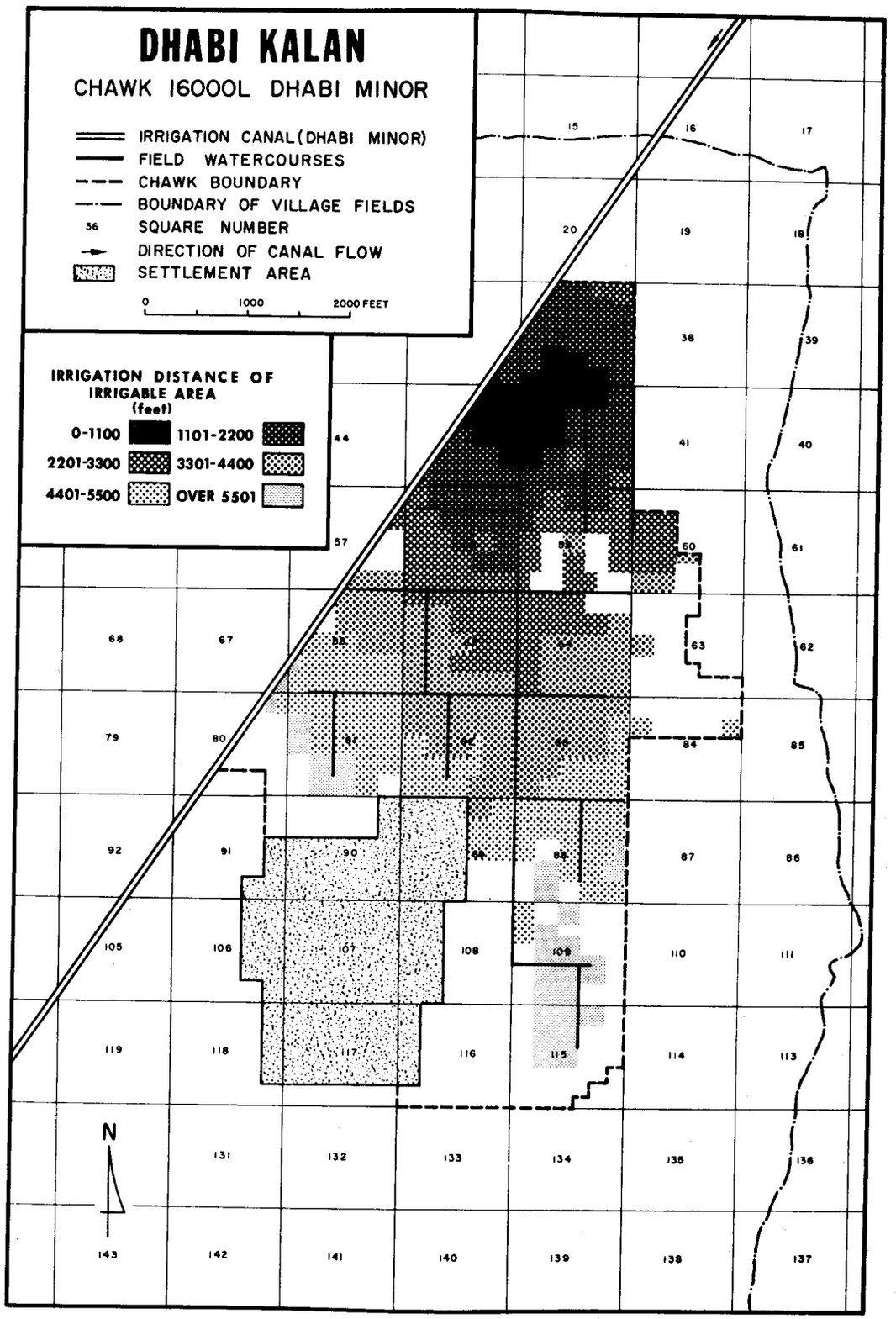

Figure 14.5.

Table 14.3.

Land use on irrigable area, *chaks* 16000 left and 21000 right, Dhabi Minor, 1964–66 (percent)

Irrigation distance of fields (feet from outlet)	Irrigated		Dry Cropped		Fallow	
	16000 L	21000 R	16000 L	21000 R	16000 L	21000 R
Less than 1101	64%	41%	3%	13%	33%	46%
1101–2200	59	32	16	25	25	43
2201–3300	43	26	28	33	29	41
3301–4400	34	24	29	33	38	43
4401–5500	29	16	30	38	41	47
More than 5500	24	19	38	30	38	51

percent over the next 2000 feet of watercourse.[20] Farmers in this and all other *chaks* in Dhabi Kalan were keenly aware of the water-loss/distance relationship, for they altered the amount of time used to irrigate an acre. For example, a farmer whose field was located one mile from the outlet for *chak* 16000 Left typically took twice the time to irrigate an acre of cotton or wheat that a farmer did for a field located within 1100 feet of the outlet.[21]

The general pattern of land use in *chaks* 16000 Left and 21000 Right, Dhabi Minor, confirms that the frequency and intensity of irrigated agriculture in Dhabi Kalan is directly related to the distance of fields from the source of

20. Parshall flumes were used to measure field watercourse discharges at the head of irrigation, at the midpoint of the watercourse, and at three tail locations during a complete irrigation week. Measured values were averaged for the week to reduce the effect of slight alterations in the discharge of the Minor. The resulting rates of water loss were somewhat higher than Bhakra project estimates (Raj [*Some Economic Aspects*, p. 92] cites a 20 percent loss rate for watercourses), but within the range of estimates made by knowledgeable local Irrigation Department personnel. Certainly the higher rates of loss are closely related to the more permeable sandy soils of this region.

21. The time needed to irrigate an acre increased rapidly with distance from the outlet. Farmers with fields one-half mile from the outlook took as much as 70 percent more time to irrigate an acre than those close to the outlet. Of course, these measurements assume that farmers were attempting to deliver similar irrigation purposes: this assumption was generally validated by direct field observations, though a few minor differences were noted (Vander Velde, "Distribution of Irrigation Benefits," pp. 144–53). Similar adjustments to the distance/water loss relationship were made by farmers in other villages in Fatehabad tehsil under the command of the Bhakra irrigation system. The difference in time taken by farmers to irrigate one acre in two other villages served by Kheri Distributary, which also supplies Dhabi Minor, was as great as four hours per acre in a distance interval of 1,500 feet (Repetto, *Time in India's Development Programmes*, p. 77).

Without doubt, the difficulties experienced by farmers in making an adequate adjustment to water losses in the watercourse network were compounded by the interpenetration of canal rotational operations and the *warabandi*, the roster of irrigation turns that governs the distribution of water among co-shares in each *chak*. This problem is cogently explained in Richard B. Reidinger, "Institutional Rationing of Canal Water in Northern India: Conflict between Traditional Patterns and Modern Needs," *Economic Development and Cultural Change* 23, no. 1 (1974): 79–104.

Table 14.4.

Frequency of irrigated agriculture, *chaks* 16000 left and 21000 right, Dhabi Minor, 1964–66

Irrigation distance (feet from outlet)	Total irrigable area (acres)	Percentage of irrigable area				
		Irrigated crops				
		4 seasons	3 seasons	2 seasons	1 season	Dry crops
0–2200	160	8%	29%	32%	16%	14%
2201–4400	255	4	16	28	20	22
More than 4401	251	4	10	15	14	36

irrigation. As distance from the watercourse outlet increases, the percentage of irrigable area on which irrigated crops are grown decreases while that devoted to dry crops increases substantially, and the area in fallows increases slightly (Table 14.3).

During the four seasons of 1964–66, 37 percent of the irrigable area located within 2200 feet—that is, within ten acres—of the watercourse outlet was planted to an irrigated crop three or four times; more than two-thirds of this area had an irrigated crop at least twice. By contrast, 57 percent of the irrigable area at distances greater than 4400 feet or more than twenty acres from the outlet had no irrigated crop in any of those four seasons (Table 14.4). Indeed, with few exceptions, fields at those distances that carried an irrigated crop three or all four seasons were located adjacent or very near to the watercourse; more distant fields served by laterals were rarely if ever irrigated (Fig. 14.6).

Three broad patterns of land use can readily be identified. Within an irrigation distance of about one-half mile, an average of 50 percent of the irrigable area will be planted to irrigated crops in any season. Fallowing is frequent here, too; about one-third of the area in any season is in fallow. This pattern reflects dependence upon fallowing as a technique to reduce the rate of nutrient losses in irrigation agriculture and partially to restore soil fertility, still necessary given the low levels of commercial fertilizer use in agriculture in Dhabi Kalan, while adjusting seasonal and yearly agricultural labor requirements to available labor supplies. In the middle-distance range, a well-mixed pattern of irrigated fields, dry crop farming, and fallow land prevails, though fallow land now exceeds 40 percent of the irrigable area in any season. In the lower reaches of the watercourse network, particularly at irrigation distances greater than one mile from the outlet, less than one-quarter of the irrigable area typically is planted to irrigated crops in any season, whereas more than one-third of this area is dry farmed, virtually a reversal of the pattern for these two land-use catagories in the middle-irrigation-distance locations. Here marginal agricultural conditions prevail for most farmers, and

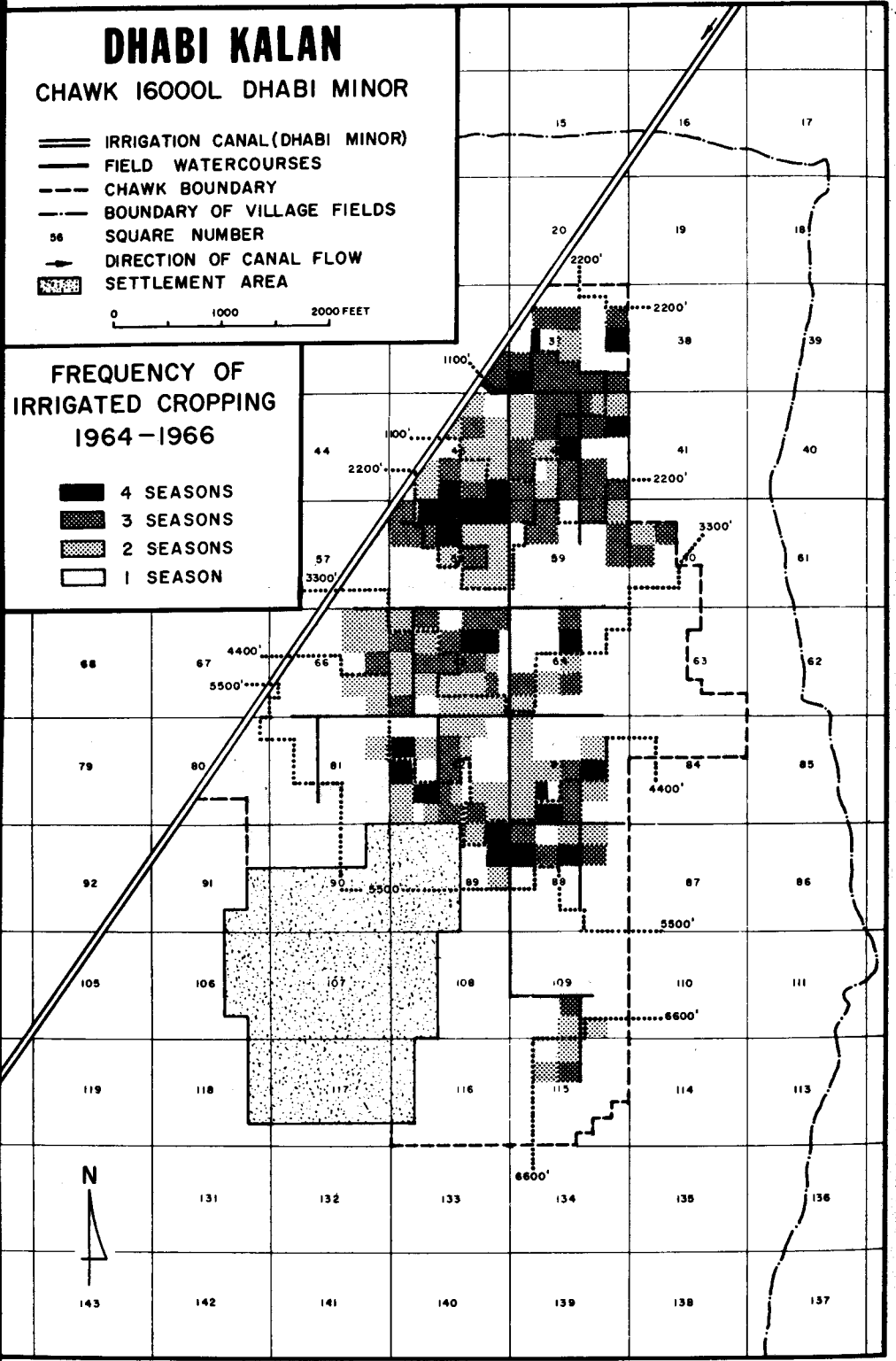

Figure 14.6.

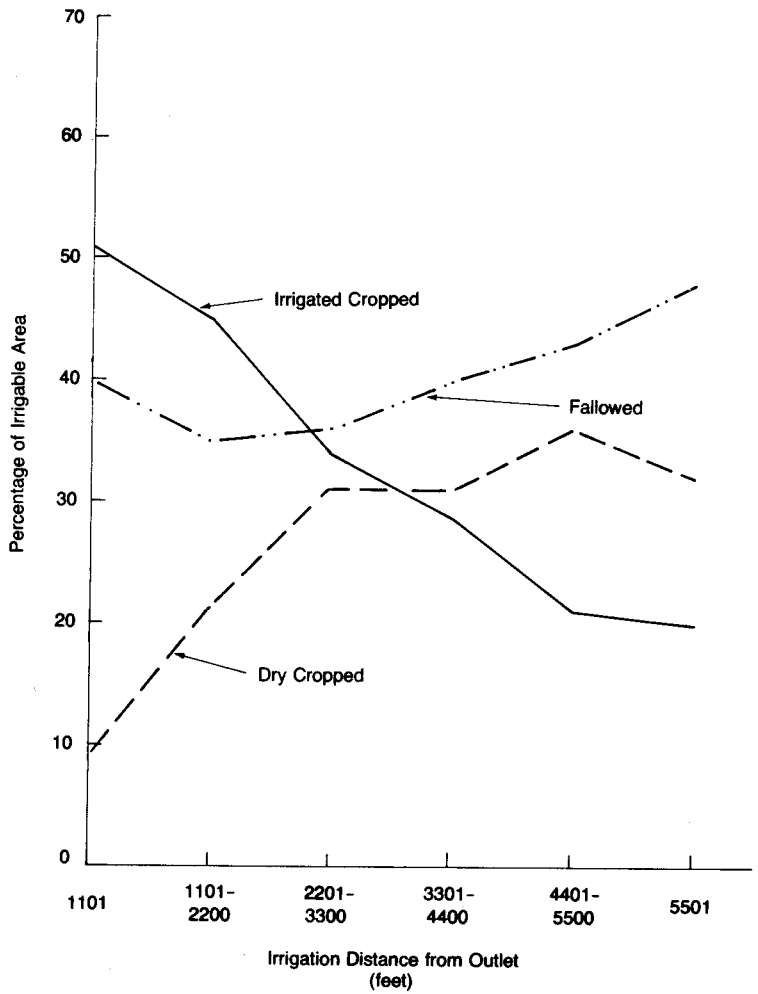

Figure 14.7.

many are nearly as dependent upon rainfall to supplement the marginal amounts of water delivered by the irrigation system or for dry crop farming as they were in the pre-Bhakra period (Fig. 14.7).

Land Tenure and Land Reform in Dhabi Kalan

Only the Jats and a few other families high in the social hierarchy of Dhabi Kalan own sufficient land to support the individual household (Fig. 14.8). Most Kumhars and virtually all Harijan families whose livelihood is agriculture must either lease land on shares or for cash rents, usually from their Jat

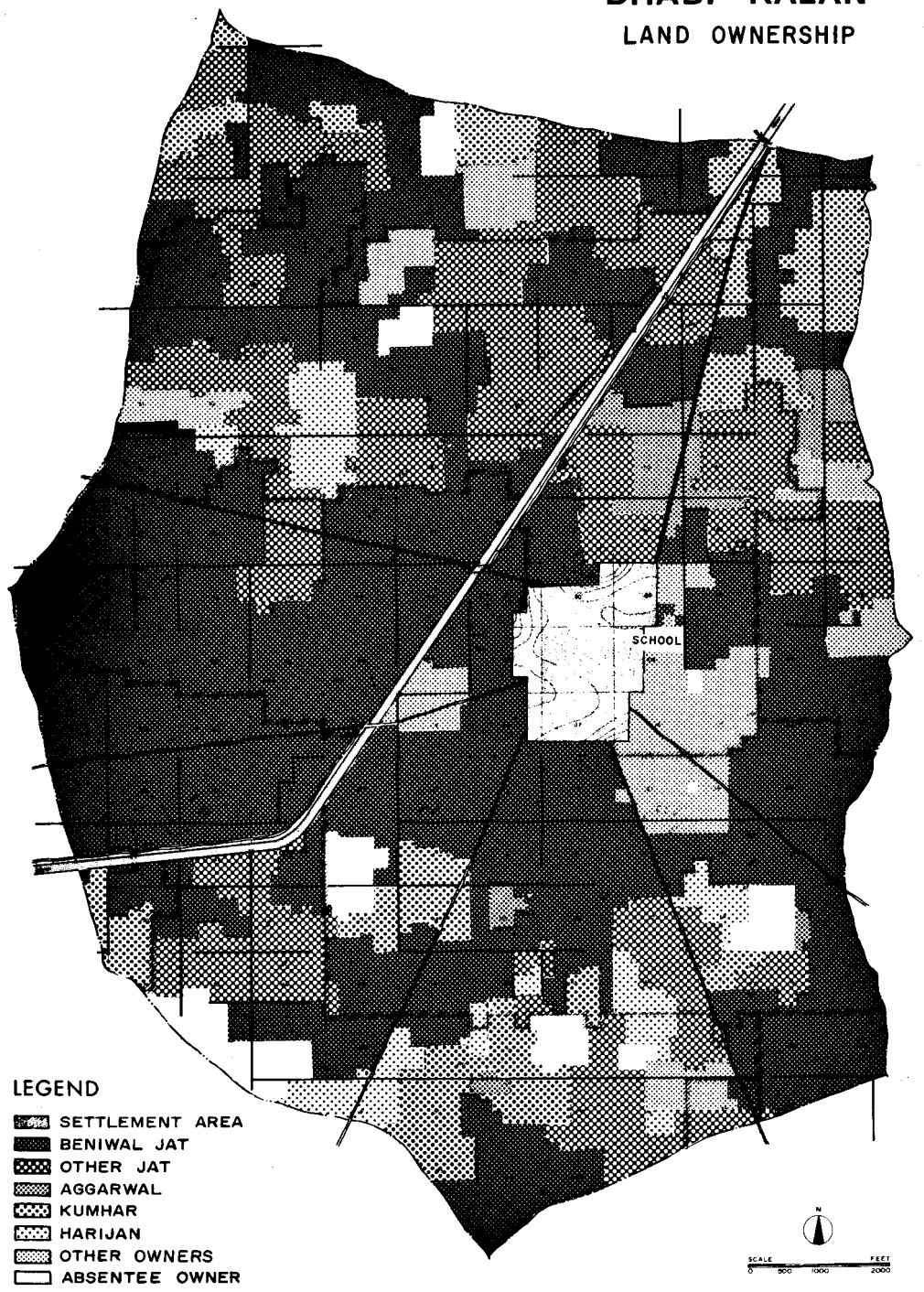

Figure 14.8.

neighbors, or find work as seasonal or permanent agricultural laborers. Most of these families successfully piece together bits of agricultural land from two or three Jat landowners or obtain an occasional large holding from a single Jat family; in virtually all such cases, sharecropping or *batai* is the leasing arrangement. The Punjab Security of Land Tenures Act (1953) limited the maximum amount of produce to which a landowner was entitled as rent under any *batai* arrangement to a one-third share.[22]

Four distinct kinds of sharecropping leases are used in Dhabi Kalan:

- *Tisra batai*: Two-thirds of the produce is kept by the cultivator and one-third goes to the owner of the land. Commonly, all inputs—seed, fertilizers if used, animal power and labor—are supplied by the cultivator, who also typically decides on the crop to be cultivated.
- *Paanjaa batai*: Three-fifths of the produce goes to the cultivator and two-fifths is given to the landowner. Again, all inputs usually are provided by the cultivator, and he also decides on the crop to be cultivated. Of the four sharecropping arrangements, *paanjaa* leases are the least common.
- *Aadh batai*: The production is divided evenly between cultivator and landowner. Generally inputs are also shared on a fifty-fifty basis, although exceptions do occur; typically the crop to be cultivated is jointly agreed. This is the single most common tenure arrangement in Dhabi Kalan.
- *Tijiya hissa*: One-third of the production is kept by the cultivator and two-thirds is turned over to the landowner, who also supplies seed, fertilizers if used, and animal power. The cultivator supplies only his labor. The owner of the land selects the crop to be grown.

Tenure agreements under any of these four types of *batai* are made on a year-to-year basis, and while they are often renewed for a succession of years between the same landowner and tenant, more often than not the fields cultivated by the tenant in one year are not those he cultivated the previous year or

22. The land-reform legislation referred to here and earlier established a ceiling on the ownership of agricultural land by a single owner at thirty standard (that is, irrigated) acres or sixty ordinary acres, provided security of tenure under certain conditions for occupancy tenants, set the maximum limit of produce to which a landowner is entitled as rent under any sharecropping arrangement at one-third share, and provided for the redistribution of land held in excess of the ceiling limitation among the landless or small landowning peasants (Government of Punjab, Legislative Department, *Land Code*, vol. 2, pp. 275–89, 305–96). That shares or rents exceeding one-third of the crop remain common in Punjab and Haryana has been noted elsewhere, though their caste distribution has not been discussed. See W. Ladejinsky, *A Study on Tenurial Conditions in Package Districts* (New Delhi: Government of India, Planning Commission, 1965), pp. 33–37; Board of Economic Inquiry, Punjab, *Resurvey of Village Birampur, District Hoshiarpore*, no. 88 (Chandigarh: Punjab Government, Economic and Statistical Organisation, 1963), pp. 16–17; Board of Economic Inquiry, Punjab, *Resurvey of Village Suner, District Ferozepore*, no. 89 (Chandigarh: Punjab Government, Economic and Statistical Organisation, 1963), p. 45; J. S. Uppal, "Implementation of Land Reform Legislation in India: A Study of Two Villages in Punjab," *Asian Survey* 9, no. 5 (1969): 359–72.

the ones he will cultivate the following year. In this way, the landowner ensures that the tenant cannot legally claim permanent occupancy of and ultimately proprietary rights over a portion of the owner's land. If a tenant can prove continuous cultivation of the same plot or plots for six years or more, under the provisions of the Security of Land Tenures Act (1953) he completes the first step necessary to substantiate a claim to occupancy of that land on a permanent basis. For similar reasons, landowners also insist upon oral leases; only one written lease existed among all the tenancies studied in Dhabi Kalan.

For the lessee, the favorable-to-unfavorable hierarchy of the four types of sharecropping tenures is immediately apparent. Certainly a one-third/two-thirds (*tijiya hissa*) lease extracts from the tenant a very high (and illegal) rent that makes him little more than an agricultural laborer. In fact, many landowners leasing land on such an arrangement do not verbally distinguish between their tenant and yearly contract agricultural labor. The word used to refer to both, *siri*, literally means "servant" or "helper."

Among the nonrandom sample of tenancies studied, 76 belonged to one of the four classes of sharecropping leases (Tables 14.5 and 14.6).[23] Thirty-six Jat households, who owned more than 55 percent of the cultivable land (2191 acres) in Dhabi Kalan, leased out 36 percent of their agricultural land through 71 sharecropping leases, primarily to members of the Harijan castes (29 tenancies) or to Kumhar families (21 tenancies). The preeminent position of the Beniwal clan as landowners among the Jats in Dhabi Kalan was reflected in the 62 tenancies held by 28 Beniwal households; they accounted for 86 percent of all agricultural land leased out by Jat landowners in the survey.

Not a single Jat or caste Hindu household, other than Kumhar households, in the survey cultivated land under a *tijiya hissa* lease, but 72 percent of all land leased to Harijans and 47 percent of that leased to Kumhars were leased through *tijiya hissa* tenure. By contrast, 80 percent of the land leased by Beniwal Jats to other Jat farmers and 53 percent of that leased to other caste Hindus were let on the much more favorable *paanjaa* and *tisra* leases, suggesting a close correlation between position in the social hierarchy and an ability to acquire a favorable sharecropping arrangement. Only three Harijan tenancies and eight Kumhar leases with Jat landowners, totaling a very modest 4 percent and 23 percent, respectively, of the land leased to members of these communities were under such favorable terms of tenure.

Clearly, the implementation of land reform in Haryana simply has not

23. This discussion is based on a detailed examination of 109 separate tenancies in Dhabi Kalan for which it was possible to collect data. Not surprisingly, securing information about land-tenure arrangements proved to be extremely difficult, so much so that data collection had to be halted before the survey was completed. Most of the tenancies studied cover both seasons of the 1965–66 agricultural year, though they are not a complete enumeration of all such arrangements operative throughout that period. There is reason to believe, however, that about two-thirds of the existing tenure agreements were identified, and the data collected do include every type of tenancy said to exist in Dhabi Kalan. Therefore, they are reasonably representative of the tenancy situation in the village.

Table 14.5.

Sharecrop tenancies in Dhabi Kalan: Jat lessors

Lessees	Number of leases by tenure: Total	*Tisra*	*Paanjaa*	*Aadh*	*Tijiya*	Season[a]
Jats	9	3	1	5	0	
Kumhars	21	5	3	7	6	
Other caste Hindus	13	3	1	9	0	
Harijans	28	2	1	13	12	
All lessees	71	13	6	34	18	
Total acreage						
Jats	64	6	30	28	0	K
	76	8	30	38	0	R
Kumhars	218	29	22	69	98	K
	222	29	22	71	100	R
Other caste Hindus	61	17	13	31	0	K
	61	17	13	31	0	R
Harijans	437	7	12	88	330	K
	441	7	12	92	330	R
All lessees	780	59	77	216	428	K
	800	61	77	232	430	R
Irrigated acreage						
Jats	25	1	15	9	0	K
	14	3	5	6	0	R
Kumhars	43	1	0	17	25	K
	31	3	2	10	16	R
Other caste Hindus	15	2	0	13	0	K
	15	2	0	13	0	R
Harijans	92	3	0	24	65	K
	55	3	0	15	37	R
All lessees	175	7	15	63	90	K
	115	11	7	44	53	R

Note: All acreage values to nearest full acre.
[a] K = *kharif*; R = *rabi*.

been successful in delivering security of tenure to tenants or, insofar as it represented an effort to diminish the concentration of wealth among the caste-based peasant elite through extractive land tenures, in limiting the rent they could be charged for the use of the land. Indeed, given that forty Jat households have holdings of thirty acres or more, and that twenty-one of these holdings contain more than thirty irrigable acres each, its failure in limiting the amount of agricultural land that individuals could own also must be acknowledged. The failure of public policy to reform either concentrated ownership in rural Haryana or to redress the unequal balance of social power and economic wealth in village society, however, was not solely the result of poorly designed legislation or subsequent legal and illegal activities to circumvent the ceilings on landholdings and rents. Nor did failure stem merely from poor enforcement of the new laws. It also failed, at least in Haryana,

Table 14.6.

Sharecrop tenancies in Dhabi Kalan: Jat Beniwal lessors

Lessees	Number of leases by tenure: Total	*Tisra*	*Paanjaa*	*Aadh*	*Tijiya*	Season[a]
Jats	7	3	1	3	0	
Kumhars	19	5	3	5	6	
Other Hindu castes	11	3	1	7	0	
Harijans	25	1	1	12	11	
All lessees	62	12	6	27	17	
Total acreage						
Jats	40	6	30	4	0	K
	52	8	30	14	0	R
Kumhars	211	29	22	62	98	K
	213	29	22	62	100	R
Other Hindu castes	56	17	13	26	0	K
	56	17	13	26	0	R
Harijans	366	2	12	87	265	K
	371	2	12	92	265	R
All lessees	673	54	77	179	363	K
	692	56	77	194	365	R
Irrigated acreage						
Jats	19	1	15	3	0	K
	8	3	5	0	0	R
Kumhars	37	1	0	11	25	K
	28	3	2	7	16	R
Other Hindu castes	13	2	0	11	0	K
	13	2	0	11	0	R
Harijans	85	1	0	23	61	K
	51	1	0	15	35	R
All lessees	154	5	15	48	86	K
	100	9	7	33	51	R

Note: All acreage values to nearest full acre.
[a]K = *kharif*; R = *rabi*.

because the resource environment was, albeit coincidentally, fundamentally altered by the provision of irrigation to a large area of the state.

Even the government fully recognized the superior quality of irrigable acreage over its rainfall-dependent dry crop counterpart when it set the land-holding ceiling at thirty standard acres, or sixty ordinary (i.e., dry crop) acres, thereby implicitly establishing the value of irrigable land as twice that of dry crop land. Cultivators in this semiarid region quickly came to hold a similar regard for the worth of irrigable land in comparison with dry crop land.[24] In the erratic rainfall environment of the Haryana Bagar, acquiring and maintaining a large, extensively cultivated holding was now no longer essential "survival insurance." Instead, the possession of irrigable acreage became the key to agricultural success and prosperity, so much so that nonirrigable land might be considered scarcely worth the effort to farm, particularly if the holding was very large and distant from the canal or poorly served by the watercourse network. A more satisfactory alternative, however, was readily available.

24. To obtain a rough estimate of the relative values of irrigable and nonirrigable land as they were perceived by farmers in Dhabi Kalan, 40 Jats, 32 Kumhars, and 40 Harijans were asked the maximum price they would pay, if they could pay any price, for "good" irrigable and "good" nonirrigable land. The responses of these farmers suggest that nonirrigable land is "worth" about 60 percent of the value of irrigable land. Jat farmers tended to ascribe a slightly higher price to both irrigable and nonirrigable land than did Kumhar and Harijan farmers.

Land Reform and Irrigation: The Coalesence of Time and Location

To understand the meaning and future implications of present land-reform legislation and irrigation development in Haryana, we must shift our focus from the failure of land reform to accomplish its stated goals to the consequences of its structural weaknesses and its implementation coincident with the development of perennial irrigation. In the tenancies surveyed, in Dhabi Kalan, about 36 percent of the total acreage leased out by Jats was actually planted to an irrigated crop during the agricultural year, irrespective of season. Nearly 50 percent of this irrigated acreage was leased under the most exploitative terms of tenure by Harijan and Kumhar cultivators; no such lease was negotiated between a landowner and any Jat or other caste Hindu lessor. This is the price that most Harijan farmers and many lower-caste farmers must pay to participate in the changing and more remunerative cropping patterns made possible in Dhabi Kalan by the Bhakra irrigation system, given that 80 percent of Harijan households and 35 percent of lower-caste houesholds own no irrigable agricultural land whatsoever. Equally significant, about 60 percent of the dry crop area leased out by Jat landowners was also under the most exploitative terms of tenure to Harijan and Kumhar cultivators, accounting for very nearly 25 percent of all nonirrigated cultivated area in Dhabi Kalan.

A more detailed examination of the pattern of landownership by caste and of cultivation units with tenants in *chak* 16000 Left, Dhabi Minor, makes the emerging pattern more explicit. In this *chak* Jat farmers own 61 percent of the CCA, typically in fairly large—ten acres or more—and compact blocks, distributed throughout the *chak*; a large and compact unit is also owned by an Aggarwal household (Fig. 14.9). Altogether, these farmers control nearly 75 percent of the CCA in the *chak*. Kumhar farmers control a small, compact block of land immediately east of the outlet, virtually all the fields of which are located within 3000 feet of the watercourse outlet. This advantageous location with respect to irrigation is somewhat negated, however, by the fact that this block of land is divided into ten separate cultivation units, the largest of which is about six acres.[25]

25. A study of irrigation agriculture in three other villages in Hissar District revealed some similar patterns. Cultivators of small operational holdings (fewer than fifteen acres) were located at a maximum of 2.5 miles from the canal outlet; the maximum distance at which farmers of large holdings (over twenty-five acres), however, were found was only 1.5 miles from the outlet. Jats were most often farmers of large holdings in these villages, too (C. R. Kaushik, "Farm Adjust-

The cultivation units in which tenants sharecrop irrigated land and the locations of these units in the *chak* are shown in Figure 14.10; details of these tenancies are given in Table 14.7. Harijan farmers (Chamar and Dhanak) were able to lease land in the nearer irrigation distance zone (cf. Fig. 14.5) only on the usurious *tijiya hissa* terms. A Kumhar farmer, however, obtained irrigable land at a similar location on a fifty-fifty share basis. At the more extreme irrigation distances, irrigable fields were farmed by both Harijan and Kumhar farmers on *aadh* leases, and another Harijan farmer had a tenancy on a *paanjaa* agreement. Land is available on the legal *tisra* terms or on cash rents averaging 50 rupees per acre per season only at maximum irrigation distances in the *chak* and provided the farmer has bid successfully for its use in the seasonal "auction" of cultivation rights to the village panchayat land. In fact, not a single field in this area was actually irrigated in any season from 1964 to 1966. Although this sample of tenancies was very small, it is notable that the area of the tenure actually irrigated also declined sharply as the irrigation distance of the cultivation units from the outlet for the *chak* increased, a function both of the difficulty in securing an adequate irrigation supply at greater distances from the outlet and of the tendency of the Jat landowners to retain for themselves part or all of the irrigation turn the tenanted unit would otherwise obtain.[26] Indeed, dry crop farming and large seasonal fallows characterized agriculture in the two most distant tenancies.

Despite its weaknesses and its failure to accomplish its stated goals, land-reform legislation in Haryana did in fact spur the redistribution and reconsolidation of agricultural land among those who already controlled it.[27] The structural weakness of the legislation facilitated the retention of large land-holdings within the family. Coincidentally, irrigation development and the methods of operation of the irrigation system transformed these large holdings, now comprising mixed amounts of highly valuable irrigable land and much less desirable dry crop land, into an even greater asset than they had

ment on the Introduction of New Irrigation Facilities in Canal-Irrigated Area of Hissar District," unpublished M.Sc. thesis, Punjab Agricultural University, Ludhiana, 1966, p. 23.

26. Estimated land values in *chak* 16000 Left follow a similar hierarchial pattern. A number of Jat farmers, all recognized as excellent farmers, were asked the maximum price they would "bid" for specific irrigable fields at various locations in the *chak*. Fields rather close to the watercourse outlet were "worth" about 2,500 rupees per acre, those in middle irrigation distance locations were "worth" 500–700 rupees per acre less, and theoretically irrigable fields at maximum irrigation distance locations were thought to be "worth" only 1,500 rupees per acre. This procedure had to be adopted to determine land values in Dhabi Kalan because very little land had been bought or sold since the beginning of perennial irrigation. Official records of land sales proved to be useless for this purpose since, for a variety of reasons, land sale prices are either inflated or deflated.

27. In fact, Jat households secured 54 percent of the total of 272 acres to which tenants obtained permanent occupancy rights of tenancy in Dhabi Kalan under the terms of the land-reform legislation, including slightly more than two-thirds of all irrigable area within this acreage (Vander Velde, "Distribution of Irrigation Benefits," pp. 52, 249).

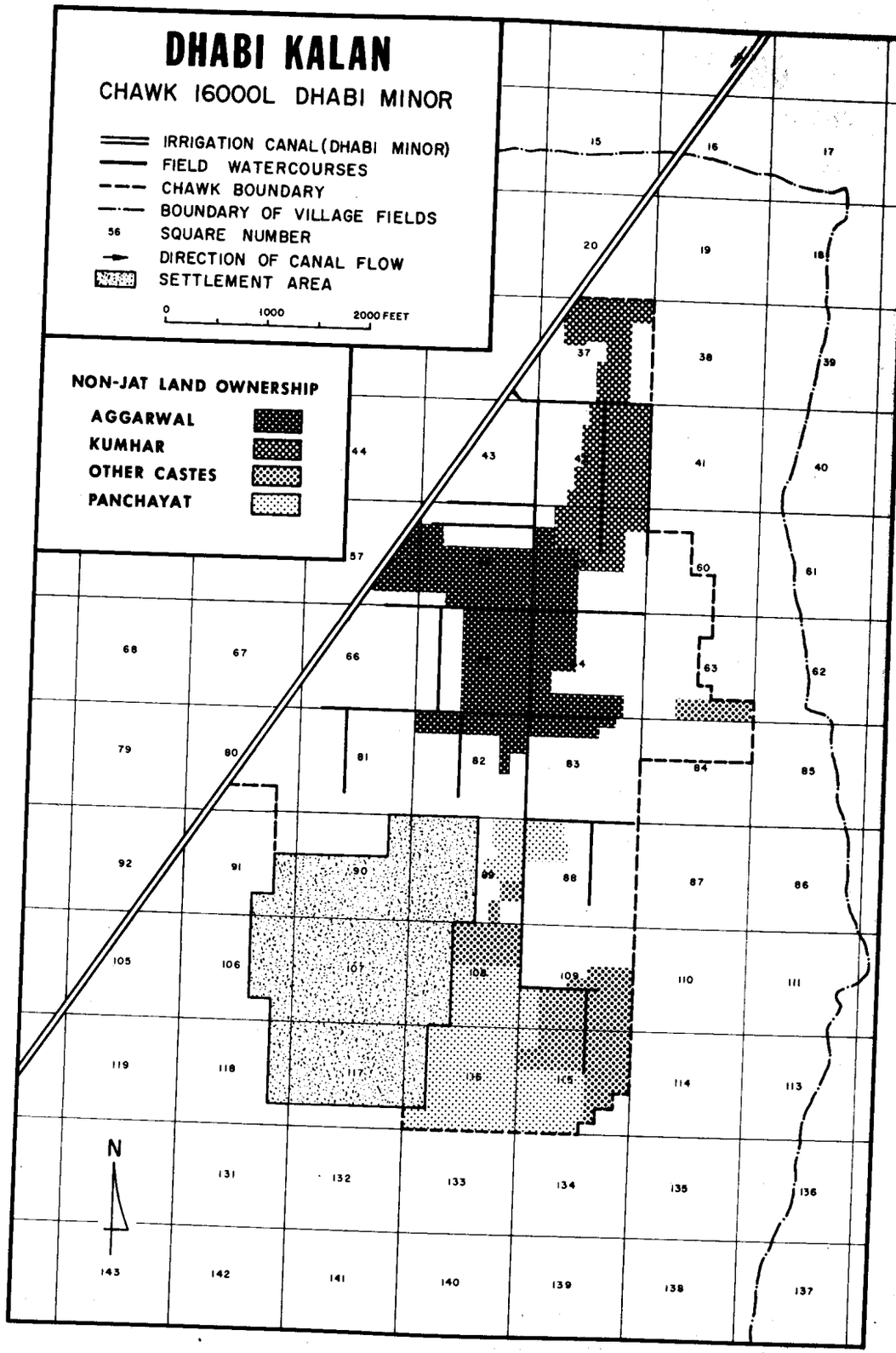

Figure 14.9.

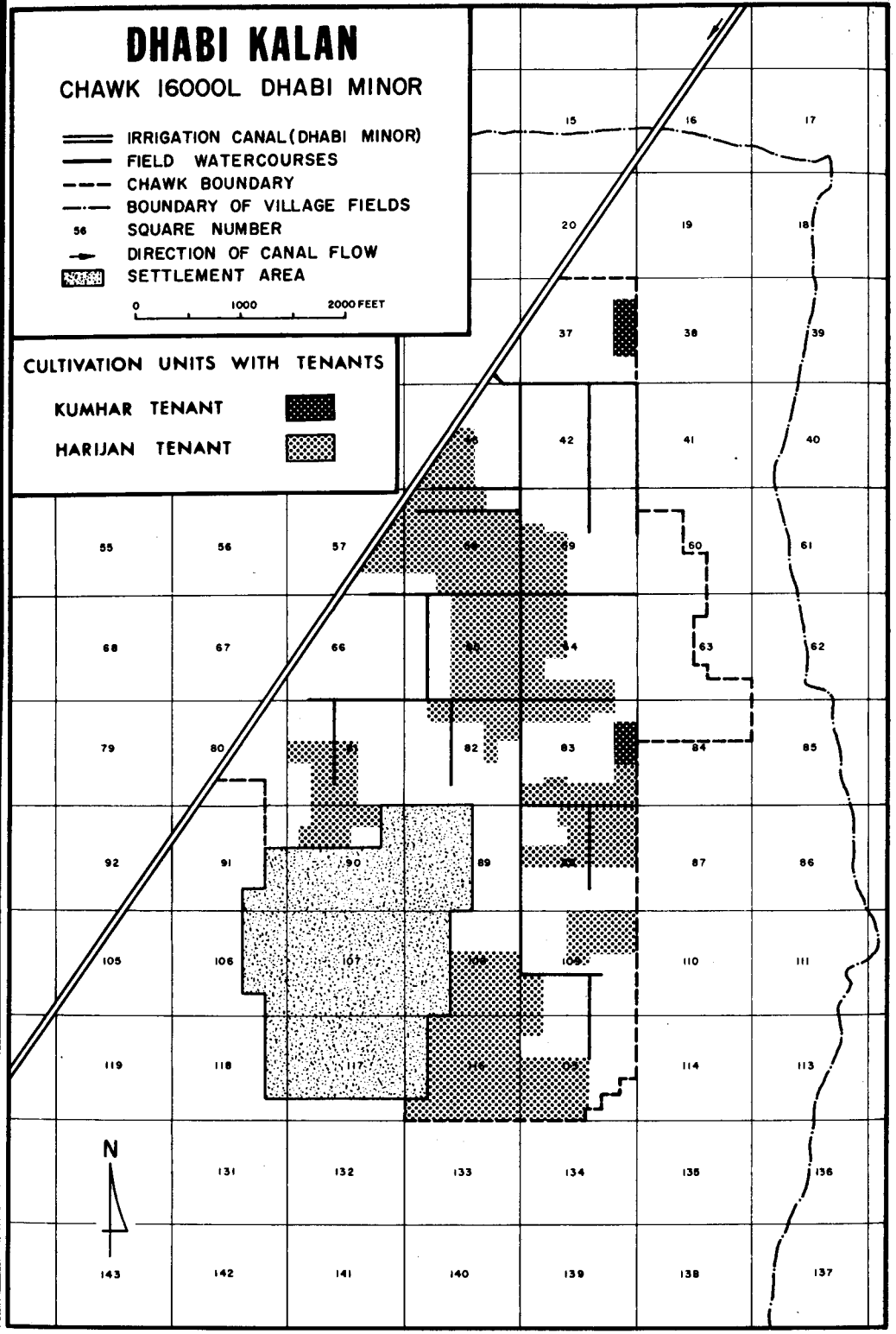

Figure 14.10.

Table 14.7.

Tenancy, caste, and location in *chak* 16000 Left, Dhabi Minor

Area of tenure (acres)	Irrigated area (acres)		Irrigation distance (feet)	Tenure type	Tenant's caste
	Summer	Winter			
10[a]	9	2½	1101–2200	*aadh*	Kumhar
30[a]	6	5½	1101–2200	*tijiya*	Chamar
26	14	9½	2201–4400	*tijiya*	Dhanak
2	0	1	4401–5500	*aadh*	Kumhar
22	3	1½	4401–6600	*aadh*	Dhanak
20½	1	0	5501–6600	*aadh*	Chamar

[a]This tenure was not wholly in chak 16000 Left.

been. Because the length of farmers' irrigation turns and thus the amount of water to which they are entitled are determined by the size of the cultivation unit in the command of the system, there is even greater reason to retain title to the largest area possible because by doing so one maximizes access to the most scarce resource in this environment.

By shifting tenants and the locations of their tenancies, registering multiple owners in the family, and using oral leases, Jat landowners secured the bulk of their large holdings from the occupancy of present and former tenants and precluded the confiscation of any significant amount of land for redistribution among the landless and low-caste peasantry. The capability and operation of the irrigation system generally restricts irrigation agriculture to a segment of the cultivation unit in any season. Thus, maintaining a large holding is necessary to assure irrigation supplies for that segment in sufficient amounts to offset the water losses experienced in the distribution system as field distance from the outlet increases. The typical Jat cultivation unit, however, still contains a considerable area that can be planted only to nonirrigated crops or fallowed. The maintenance of the usual unirrigated cropping pattern—one dry crop per year—is relatively unprofitable for the large landowner when compared with the potential of irrigated land to yield two crops a year or three crops in four seasons; moreoever, the risk of failure remains high for dry crop agriculture.

The persistence of numerous landless farmers and small landowners as well as the traditional system of sharecropping tenures in the post-land-reform period have made it possible for large landowners to keep substantial amounts of dry crop land in production at a profit even though it is too expensive for them to cultivate it. The frequent acceptance of disadvantageous and illegal tenures by farmers who rank low in the social and economic hierarchy of rural society reveals that those who most needed security of tenure and security from crop failure—the objectives of land-reform legislation and irrigation development—still have it least. By contrast, for the Jat landowners, the returns from such sharecrop tenancies constitute a kind of guaranteed bonus,

since their extensive holdings have been largely protected from crop failure through the irrigation system.

In the pre-irrigation Bagar region of Haryana, landowners, owner-cum-tenants, and the landless, despite the obvious maldistribution of the land resource, faced essentially the same level of environmental risk. The *location* of one's cultivation unit counted for relatively little, although those whose fields were at the periphery of the village lands did face a greater investment of labor time in agriculture. This "production cost," however, was relatively insignificant when compared with the need to survive in a harsh environment with few economic alternatives. Rather, large holdings were important in at least partially offsetting the high risk of crop failure in the region, and the landholdings of the Jat clans were by far the largest.

Following the completion of the Bhakra irrigation project, the *location* of one's landholding counts for a great deal, for in large measure it determines who can grow what, how much, and when. Differential access to water in the irrigation system, a result of the interaction of size of holding and location within the *chak*, has tended to concentrate its benefits—greater security from crop failure, the opportunity to grow more valuable crops, and enhanced land values—among a relatively small number of farmers. And the pre-land-reform, pre-irrigation pattern of economic and social dominance, which land reform directly and irrigation at least tangentially sought to break up, continues almost intact.

The recent development and rapid diffusion of higher yielding, hybrid crop varieties may facilitate the further concentration of benefits among these secure and increasingly wealthy farmers. In the Haryana Bagar, irrigation is a prerequisite to the cultivation of these crops, which are far more remunerative than traditional varieties when grown with appropriate amounts of fertilizer and proper pest-control measures. Thus, even more than before, water is the critical means of agricultural production, and when access to water is combined with the concentrated ownership of agricultural land, the functional dominance of local economy and society by the high-caste, landowning agricultural classes is reinforced. In Hissar District, and throughout much of Haryana, this is, as it has long been, the Jat community.

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In the pre-irrigation Bagar region of Haryana, landowners, owner-cum-tenants, and the landless, despite the obvious maldistribution of the land resource, faced essentially the same level of environmental risk. The *location* of one's cultivation unit counted for relatively little, although those whose fields were at the periphery of the village lands did face a greater investment of labor time in agriculture. This "production cost," however, was relatively insignificant when compared with the need to survive in a harsh environment with few economic alternatives. Rather, large holdings were important in at least partially offsetting the high risk of crop failure in the region, and the landholdings of the Jat clans were by far the largest.

Following the completion of the Bhakra irrigation project, the *location* of one's landholding counts for a great deal, for in large measure it determines who can grow what, how much, and when. Differential access to water in the irrigation system, a result of the interaction of size of holding and location within the *chak*, has tended to concentrate its benefits—greater security from crop failure, the opportunity to grow more valuable crops, and enhanced land values—among a relatively small number of farmers. And the pre-land-reform, pre-irrigation pattern of economic and social dominance, which land reform directly and irrigation at least tangentially sought to break up, continues almost intact.

The recent development and rapid diffusion of higher yielding, hybrid crop varieties may facilitate the further concentration of benefits among these secure and increasingly wealthy farmers. In the Haryana Bagar, irrigation is a prerequisite to the cultivation of these crops, which are far more remunerative than traditional varieties when grown with appropriate amounts of fertilizer and proper pest-control measures. Thus, even more than before, water is the critical means of agricultural production, and when access to water is combined with the concentrated ownership of agricultural land, the functional dominance of local economy and society by the high-caste, landowning agricultural classes is reinforced. In Hissar District, and throughout much of Haryana, this is, as it has long been, the Jat community.