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Irrigation Financing and Cost Recovery Policy in India: Case Studies from Bihar and Haryana

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Several recent studies analyze the financial aspects of public irrigation systems in Asia. Repetto (1987) points out that governments collect from user fees on average less than 10 percent of the full costs of irrigation services; government subsidies range from 75 to 99 percent. Among the widespread problems encouraged by subsidies are chronic excess demand for water and water projects, poor operation and maintenance of completed systems, and inattention to water conservation opportunities. In a multicountry study of financing and cost recovery mechanisms in Asia, Small and others (1986) conclude that it is probably not feasible to collect irrigation service fees based on the volume of water used because of two factors: the inability of most agencies to measure water consumption accurately at the turnout and the administrative costs of collecting fees from the large number of individual farmers usually found in the irrigation systems of developing countries. There does, however, appear to be scope for charging organized groups of farmers served from a common canal. Svendsen (1986, 109) reaches a similar conclusion:

> The upshot of all of this is that it is virtually impossible to construct a plausible scenario wherein the price that is set for irrigation water has some incentive effect on water use decisions at the tertiary or "on-farm" level without postulating significant changes in the way that water is generally measured and delivered or in the way that farmers and the irrigation agency are organized and interact with each other.

Moreover, the implicit and explicit levies collected from the farmers in addition to water charges need to be carefully assessed and compared with implicit and explicit subsidies for all the agricultural inputs in a region and irrigation project. According to P. K. Rao (1984, 3),

> Only then one may be in a position to argue about the relevant range over which the water rates could be determined, in contrast to simplistic and misleading application

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> of thumb rules on [cost] recovery on administratively defined costs of irrigation projects.

This chapter points to the need to take a systems view of the financial flows related to the provision of irrigation services. It argues that instead of being confined to the direct recovery of water charges, studies should quantify the direct and indirect contributions that an irrigation project makes to central, state, and local government revenues. It also suggests that determining water rates for canal irrigation requires explicit consideration of the following issues: (1) subsidies on investment, operation, and maintenance costs of public tubewells and privately managed small tubewells, including subsidized electricity or diesel oil; (2) pricing of other inputs such as fertilizers and pesticides; (3) pricing policies for farm output; and (4) the terms of trade between farm and nonfarm sectors.

The chapter is organized as follows. First it presents an overview of the irrigation development in Bihar and Haryana since 1951, followed by analyses of changes in water rates and collection costs of water charges. Next comes a critical evaluation of operation and maintenance (O&M) costs of irrigation projects in the two states. The following section presents estimates of farmers' ability to pay for irrigation services and compares water rates with net income from irrigation as well as with gross value of output. The implications of raising water rates to cover O&M costs or capital costs or both are also covered. The issues relating to output prices and terms of trade are discussed next, emphasizing the need for a comprehensive view of policies affecting irrigated agriculture. This is followed by the estimates of total resource flows related to publicly managed irrigation and irrigated agricultural sectors in Bihar. The last section outlines some issues for further discussion.

IRRIGATION DEVELOPMENT IN BIHAR AND HARYANA

As mentioned earlier, two states in India--Bihar and Haryana--were selected for in-depth analysis of available data and evaluation of alternative policies. The irrigation systems in both states are characterized by a mix of century-old irrigation systems and new projects constructed during the past three decades. Both states are in the Indo-Gangetic Plains of northern India. While Bihar, in the east, is known for its high resource base and low use of both groundwater and surface water, Haryana is known to be nearing its limit on available water resources. While the per capita income in Bihar in 1980/81 was 35 percent lower than the average for India, that of Haryana was 52 percent higher than the national average (Table 14.1). The economic development of Bihar decelerated in the 1970s and 1980s compared with the 1960s due to a number of political, social, and economic factors. The economy of Haryana grew rapidly: the state income (net state domestic product) at constant prices grew 76 percent over the decade from 1973/74 to 1983/84. The per capita income of Haryana rose from Rs 818 in

Table 14.1--Profile of India, Bihar, and Haryana, 1980/81

Item	Unit	India	Bihar	Haryana
Area	1,000 sq km	3,183.00	174.00	44
	(Percent)	(100)	(5.3)	(1.38)
Population (1981)	Million	684.00	69.8	12.9
	(Percent)	(100)	(10.2)	(1.9)
Population growth rate (1971/81)	Percent	2.5	2.4	2.9
Percent of rural population		76.3	87.6	78.1
Percent of agricultural workers to rural population		212.00	402.00	291.00
Population density	Persons/sq km	212.00	402.00	291.00
Towns		n.a.	161.00	84.00
Villages		576,000.00	77,959.00	7,604.00
	Percent	(100)	(13.5)	(1.3)
Average size of land holdings	Hectare	2.00	1.11	3.58
Total geographical area	Million ha	304.00	17.30	4.40
Net area sown	Million ha	140.00	8.3	3.60
Total cropped area	Million ha	173.00	11.1	5.50
Intensity of cropping	Ratio	124.00	134.00	153.00
Net irrigated area	Million ha			

Continued

Table 14.1 continued

Item	Unit	India	Bihar	Haryana
Total		38.8	3.00	2.1
Canals		15.3	1.2	1.2
Tubewells		9.5	0.8	0.9
Gross irrigated area	Million ha	49.6	3.6	3.3
Per capita income (current prices)	Rs	1,537.00	870.00	2,331.00

Source: Ramesh Bhatia, "Resource Mobilization for Financing *Irrigation Services in India: A Case Study of Bihar and* Haryana," paper prepared for the International Irrigation Management Institute, Sri Lanka, 1987.
Note: Figures in parentheses are the percent of the all-India total.
n.a. Not available.

1973/74 to Rs 1,127 in 1983/84 (at constant prices), an increase of 28 percent. Bihar is known for its dense population, high unemployment levels, and fast-expanding bureaucracy. Haryana is characterized by a lower density of population and a relatively more efficient bureaucracy.

Prior to 1951 there was only one major scheme, the Sone Canal Irrigation System in Bihar, which had been operating since 1858. The irrigation benefits achieved by 1951 from major and medium schemes were 0.4 million ha. In 1968 a new barrage was commissioned at Inderpuri, 8 km upstream of the old anicut. The new barrage supplies water through newly constructed canals to eastern and western low- level canals. According to the Central Water Commission, the cumulative potential created by major and medium schemes by 1981 was supposed to reach 2.532 million ha. Estimated use was only 1.7 million ha, while the actual area irrigated by canals (as reported by the irrigation department) was 1.2 million ha. The cumulative expenditure was estimated to be Rs 7,460 million: Rs 3,020 per ha of potential created and Rs 4,440 per ha of potential used (without adjusting for price changes).

Prior to 1951, the only main project in the Haryana region was the Western Yamuna Canal System, one of the oldest canal systems in the country. The irrigation benefits from preplan major and medium schemes were on the order of 0.44 million ha. The new state of Haryana came into existence on 1 November 1966, after the bifurcation of the erstwhile state of Punjab. The major Bhakra-Nangal Project, with a portion in Haryana, was completed in 1963/64 adding a potential of 676,000 irrigated ha. The cumulative potential added from major and medium schemes up to 1980/81 was estimated at 1,785

million ha, while the cumulative use was estimated at 1.66 million ha.

IRRIGATION CHARGES OR WATER RATES

The water charges for a crop are usually figured per hectare of area under the crop. The crop-area basis is adopted for irrigation water rates because it is convenient to measure. Besides, almost no irrigation projects have the facilities for measuring water quantities on a volume basis. The advantages and disadvantages of the crop method have been discussed by experts and field engineers (see India, Irrigation Commission 1972; Malhotra 1982, 1985). According to Malhotra (1985, 63), "the crop method does not offer any economic incentive to a cultivator to be more frugal with the use of water or to pay any heed to such water management practices as are recommended by experts."

In Haryana, experiments have been made with the wari-metric method, which is said to be a proxy for the volumetric method when the warabandi (rotational) system of water distribution is used. Wari-metric assessment was introduced on Sotha Distributary in Hissar District in Kharif 1976. Malhotra (1985, 70) explains how it works:

> The price of unit time of Wari (turn) for each water course can be fixed in several ways but in this particular case, it was fixed in a manner that the level of taxation remained the same as with crop method. The average of 3 years assessment of each water course was divided by its net Wari (turn) time to get the price of unit time of Wari with no regard to number of times cultivator received his water.

Under the wari-metric method, field to field collection of crop data for preparing water bills is not necessary because the water bill can be prepared with data available in the office. The experience of Sotha distributary where the wari-metric method was introduced in 1976 and is still in use has not been critically evaluated. The experiment did not provide an apparatus for observing whether this method induces cultivators to use water better and more economically. However, Malhotra (1985, 73) found "enquiries made from cultivators after 4 years reveal that they are happy because for their water bill they have no longer to depend upon the integrity and efficiency of any one individual." The volume-based water rate is adopted for nonirrigation uses such as industrial water supplies.

The most prevalent method of water charges, both in Haryana and Bihar, is the crop method under which water charges are levied on an area basis for different crops irrigated in any given year. In Haryana, the particulars of the crops sown, along with the names of the cultivators, are recorded in a register called Khasra.

> This register is the initial record of the area irrigated and all disputes about the irrigation status of a particular piece of land are decided on its basis. This record is recognized by the courts and hence the necessity for its

> maintenance according to rules. Thus the importance of an Irrigation Booking Clerk who maintains this initial record can well be imagined. (Malhotra 1985, 64)

Although rules provide a number of checks on the work of the irrigation booking clerk by the zilladar, the deputy collector, the subdivisional officer, and the executive engineer, in practice the crop method of water charges places great reliance on the efficiency and integrity of the irrigation booking clerk.

Every year in Bihar, crop and farmer assessment is done by revenue staff in the field. A collector moves from door-to-door, contacting each farmer to collect current demand and arrears. The farmer can make payment in full or in part, and the collector issues a receipt for the amount paid. Certificate proceedings are initiated in court against farmers for pending demands, and warrants are issued against defaulters. In such cases, surcharge and interest are also realized along with the arrears from the farmers.

Changes in Water Rates

Table 14.2 gives figures for water rates for two major crops--rice and wheat--over time in Bihar. In 1984/85, the water rates or irrigation charges for rice (Kharif) were 80 percent higher than those for wheat in perennial canals such as the Sone Canal system. The water rates for nonperennial canals other than Sone were equal for rice and wheat. The water rate for rice increased from Rs 25 per ha during 1953/65 to Rs 90 per ha in 1984/85. The corresponding figures for wheat are Rs 12 per ha and Rs 51 per ha. Thus in nominal terms, the water rates for rice increased 3.6 times over the past twenty years, while those for wheat increased 4.25 times. The data also show the stickiness in revising water rates. These did not change at all over the 13-year period from 1953 to 1965 nor from 1974 to 1983. The most recent increase was of 13 to 15 percent in 1984/85.

When the charges in water rates are adjusted for changes in the wholesale price of rice and wheat, the water rates in real terms did not increase at all during the past decade. In fact, they declined 11 percent for rice and 14 percent for wheat in the case of perennial canals.

Water rates in Bihar are charged either on the basis of a season (involving three waterings) or of a single watering.[2] The rates for a single watering are about 80 percent of those for a season for rice but are almost equal for wheat. The water rate charged for three waterings for rice from state tubewells was Rs 125 per ha in 1984/85, about 37 percent higher than that for canal irrigation. The water rates for wheat under state tubewells may be 40 to 140 percent higher depending on the number of waterings required.

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[2] About five years ago, the long-lease system of charging for watering was abolished because influential farmers were monopolizing the use of water by local maneuvering and force. As a result, the number of litigations grew abnormally. Hence, the long-lease system was replaced by seasonal or simple watering.

Table 14.2--Water rates in Bihar and Haryana, various years, 1965-85

Rates	Bihar, Perennial (Sone Canals)		Haryana, Storage Scheme (Bhakra-Nangal Project)	
	Kharif (Rice)	Rabi (Wheat)	Kharif (Rice)	Rabi (Wheat)
		(Rs)		
At current prices				
1965/66	25	12	24	15
1972/73	40	22	74	62
1974/75	78	45	74	62
1982/83	78	45	74	62
1984/85	90	51	n.a.	n.a.
In real terms[a]				
1965/66	37	17	35	21
1972/73	34	21	64	58
1974/75	43	25	40	34
1982/83	30	21	29	29
1984/85	33	24	n.a.	n.a.

Sources: India, Central Water Commission, for water rates; wholesale price indexes for rice and wheat are from the Economic Surveys of different years.

Note: The water rates in 1984/85 for non perennial schemes in Bihar were about 50 percent of those in perennial schemes for rice and 75 percent in those for wheat. In 1983/84, for Haryana, the rates for schemes were the same as those in storage schemes for rice and 75 percent of those in storage schemes for wheat.

n.a. Not available.

[a]Adjusted for wholesale prices of rice and wheat, 1970/71 = 100.

Collection of Water Charges

Table 14.3 presents data on current demand, arrears, and collection of irrigation charges in Bihar for 1982/83 to 1984/85. The arrears of irrigation charges were on the order of Rs 223 to 256 million from 1982 to 1985. These were around three times more than the current charges in those years. In 1982/83, current demand for irrigation charges was Rs 71 million, while the charges for industrial water supplied to Bokaro Steel Limited were Rs 26 million. The assessed charges for irrigation declined to Rs 62.4 million in 1984/85, partly because the area irrigated declined and partly because average rates were lower. The assessment of industrial water supply in 1984/85 was also much lower: Rs 10.2 million, a reduction of 60 percent in two years.

Collection Costs

As described elsewhere (Bhatia 1987), the government of Bihar has an elaborate revenue administration in its irrigation department. Expenditure on revenue establishment, which represents the costs of collecting of water rates, was Rs 60 million in 1982/83 and increased to Rs 63.7 million in 1984/85 (Table 14.3). These costs are quite high when compared with the actual collection or current assessment. For example, in 1982/83, costs of collection were about 78 percent of the total revenue collected from irrigation projects. Since revenue from the supply of industrial water to the Bokaro steel plant was a significant proportion of total revenue (31 percent), the total collection from the sale of water for irrigation, at Rs 53.4 million, was about 10 percent less than the expenditure on revenue establishment (Rs 60 million). Since collection of charges from Bokaro Steel Limited does not require any revenue establishment, one can conclude that if the water charges were abolished and the Directorate of Revenue Administration was disbanded, the state government would have benefited to the extent of Rs 6.6 million (Table 14.3). The figures for 1983/84 and 1984/85 show the same pattern: the costs of collecting irrigation charges are higher than the revenues obtained from farmers for providing irrigation services.[3] In fact, the deficit increased from Rs 9.5 million in 1983/84 to Rs 15.5 million in 1984/85. Thus, abolishing water charges along with the staff for revenue administration would have provided the state government with an additional Rs 1.6 million during 1982/83 to 1984/85. This would have been over and above the Rs 47.9 million collected from Bokaro Steel Limited during the three-year period. Thus the increasing expenditure on revenue administration should be treated as a means of providing employment to a large number of people rather than as a cost of providing irrigation services. It would be unfair to raise water rates to cover the ever-increasing expenditure on revenue administration when this expenditure does not improve irrigation services, but reflects a welfare measure to provide employment and is entirely politically motivated.

Table 14.2 presents data on water rates in Haryana. Water rates were raised only once during the past decade or so. In real terms, after adjusting for changes in the wholesale price of rice and wheat, the water rate for rice in 1983/84 was only Rs 25 per ha compared with Rs 74 per ha at current prices. For wheat, although the nominal water rates remained around Rs 62 per ha, in real terms they declined from Rs 58 to Rs 29 per ha from 1972/73 to 1982/83.

Table 14.4 shows gross receipts at current prices from irrigation works in Haryana. Gross receipts increased 42 percent over the decade 1973/74 to 1982/83, but gross receipts per ha increased only 23 percent. In real terms deflated by the wholesale price index (1975/76 = 100), gross receipts not only did not increase, they declined from Rs 85 million in 1975/76 to Rs 66 million in 1981/82.

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[3] The cost of establishment for collecting land revenue in Bihar is also higher than the actual collection of land revenue.

Table 14.3--Annual demand, collection, and expenses of revenue administration in Bihar, 1982/83 to 1984/85

Indicator	1982/83			1983/84			1984/85		
	Irrigation	Bokaro Steel	Total	Irrigation	Bokaro Steel	Total	Irrigation	Bokaro Steel	Total
Arrears[a]	223.0	0.0	223.0	256.0	2.3	258.3	251.9	0.0	251.9
Current demand	71.0	26.0	97.0	73.5	12.4	85.9	62.4	10.2	72.6
Total demand (including arrears)	294.0	26.0	320.0	329.5	14.7	344.2	314.3	10.2	324.5
Target of collection	n.a.	n.a.	n.a.	327.7	16.5	344.2	184.3	n.a.	184.3
Total collection (actual)	53.4	23.7	77.1	49.5	14.7	64.2	48.2	9.5	57.7
Expenditure on revenue establishment[b]	60.0	0.0	60.0	59.0	0.0	59.0	63.7	0.0	63.7
Actual collection minus expenditure on revenue establishment	-6.6	23.7	17.1	-9.5	14.7	5.2	-15.5	9.5	-6.0
Expenditure on revenue establishment as percent of annual collection	112.0	0.0	78.0	119.0	0.0	92.0	132.0	0.0	110.0

Continued

Table 14.3 continued

Indicator	1982/83			1983/84			1984/85		
	Irri-gation	Bokaro Steel	Total	Irri-gation	Bokaro Steel	Total	Irri-gation	Bokaro Steel	Total
Actual collection as percent of target	18.0	92.0	24.0	15.0	89.0	19.0	26.0	n.a.	31.0
Area assessed under irrigation (million ha)	1.42	...	...	1.48	...	...	1.32	...	...
Actual collection per ha (Rs)	37.6	...	...	33.4	...	...	36.5	...	...
Revenue expenditure per ha (Rs)	42.2	...	...	40.0	...	...	48.1	...	...

Source: Bihar Department of Irrigation files.
Note: Figures are in millions of rupees, unless otherwise noted.
n.a. Not available.
... Not applicable.
[a] The figures of arrears from one year to the next are not consistent with those obtained from estimates of demand and collection.
[b] Figures of expenditure on revenue establishment are marginally different from those obtained from budget papers.

Table 14.4--Gross receipts and working expenses of irrigation projects in Haryana at current prices, 1973/74 to 1982/83

Year (1)	Gross Area Irrigated (2)	Gross Receipts (Direct and Indirect) (3)	Working Expenses (Direct and Indirect) (4)	Gross Receipts as Percent of Working Expenses (5 = 3/4)	Gross Receipts (6 = 3/2)	Working Expenses (7 = 4/2)
	(million ha)	(million Rs)		(percent)	(Rs/ha)	
1973/74	1.626	57	64	89	35	39
1974/75	1.513	50	95	54	33	63
1975/76	1.694	85	115	74	50	68
1976/77	1.535	111	101	110	72	66
1977/78	1.540	89	116	77	58	75
1978/79	1.667	95	131	73	57	79
1979/80	1.673	80	164	49	48	98
1980/81	1.818	101	181	56	56	100
1981/82	1.892	108	207	52	57	109
1982/83	1.865	81	211	38	43	113
Percent increase of 1982/83 over 1973/74	15	42	229	...	23	190

Source: Haryana, Economics and Statistical Organization (ESO), Economics of Farming in Haryana, 1981/82 (Chandigarh: Government of Haryana, 1985); Haryana, ESO, Statistical Abstract of Haryana, 1983/84 (Chandigarh: Government of Haryana, 1985).

... Not applicable.

Gross receipts per ha, at current prices, remained around Rs 50 per ha during the late 1970s and declined to Rs 43 per ha in 1982/83. Gross receipts covered only 52 percent of O&M expenses in 1982/83 and only 38 percent the following year.

Operation and Maintenance Costs

State government allocations for the operation and maintenance (O&M) of irrigation projects have been the concern of a number of government committees and commissions. As estimated by the Irrigation Commission (1972), public irrigation works in Bihar and Haryana experienced losses in 1967/68 (see Table 14.5). The Public Accounts Committee, which examined the planning process and monitoring mechanism of irrigation projects, in 1983 observed that maintenance of existing irrigation system is not getting the attention of the states as required. The main reason for this is seen to be inadequate allocation made available by the States.

In a note sent to the Seventh Finance Commission in November 1977, India's Department of Irrigation suggested that one of the main reasons for underuse of irrigation potential was neglect of the maintenance of irrigation and drainage systems. The department noted that a Central Water Utilization Team had found that the operation and maintenance budgets were grossly inadequate in many cases and the system was gradually deteriorating. The Finance Commission (1984) examined data submitted by the Union Ministry of Irrigation and found that the maintenance expenditures incurred showed wide variations, not only from state to state but also from project to project within the same state. For instance, the maintenance expenditure in Maharashtra in the year 1979/80 was only Rs 27.95 per ha on the Gangapur Project, but as high as Rs 171.7 per ha for the Jayakwadi Project. In Punjab, the variation was from a *minimum of Rs 9.10 per ha on the Upper Doab Canal system to Rs* 38.66 per ha on the Bhakra Canal System.

O&M Expenses in Bihar

Data on O&M expenses for major irrigation projects are from the annual budget papers of the Bihar government for the year 1984/85 and from Bihar's Department of Irrigation for the period 1980/81 to 1984/85. Table 14.6 presents data for 1984/85 indicating that Rs 167.6 million were allocated for O&M expenses for multipurpose and irrigation projects. Taking the figure for irrigation potential used in 1984/85 at 1.7 million ha gives an estimated O&M allocation of Rs 98.6 (US$8.2) per ha. In addition, the budget also provides information on expenditure for revenue establishment, which was estimated at Rs 70.7 million or Rs 41.6 per ha. Similar data (see Table 14.7) for a period of five years are available for four major projects (Sone, Kosi, Badua, and Chandan). The costs of establishment (salaries and wages) increased significantly from 1980 to 1985, particularly during the last two years. The increase in the expenses for irrigation establishment between 1980/81 and 1984/85 was 260 percent. There has recently been a change in the practice of allotting major repair and maintenance work to contractors.

Table 14.5--Financial returns of public irrigation works in Bihar, Haryana, and India, 1967/68

Indicator	Bihar	Haryana	All India
		(million Rs)	
Gross area irrigated (million ha)	n.a.	0.6	14.4
Capital outlay	98.1	175.0	1,511.0
Accumulated interest	120.5	3.0	4,555.0
Accumulated revenue	53.7	176.0	1,948.0
Sum-at-charge	218.6	178.0	17,737.0
Gross receipts	27.1	14.0	380.0
Working expenses	22.6	8.0	330.0
Revenue	5.5	6.0	41.0
Interest	4.7	8.0	606.0
Net project	...	...	11.0
Net loss	10.2	2.0	577.0

Source: India, Irrigation Commission, Report of the Irrigation Commission, Vol. 1 (New Delhi: Irrigation Commission, 1972), 263.
n.a. Not available.
... Not applicable.

Jobs that had previously been given to outside contractors are now being undertaken by the irrigation department itself, which may partly explain the jump of almost 50 percent in establishment costs in 1983/84. This seems to be the case if one looks at the estimated expenses under works, which declined during that year. The subtotal of expenses on establishment and works related to O&M increased 37 percent, from Rs 59.3 million in 1980/81 to Rs 81.1 million in 1984/85. These increases in costs are much lower when adjustments are made for changes in the prices or wages of tied labor and materials.

Adjusting by the wholesale price index (WPI) for all commodities gives the following results: (1) the establishment component of O&M costs increased 173 percent in real terms over the five-year period, (2) the works component declined 23 percent in real terms, (3) the

Table 14.6--Expenses and receipts from irrigation projects in Bihar, 1984/85

Indicator	Total	Per irrigated ha[a]	
	(million Rs)	(Rs)	(US$[b])
Expenses			
Operation and maintenance	167.6	98.6	8.2
Revenue establishment	70.7	41.6	3.5
Total (including 4.5 million for direction and administration)	242.8	142.8	11.7
Receipts			
Total receipts[c]	126.4	74.4	6.2
Net revenue after deducting cost of collection	55.7	32.8	2.7
Net revenue as a percent of O&M costs	33.2	33.2	...
Net receipts after deducting the cost of collection and O&M	-116.4	-68.4	-5.7

Source: Bihar, Department of Irrigation, 1985/86 Budget (Patna: Bihar Department of Irrigation, 1985), 77-80, 186-192. Area irrigated was given by department of irrigation.

... Not applicable.

[a]Assuming irrigation potential used in 1984/85 was 1.70 million ha.

[b]Assuming US$1 = Rs 12.

[c]The estimates of revenue from the budget papers differ from those obtained from the Irrigation Department because the former include revenues from the sale of produce from land and orchards under the control of the irrigation department. It was not possible to obtain disaggregated figures under these headings.

subtotal of O&M expenses increased 4 percent in real terms, (4) the revenue establishment expenses increased 62 percent in real terms (instead of 113 percent in nominal terms), and (5) the sum of O&M costs and revenue establishment expenses rose 23 percent in 1984/85 over 1980/81, at constant prices.

If these figures of O&M expenses are divided by irrigated area (cumulative potential used for these projects), the O&M expenses show a remarkable stability: Rs 50.2 per ha in 1980/81 and Rs 53.3

Table 14.7--Costs of establishment, works and revenue collection from major irrigation projects in Bihar, 1980-85

Costs	1980/81	1981/82	1982/83	1983/84	1984/85
			(million Rs)		
Total costs					
Establishment	9.1	15.2	20.4	30.0	32.7
Works	50.2	50.8	53.6	46.3	48.4
Subtotal	59.3	66.0	74.0	76.3	81.1
Revenue establishment	29.8	37.1	52.0	60.7	63.6
Total	89.1	103.1	126.0	137.0	144.7
Irrigated area: cumulative potential used (million ha)	1.18	1.26	1.34	1.42	1.52
Costs (Rs per ha)					
Establishment	7.7	12.1	15.2	21.1	21.5
Works	42.5	40.3	40.0	32.6	31.8
Subtotal	50.2	52.4	55.2	53.7	53.3
Revenue establishment	14.7	29.4	38.8	42.7	41.8
Total	64.9	81.8	94.0	96.4	95.1

Source: Bihar, Department of Irrigation files.

Note: The irrigation projects included are Sone, Kosi, Badua, and Chandan.

per ha in 1984/85. However, the expenses on revenue establishment increased significantly, 113 percent over the five-year period. The costs of revenue establishment, which were Rs 14.7 per ha in 1980/81, increased to Rs 41.8 per ha in 1984/85 (Table 14.7). Thus the total expenses for O&M costs and revenue establishment were Rs 95.1 per ha in 1984/85, showing an increase of 47 percent over the five-year period. The expenses for revenue establishment, which were about half of the total O&M expenses in 1980/81 increased to

about 78 percent of the latter in 1984/85. The share of works in the total expenses for establishment and works declined from about 85 percent in 1980/81 to about 60 percent in 1984/85. This decline may reflect either a change in policy, where more work is being done departmentally, or a genuine reduction in expenses for repairs as the expenses for maintaining the establishment increase. Since salaries and wages for regular employees of the department would be the first charge on funds allocated to O&M, a three-fold increase in establishment costs is likely to be at the cost of repair and maintenance work on the canals, distributaries, and minors.

Similar trends may be noted in the O&M costs and the expenses for revenue establishment in the case of Sone Canal, the oldest system in the state (Table 14.8). While the establishment costs and expenses for revenue collection each almost doubled over the five-year period from 1980 to 1985, the expenses for works increased only marginally (5 percent). The figures for the Kosi Project show the same pattern: stagnation (actually a decline from Rs 33.6 million to Rs 30.1 million) in the expenses shown under works, while the O&M establishment costs increased more than 700 percent (Table 14.9). The establishment costs of revenue collection also increased by 125 percent from Rs 10.7 million to Rs 24.1 million over the five-year period. These phenomenal increases in establishment expenses need to be analyzed in depth, as do the reductions in works costs and their implications for the quality of O&M functions performed by (or on behalf of) the irrigation department. The increase in establishment costs of O&M as well as revenue collection are very high even when adjustment for price changes are made. In fact, the reductions in expenditure on works in real terms would be even higher: 20 percent for Sone and 32 percent for Kosi projects, respectively.

Juxtaposing these O&M costs and expenses for revenue collection with the receipts from irrigation projects provides valuable insights into irrigation financing in the state of Bihar. Table 14.6 shows that the total receipts from irrigation projects (including multipurpose projects) was Rs 126.4 million in 1984/85. After the costs of revenue establishment (Rs 70.7 million) are deducted, the net revenue from these projects was Rs 55.7 million. This accounted for only 33 percent of the total O&M costs of Rs 167.6 million. Thus, the net receipts from the operation of irrigation projects was negative: Rs -116.4 million or Rs -68.4 per ha.[4]

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[4] For the sake of comparison, the figures for Maharashtra for the year 1983/84 were Rs 116 million on establishment and Rs 108 million on works. The potential created was 1.5 million ha and 0.8 million ha was used. Revenue receipts for 1983/84 were Rs 157 million from the sale of water and Rs 35 million from other cesses. This gives a deficit of Rs 32 million. See Pawar (1985). The figures, in Rs per ha of potential used are Rs 145 for establishment, Rs 135 for works, Rs 196 from the sale of water, and Rs 40 from other receipts. The corresponding figures for Bihar for 1983/84 were Rs 21.1 per ha on establishment, Rs 32.6 per ha for works, and Rs 42.7 for revenue establishment. The gross receipts from the sale of water were Rs 61.4 per ha in 1984/85.

Table 14.8--Costs of establishment, works, and revenue collection for Sone Canal Project, 1980-85

Costs	1980/81	1981/82	1982/83	1983/84	1984/85	Increase (1984/85 over 1980/81)
			(million Rs)			(percent)
Establishment	5.9	5.9	8.0	8.5	11.1	88
Works	12.8	14.3	14.0	15.3	13.4	5
Subtotal	18.7	20.2	22.0	23.8	24.5	31
Revenue collection	19.1	23.0	28.3	39.3	39.5	106
Total	37.8	43.2	50.3	63.1	63.0	66

Source: Bihar, Department of Irrigation files.
Note: These figures are marginally different from those contained in the budget papers.

Table 14.9--Costs of establishment, works, and revenue collection for Kosi Project, 1980-85

Costs	1980/81	1981/82	1982/83	1983/84	1984/85	Increase (1984/85 Over 1980/81)
			(million Rs)			(percent)
Establishment costs	2.5	8.6	11.4	20.5	20.8	732
Works	33.6	32.0	34.1	26.5	30.1	-11
Subtotal	36.1	40.6	45.5	47.0	50.9	41
Cost of revenue collection	10.7	14.2	23.7	21.4	24.1	125
Total	46.8	54.8	69.2	68.4	75.0	60

Source: Bihar, Department of Irrigation files.
Note: These figures are marginally different from those contained in the budget papers.

O&M Expenses in Haryana

The direct and indirect working expenses for irrigation projects in Haryana are presented in Table 14.10. During the period 1975/76 to 1981/82, these expenses increased (at current prices) from Rs 115 million to Rs 207 million, an increase of 80 percent over the seven-year period. The estimated index of O&M charges, accounting for changes in the prices of field labor and materials (such as cement, steel structure, and paints), increased from 100 in 1975/76 to 162 in 1981/82. When total working expenses are deflated by this index, which the Eighth Finance Commission used in its report (India, Finance Commission 1984), the increase in working expenses in real terms was quite low (only 11 percent). This shows that the near doubling of total working expenses in Haryana was mainly due to changes in the price of labor and materials.

During the same period, gross area irrigated by government canals increased from 1.69 million ha to 1.86 million ha, an increase of 10 percent. The estimated working expenses at current prices increased from Rs 68 per ha in 1975/76 to Rs 113 per ha in 1982/83, an increase of 66 percent. (This was approximately three times higher than 1973/74 expenses). However, when the increase in prices of field labor and materials is taken into account, the working expenses in real terms did not increase at all during the period 1975/76 to 1982/83.

In contrast, the gross receipts, both direct and indirect, increased 27 percent, at current prices, over the seven-year period, indicating that prices declined significantly in real terms (when deflated by the wholesale price index of all commodities). Compared with Rs 85 million in 1975/76, gross receipts declined to Rs 66 million in real terms, a decline of 23 percent. Thus in real terms, gross receipts, which accounted for 74 percent of the total working expenses in 1975/76, contributed only 52 percent of the total in 1981/82. Gross receipts per ha averaged, at current prices, Rs 35 in 1973/74, Rs 50 in 1975/76, and Rs 43 in 1982/83. In real terms, the gross receipts per ha declined by almost half over an eight-year period, from Rs 50 in 1975/76 to Rs 26 in 1982/83.

Comparison of O&M Expenses and Net Receipts

Table 14.11 presents a comparison of O&M expenses and receipts in government-managed irrigation systems for 1984/85. In Bihar, O&M expenses ranged from Rs 44.7 per ha in Sone Canal to Rs 120 per ha for the Kosi Project. By contrast, in Haryana the average O&M expenses were Rs 120 per ha after deducting 10 percent for revenue establishment. However, since the cost of revenue establishment is relatively higher in Bihar, the sum of O&M and revenue establishment expenses for 1984/85 were Rs 117 per ha for Sone and Rs 177 per ha for Kosi. The O&M expenses for state tubewells were very high at Rs 4,257 per ha of irrigated area.

Table 14.10--Gross receipts and working expenses of irrigation projects in Haryana in real terms, 1975/76 to 1981/82

Year (1)	Gross Receipts (Current Prices) (2)	Working Expenses (Current Prices) (3)	Wholesale Price Index (WPI)[a] (4)	Gross Receipts Deflated by WPI[a] (5)	Estimated Index[b] of O&M Charges[a] (6)	Working Expenses Deflated by Index of O&M Charges (7)	Percent of Receipts to Working Expenses (8 = 5/7)
			(million Rs)				(percent)
1975/76	85	115	100	85	100	115	74
1976/77	111	101	102	109	107	94	116
1977/78	89	116	107	83	111	105	79
1978/79	95	131	107	89	118	111	80
1979/80	88	164	120	88	131	125	70
1980/81	101	181	148	68	142	127	54
1981/82	108	207	163	66	162	128	52
Percent increase 1981/82 over 1975/76	27	80	63	...	62	11	...

... Not applicable.

[a] 1975/76 = 100

[b] This is a consolidated index as estimated by the Eighth Finance Commission. It assumes that 80 percent of the maintenance costs are accounted for by field labor and 20 percent by materials such as cement, steel structures, paints, and varnishes.

Table 14.11--O&M expenses and receipts in government-managed irrigation systems, 1984/85

State and Indicator	O&M Expenses (1)	Cost of Revenue Establishment (2)	Gross Receipts (3)	Net Receipts (4 = 3 -2)	Net Receipts as Percent of O&M Expenses (4-1)
	(Rs per ha of potential used)				(percent)
Bihar					
Surface irrigation					
Major irrigation projects	81.4	34.3	61.4	27.1	33.0
Four major projects	53.3	41.8	n.a.	n.a.	n.a.
Sone Canal[a]	44.7	72.0	110.0	38.0	85.0
Kosi project	120.0	57.0	45.0	-12.0	Negative
Groundwater					
State tubewells (STW)	4,257.0	[c]	16.0	16.0	0.4
Haryana[b]					
Working expenses, direct and indirect	133.0	[c]	51.0	51.0	38.0

Sources: See Tables 14.5 to 14.10.
n.a. Not available.
[a]For Sone, irrigated area is taken as 0.548 million ha, for Kosi as 0.425 million ha at 76 percent use of ultimate potential.
[b]Figure for Haryana for 1982/83 has been converted to 1984/85 prices by using the wholesale price index (WPI) for all commodities, which corresponds to the price of field labor and materials.
[c]Included in O&M expenses.

Financial Performance of State Tubewells in Bihar

The Bihar Water Development Corporation (BWDC) is responsible for construction, operation, and maintenance of public tubewells with a discharge capacity varying from 1.5 to 2.0 cusecs (0.042 to 0.57 cumecs). The BWDC is responsible for installing electric pumps, constructing channels, maintaining completed works, giving irrigation to the field, assessing and realizing water rates. By 1985, the government of Bihar had contributed Rs 100 million toward its capital share. The BWDC plans to create an additional potential of 90,000 ha during the Seventh Five-Year Plan (1985/90). A provision of Rs 450 million was made for 1985/90, which includes Rs 140 million toward an increased capital share of the government of Bihar.

The working of the public tubewells has not been satisfactory in Bihar as shown in Table 14.12. Out of 5,311 state tubewells (STW) constructed up to 1984/85, about 400 to 500 were not energized for the past three years. The average number of working tubewells declined from 3,469 in 1980/81 to 2,167 in 1984/85. This shows that in 1984/85, only 44 percent of energized tubewells (and 40 percent of the total constructed) were in working condition. The main reasons for nonfunctioning include ineffective management, lack of power, and lack of maintenance of pumpsets or channels. As a result, the total area irrigated by the STWs declined from 77,000 ha in 1980/81 to 35,000 ha in 1984/85. In 1984/85, area irrigated per working private tubewell was 16.2 ha compared with the estimated command area of 40 ha.

The financial performance of STWs is shown in Table 14.12. While the total O&M expenses increased from Rs 106 million in 1981/82 to Rs 149 million in 1984/85, the total revenues collected by the BWDC declined from Rs 0.77 million to Rs 0.56 million. Thus, the net losses from the operation increased from Rs 105 million in 1981/82 to Rs 148 million in 1984/85. In 1984/85, revenue collection accounted for only 0.4 percent of all O&M expenses. Average revenue was Rs 15.7 per ha, while the area irrigated per STW was 16.2 ha. The estimated revenue per STW was Rs 254 compared with an estimated O&M cost of Rs 4,244.

An analysis of O&M costs shows that during 1984/85, Rs 90 million was spent on the establishment expenses of the BWDC, while Rs 59 million was spent on electricity.[5]

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[5] Due to the shortage of funds, the Bihar Water Development Corporation (BWDC) does not pay the State Electricity Board the charges due for operating the public tubewells. These charges were estimated at Rs 27,226 out of total estimated O&M expenses of Rs 68,760 per public tubewell. The deficit for Bihar Water Development Corporation would partly explain the Bihar State Electricity Board's 1982/83 commercial losses of Rs 927 million.

Table 14.12--Financial performance of public tubewells in Bihar, 1981/82 and 1984/85

Indicator	1981/82	1984/85
Number of tubewells in working condition	3,364	2,167
Total revenue collection (million Rs)	0.77	0.56
Total expenses for O&M (million Rs)	106.00	149.00
Net losses (million Rs)	105.00	148.00
Revenue collection as percent of total expenses	0.70	0.40
Area irrigated per tubewell (ha)	24.70	16.20
Revenue (Rs per ha)	9.30	15.70
O&M expenses (Rs per ha)	1,276.00	4,244.00

Source: Bihar Water Development Corporation, Patna.

RESOURCE FLOWS RELATING TO IRRIGATION: A COMPREHENSIVE VIEW

Farmer's Ability to Pay for Irrigation Services

Table 14.13 presents data on gross income, farm expenditure, and net income of irrigated and nonirrigated farms in Bihar. These data were obtained from a farm-level survey conducted in the Sone River Basin in 1983/84 by the National Council of Applied Economic Research, New Delhi. They found that the intensity of cropping on a 1-ha farm in the region was 180 percent. For a representative 1-ha farm, one could assume 1 ha of rice plus 0.8 ha of wheat. Gross income on the irrigated farm was estimated to be Rs 8,438, compared with Rs 4,450 on an unirrigated farm. The estimate of net income per ha per year is presented as returns to all family resources including land, labor, capital, and management, assuming that the family owns all of the land farmed. Net income (returns to farm family resources) was estimated to be Rs 5,774 per ha per year on irrigated farms compared with Rs 3,263 per ha per year on unirrigated farms. The net benefits of irrigation after deducting increased production costs were Rs 2,511 per ha per year. The irrigation costs (water rates or irrigation service fees) were estimated to be Rs 72 per ha per year for this crop rotation.

Table 14.13--Gross income, farm expenditure, and net income of irrigated and nonirrigated farms in Bihar

Indicator	Irrigated	Unirrigated	Additional Net Income or Benefits from Irrigation
		(Rs per ha)	
Gross income[a]			
Rice (1.0 ha)	5,217	2,434	2,783
Wheat (0.8 ha)	3,221	2,016	1,205
Total	8,438	4,450	3,988
Farm Expenditure			
Fertilizers	1,646	115	...
Irrigation cost	72	...	...
Cost of materials (seeds, manures, fertilizers, etc.)	2,676	795	...
Total cash expenses[b]	2,664	1,187	...
Net income			
Returns to farm family resources	5,774	3,263	2,511

Source: National Council of Applied Economic Research, Agro-economic and Socio-economic Survey of the Sone River Basin (New Delhi: NCAER, 1985).

... Not applicable.

[a]The intensity of cropping on a 1-ha farm is assumed to be 180, that is, 1.0 ha rice and 0.8 ha wheat.

[b]Includes paid-out cash expenses on purchased inputs only.

Irrigation costs were only 1.2 percent of the net income on irrigated farms and about 2.9 percent of the estimated net benefit from irrigation. Similar estimates of net income and net benefit from irrigation were also calculated from data obtained by the Ministry of Agriculture, New Delhi, in studies on the cost of cultivating major crops. Analysis of farm-level data for the Sone Canal region is presented in Table 14.14. The irrigation cost given in these surveys is estimated to be Rs 130 per ha per year on canal-irrigated farms. Using an estimated intensity of cropping of 170 percent (1 ha of paddy plus 0.7 ha of wheat), the net income on an irrigated farm was estimated to be Rs 7,012 per ha per year. The estimate of net income on unirrigated farm is Rs 2,639, taking an intensity of cropping of 133 percent (1 ha of paddy plus 0.33 ha of wheat). This gives an estimated net benefit from irrigation of Rs 4,373 per ha per year. This estimated net benefit of irrigation is

Table 14.14--Irrigation charges and net income (returns to own farm resources) for a one-hectare farm in Bihar, using cost of cultivation data

Indicator	Paddy		Wheat		Paddy Plus Wheat		Net Additional Income or Benefits from Irrigation
	Canal Irrigated (1)	Unirrigated (2)	Canal Irrigated (3)	Unirrigated (4)	Irrigated[a] (5)	Unirrigated[b] (6)	(5-6)
Irrigation costs							
(Rs per ha)	74.70	...	79.24	...	130.00	...	...
(kg paddy per ha)	46.70	...	49.50	...	81.30	...	...
Net income							
(Rs per ha)	3,284.00	1,542.00	5,325.00	3,324.00	7,012.00	2,639.00	4,373.00
(kg paddy per ha)	2,053.00	964.00	3,328.00	2,078.00	4,383.00	1,649.00	2,733.00
Gross production							
(Rs per ha)	4,616.00	2,781.00	6,612.00	4,940.00	9,244.00	4,411.00	...

Source: Table 14.13.
... Not applicable.
[a]For canal irrigation, the intensity of cropping was 170, that is, 1 ha of paddy plus 0.7 ha of wheat.
[b]For unirrigated farms, the intensity of cropping was 133, that is, 1 ha of paddy plus 0.33 ha of wheat.

almost 75 percent higher than that estimated from the National Council of Applied Economic Research (1985) data. Both these estimates were used to evaluate the alternative policies indicated in Tables 14.14 to 14.19.

Similar estimates of water rates for canal irrigation and net income were obtained from data given in a report on the economics of farming in Haryana (1981/82) by the Haryana's Economic and Statistical Organization. The estimates of water rates (Rs 105 per ha per year) and net benefit of irrigation (Rs 3,864 per ha per year) are presented in Table 14.15.

Table 14.15--Irrigation charges and net income on selected farms in Haryana, 1981/82

Indicator	Irrigated	Unirrigated	Difference of Irrigated over Unirrigated
Gross income	8,027.00	2,664.00	5,363.00
Farm expenditure (purchased inputs only)	2,023.00	524.00	1,499.00
Net income	6,004.00	2,140.00	3,864.00
Irrigation costs			
Water rates	105.00	...	...
Tubewell/pumping,etc.	737.00	...	...
Subtotal	842.00	...	...
Irrigation costs as a percent of			
Gross income	10.00	...	...
Farm expenditure	42.00	...	...
Net income	14.00	...	...
Additional income	22.00	...	...
Water rates as a percent of additional income	3.00	...	...

Source: Haryana, Economic and Statistical Organization, Economics of Farming in Haryana 1981/82 (Chandigarh: Government of Haryana, 1985).

... Not applicable.

Recovery of O&M Costs

Estimates of water rates and net income for Bihar and Haryana are brought together in Table 14.16. Irrigation charges or water rates for canal irrigation range from 43 kg of paddy per ha per year in Bihar to 98.1 kg in Haryana. Net returns to farm family resources range from 3,458 kg of paddy per ha per year in Bihar to 5,709 kg in Haryana. Similarly, benefits from irrigation range from 1,504 kg of paddy per ha per year in Bihar to 3,709 kg in Haryana. Total direct and indirect irrigation-related payments by water users under alternative policy assumptions are presented in Table 14.17.[6] The first column of the table shows the average or typical amounts that farmers are charged under current policies. The estimated water rates are equivalent to between 43 and 81 kg of paddy per ha per year in Bihar, depending on the source of data used. For Haryana, the actual payment is equivalent to 98 kg of paddy per ha per year.[7]

The second column of Table 14.18 shows the estimated amounts that would be needed if current policies were modified so that irrigation service fees per ha were equal to the costs of O&M. This represents the level of payments that would be necessary to provide full recovery of O&M costs through an irrigation service fee, assuming that collection rates are 100 percent. The last two columns indicate the charges required for the amounts charged per ha to equal the full cost of both O&M and capital investment. Increases in irrigation fees amounting to 97 percent would be needed in Bihar given the irrigation charges paid by farmers indicated in the survey by the National Council of Applied Economic Research (NCAER) survey. However, for recovering O&M costs, no increase would be indicated if the actual irrigation charges were based on cost of cultivation studies. In Haryana, the actual amounts reportedly paid by farmers are about 10 percent higher than the average O&M costs. Thus full recovery of O&M costs would not require an increase in water rates (rather it suggests a decrease of 9 percent) but would perhaps require higher collection efficiencies. Water rates would have to be increased substantially (18 to 34 times in Bihar and 19 times in Haryana) for the full cost of both O&M and capital investment to be recovered.

Benefit Recovery Ratios

The figures given in Tables 14.14 and 14.16 yield the estimated benefit recovery ratios under alternative policies for Bihar and

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[6] Under gravity irrigation systems in India, water charges are paid in cash only. No contributions are made in labor (or foodgrain) except in some emergencies.

[7] These estimates of irrigation-related payments are nearer to those in Nepal and Thailand (based on an implicit tax of 6.2 percent on the price of paddy), which are 75 kilograms of paddy per ha per year for Nepal and 85 kilograms of paddy per ha per year for Thailand. These are much lower than the value for Korea, the Philippines, and Indonesia (Small et al. 1986).

Table 14.16--Annual irrigation charges and additional net income from irrigation[a] in Bihar and Haryana

Place and Year	Irrigation Charges		Net Return to Farm Family Resources from Irrigated Farm		Net Return to Farm Family Resources from Unirrigated Farm		Additional Net Income or Benefits from Irrigation	
	(Rs per ha)	(kg paddy per ha[b])	(Rs per ha)	(kg paddy per ha)	(Rs per ha)	(Kg paddy per ha)	(Rs per ha)	(kg paddy per ha)
Estimate I								
Bihar (1983/84)	72 (130)	43.1 (81.3)	5,774 (7,012)	3,458 (4,383)	3,263 (2,639)	1,954 (1,649)	2,511 (4,373)	1,504 (2,733)
Haryana (1981/82)	105	98.1	6,109	5,709	2,140	2,000	3,969	3,709

Sources: Tables 14.13 and 14.14.
Note: Figures in parentheses are for data from cost of cultivation studies. These data are for 1982/83.
[a]Excluding irrigation charges from canal irrigation.
[b]Farm harvest prices (FHP) of paddy have been used in computing kg paddy per ha. These were Rs 1.67 per kg in 1983/84, Rs 1.60 in 1982/83, and Rs 1.07 in 1981/82.

Table 14.17--Total direct and indirect payments for irrigation by water users under alternative policy assumptions in Bihar and Haryana

State	Actual	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Cost[a]	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Plus Full Recovery of Capital Cost[b]
		(kg of paddy per ha per year)[c]	
Bihar[d]	43.1 (81.3)	80.8 (80.8)	1,464 (1,464)
Haryana[e]	98.1	89.7	1,869

Sources: Tables 14.14 and 14.16.
[a]O&M costs for Bihar are for 1983/84, Rs 135 per ha; O&M costs for Haryana for 1982/83 are Rs 113 per ha for total working expenses on irrigation projects.
[b]Capital costs used are Rs 22,900 per ha for Bihar; Rs 22,230 per ha for Haryana. The capital recovery factor (CRF) used to amortize capital costs equals 0.100859, assuming an interest rate of 10 percent and a project life of 50 years. These figures give amortized (annual) capital costs of Rs 2,312 per ha for Bihar and Rs 2,242 per ha for Haryana.
[c]Farm harvest prices (FHP) of paddy used for computing kg of paddy per ha are Rs 1.67 per kg in 1983/84 and 1.60 per kg in 1982/83 in Bihar; for Haryana, FHP were Rs 1.36 per kg in 1983/84, Rs 1.26 in 1982/83, and Rs 1.07 in 1981/82.
[d]Figures in parentheses are based on data from cost of cultivation studies conducted by the Ministry of Agriculture, New Delhi. These data are for 1982/83.
[e]For Haryana, the irrigation rates are for 1981/82, while O&M costs are for 1982/83. These have been converted to kg of paddy per ha using FHP of the corresponding year. As a result, the quantity of paddy required to cover O&M costs declines even though the O&M costs per ha, at Rs 113, are higher than the average water charges of Rs 105 per ha.

Haryana that are displayed in Table 14.18. Under actual policies (and water rate levels), the estimated benefit recovery ratio is 2.8 percent for Bihar and 2.6 percent for Haryana.[8] For full recovery

[8] These may be compared with 5 percent for Nepal, 9 percent for Thailand, 10 percent for the Philippines, and 26 percent for Korea. See Small et al. (1986).

of O&M costs, the estimated benefit recovery ratios would rise for both states, although marginally for Bihar (the estimate in parentheses) and Haryana. The last column in Table 14.18 shows that the benefit recovery ratio would be almost 100 percent in Bihar if the net benefit to irrigation were similar to that estimated in the NCAER survey. However, given a higher figure of net benefit of irrigation (based on the cost of cultivation study), the benefit recovery ratio needed to cover full costs of O&M and capital investment would be 55.9 percent for Bihar. The corresponding figure for Haryana is 59.3 percent.

Table 14.18--Estimated benefit recovery ratios under alternative financing policies

Place	Actual	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Costs	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Plus Full Recovery of Capital Costs
		(percent)	
Bihar[a]	2.9 (3.0)	5.4 (3.1)	97.4 (55.9)
Haryana	2.6	2.8	59.3

Sources: Tables 14.14, 14.16, and 14.17.
Note: O&M costs are Rs 135 per ha for Bihar and Rs 113 per ha for Haryana; amortized capital costs are Rs 2,310 per ha for Bihar and Rs 2,242 per ha for Haryana.
[a]Figures in parentheses are based on data from cost of cultivation studies conducted by the Ministry of Agriculture, New Delhi.

The estimates presented in Table 14.18 indicate that in both states, wherever reasonable irrigation service is available, the incremental benefits derived from irrigation are adequate to allow full recovery of O&M costs of irrigation and leave the farmers with significantly higher net incomes than before irrigation. The benefits of irrigation are not high enough, however, to allow the full recovery of O&M plus capital costs and leave enough margin for the farmer to use irrigation.[9]

[9] In this case, the situation in Indian states is similar to that in Nepal and the Philippines, assuming moderate capital costs. See Small and others (1986, Table 5).

Net Income from Irrigation

In Table 14.19, the estimates of net income presented in Tables 14.13 to 14.15 are compared with the amounts of irrigation-related payments required under the three alternative policies. The comparison is presented as the amount of the payment as a percentage of the net income remaining with water users after payment has been made. Under the actual policies of the two states, the estimates range between 1.2 and 1.8 percent for Bihar and 1.7 percent for Haryana. Raising irrigation service fees to cover O&M costs results in relatively modest changes in the percentage of net income needed to pay for water, except in the case of Bihar (the first estimate using the NCAER survey). The percentage of net income needed to cover O&M costs remains less than 2 percent in both the States. However, raising irrigation service fees still further to cover the full capital costs as well as O&M costs leads to irrigation charges in the range of 35 to 43 percent of the farmer's net income. The implications of the figures in Table 14.19 are consistent with conclusions drawn from Table 14.18, namely, that farmers generally have the ability to pay for the full cost of O&M for irrigation through irrigation service fees, but that the additional payment for the full cost is not feasible.

Payments as a Percentage of Gross Income

Comparing payments for irrigation services with gross income is conceptually less meaningful than either of the previous two approaches to analyzing farmers' ability to pay. It does not, however, require data on farm income, which are often limited to a few specific surveys or projects. Estimates of the typical percentages of gross income required as payments for irrigation under the three alternative policy situations are presented in Table 14.20. Under the actual policies, these range between 0.9 percent and 1.4 percent. They would range between 1.4 to 1.6 percent if water rates were raised to cover O&M costs. However, about 30 percent of the gross value of output would have to be paid as water rates (irrigation charges) if irrigation service fees were raised to cover O&M costs as well as full capital investment.

Role of Price Policies for Output

The objectives of the agricultural price policies included under the 1955 terms of reference of the Agricultural Prices Commission (APC) are (1) to provide incentive to the producer for adopting improved technology and for maximizing production, (2) to ensure rational use of land and other production resources, and (3) to consider the likely effect of the price policy on the rest of the economy, particularly on the cost of living, level of wages, and industrial cost structure. According to the revised terms of reference (1978), the APC is required to take into account changes in the

Table 14.19--Total direct and indirect payments for irrigation by water users as a percent of the net returns to the farm family resources[a] under alternative policy assumptions

Place	Actual Policies	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Costs	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Plus Full Recovery of Capital Costs
		(percent)	
Bihar	1.2 (1.8)[b]	1.9 (1.9)[b]	42.3 (34.9)[b]
Haryana	1.7	1.9	39.1

Source: Table 14.14.
[a]Net income estimates are presented as returns to all family resources (including land, labor, management, and capital) under the assumption that the family owns all of the land farmed. These estimates of net income are compared with the amounts of irrigation-related payments required under the three alternative policies. The comparison is presented as the amount of the payment as a percentage of the net income remaining with the water user after payment has been made.
[b]Figures in parentheses are based on data from cost of cultivation studies.

terms of trade between the agricultural and the nonagricultural sector.[10] The APC considers the cost of production, the demand, and the supply of agricultural commodities and discusses various aspects of policy with the state governments, concerned ministries, and concerned industry and trade circles. The report of the APC is circulated to the different economic ministries, planning commission, and state governments before it is put up for the approval of the Union Cabinet. The final decision is taken at the cabinet level (Tyagi 1982).

Broadly, two sets of administered prices are fixed by the government (Kahlon and Tyagi 1983, 12-13): (1) minimum support prices for the country's major field crops, which are fixed annually and meant to be the floor levels below which market prices should not be allowed to fall; and (2) procurement prices for Kharif and Rabi cereals at which the grain is to be domestically procured by

[10] For a detailed discussion of issues relating to agricultural prices and terms of trade, see Tyagi (1981), Rath (1985), and Mishra (1985).

Table 14.20--Total direct and indirect payments for irrigation by water users as a percent of gross production under alternative policy assumptions

Place	Actual Policies	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Costs	Actual Policy Modified to Set Irrigation Service Fees Equal to O&M Plus Full Recovery of Capital Costs
		(percent)	
Bihar	0.9 (1.4)[a]	1.6 (1.5)[a]	28.9 (26.5)[a]
Haryana	1.3	1.4	29.3

Sources: See Tables 14.14 and 14.16.
Note: Gross production refers to gross value of output on a one-hectare irrigated farm assuming two crops of rice and wheat. In Bihar, the intensity of cropping is 180, that is, 1 ha of rice plus 0.8 ha of wheat. In Haryana, the intensity of cropping is 170, that is, 1 ha of rice plus 0.7 ha of wheat.
[a]Figures in parentheses are from cost of cultivation studies of the Ministry of Agriculture, New Delhi.

public agencies for release through the public distribution system. The procurement prices are announced for major centers and sub-offices, which in effect increased the procurement of foodgrains from 4.03 million tons in 1965, to 13.8 million tons in 1979, and to 30 million tons in 1985. It also expanded storage capacity from 2.9 million tons in 1972 to 4.6 million tons in 1985. The total storage accommodation available to the Food Corporation of India (FCI) was 17.2 million tons by January 1984. The FCI is also responsible for supplying foodgrains to state governments for meeting the requirements of their public distribution systems, that is, the foodgrains sold through fair price shops at subsidized prices. All these developments have strengthened the market infrastructure and helped provide adequate support to farmers and create confidence that an agency exists that is ready to purchase the produce at the announced prices.

Although, in theory, all efforts are made to ensure that the farmers get remunerative prices, in practice the price that the farmer gets for his produce depends on the organizational and operational efficiency of the market structure. According to Kahlon and Tyagi (1983, 413), "it is, therefore, not enough to have a price support/ procurement policy for agricultural commodities. In fact, it is more important to develop a market structure which enables the farmer to realize at least the minimum support price." Analysis of

data for the late 1970s on procurement prices and open market prices during the harvest season shows that in the states where infrastructure facilities are good (such as Punjab, Haryana, and western Uttar Pradesh), the market price for wheat was higher than procurement prices fixed by the government, but in Rajasthan the price of wheat was about 20 percent lower than the procurement price. Similarly in Andhra Pradesh, Punjab, and Haryana, the open market price for rice remained either equal to or higher than the procurement price during the late 1970s, but in Madhya Pradesh and Orissa the price for paddy occasionally was even lower than the procurement price (Kahlon and Tyagi 1983, 415). The phenomenon of farmers getting prices 14 to 18 percent lower than the procurement prices for rice was reported for the agricultural year 1985/86 for a few surveyed districts in eastern Uttar Pradesh (J. P. Singh, personal communication).

It is quite likely that farmers in Bihar are receiving prices much lower than the support prices or the procurement prices announced by the government due to inadequate infrastructure for purchasing and storing foodgrains. By contrast, farmers in Haryana are able to receive remunerative prices for their agricultural output mainly because of the government's infrastructural facilities. These differences have to be kept in mind when estimating the additional benefits to irrigation across regions and over time. A comparison of water rates with procurement prices may not reveal the true relationship between input and output prices.

Domestic Prices Compared with Import Prices

The government policy on agricultural prices may be designed to protect consumers from high prices rather than to allow producers to get higher prices through sales in deficit regions within the country or abroad (agricultural exports). The first objective may be achieved by zoning, or restricting the movement of agricultural commodities from one state or zone to another.[11] For wheat and rice, restrictions on imports and exports of foodgrains may result in domestic prices that are lower than the corresponding border prices. As pointed out in a recent study (Mishra 1985), the domestic prices of wheat and rice in India were much lower than their corresponding border prices in 1975 and 1980. For example, in 1980 the domestic price of wheat was US$177 per metric ton at the official exchange rate and US$142 at the shadow exchange rate. The corresponding border price was much higher: at US$308 per ton. The negative values of the nominal rates of production (NRP) show taxation, rather than protection, of agriculture.

This is also a method by which returns to the use of irrigation can be affected indirectly by macropolicies of trade restrictions, zoning, and other administrative controls. These should be taken into account when analyzing the alternatives for raising resources from the agricultural sector. Raising water rates is only one method; transferring resources from agriculture or irrigated agriculture to "the rest of the economy" can also be achieved by

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[11] Zonal restrictions on the free movement of foodgrains were followed from time to time in India.

policies that affect prices of outputs and inputs as well as policies that directly and indirectly tax incomes accrued in the agricultural sector.

Terms of Trade between Farm and Nonfarm Sectors

Changing the terms of trade between the farm and nonfarm sectors is another way to transfer resources from one sector to the other. By changing administered prices of outputs and inputs, the government can affect resource flows from the farm sector to the government and to the manufacturers of agricultural inputs, implements, and other commodities purchased by farmers. A detailed analysis of commodity terms of trade in India is reported in Rath (1985). As may be noted in Table 14.21, the ratio of farm harvest prices to prices of inputs purchased from the nonfarm sector declined after 1974/75 and fell to very low levels in 1980/81 and 1981/82. This is true for paddy and wheat in Bihar and for bajra and wheat in Haryana. Although the ratio was slightly higher in 1982/83 in Bihar, it declined or remained stagnant for the two crops in Haryana. Similar trends are evident in the ratio of farm harvest prices paid by rural households for household consumption goods. Not only did the ratio of these prices decline continuously (with the exception of 1977/78) after 1974/75, but the level actually fell much below the level prevailing in 1960/61. Thus, the changes in farm harvest prices did not keep pace with changes in the prices of inputs and other commodities purchased by farmers. The purchasing power of goods produced by the farm sector definitely eroded as well. These factors should be taken into account when considering raising the water rates to recover O&M expenses and capital costs. Such comprehensive analysis is needed to ensure that both the productivity and the equity aspects of benefits from irrigation projects are taken into account when formulating agricultural policies.

Incidence of Direct and Indirect Taxes on Incomes

Apart from irrigation rates, farmers pay land revenue, agricultural income tax, and indirect taxes on commodities and services levied by the central and state governments. The amount of indirect tax paid by a farmer depends on the quantity and type of commodities purchased; these depend, in turn, on the level of income and expenditure. An attempt is made here to estimate the amount of indirect taxes paid by farmers who are using canal irrigation as well as by farmers who do not use irrigation. The difference in the amount of indirect taxes paid by each category of farmers (those with irrigated and those with unirrigated farms) provides the estimate of indirect tax that could be attributed to providing gravity irrigation. This difference in the total taxes paid is considered to be the indirect flow of financial resources as a consequence of higher incomes and expenditures generated by the use of irrigation.

Table 14.22 provides details of the assumption made in calculating the incidence of indirect taxes. First, the area under two sizes of farms (1 ha and 2 ha) receiving canal irrigation in Bihar

Table 14.21--Commodity terms of trade between farm and nonfarm sectors in Bihar and Haryana, 1970/71 to 1982/83

	Ratio of Farm Harvest Prices to Prices of Inputs Purchased from Nonfarm Sector				Ratio of Farm Harvest Prices to Prices Paid by Rural Households[a] for Consumption Goods	
	Bihar[a]		Haryana[b]		Bihar[c]	
Year	Paddy	Wheat	Bajra	Wheat	Rice	Wheat
1970/71	143	117	89	138	109	88
1971/72	132	112	108	141	100	81
1972/73	144	138	187	135	102	96
1973/74	182	186	156	155	113	117
1974/75	183	111	131	112	182	108
1975/76	106	78	81	96	111	80
1976/77	116	92	82	103	94	73
1977/78	135	89	91	106	109	71
1978/79	115	89	81	107	88	68
1979/80	211	96	102	102	78	69
1980/81	96	86	94	91	82	75
1981/82	84	85	83	92	82	84
1982/83	120	103	81	92	111	97

Source: Nilakantha Rath, "Presidential Address," presented to the forty-fifth annual conference of Indian Society of Agricultural Economics, Vallabh Vidyanagar, Gujarat, 27-29 December, 1985.

[a]Data on the ratio of farm harvest prices to prices of household goods were not available for Haryana.

[b]1961/62 = 100.

[c]1960/61 = 100.

Table 14.22--Net income and incidence of indirect taxes in canal-irrigated farms in Bihar

Indicator	Unit	Irrigated by Canals		Unirrigated	
		1 ha	2 ha	1 ha	2 ha
Area under each category of farm	Ha	0.48	0.70	0.48	0.70
Number of farms in each category	Million	0.48	0.35	0.48	0.35
Net income in each category of farm	Rs per ha per year	7,012	14,024	2,639	5,278
Annual per capita income/expenditure[a]	Rs	1,169	2,337	440	880
Monthly per capita income/expenditure in each category	Rs	97	194	37	74
Annual amount of tax per capita[b]					
Central taxes	Rs	73	196	24	73
State taxes	Rs	42	112	16	42
Total	Rs	115	308	40	115
Total annual tax for each farm family	Rs	690	1,848	240	690
Total annual tax for all farms in each category	Million Rs	331	647	115	241
Tax as percent of income/expenditure	Percent	9.8	13.2	6.2	8.9

Source: National Institute of Public Finance and Policy, Incidence of Indirect Taxation in India, 1973/74 (New Delhi: NIPFP, 1978).

Note: It is assumed that the level of incidence in 1983/84 remained the same as in 1973/74.

[a]Taking a family size of 6 and assuming that nonagricultural income balances savings and net income from agriculture represents total consumption expenditures.

[b]The estimated tax incidence is determined on the basis of average annual expenditure in each category.

was estimated. The total net area irrigated by canals (1.18 million ha) was divided as follows: 0.48 million ha with an average farm size of 1 ha and 0.70 million ha with an average farm size of 2 ha. This produced an estimated number of households with each size of farm to be 0.48 and 0.35 million, respectively. Net income in each category was calculated based on the data used in Table 14.14. Per capita income and expenditure was then calculated assuming (1) a family size of six adult-equivalents, (2) nonagricultural income equal, on average, to farm savings, and thus (3) net income from agriculture as the total consumption expenditure of the family. Using the estimates of per capita expenditure, the amount of taxes paid per year was calculated using estimates from a study conducted by the National Institute of Public Finance and Policy, New Delhi. This gave estimates of total indirect taxes paid by each farm family to the central and state governments. For example, a farm family having, on average, a 1-ha irrigated farm would pay a tax of Rs 690 per year. The estimated tax for a 2-ha irrigated farm would be Rs 1,848, which is 13.2 percent of the total income or expenditure per year. The corresponding figures for unirrigated farms would be Rs 240 for 1-ha farms and Rs 690 for 2-ha farms. These families would pay 6.2 and 8.9 percent of their annual income as indirect taxes, respectively. Multiplying these tax payments per family by the total number of farm families in each category produces estimates of the total indirect taxes paid by these groups (Table 14.23). The total estimated taxes paid by farm families using canal irrigation would be Rs 978 million (Rs 331 million plus Rs 647 million). The corresponding figure for families not using irrigation would be Rs 356 million (Rs 115 million plus Rs 241 million). Thus the additional tax liability attributed to irrigation would be Rs 622 million (Rs 978 million minus Rs 356 million). According to the assumptions made and the estimates of the tax incidence used in this study (based on the National Institute of Public Finance and Policy study of 1973/74), around Rs 400 million would be due to indirect taxes levied by the central government (excise duties and customs duties) and Rs 222 million to state taxes (state excise, sales taxes, sales tax on motor spirit, motor vehicles tax, taxes on goods and passengers, entertainment tax, and electricity duty). These estimates must be seen in the context of the following figures: in 1984/85, the share of Bihar in total Union excise duties was Rs 5,165 million, total Bihar state taxes on commodities were Rs 4,372 million, and total revenue from indirect taxes in Bihar was Rs 9,537 million.

Resource Flows Related to Irrigation Financing: A Comprehensive View

As discussed above, it is important to take a comprehensive view of resource flows related to irrigation financing in India. This requires estimating the capital and current flows into the agricultural sector for investments and O&M expenses incurred on government-managed irrigation systems. It also requires estimating subsidies on the use of fertilizers, electricity for water pumping, and diesel oil for pumpsets and tractors. Resources flow out of the rural sector through payments of land revenue, agricultural income

Table 14.23--Incidence of indirect taxes on irrigated farms and total tax revenues in Bihar

Incidence	Irrigated Farm			Unirrigated Farms			Total Additional Taxes[a]
	1 ha Farms	2 ha Farms	Total	1 ha Farms	2 ha Farms	Total	
				(million Rs)			
Central taxes	210	412	662	69	153	222	400
State taxes	121	235	356	46	88	134	222
Total indirect taxes in 1984/85	331	647	978	115	241	356	622

Source: Table 14.22.
[a]Calculated from taxes on irrigated farms minus taxes on unirrigated farms.

tax, irrigation charges, cess on commercial crops, and indirect taxes on commodities used by households and rural enterprises. Table 14.24 contains estimates of total resource flows related to irrigation financing in Bihar in 1984/85. These are preliminary estimates that need further refinement. They do, however, provide an order-of-magnitude number with which to put in perspective various policy alternatives relating to irrigation financing.[12] The total O&M expenses in 1984/85, including revenue establishment, were Rs 242.8 million for surface irrigation projects. Total O&M expenses including electricity charges for public tubewells were an estimated Rs 149.6 million. Thus, expenditures on government-managed irrigation systems were Rs 392.4 million for 1984/85. Against this, the revenue collected from the irrigated farm sector was Rs 126.4 million from irrigation charges and Rs 622.0 million from additional indirect taxes paid by farmers using canal irrigation (Tables 14.23 and 14.24). The net financial flows from the canal-irrigation sector were Rs 505.6 million. When public tubewells are also considered, the net flows are reduced to Rs 356.0

[12] The analysis here is confined to current (annual) revenues and expenditures owing to lack of data on capital transfers (that is, plan funds).

Table 14.24--Resource flows related to irrigation financing in Bihar, 1984/85[a]

Resource Flow	Indicator
Resource Flows into the Irrigation Sector of Agriculture	Annual Flows[a] (million Rs)
1. Surface irrigation projects	
O&M expenses	167.6
Direction and administration	4.5
Revenue establishment	70.7
Subtotal	242.8
2. State tubewell projects	
O&M expenses (including revenue establishment)	90.3
Electricity charges	59.3
3. Private tubewells	
Subsidy on electricity charges[b]	868.0
4. Fertilizer subsidy[c] on imported fertilizers used on irrigated land	314.0
5. Subtotal for government-managed irrigation (1+2)	392.4
6. Subtotal for government-managed irrigated agriculture	476.1
7. Subtotal for the entire irrigation sector (1+2+3)	1,260.4
8. Total for the irrigated agricultural sector	1,574.4
Resource Flows out of Agriculture	Current Revenue/ Expenditure Flows (million Rs)
1. Land revenue and agricultural income tax	
Gross collections	84.0
Cost of collection	93.0
Net revenues	-9.0
2. Irrigation sector direct receipts	
Gross receipts	126.4
Other receipts	n.a.
Subtotal	126.4
Indirect receipts	
Cess on commercial crops	n.a.

Continued

Table 14.24--Continued

Resource Flow	Indicator
Resource Flows out of Agriculture	Current Revenue/ Expenditure Flows (million Rs)
3. Indirect taxes/revenues	
Additional incidence of indirect taxes on households (canal-irrigated farms only)	622.0
Share of indirect taxes on agroprocessing industries	...
Share of direct taxes on manufacturing	...
Export revenues attributable to irrigation	...
Reduction in import revenue due to irrigation	n.a.
4. Subtotal (2+3)	748.4
Net financial flows (excluding land revenue)	
1. Net financial flows for canal irrigation	748.4 - 242.8 = 505.6
2. Net financial flows for government-managed irrigation	748.4 - 392.4 = 356.0
3. Net financial flows for the total irrigation sector	748.4 - 1,260.4 = - 512.0
4. Net financial flows for irrigated agriculture	748.4 - 1,574.4 = - 826.0

n.a. Not available.
... Not applicable.
[a]Includes only current revenues and expenditures.
[b]Assumes that the entire losses of the State Electricity Board are from rural electrification, mainly state and private tubewells. According to the report of the Committee on Power, Government of India (1980), rural electrification losses in 1976/77 were Rs 1,568 million compared with overall losses of Rs 1,118 million.
[c]Fertilizer consumption (total NPK) in Bihar estimated at 0.225 million tons, or 2.7 percent of India's total consumption. Fertilizer subsidy estimated at Rs 18,320 million, or Rs 2,234 per ton of NPK. Hence total fertilizer subsidy was Rs 503 million. Subsidy on imported fertilizers alone was Rs 1,744 per ton or Rs 392 million. 80 percent of fertilizer consumption is assumed to be on irrigated land, distributed between government irrigation and private tubewells on the basis of area irrigated, with a ratio of 1:2.

million due to their high O&M costs and very low irrigation benefits. If gross collections of land revenue are also considered, the areas irrigated by canals (1.18 million ha) contributed about Rs 27 million, an average Rs 23 per ha. Thus the total estimated current resource flows or revenues to the central government and state government from canal irrigation were much higher than the expenditures in 1984/85. The gross receipts obtained directly from the farmers by water rates were only 17 percent of the total receipts from this sector. Similarly, net resource flows into canal irrigation (Rs 116.4 million equals Rs 242.8 million minus Rs 126.4 million) were about the same as subsidies on the use of imported fertilizers (Rs 103 million) consumed on these farms. This analysis shows that canal-irrigated agriculture is providing substantial financial and real resources indirectly through commodity taxes and other means. Efforts to raise more resources from this sector need not be confined to the mechanical approach that raises water rates to cover O&M expenses plus a percentage of capital costs.

ISSUES FOR DISCUSSION

Contrary to the general impression, water rates in Bihar increased about 70 to 80 percent in nominal terms over the past decade, while those in Haryana did not. In real terms, the farmers in Bihar are expected to pay higher rates than Haryana farmers for using canal irrigation for paddy and wheat. However, farmers in both states pay a very small proportion (between 2 and 3 percent) of the net benefits due to irrigation or of the gross value of output of irrigated agriculture. If irrigation charges were raised to cover the operation and maintenance expenses of irrigation works, the proportion of net benefit due to irrigation being diverted for irrigation-related payments would increase moderately. However, if water rates were raised to cover full O&M costs and capital investment, the share of net benefits being diverted to irrigation-related payments would be substantial (50 to 90 percent). The welfare and disincentive effects of raising water rates to cover O&M costs as well as full capital charges should be evaluated, and the prospects of "full cost recovery" must be considered and analyzed. In this context, the following issues are presented for discussion.

Should Water Rates Be Raised to Cover Full Costs in Existing Projects?

The first issue to consider is whether water rates should be increased to cover O&M charges as well as 100 percent of capital costs? This policy is not desirable either for economic efficiency or for equity considerations. The principle of "full cost recovery" implies that water rates should be increased from between Rs 100 and 130 to between Rs 2,350 and Rs 2,450 per ha. These increases are substantial and account for almost two-thirds of the estimated net benefit due to irrigation. Even if 50 percent of the amortized capital costs (Rs 2,300 per ha) were recovered along with O&M costs (Rs 113 to Rs 135 per ha), the increase would be substantial, that is, more than ten times.

Apart from the fact that it would be politically unacceptable, such an increase is likely to discourage farmers from demanding water for irrigation. Since India's irrigation projects are designed for protective irrigation and irrigation water supplies are uncertain and erratic (except for some influential farmers at the head reaches), farmers would certainly respond by opting out of the canal irrigation network. Some farmers would opt for rainfed agriculture, while others would invest in private sources of irrigation (tubewells, wells). Since capital costs of existing irrigation projects are "sunk costs," there is no justification for insisting on recovering these capital charges from the present generation of farmers, particularly when this insistence will reduce crop yields and employment or encourage investment in alternative irrigation devices. At best, there is justification for recovering the variable component of O&M costs[13] through water rates. Thus, for completed projects, the appropriate criterion for pricing water should be the short-run marginal costs of operating and properly maintaining the irrigation works.

Given the "sunk capital costs" for existing projects, insistence on recovering full or even part of the capital charges would distort investment choices. In areas where groundwater is available, it would promote investment in electric motors or diesel engines and produce, in turn, excess demand for electricity or diesel oil. Given the high capital costs of rural electrification and high transmission and distribution losses, such a policy would require diversion of investments in electricity generation and distribution. In situations where electricity is not available, this would result in high import costs of diesel oil or high capital costs of oil refining coupled with foreign exchange outflows to import crude oil. Both results are undesirable from the viewpoint of economic efficiency.

Apart from resulting in inefficient allocation of resources, recovering capital costs of completed projects is also inequitable for the following reasons. First, the high capital costs of major irrigation projects in India reflect cost and time overruns due to inefficient management as well as a significant amount of resource "leakage" by unscrupulous officials and constructors. As argued by P. K. Rao (1984, 2),

> The officially reported cost estimates are over-estimates of real costs incurred in project development and maintenance, due to significant leakages, corruption, and inefficiencies commencing with cost escalation in executing project works. . . . As a whole, it appears that only about half of the officially estimated costs should be taken as real costs.

Similarly, the costs of O&M have been increasing mainly because of increases in the wages and salaries of workers and officials. As noted elsewhere in this paper, 80 percent of the O&M expenses are

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[13] As discussed in Duane (1975, annex 3), the O&M costs have an overhead component, which is available only by abandoning an irrigation project.

for salaries and wages, and the expenses on the entire revenue administration are for the purpose of employment creation and thus provide considerable political mileage. It is unfair to ask farmers to bear the burden of these ever-increasing expenditures.[14] Increasing water rates to cover the full costs of an existing project is not justified on the grounds of either economic efficiency or equity.

Should Full Cost Recovery Be the Basis for Water Pricing for New Projects?

It may be argued that 'full cost recovery' should be the basis for determining water charges so that beneficiaries or project users contribute to the investment costs of the project. As shown by Duane (1975), desirable forms of cost recovery satisfy the following requirements: (1) they have the power to discriminate between a project's direct beneficiaries and nonbeneficiaries, that is, between water users and nonusers; (2) they either guide the efficient allocation of resources or are neutral; at worst, they interfere as little as possible in this regard; (3) at least one instrument has the capacity to permit progressive rates of charges; and (4) they are fair, in that they require users who are equally poor or equally rich to pay the same charge for the same benefit or service. Duane (1975, 14) accepts, however,

> that there are some circumstances perhaps in which the relevance of efficiency pricing can be dismissed a priori. For example, existing canal projects which are designed for continuous field-to-field flooding and where lack of control structures are of little consequence--many of the paddy growing areas of South and Southeast Asia--would simply not allow the required discrimination against "non-buyers." There are other situations also: where canal authorities cannot enforce their preferred patterns of water distribution even under existing arrangements, because of undisciplined, unlawful user behavior and their lack of enforcement ability. It would be quixotic to attempt sophisticated improvements to water marketing if more fundamental problems like these were left unchanged.

Since the situation in most of the canal systems in India is similar to the one described above, putting too much emphasis on cost recovery and financial returns from a new project would not be desirable.

Financial returns (or cost recovery) may not, however, be a major criterion for evaluating new projects for sanction. The

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[14] According to Rao (1984, 3), "the reported expenditure on operations and maintenance might not be on the relevant type and magnitude, from the agricultural production view-point; in other words, the unproductive, irrelevant, and extravagant expenditures that might be incurred on this account cannot be expected to be paid for by the users."

contribution of a new irrigation project is assessed with the help of social benefit cost analysis, which has been the accepted methodology of project selection in India.[15] Thus emphasizing financial returns or cost recovery, even for a new project, is likely to distort the choices for allocating investment in the irrigation sector.

Should Water Rates for Canal Irrigation Be Abolished in Eastern India?

It is suggested here that water charges should be abolished or merged with land revenue, particularly in eastern India where these charges are collected from millions of farmers. It is argued that abolishing water charges would improve economic efficiency as well as equity in the eastern regions.

As shown earlier, the cost of collecting water charges in Bihar is more than the actual revenues obtained. Almost 5,000 persons at the field level are engaged in socially unproductive activities such as preparing water bills, verifying them, and collecting dues (which influential farmers do not pay anyway). Abolishing water charges would release this manpower at the field level for productive activities relating to irrigation water management, such as organizing farmers for water use, providing information about maintenance requirements, as well as carrying out routine maintenance activities.[16] This would, one hopes, result in better management practices and water use and therefore in higher economic efficiency. Abolishing water charges would not affect the use of water (that is, it would not waste water or distort cropping patterns) because the existing rates are so low that they do not affect the water demand choices of farmers in any case.[17] If water rates cannot be increased for political reasons and, given the design and management of irrigation systems in India (particularly in eastern India, which has field-to-field flooding), higher water prices cannot play a role in the efficient allocation of water, abolishing water rates (or merging them with land revenue) would improve economic efficiency.

Abolishing water rates would also be more equitable because the existing rates and the present method of collecting them help

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[15] See India Irrigation Commission (1972). Recently a Committee headed by Nitin Desai gave detailed recommendations regarding presanction appraisal of irrigation projects in India. For a detailed methodological discussion and a case study of social benefit cost analysis of a major irrigation project in Bihar, see Sinha and Bhatia (1982).

[16] It is understood that in Bihar the revenue collection machinery was also responsible for some maintenance activities before these functions were separated recently. This could be easily restored.

[17] In economic terms, the existing rates are so low that they do not cut the demand function for water, if any. Lowering these rates or equating these to zero would not affect water demand.

influential farmers in the head reaches of the canals. With the abolition of rates, the general complaints of small farmers about being charged without receiving water would also be removed. Having no water rates to be collected and paid would reduce corruption among the field staff, which would help small and marginal farmers.

Should Electricity Charges Be Abolished in Eastern India?

If canal water were provided free, equity among users would require that pricing of other forms of irrigation be changed correspondingly. This suggests (1) free boring of tubewells, (2) free electricity to existing owners of electric motors, (3) interest-free loans to purchasers of new electric motors (which could also be subsidized), and (4) higher subsidies to light diesel oil (LDO) along with interest-free loans for diesel engines run on LDO (as against high-speed diesel oil). Although the detailed macro-implications would have to be worked out, these policy decisions would seem to improve economic efficiency and promote equity (both interpersonal and interregional). It is argued here that providing these facilities to increase the use of groundwater would result in higher incomes, employment, and tax revenues. Since the eastern Indian states of Bihar, Orissa, West Bengal and 15 districts of eastern Uttar Pradesh have not received adequate investments for developing canal irrigation (for both water resources and environmental considerations), this region should now be provided all the facilities for using groundwater. Apart from increasing irrigation, increased water pumping would also lower the water table in some regions, thus reducing waterlogging and salinity. The revenue implications of these suggestions would not be very significant because in the present circumstances only part of the electricity consumption in rural areas is paid for[18] (which explains the high distribution losses) and the tariff charged is not more than 15 to 20 percent of the real cost of providing electricity to rural areas (see India, Planning Commission 1987). In such circumstances, not more than 10 percent of the costs are recovered from the farmers. Providing electricity free of cost would improve the use of electric motors (for the period for which electricity is available) and reduce the price at which water is sold to farmers who do not own electric motors.[19] This would discourage the tendency to use large-size motors and encourage the improved use of water because the farmers might invest in water-conveyance systems. This will, of course, provide water to resource-poor small and marginal farmers at

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[18] As shown in the paper by Dr. Pant (Chapter 18) the state electricity boards recover only a small part of the total bills on rural electricity.

[19] See Shah and Raju (1988) for the experience of Andhra Pradesh in using flat-rate tariffs. Power consumption per tubewell reportedly increased 50 percent after a switch to flat rates.

prices they can afford.[20] The revenue implications of such a move would not be very significant since only 10 percent of the estimated cost is presently realized.

This is not to argue that those who benefit from the services provided by the state should not pay for them. Rather, the point is that if a system is recovering only 10 to 15 percent of the costs, then it is better for the physical condition of the system (design of canal systems, extension of electricity distribution systems over large areas) and for political reasons to provide these basic inputs free of cost so that all users can benefit from investments, which would improve economic efficiency and equity.

Should Cost Recovery be Concerned Only with Direct Water Charges?

As shown in this paper, the revenue flows that are one result of higher incomes from canal irrigation are much more significant than the direct recoveries through water charges. In Bihar, revenues from indirect taxes (Rs 622 million) in 1984/85 were much higher than both the direct collections and the O&M expenses on irrigation projects. Taking a comprehensive view of resource flows related to canal irrigation shows net resources flows from canal irrigation to the exchequer. O&M expenditures should be detached from collection of water charges, and maintenance works should be carried out on the basis of physical needs of the systems. Separating O&M expenditures from cost recovery would improve economic efficiency as well as equity.

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[20] Since boring would be done free of cost and electricity would be available without charge, a number of farmers are expected to invest in these devices, thus increasing the number of sellers and reducing water charges.