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Article *in* Journal of Development Studies · April 1987

DOI: 10.1080/00220388708422037

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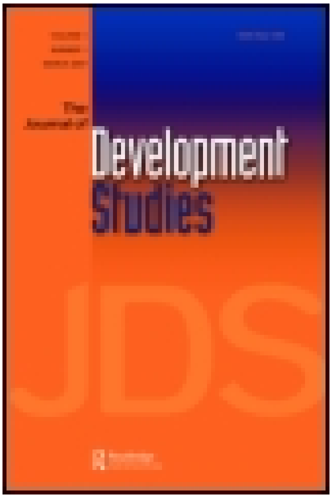

The Journal of Development Studies
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/fjds20

Irrigation and imperialism: The causes and consequences of a shift from subsistence to cash cropping

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Published online: 23 Nov 2007.

Irrigation and Imperialism: The Causes and Consequences of a Shift from Subsistence to Cash Cropping

*by Donald W. Attwood**

Dependency theorists and others have suggested that villagers in British India were compelled to grow cash crops under canal irrigation and this made them more vulnerable to famines. Evidence on cropping patterns in western India c. 1900 shows that cultivators had good technical reasons for not irrigating subsistence crops. In response to fiscal pressures and cultivators' choices, the government turned from a policy favouring subsistence crop irrigation to one favouring sugarcane. Paradoxically, this new policy also stimulated foodgrain production, providing greater subsistence security for the region.

> There has been a drift in the Irrigation Policy of Government. The drift is in favour of the Capitalists. [*More, 1938: 61*]

INTRODUCTION

What are the conditions which encourage or compel subsistence farmers to undertake cash cropping? And what are the consequences for their subsistence security? Realistic answers to such questions are critical in formulating effective agricultural policies in the developing world today; and the choice of policies is influenced by assumptions about what has happened in the past to village cultivators who have switched to market crops.

There are two main schools of thought on these questions: one predicts that new markets and technologies will, on balance, bring more benefits to village cultivators [see, for example, *Schultz, 1964; Popkin, 1979*]; and the other predicts that such changes will do far more harm than good [see, for example, *Scott, 1976; Lappé and Collins, 1979; Frank, 1969*]. Western market economists form the core of adherents to the former school, while dependency and world-system theorists are among those committed to the latter. Market economists tend to assume that villagers are indepen-

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dent decision-makers, seizing on new entrepreneurial activities as opportunities arise, while dependency theorists tend to assume that villagers are coerced into new productive activities by powerful landlords, merchants, industrialists, or state officials.

The historical role of coercion in shaping some agrarian systems, such as the sugar plantations of the Caribbean or the cotton plantations of the US south, is undeniable. However, it is the argument of this article that there are other cases in which coercion plays a minor part in the transformation of subsistence agriculture. The main example here comes from western India during the late nineteenth and early twentieth centuries.

During the nineteenth century, the semi-arid region of western India known as the Bombay Deccan (now part of Maharashtra state) was prone to frequent and widespread famines. Agricultural production was precarious in many districts and relied mainly on drought-resistant varieties of *jowar* (Indian millet, *Sorghum vulgare*, here referred to as 'sorghum') and *bajri* (spiked millet, *Pennisetum typhoideum*, here referred to as 'millet'). Starting in the late nineteenth century, parts of this countryside were transformed by the construction of large-scale irrigation canals, which were intended to provide famine protection through the *extensive* irrigation of subsistence crops. However, the canals failed to provide water effectively for this purpose. In 1901, therefore, a new set of irrigation policies was tried out, leading to a more *intensive* use of canal water for an expensive and thirsty cash crop, sugarcane. Ever since, sugarcane has been the basis of increasing prosperity in the canal villages, while the majority of villages remain dry and poor.

The first objective of this article is to understand why there was a policy shift favouring more intensive irrigation. A second and related objective is to determine whether this policy shift was a threat to the subsistence security of the region. Starting in the late nineteenth century, Indian nationalists argued that the British government was encouraging cash crop production at the expense of subsistence crops, thus rendering the country more vulnerable to famines [e.g. *Dutt, 1903*; cf. *Chandra, 1966*]. This same theme has been taken up and elaborated by dependency theorists and others in recent years. Whitcombe argues in her [*1972*] book on northern India that cultivators were coerced into growing cash crops under canal irrigation; and as a result, this region became more vulnerable to famines. Likewise, Scott [*1976*] argues on a more general level that subsistence crises follow when peasants are lured or coerced into growing crops for export markets, illustrating this argument with case studies from colonial South-east Asia.

In response, this article will attempt to answer the following questions. First, whose interests were at stake and what causes were at work in the shift toward a more intensive irrigation policy in the Bombay Deccan? Second, were the cultivators coerced or manipulated into accepting this policy, or did they do so voluntarily? Third, what were the consequences of this policy for subsistence crop production and famine protection? And finally, how do the answers to these questions fit with recent debate concerning the impact of irrigation and cash cropping in north-western India?

ORIGINS OF THE DECCAN CANALS

The Bombay Deccan is a hilly plateau region on the west-central side of the Indian peninsula, inland from coastal mountains which shield it from monsoon rains sweeping in off the Arabian Sea. The districts in this rain shadow suffer so frequently from drought as to be labelled the famine belt of western India. In this belt, the average annual rainfall is only about 20–25 inches, and even this exiguous supply fails every few years.

When the British raj acquired an interest in improving Deccan agriculture, attention was naturally drawn to irrigation. Twenty years after the conquest of the Deccan, the Government of Bombay published a compilation of reports from district officers concerning indigenous irrigation works – wells, tanks and weirs [*Bombay Government, 1838*]. After the British Crown took over from the East India Company in 1858, attention was devoted to surveying and constructing new irrigation works. In Poona District, for example, engineering surveys were made in 1863–64 of 20-odd sites proposed for tanks, weirs and canals, and one old tank was restored as a famine relief work [*Beale, 1901: 236*].[1]

In 1856 a study was made of the cost of well irrigation in the Deccan. The author concluded that the cost of merely operating (let alone constructing) a well was very high and that the government should attempt to supply cheaper water by building tanks and weirs [*Taylor, 1856*]. Nevertheless, since wells could be more widely distributed than other sources of irrigation, since they could be built and operated without government supervision, and since about one-third of their operating expenses went for hired labour (thus providing a major source of employment), the building and repairing of wells was encouraged by the government, especially during famines. The instrument for encouraging well construction was the *takavi* advance, a loan from the government to the cultivator with repayments collected through the land revenue machinery. In 1877–78, following a very bad famine year, some 300,000 rupees were advanced as *takavi* loans, principally for digging new wells and repairing old ones, but also for buying seed-grain, cattle, and fodder. In a series of bad famines from 1899 to 1902, *takavi* advances rose to over Rs.20 million, including some 3.75 million for building and repairing wells [*Mann, 1925: 7; McAlpin, 1983: 179–84*].

This pattern of assistance extended well into the twentieth century, in a period when the government was also investing in several new canal systems. Between 1896 and 1912, the number of irrigation wells in the Bombay Presidency increased by 30 per cent from 200,000 to 260,000 [*Keatinge, 1921:50*]. In the famine of 1918–19, about Rs.15 million were distributed as *takavi* advances, of which about four million were for wells. These figures indicate that the Bombay Government never developed a one-sided commitment to canal irrigation. Wells and canals were the two largest sources of irrigation; and of the two, wells continued to irrigate the largest area by far [*Irrigation Inquiry Committee, Bombay (IICB), 1938: 6, 82*]. The question raised at the start of this article (why did the government choose an intensive over an extensive irrigation policy?) is thus a simplication of the issues, since a key extensive policy (*takavi* advances for well irrigation) continued to expand at need.

By the 1860s, officials were well aware that small, scattered works, such as wells, tanks and weirs, all suffered from one dismal flaw: in the worst droughts they dried up. Even in normal years, the minor rivers ceased to flow in the hot season (March to May). The wells and tanks were recharged annually by monsoon rains, and if no rains fell, many went dry. Where could an assured supply of water be found? Obviously, in the coastal mountains, where the headwaters of the rivers flowing eastward across the Deccan are replenished by more than 100 inches of rainfall each year. Nearly all this rain falls from June through October. Thus, in order to provide irrigation for the important *rabi* or winter-season crops, it would be necessary to store this abundant rainfall behind dams in the coastal mountains and then transport it 100 miles and more into the famine belt after the rainy season.

Irrigation systems of this magnitude were not completed until the late nineteenth century. Work on the Mutha canal system, which was the first to employ a storage dam, began in the late 1860s. The system came into operation in 1874, costing some Rs.1.8 million and capable of irrigating nearly 17,000 acres [*Indian Irrigation Commission (IIC), 1902: 223*]. Construction of a much larger system, the Nira Left Bank Canal, was started in 1876 as a famine relief work. This canal went into operation in 1885 with an estimated capacity of 113,000 acres. By 1900–1, with the addition of interest and other charges, the total capital cost of the Nira canal was almost Rs.5.7 million [*ibid.*].

Although the cost of construction was high, an assured supply of water should have been irresistible to the cultivators. However, as a former Director of Agriculture wrote: 'It might be thought that when a canal is opened in these arid regions the owners of the land under command would lose no time in making use of the water provided. But this is not the case' [*Keatinge, 1921: 80*]. After investing so much in them, the government discovered that the canals were not wanted on a regular basis.

THE PROBLEM OF UNWANTED WATER

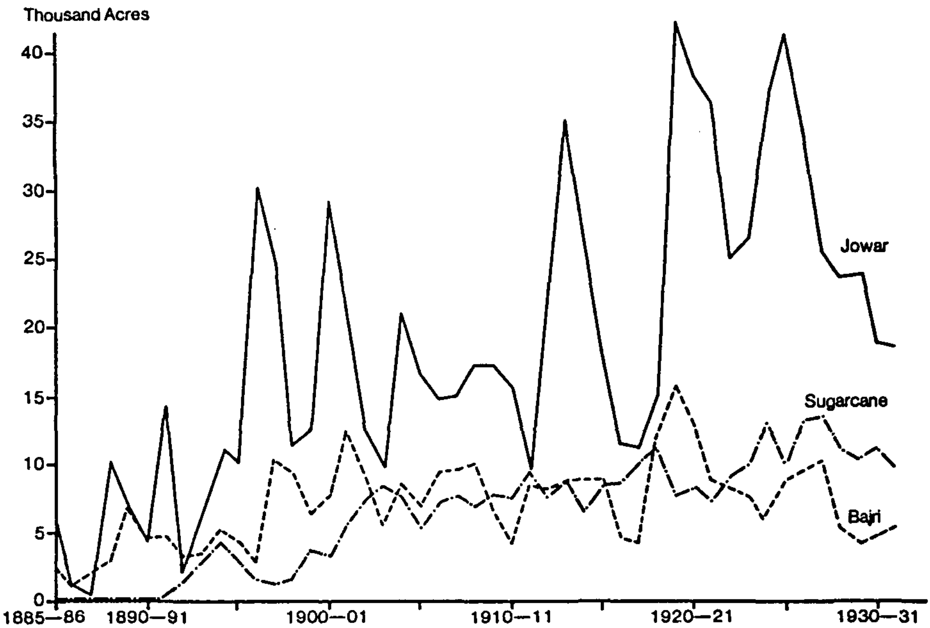
The Deccan canals were conceived and built as 'protective' works, which in the vocabulary of the Indian administration meant two things: first, the canals were intended to protect food crop production against droughts over as wide an area as possible; and second, they were not required to be self-financing. In other words, the authorities did not expect to recover the full interest on capital costs from irrigation charges. In these two respects, protective works like the Deccan canals contrasted with canals built in other parts of India, which were often classified as 'productive' works because they could eventually pay for themselves [*Stone, 1984: 23–6*]. The fundamental paradox of the Deccan canals was that, although they were built in response to a devastating series of famines, they failed initially as protective works; and it was this failure which caused them to be treated more as productive works, with markedly greater success.

The unsatisfactory demand for water along the Deccan canals can be indicated by comparison with other regions. In all other provinces except Bengal, the area actually irrigated by major government works was said to be more than 80 per cent of the area which could be irrigated. In the Bombay Presidency, on the other hand, this proportion was only 33 per cent [*IIC, 1902: 236*].[2] During the period from 1891–92 to 1901–2 (which was a decade with unusually severe and frequent famines), the area actually irrigated by the Nira canal ranged from 16 per cent to 46 per cent of the estimated irrigable area [*ibid.: 223*]. These results brought the Bombay irrigation administration under criticism from the central government.

The Nira canal was by no means useless in a famine, as is shown by Figure 1. In the famine of 1891–92, for example, the irrigated area under

FIGURE 1

ACREAGE OF CROPS UNDER IRRIGATION ON THE NIRA (LEFT BANK) CANAL



Source: C.C. Inglis and V.K. Gokhale [*1934*], 'Development of Irrigation in the Deccan Canal Areas', P.W.D. Technical Paper No.49, Bombay: Government Central Press, pp.34–5, 44–5.

rabi jowar (winter sorghum, the main subsistence crop) expanded rapidly from about 4,500 to 14,000 acres [*Inglis and Gokhale, 1934: 45*]. This shows that the canal was filling one important function of a protective work: providing emergency irrigation for food crops in the event of drought. During the severe famines which followed later in the 1890s, the area of irrigated *jowar* soared to around 30,000 acres. However, this area continued to rise and fall quite irregularly, varying inversely with the amount of rainfall. When the rains were adequate, the cultivators cut back drastically on their irrigation of *jowar* and other subsistence crops. As a result, during the period 1890–91 to 1931–32, there was a negative correlation (–0.32) between the area of irrigated *jowar* and the rainfall from September to December, this being the rainfall which most affected the winter crops (calculated from Inglis and Gokhale [*1934: 19, 45, Fig. 14*]).[3]

Because many or perhaps most of the cultivators did not take water on a regular basis, it was not easy to provide them with emergency irrigation in a drought. Fields not regularly irrigated were, for the most part, not adequately levelled, diked and ditched, with the result that 'the water will drown some parts, not reach others, and will generally be wasted' [*Beale, 1901: 30*]. Moreover, the cultivators usually waited until the last minute to request canal water, in the hope that the rains might come after all; 'and as no canal is constructed to satisfy sudden demands on a large scale, many of the crops will wither before they can be irrigated' [*ibid.*].

The Executive Engineer for Irrigation, Poona, elaborated on the problems of meeting sudden surges in demand:

> The capacity of the canal staff is taxed to the utmost in order to ensure a fair distribution and mature as large an area as possible .... Tens of thousands of acres of rabi crops require water at the same time and all in 12 or 15 days. On such occasions the demand is most intense and an equitable distribution of the areas becomes well-nigh impossible. [*Visvesvaraya, 1903: 4*]

Various forms of inequity resulted from the sporadic demand: 'Some villages have small areas under irrigation while others may be over-irrigated. Capitalists monopolise the water supply for large areas. The poorer cultivators cannot obtain capital and have no chance in a year of plague or famine' [*ibid.*]. (The 'capitalists' in question were immigrant market gardeners of the Mali caste, clustered around the market towns.) One of the Executive Engineer's goals in formulating a new system of irrigation was to encourage local cultivators in *all* the canal villages to use water regularly.

For a number of reasons, then, the canal could not supply water equitably and efficiently to a much larger area in famine years than was served in normal years; consequently, there were a great number of cultivators who either could not get water when they most needed it or else could not make effective use of what they got. Because the cultivators were not using much of the canal's capacity on a regular basis, neither they nor the irrigation officials were able to cope effectively with severe droughts. The critical question, then, was this: why were the cultivators not using the water regularly on their subsistence crops?

Perhaps the irrigation rates were too high. The rate for winter sorghum, the main subsistence crop, was Rs.2.25 per acre in 1901 [*ibid.: 12*]. This was just twice the maximum land revenue rate charged in many canal villages, a rate which every cultivator could pay in a normal year [*Bombay Government, 1912: 136*]. Moreover, McAlpin [*1983: 198–202*] has calculated that the real value of revenue payments, measured in terms of the quantity of sorghum which had to be sold to pay the revenue on an acre of land, was declining rapidly as prices rose in the late nineteenth and early twentieth centuries. If the revenue rate was becoming more affordable, then the irrigation rate should not have been prohibitive. At the turn of the century, the market value for one acre of sorghum grain under canal irrigation was about Rs.50. (The estimated average yield was 1,550 lbs.; and *jowar* prices averaged about Rs.3.18 per hundred pounds in the period 1893–1903 along the Nira canal [*Beale, 1901: 30; Bombay Government, 1912: 53*].) The irrigation charge was thus less than five per cent of the gross value of the crop, which seems a reasonable rate for what was, if nothing else, insurance against drought. This is especially true if we include the value of sorghum fodder, an excellent cattle feed, which added 20–40 per cent to the value of the grain [*Patil, 1928: 64–70*].

It might be thought that the irrigation rates were biased against subsistence crops and in favour of cash crops. But the rate charged for sugarcane in 1903 was Rs.25 per acre, 11 times the rate for sorghum. As with *jowar*, the cane rate was below five per cent of the value of the crop, which sold for around Rs.550–600 per acre [*Visvesvaraya, 1903: 12; Inglis and Gokhale, 1928: 15*]. By the 1920s, the irrigation rate for cane had increased to more than Rs.50 per acre. The rates for seasonal grain crops were also increased, but the cane rate stayed nine times higher [*Inglis and Gokhale, 1928: 15; 1934:21*]. The much higher cane rates reflected different water requirements, for cane needed eight to ten times the amount of water necessary for a seasonal grain crop [*IIC, 1902: 251*]. Thus it appears that charges per volume of water were held roughly equivalent, and the rates for subsistence crops were not high compared to those for sugarcane. In fact, the rates charged for foodgrains did not even pay the average cost per acre of canal administration, let alone produce a repayment on capital costs [*ibid.: 230*]. Even so, the customers were hesitant.

One genuine cause of hesitation was the cost of preparing a field for irrigation: at least Rs.17 per acre for levelling, ditching and diking [*ibid.: 220*]. This was not a great sum for those going into cane production, since they would expect to spend annually Rs.500 or more per acre, for a profit of a hundred rupees or more [*Inglis and Gokhale, 1928: 15; Attwood, 1984*]. On the other hand, Rs.17 was a much larger share of the value of an acre of irrigated sorghum, though the initial cost would have been amortised after a few years. Another basic problem was the chronic shortage of plough cattle [*Charlesworth, 1985: 140, 212*]. This made any shift to permanent irrigation, entailing more intensive working of the land, even more expensive.

Aside from these constraints, the principal cause of irregular demand for canal water was the nature of the soil and the crops which were adapted to it. In the river valleys along the canals, much of the soil was Deccan black soil, also called black cotton soil, which was very moisture-retentive. If the rains did not fail altogether, the cultivators could usually manage to subsist on their hardy *jowar*, *bajri* and pulses. Conversely, it appears that adding irrigation in seasons of normal rainfall did not increase the yields of these crops in proportion to the additional cost of irrigation, labour, bullocks and equipment [*IIC, 1902: 227*]. The staple foodgrains had been adapted over centuries to the semi-arid climate. Above a certain minimum, extra doses of water contributed mostly to growth of leaves and stem, not the grain head; and longer stems increased the danger of lodging.

To investigate this point, we require quantitative data on the results of irrigating subsistence crops in years of normal rainfall. A number of field surveys and experimental studies were made of the costs and yields of subsistence crops when cultivated either on rainfall alone or with the assistance of well irrigation [*Mann, 1917; Mann and Kanitkar, 1921; Patil, 1928, 1932; Tamhane et al., 1927*]. However, only limited studies were made of the costs and yields of these crops under canal irrigation.[4]

Patil and his associates [*1928, 1932*] observed cultivators working a small number of subsistence plots in both canal-irrigated and dry villages, during three crop years, 1925–28. All three were years of normal rainfall, so the dry plots gave adequate yields while the canal plots showed the value of irrigation under non-famine conditions. In the dry villages selected for study, *jowar* was not an important crop; the figures on *bajri* are more informative, since more plots were studied. The results are listed in Table 1, and below the raw data are the results of my calculations.[5]

First, we may note that, while canal irrigation increased the mean yield by 66 per cent, costs rose by 87 per cent. Consequently, net profits declined. In other words, cost efficiency was lower on the canal-irrigated plots: these produced about 12.6 pounds of grain per rupee as compared with about 14.2 pounds per rupee on the dry plots. The average net profit was therefore higher on the dry plots (seven per cent) as compared with the wet ones (–5 per cent).

Another striking feature in Table 1 is the increased variability of net profits under canal irrigation. The coefficient of variation (the standard deviation divided by the mean) rises from 6.84 for the dry plots to 12.20 for the wet ones. Moreover, the variability of yields does not decline under irrigation. If profits are much more variable for canal-irrigated *bajri*, this means that the greater costs do not consistently lead to proportionately greater yields. This hypothesis is supported by the correlations between yields and costs, which are strikingly different in the two sub-samples. The dry plots show a positive correlation of 0.57, suggesting that when more labour, fertiliser, etc., were added to a plot, the yield rose accordingly; but

TABLE 1

BAJRI (MILLET) PRODUCTION ON DRY AND CANAL-IRRIGATED PLOTS, POONA DISTRICT

	Dry Plots				Canal-Irrigated Plots			
	Plot Number	Grain Yield (Lbs. per Acre)	Cost (Rs. per Acre)	Net Profit (Rs. per Acre)	Plot Number	Grain Yield (Lbs. per Acre)	Cost (Rs. per Acre)	Net Profit (Rs. per Acre)
Raw Data	1	538	37.91	+ 5.14	5	540	59.64	-18.64
	2	285	24.95	- 0.11	6	360	36.80	- 9.60
	3	88	17.11	-10.79	7	928	44.28	+19.94
	4	611	31.96	+15.02	8	493	51.69	-14.83
	3A	124	33.43	-25.06	9	760	33.82	+26.45
	4A	588	30.38	+15.06	10	140	37.02	-23.52
	5A	433	20.78	+16.66	7A	720	32.88	+22.63
	6A	260	21.00	+ 2.33	8A	300	85.65	-59.65
	13B	615	28.96	+ 8.54	9A	600	56.41	-11.66
	14B	205	15.74	- 1.98	10A	1280	48.96	+43.88
	15B	300	23.71	- 4.66				
Mean		367.91	25.99	+ 1.83		612.10	48.72	- 2.50
Mean Change with Irrigation						+66.37%	+87.46%	-236.61%
Mean Ratio of Yield to Cost		14.16 Lbs./Re.				12.56 Lbs./Re.		
Mean Ratio of Profit to Cost				+7.04%				-5.13%
Correlation of Yield to Cost		+0.569				-0.196		
Standard Deviation		197.30	7.09	12.52		330.45	16.06	30.51
Coefficient of Variation		0.536	0.273	6.84		0.540	0.330	12.20

Source: Calculated from P.C. Patil, 1928, *Studies in the Cost of Production of Crops in the Deccan*, Department of Agriculture, Bulletin No. 149, Poona: Yeravda Prison Press, pp.10, 29–48; and P.C. Patil, 1932, *Preliminary Studies of Important Crops in the Bombay Deccan in the Post-War Period*, Department of Agriculture, Bulletin No. 168, Bombay: Government Central Press, pp.69–101.

the canal-irrigated plots show a *negative* correlation of –0.20, suggesting irrigation of dry-land subsistence crops was financially risky (except in a drought).[6]

In a year of normal rainfall, canal irrigation raised millet yields to some extent, but apparently not enough to compensate for the additional costs. The likely cause of this problem was that yields were not very responsive to extra water. With garden crops, on the other hand, this problem did not arise. In a study of 30 sugarcane plots along the Nira canal in 1920–21, costs and yields show a positive correlation of 0.32 (calculated from Inglis and Gokhale [*1928: 18, Plate IIIA*]).[7]

To sum up, Patil's data show that the use of canal irrigation for growing millet in years of normal rainfall meant: (1) a decrease in cost efficiency, (2) an increase in the variability of net profits, and (3) a negative correlation between costs and yields. Although the number of plots is small, the data suggest why the cultivators did not find it in their interest to use canal irrigation for subsistence crops on a regular basis.

It might still be supposed that the fault for this situation lay with some characteristic of the design or administration of the canals. However, it is possible to test this hypothesis by comparing the cropping pattern under canal irrigation with the one chosen for fields under well irrigation. Wells were constructed, owned and operated by the cultivators, who were free to select crops according to their own needs and resources. If there were a bias against certain crops on the canals, this should manifest itself in a quite different pattern.

Table 2 presents the appropriate data for this comparison, taken from D.R. Gadgil's classic study on the *Economic Effects of Irrigation* [*1948*]. Gadgil and his associates surveyed nearly 400 farms over two crop years in the Bombay Deccan. These farms were located in matched pairs of dry and canal-irrigated villages, the villages in each pair being close neighbours and the whole set being spread over two canal systems in Ahmednagar District. The table summarises cropping patterns for millet and sorghum grown under well or canal irrigation.[8] The patterns are remarkably similar: in both cases, the cultivators put about 16 per cent of the irrigated area under these two crops. This shows clearly that the canals did not distort established cropping patterns chosen by the cultivators. Water was expensive in either case, and it did not pay to use a large share of it on subsistence crops.

This might sound as though the cultivators clung blindly to past experience. In some respects, canal irrigation provided new opportunities: it was far more reliable in a drought, and it could deliver abundant water to hundreds of acres in a compact block, which wells could never do. Thus it makes sense to ask whether the cultivators could have learned to make better use of canal water for their subsistence crops.

If they could have learned this, then they must have been remarkably obtuse not to have done so. Returning to Figure 1, it is evident that, for a period of 45 years, many cultivators rushed to increase their areas of irrigated *jowar* and *bajri* when the rains failed and then, when the weather

TABLE 2

AREA OF SUBSISTENCE CROPS UNDER CANAL AND WELL IRRIGATION, AHMEDNAGAR DISTRICT

	Dry Villages (Well Irrigation Only)				Canal Villages (Canal Irrigation Mostly)			
Year	Millet (Bajri)	Sorghum (Jowar)	Millet & Sorghum	All Wet Crops	Millet (Bajri)	Sorghum (Jowar)	Millet & Sorghum	All Wet Crops
1938-39								
Acres	17.30	8.40	25.70	144.70	118.80	116.60	235.40	1,386.90
Percent	11.96	5.81	17.77	100	8.57	8.41	16.98	100
1939-40								
Acres	14.50	37.50	52.00	353.70	157.40	237.10	394.50	2,413.80
Percent	4.10	10.60	14.70	100	6.52	9.82	16.34	100
Mean Percent (1938-40)	8.03	8.21	16.24	100	7.55	9.12	16.66	100

Source: Calculated from D.R. Gadgil, 1948, *Economic Effects of Irrigation*, Poona: Gokhale Institute of Politics and Economics, Publication No.17, pp.26–7, 30–33.

returned to normal, promptly stopped irrigating these crops. As the experience was repeated, moreover, the fields were undoubtedly better prepared for irrigation; and yet the same cultivators discontinued irrigating these crops in normal years. This could only mean that the yields were never sufficiently high to offset the additional monetary and labour costs or the additional uncertainty in the relationship between costs and yields.

A similar conclusion was offered by the Executive Engineer for Irrigation, Poona District:

> Black soil has a peculiar property of resisting evaporation . . . . In good seasons the black soil of the Deccan yields a full harvest and in ordinary years a fair harvest . . . . It is only in a year of severe drought that irrigation of dry crops is really useful, and that there is any large demand for water for them. [*ICC, 1902: 227*]

To sum up this section, we have found that it was not profitable to apply canal water to subsistence crops, except during years of drought. This situation was brought about not by biased irrigation policies but by the nature of the soils, climate and subsistence crops. Consequently, so long as the canal administration aimed at the irrigation of subsistence crops, it was doomed to waste a large share of the available water. In a semi-arid climate, such waste was unacceptable.

FISCAL PRESSURES AND THE ORIGIN OF THE BLOCK SYSTEM

If the cultivators would not pay for water on a regular basis, the government could not recover even a small fraction of its investment in the canals. In the year 1899–1900, for example, the irrigation works of Bombay generated a net revenue of 1.4 per cent on capital outlay, as compared with an average of 6.4 per cent for all of India and nearly ten per cent for Punjab [*IIC, 1902: 225*]. Referring to these melancholy facts in testimony before the Indian Irrigation Commission, M. Visvesvaraya, Executive Engineer for Irrigation, Poona, commented defensively:

> These results which have been more or less the same in all recent years, have discredited the Bombay works in the estimation of the Government of India. The annual grants for new works have in consequence been curtailed and the strictest economy is enforced in the maintenance of existing works [*ibid.: 225*].

This financial problem had two causes: one, just discussed, was the lack of regular demand for irrigation; and the second was simply the much greater expenditure required for canals in the Deccan as compared with other regions. This additional cost was due to the lack of perennial rivers, which compelled the government to build large storage dams. As Visvesvaraya noted:

> Water is very expensive in Bombay . . . . I have shown that an expenditure of Rs.100 has provided facilities for irrigation of about five acres in Punjab, four in Madras and three in the North-Western

> Provinces. In Bombay the corresponding area is less than half an acre. It may be roughly stated that, on account of the great cost of storage, water-supply is three to six times more expensive here than on the other irrigation systems. [*ibid.: 225*]

As custodians of the most expensive water in the country, Visvesvaraya and his colleagues were understandably keen to find a use for it. Before 1901, the protective policy meant that as much water as possible was kept in storage after the monsoon for irrigating winter foodgrains – sorghum and wheat. However, much of this precious store was wasted in normal seasons. Consequently, Visvesvaraya proposed a more intensive policy of cash-crop irrigation.

There was certainly an element of fiscal self-interest behind this proposal. The rate charged for irrigating foodgrains was less than the cost of delivering the water, in part because extensive irrigation entailed high distribution losses through evaporation and percolation over a widely scattered network of distributaries.[9] Consequently, the larger the irrigated area under subsistence crops, the more financial problems the canals had. 'Increase in the irrigation of ordinary crops will never pay in Bombay. Water is too costly to be profitably applied to them', as Visvesvaraya [*IIC, 1902: 227*] pointed out. 'If the Bombay works are ever to prove remunerative, perennial and other high class irrigation should be largely encouraged in ordinary years' [*ibid.*].

Among the crops in this region, sugarcane grew well under canal irrigation and had one special advantage: it was flexible in the timing of planting, watering, and harvesting. Thus cane was suited to become the premier cash crop along the Deccan canals. As irrigation officials subsequently observed: 'the more flexible the crop requirements the better for all concerned . . . . Sugarcane which meets irrigation limitations and natural conditions best has been a very profitable crop to the cultivators and Government, and has brought in more than half the canal revenue' [*Inglis and Gokhale, 1934: 21*]. These authors reviewed the results of irrigating a variety of other cash crops and found that none were as well suited to the soils, climate and canals of the famine belt.[10]

As we have seen, sugarcane was charged a higher rate per acre than other crops, since it needed water regularly all year round, particularly during the hot season (March–May), when most other crops were not grown. In 1901 the rate for an acre of cane was eleven times the rate charged for *rabi* crops [*Visvesvaraya*, 1903: 12]. As a result, it was evident that sugarcane would have a strong positive influence on the irrigation budget. On the Nira canal, sugarcane was generating 57.5 per cent of the revenue by 1901–2, even though it covered only 11.6 per cent of the irrigated area [*Visvesvaraya, 1903: 8*]. Beset as they were with recurring famines, budget cuts, and criticism from the Government of India, the Bombay irrigation officials seized on sugarcane as a crop which would utilise their water and balance their budgets.

That the government was ultimately more concerned about wasted water than fiscal losses was demonstrated by the outcome of hearings held by the Indian Irrigation Commission in 1901. One result was to approve Visvesvaraya's plan to experiment with a more intensive policy, a decision which might have been motivated simply by frugality. However, another decision by the same Commission – one with even more profound effects on the future of the Bombay Deccan – was in favour of constructing a whole new series of Deccan canals [*IIC, 1903: 72–9*]. Once Visvesvaraya had demonstrated how to find a reliable demand for canal water, the government invested vigorously in a seven-fold expansion of the canals, even though there was no foreseeable date when they would pay back their costs.

Nevertheless, the fiscal interests of the bureaucracy certainly encouraged the shift toward irrigation of sugarcane. Were there other interests in the British raj pushing for more sugar production in the Bombay Deccan? For the most part, such interests did not exist. Sugar was not an export crop: it was produced entirely for the vast home market in India. Consequently, British shipping or trading companies did not expect to earn profits, nor did the government expect to earn export taxes, by promoting sugar production. Only one British-owned sugar factory was ever established in the Bombay Deccan; all the rest of the privately-owned factories (there were 11 by 1941) were owned by Indian industrialists [*Attwood, 1985*]. In sum, there were almost no private British firms with a stake in the sugar economy of the Deccan, and the government had no stake in export earnings from this product.

After sugarcane began to flourish along the canals, the government did develop an increasing attachment to the crop and to the prospects for industrial sugar production [see *Keatinge, 1921: 77–88; Deccan Canals Financial Improvement Committee (DCFIC), 1932; IICB, 1938*]. However, this attachment remained firmly rooted in concern over the utilisation of expensive water. The decisive step toward solving this problem was the sugarcane block system, pioneered by Visvesvaraya.

THE CANE BLOCK SYSTEM

In his memorandum to the Irrigation Commision, Visvesvaraya explained the problems of irrigation management in the Deccan and followed with a proposal for a more effective irrigation policy: the sugarcane block system. This system, which Visvesvaraya tried out first on the Nira canal, included the following basic features [*IIC, 1902: Visvesvaraya, 1901, 1903*]:

(1) By a signed contract, a cultivator would agree to take canal water on a certain area, which constituted the block, for six years; and the government would guarantee to supply this water. This would eliminate the delays and uncertainties caused by the prevailing system of seasonal applications for water. The cultivators would be more willing to invest in the preparation of their fields if they were certain to receive water for several years. It was Visvesvaraya's belief, borne out by subsequent experience, that the temptation of sugarcane profits was the best

inducement for getting ordinary cultivators to demand irrigation on a regular basis. If irrigation were not guaranteed for several years, only the wealthy farmers would dare to invest in this very expensive crop.

(2) Block irrigation would be charged at a fixed rate per acre, regardless of the crops grown. This would reduce the complications connected with charging different rates for different crops.

(3) Perennial or 12-month irrigation, suitable for cane cultivation, would be provided on one-third of each block. The other two-thirds would receive irrigation for eight months, suitable for double cropping in the monsoon (*kharif*) and winter (*rabi*) seasons. (No irrigation would be supplied to this portion of the block during the hot season, March through May.) This division of the block area into thirds fitted an established system of crop rotation. Blocks would be allotted in multiples of 1.5 acres, with one-half acre for cane and one acre for seasonal crops. Since the cultivators would be paying for eight-month irrigation on two-thirds of every block, they would be induced to use canal water on their seasonal crops.

(4) In the 30 villages under the block system, the total block area would be about 21 per cent of the cultivable area under command of the canal. The area of perennial irrigation would thus be only seven per cent (one-third of 21 per cent) in these villages [*Visvesvaraya, 1903: 9*]. The total block area would be 18,000 acres, with 6,000 acres of cane planted each year. Distributing the blocks among all 30 villages would encourage local cultivators to take up cane cultivation and correct the imbalance caused by Mali immigrants clustered around the market towns.

(5) The distribution of perennial irrigation on this basis could not be guaranteed below the first 65 miles of the canal. On the last 40 miles, serving 33 villages, preference would be given for irrigating seasonal crops. The stored water available for *rabi* (winter) crops would irrigate from 23,000 to 33,000 acres, depending on the amount of rainfall collected in the previous monsoon season. (Under the extensive policy, by comparison, the maximum irrigated area of *rabi* crops had been 37,000 acres in the famine of 1900–1 [*ibid.*].)

Instead of storing the maximum volume of monsoon rain behind the dams, in case there might be a drought in the *rabi* season, the block system would guarantee water for 6,000 acres of sugarcane, leaving a lower supply for emergencies. However, as we shall see, the system could be adjusted in a crisis so that even larger areas of *rabi* crops could be irrigated.

When Visvesvaraya appeared before the Irrigation Commission, he had already obtained the endorsement of many cultivators for the block system:

> During 1900, cultivators were consulted as to their willingness to bind themselves to take water for selected areas for fixed periods of 5 or 6 years. There was a very ready response. Applications were received for about 18,000 acres in the upper half of the canal. They were willing to pay Rs.10 per acre. [*IIC, 1902: 232*]

The rate was soon changed to Rs.12 per acres [*Visvesvaraya, 1903: 12*]. A three-acre block was charged Rs.36, which was two rupees more than the previous rate for one acre of cane plus two acres of eight-month irrigation.

At the time Visvesvaraya canvassed the cultivators, there were about 3,500 acres of cane on the Nira canal. Immediately after the block system was introduced, the area rose to between 7,000 and 8,000 acres, staying at about this level until the First World War (see Figure 1). Some of this additional cane acreage was planted by big entrepreneurs, particularly the Mali immigrants. However, a large share was also grown by local villagers with small- and medium-scale holdings (25 acres or less at that time). (See Attwood [*1979, 1984, 1985*] for details and explanations.)

Not only did the cane area double, but total irrigated crop area increased by more than the additional cane acreage. The average for all crops rose from 42,700 acres in the five years preceding 1901–2 to 54,700 acres in the five years preceding 1915–16 and 76,500 acres in the five years preceding 1925–26 [*Visvesvaraya, 1903: 24–25; IICB, 1938: 84–5*]. Thus overall capacity utilisation rose dramatically: before 1900 the largest proportion of the estimated irrigable area ever watered by the Nira canal was 42 per cent. By 1922–23, the proportion was 66 per cent, and this was typical for the decade. Likewise, the rate of return on capital outlay rose from 1.5 per cent in 1899–1900 to 8.28 per cent in 1922–23 [*IIC, 1902: 242–3; IICB, 1938: 8, 84–5*]. In the history of agricultural development, few administrative reforms can have been so timely or effective in both stimulating increased production and helping to repay public investment.

CANE BLOCKS AND FAMINE PROTECTION

The cane blocks made canal irrigation more intensive and less wasteful. This did not mean, however, that the Nira canal lost its protective function; indeed, as it turned out, the canal became *more* protective in various ways as a result of the new block system. Food production and agricultural employment expanded and stabilised after the block system was introduced. There were several reasons for this:

(1) Between one-third and two-thirds of each block (depending on the amount of overlapping cane) was devoted to seasonal crops, generating a larger and more stable output of foodgrains [*Inglis and Gokhale, 1934: 21*] and stabilising foodgrain prices at lower levels in years of drought.

(2) Seasonal crops on the block system gave higher yields because they were irrigated and also because they were rotated with sugarcane, benefiting from residual manure in the soil and from the careful levelling, ditching and diking required for cane [*Patil, 1932: 56, 101*].

(3) Expanding cane cultivation increased the demand for bullocks (for ploughing, processing and transport), and more bullocks needed more fodder. Since *jowar* was an excellent fodder as well as a staple foodgrain, *jowar* production rose even higher. This was another reason why *'the irrigation of seasonal crops follows sugarcane and does not precede it'* [*Inglis and Gokhale, 1934: 21*, italics in original]. This is shown in Figure 1,

where the area under irrigated *jowar* remains at higher levels following the introduction of the block system.

These points are confirmed by data in Gadgil's [*1948*] study on the impact of canal irrigation in Ahmednagar district, just north of the Nira canal area. As mentioned, Gadgil compared agricultural inputs and outputs in two sets of nearby villages, canal-irrigated and dry. His data on the production of foodgrains (millet, sorghum and wheat) are summarised in Table 3. This table shows that foodgrains continued to occupy most of the cultivated area, even in the canal villages. Those concerned about the negative impacts of cash cropping might point to the lower proportion of acreage devoted to foodgrains in the canal villages (71 per cent as compared with 82 per cent). However, it is important to remember that much higher yields were produced under irrigation. Consequently, total foodgrain output (valued in rupees per net cultivated acre) was 31 per cent higher in the canal villages than in the dry ones. Irrigated cash cropping, far from undermining the subsistence economy, was in fact helping it to grow and stabilise.

Gadgil's figures also show that investments in livestock, buildings and equipment were much higher in the canal villages [*ibid.: 35*]. Thus irrigated cash cropping relieved the basic shortages of capital and other resources which were, according to Charlesworth [*1985: 76–8, 212*], the fundamental constraints on Deccan agriculture.

The demand for labour was also much higher in the canal villages. Double cropping and cash cropping, made possible by irrigation, required more labour at more regular intervals. In the irrigated villages, expenditures on hired labour (per net cultivated acre) rose 365 per cent by comparison with the dry villages, while inputs of family labour remained about the same [*Gadgil, 1948: 49–51, 63–7*]. Thus the Deccan canals dramatically increased the overall demand for labour in the region.

This effect came about in two stages. First, a large supply of construction labour was needed to build the canals. Later, many labourers who migrated to the construction sites found employment as agricultural labourers and were followed by still more migrants from the dry villages. Expanding demand caused a fairly steady rise in real wages for agricultural labourers until the 1930s [*Shirras, 1924; Patil, 1932: 3*].

The rise in labour demand, along with increased foodgrain production, helped protect the region against periodic famines. Changes in famine mortality rates and relief administration have been analysed with great care by McAlpin [*1983*]. She shows, among other things, that although the crop failures of 1899–1900 and 1918–19 were about equally severe and widespread, the later famine caused much lower mortality [*ibid.: 168–71*]. The improved situation in 1918–19 was brought about partly by more efficient famine relief administration; but it was also helped by better economic conditions in general [*ibid.: 161–9*]. The Deccan canals contributed to these improved conditions by creating a larger and more stable demand for labour. As a result, the demand for employment on famine relief works was lower in 1918–19 than in 1899–1900. For 12 months in

TABLE 3

FOODGRAIN OUTPUT IN DRY AND CANAL-IRRIGATED VILLAGES, AHMEDNAGAR DISTRICT

Villages and Years	Net Cultivated Area (Acres)	Foodgrains* Area (Acres)	Foodgrains as % of Net Cultivated Area	Total Foodgrains Output Valued in Rupees	Foodgrains Output per Net Cultivated Acre (Rs. per Acre)
Dry Villages					
1938-39 (6 villages)	5,304.0	4,377.4		41,106.5	
1939-40 (8 villages)	6,521.6	5,310.7		60,320.4	
Total (1938-40)	11,825.6	9,688.1	82%	101,426.9	8.57
Canal Villages					
1938-39 (6 villages)	4,489.8	3,212.8		49,672.4	
1939-40 (9 villages)	6,604.0	4,655.5		74,884.4	
Total (1938-40)	11,093.8	7,868.3	71%	124,556.8	11.23

*Foodgrains: *bajri* (millet), *jowar* (sorghum) and wheat.

Source: Calculated from D.R. Gadgil, 1948, *Economic Effects of Irrigation*, Poona: Gokhale Institute of Politics and Economics, Publication No.17, pp.30–33, 42–5.

1899–1900, the average daily number of persons receiving famine relief was over one million, peaking at 1.5 million. In 1918–19, on the other hand, the corresponding numbers were only one-tenth as large, and the crisis lasted for only about six months [*Keatinge, 1921: 56–7*]. Many villagers from the dry areas, who would have sought employment on relief works under other conditions, migrated to the canal areas instead. Consequently, expenditure on famine relief works declined along with mortality rates [*IICB, 1938: 99*].

Moreover, the severe drought of 1918–19 showed that the block system could be modified in the direction of more extensive irrigation during a crisis. In that year, the government cancelled irrigation for overlapping cane. (Cane was often in the ground for 15 to 18 months; thus the old crop would overlap with newly planted cane.) As a result of this cancellation, the total area of cane went down and the area under *jowar* rose to a record high, as seen in Figure 1. This brief modification of the block system made the canal far more protective than it had ever been before the blocks were introduced.

COMPARISON WITH NORTH-WEST INDIA

The block system was not adopted on the great canals of north-western India – in Punjab and the western region of the United Provinces (U.P.) – where sugarcane was a major cash crop and sorghum and millet were also important subsistence crops. If the block system was really necessary in Bombay, why not in the north-west?

The north-western canals operated efficiently without a block system for several reasons. In the first place, the cost of construction per irrigated acre was much lower. Drawing their waters from snow-fed perennial rivers, these canals did not require the massive storage dams needed in Bombay [*IIC, 1902: 225, 227*]. Second, the open plains of north-western India made for easier canal building than the hilly terrain of the Deccan plateau. The plains also allowed the canal water to disperse over wider areas, whereas the Deccan canals were confined to narrower river valleys. Finally, as noted earlier, a larger share of the capacity of the north-western canals was regularly utilised. In short, the water was delivered at lower cost, it was not wasted, and the canals paid their own way [*Stone, 1984: 25, 31*]. Special policies were not needed to tempt the cultivators to make regular use of canal water. Why did they behave so differently?

In fact, cultivators in western U.P. behaved like those in Bombay with reference to the crops discussed above. Dryland subsistence crops were the same – *jowar* and *bajra* – and these were seldom given canal irrigation except, perhaps, in emergencies. Canal irrigation, as in Bombay, was applied mainly to the 'valuable' crops, to those that would fetch a good price on the market [*ibid.: 127; Whitcombe, 1972: 71–4*].

The response to canal irrigation showed one major contrast with the Bombay Deccan: the choice of cash crops was different. During the late nineteenth century, the three most important cash crops in western U.P. were wheat, indigo and sugarcane; and among all crops, wheat covered the largest area under canal irrigation. Wheat was more widespread in the north-west than in Bombay since the crop likes cold winters [*Inglis and Gokhale, 1934: 19, 29, 46*]. (Conversely, sugarcane was lower yielding and less important because of the cold.) Wheat was not previously a subsistence crop; that is, it was not ordinarily consumed in village households. However, unlike sugarcane, wheat could play a dual role in the local economy. If drought caused the non-irrigated subsistence crops to fail, wheat could take their place in the local diet. Nevertheless, Whitcombe [*1972: 75*] argues that canal policy in U.P. should have leaned much more toward the irrigation of sorghum and millet, in order to provide better famine protection.

Whitcombe's book assesses the overall impact of British policies on agrarian conditions in the United Provinces during the late nineteenth century. She concludes that the canals were a 'costly experiment' which did little to protect the region from scarcity and famine, even though they increased the production of valuable cash crops. The canals not only failed to keep the villages adequately supplied with food as population increased: they also caused widespread soil deterioration and declines in productivity, as well as increased health problems and ecological disruptions [*ibid.: 89–91*]. This is, of course, the standard view of dependency and world-system theorists, who condemn most technological change and commercial expansion in the agricultural sector, even when (as in the recent outpouring of criticism against India's 'green revolution') these do not occur under a colonial regime.

The data reviewed in the earlier sections of this article lead to a number of questions about Whitcombe's assessment. Why did the north-western cultivators choose to irrigate valuble cash crops instead of basic food crops? Whitcombe believes they were coerced into this choice. This might be a plausible argument for eastern U.P., where dense population, land hunger, economic stagnation, and extreme inequality put many cultivators at the mercy of landlords, merchants, and others [*Amin, 1984*]. However, the canals were concentrated in western U.P. (and Punjab), where the cultivators were far more independent [*ibid.: 60–61; Stone, 1984: 302–14; Stokes, 1978*].

What were the precise mechanisms which, according to Whitcombe, forced the cultivators to irrigate cash crops instead of subsistence crops? The answer is not as clearly drawn together as it might be, but the following arguments emerge at various points: (1) the government promoted the production and trade of valuable crops for the revenues derived therefrom [*Whitcombe, 1972: 86*]; (2) moneylenders and processors of indigo and sugar promoted crops which they could finance and market [*ibid.: 170–79*]; (3) the timing of land revenue demands (just before or after harvest) made the cultivators even more dependent on moneylenders [*ibid.: 155–6, 194*]; and (4) landlords, who often could not raise rents at will, found it more profitable to engage in usury and thus in the promotion of expensive market crops [*ibid.: 166–8*]. In other words, the cultivators were controlled by their creditors.

All this was undoubtedly true to some extent, but did this unholy alliance of landlords, officials, and moneylenders actually dictate the choice of irrigated crops, contrary to the subsistence interests of the cultivators? The direct evidence to support this interpretation (which might be called the puppet model of peasant production) is not very substantial, particularly not for western U.P. and Punjab, where the canals were concentrated. Then and now, neither cultivators nor money-lenders are willing to discuss their credit transactions in any detail. What, then, is the indirect or circumstantial evidence? Whitcombe does not say so explicitly, but she seems to believe that failure to irrigate the 'coarser foodgrains' (particularly *jowar* and *bajra*) is decisive evidence in itself that the crops were chosen by creditors and not by cultivators. However, this only makes sense if it can be established that the cultivators *would* have irrigated these foodgrains, had they been free to choose. Whitcombe simply assumes they would have done so.

Although there were differences between western U.P. and the Bombay Deccan in terms of soils, climate, irrigation costs, and local seed varieties, it seems likely that sorghum and millet responded similarly to canal irrigation in the two regions. In other words, costs may have risen more rapidly than yields; profits may have become more uncertain; and the correlation between yields and costs may have turned negative. If this were the case, it would hardly be surprising that the cultivators of north-western India also spurned the use of canal water on subsistence crops. As hypothetical free agents, they would have every reason to do so, and it would be quite unnecessary to argue for the controlling influence of landlords and moneylenders.

If Whitcombe's argument is open to doubt from comparison with the Bombay Deccan, it also appears that some of her factual premises regarding U.P. are wrong. Stone [*1979: 93–101; 1984: 127–9, 243–55*] shows that foodgrain production *increased* under canal irrigation in western U.P., primarily because irrigation helped the cultivators switch from cheap and low-yielding foodgrains to crops such as wheat, sorghum, and barley, which were higher-yielding under irrigation as well as more valuable on the market. While wheat may not have been a traditional food crop, in the canal tracts it became a regular part of the diet for many villagers [*ibid.: 255*]. Stone also shows that the demand for agricultural labour grew larger and more stable in the canal villages because more land was double-cropped and cash crops were more labour intensive. As a result, labourers in these villages experienced no decline in employment or real wages during famines; and the same villages also provided employ-ment to migrants fleeing famines in the dry villages [*ibid.: 272–7*].

Stone's careful study of the famine records yields a fundamental insight into the causes and consequences of these crises. For most cultivators, the initial crisis caused by drought was not a food shortage but a cash shortage. Cash was urgently needed to pay rents, and to buy seed-grain and fodder –

in other words, to finance continued production. The vital advantage for the canal villagers, then, was their reliable cash flow. They used income from monsoon-season cash crops to finance the production of irrigated foodgrains in the winter – a strategy which they followed particularly when the rains had failed and coarse foodgrains were scarce. Thus a reliable cash income made foodgrain production more secure [*ibid.: 255–71*]. In general, then, canal irrigation in the north-west made the region more famine-resistant, just as it did in the Bombay Deccan.[11]

CONCLUSION

Dependency and world-system theorists tend to assume that cash-cropping cuts against the interests of village cultivators by undermining their subsistence security. Consequently, the cultivators must be duped or coerced into growing such crops. For example, Scott's [*1976*] book attempts to show how peasants in colonial Vietnam and Burma were trapped into producing crops for the world market and how that entrapment undermined their subsistence security, leading to peasant uprisings in the 1930s. For Scott, export crop production was necessarily threatening to subsistence security and thus was inevitably brought about by coercion, regardless of the divergent class structures, colonial policies and ecological settings in different parts of South-east Asia [but cf. *Adas, 1974; Paige, 1975; Popkin, 1979*]. Whitcombe's [*1972*] book does not make such sweeping claims, but her analysis of the impact of canal irrigation is in the same tradition.

The results of this article point to the following conclusions. First, the cultivators had good technical reasons for not wanting regular canal irrigation for subsistence crops. There is no evidence that they were compelled to switch to cash crops on the canals, since the same proportion of irrigated land was devoted to sorghum and millet under wells. Irrigation was too expensive, and the returns too uncertain, for subsistence crops to receive much canal water.

The second conclusion is that the Bombay government switched to a more intensive irrigation policy because the cultivators were simply not using the canal water. Except for fiscal pressures, the government had no particular stake in the growth of an indigenous sugar industry.[12] Decisions about irrigation policy were pragmatic responses to decisions made by the cultivators themselves. The officials who decided to experiment with the cane block system were swayed by the example of a few market gardeners making profitable use of the canal water while nobody else was using it regularly [*Attwood, 1985*]. This point has serious implications for those who prefer to see Third World cultivators as puppets, as the passive victims of history.

The third conclusion is that a more intensive irrigation policy decreased rather than increased the region's vulnerability to famines, since the cane blocks encouraged regular irrigation of seasonal foodgrains as well as sugarcane. In addition, irrigated cash cropping multiplied the demand for labour, reducing the public employment which had to be provided on famine relief works. Even though they were no longer regarded as purely protective works, the Deccan canals helped famine-proof the region to an extent which had proved impossible under the older, extensive irrigation policy.[13]

What would have happened to the Bombay Deccan if there had been no shift to a more intensive irrigation policy? This question has important implications for current debates about irrigation policies in western India [e.g. *Dandekar et al., 1979; Rath and Mitra, n.d.*] – though conditions have certainly changed since the turn of the century.[14] In 1901, when Visvesvaraya persuaded the Indian Irrigation Commission to sanction the cane blocks, there were only two major canal systems in the Bombay Deccan. Had these canals continued to waste water and lose money at the prevailing rate, it is likely that investments in future canal systems would have slowed down or ground to a halt. The prospect of reduced wastage enabled the Irrigation Commission to sanction investments for a whole series of new canals, so that by 1936–37 there would be six major systems in operation, irrigating more than seven times the area watered by the Nira and Mutha canals in 1899–1900 [*IIC, 1902: 242; IICB, 1938: 84–5*]. These new canals vastly increased the region's resistance to famines; and it is likely that they would never have been built, or that their construction would have been slowed by decades, if there had been no shift to irrigation on the block system.

final version received July 1986

NOTES

1. Famine relief works were construction projects (such as roads or canals) set in motion during a drought in order to provide employment to villagers. Most government irrigation works constructed in the nineteenth century were famine relief projects.
2. The data given on the other provinces seem too good to be true, but there is little reason to
doubt that the Deccan canals were doing worse than those in other regions, particularly those in north-western India.
3. This correlation is significant at the five per cent level. It would probably be stronger if we
had the *rabi* rainfall series for the Nira valley alone, instead of an average for three weather stations across the Deccan. The same relationship holds between the area of irrigated *bajri* and the monsoon season rainfall (June to August) [*Inglis and Gokhale, 1934: 18–19, 44, Fig.13*].
4. Gadgil [*1948*] compares the costs and values of crops produced in canal-irrigated villages with those in nearby dry villages; unfortunately, the costs in his tables are not distributed by specific crops.
5. Patil's sample villages were near Poona city, where summer *bajri* was grown more than winter *jowar*, and where rainfall was more secure than in the famine belt to the east. Consequently, his findings may be slightly more favourable to the dry plots than they would have been in the famine belt. The three crops years, 1925–26 to 1927–28, are indicated by letters attached to the plot numbers. Two 'dry' plots have been removed from the raw data because *bajri* was preceded by canal-irrigated sugarcane, and the residual moisture and fertiliser raised the yields far above normal [*Patil, 1932: 56, 101*].

Patil's cost data include imputed wages for family labour and imputed rents for bullocks and land, valued at prevailing market rates, plus all the normal cash expenditures.

6. The difference between the two yield-cost correlations is significant only at about the ten per cent level, since the number of plots was small.
7. This correlation is significant only at the ten per cent level, due to the low number of plots.
8. In the dry villages, wells irrigated about four per cent of the net cultivated area, while in the canal villages, 28 per cent was irrigated. Nearly all the latter area (82 per cent) was watered by canals. (Eleven per cent was watered by wells and seven per cent by canals and wells combined.) The figures in Table 2 include crops under all forms of irrigation in the canal villages.
9. If distributional losses had been included in comparisons of water consumption by foodgrains vs. sugarcane, the difference in their requirements would have been narrowed significantly. Consequently, the rates charged for foodgrains would have appeared even more concessional.
10. It is interesting that cotton, which was an important crop in some parts of the Bombay Deccan, was scarcely grown at all along the Nira canal before 1925. Cotton required irrigation during the hot season (May in particular), so it competed directly with cane when canal water was scarcest [*Inglis and Gokhale, 1934: 16–18*]. The same source also explains why wheat, fruit trees, groundnuts and vegetables were less popular than sugarcane.
11. Perhaps the most impressive achievement of Stone's book is his comparative analysis of the causes of agricultural progress and stagnation in western and eastern U.P. – continuing a line of inquiry laid down by Stokes [*1978*]. This problem is outside the scope of the present article but has been touched on in articles comparing sugar production in western and northern India [*Attwood, 1984, 1985*].
12. Later policy decisions were influenced by addiction to sugar as a remedy for the fiscal problems of the Deccan canals. After the First World War, the government discussed and experimented with various means to encourage the rise of a modern sugar industry in this region [see *Indian Sugar Committee, 1921; Keatinge, 1921: 77–88; DCFIC, 1932; IICB, 1938*]. Village cultivators eventually took the sugar industry into their own hands through a series of economic and political innovations which are analysed in Baviskar [*1980*], Attwood [*1984, 1985*], and Attwood and Baviskar [*n.d.*].
13. One other theme of dependency theorists has been discussed elsewhere. This is the notion that cash cropping inevitably undermines the economic security of small farmers, with the result that large-scale commercial farmers become the main beneficiaries. From a sample survey of farmers and labourers in a Nira canal village [*Attwood, 1979, 1987*], I have shown that landholdings became no more concentrated in 1970 or 1980 than they had been in 1920, and that numerous small and medium-scale farmers (those with less than 2.5 and 14 acres, respectively, in 1978) survived and prospered by growing sugarcane. The reasons for their survival have been analysed in detail [*Attwood, 1984, 1985*], as have the reasons for their successful participation in cooperative sugar factories [*Attwood and Baviskar, n.d.*].
14. It is now possible to grow high-yielding varieties of foodgrains under canal irrigation. This is one of many changes which mean that canal water is now in demand for other crops besides sugarcane. Moreover, the social costs of intensive irrigation are being called more into question, with the result that recent canal policies have become more extensive. It remains true, however, that extensive irrigation entails high public costs in terms of distribution losses. Thus the problem remains, as before, one of balancing social costs and benefits.

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