

FINANCING IRRIGATION SERVICES IN INDIA: A CASE STUDY OF BIHAR AND HARYANA STATES

INTRODUCTION

For this study, the States of Bihar and Haryana in northern India have been selected for in-depth analysis of available data and evaluation of alternative policies for financing irrigation services. The irrigation systems in both States are characterized by a mix of century-old projects and new ones built in the last few years. Both States are in the Indo-Gangetic Plains of northern India. While Bihar, in the East, is known for its high water resource base (both groundwater and surface water) and its low utilization, Haryana is known to be nearing its limits in using available water resources. Per capita income in Bihar in 1980-81 was 35 percent lower than the all-India average; that of Haryana was higher than the country average. The economic development of Bihar has decelerated in the 1970s and the 1980s, compared with the 1960s, on account of a number of political, social, and economic factors. The economy of Haryana has been growing fast; an increase of 76 percent in state income (Net State Domestic Product) at constant prices over the decade 1973-74 to 1983-84. The per capita income, during the same period, rose from Rs 818 in 1973-74 to Rs 1,127 in 1983-84 (at constant prices) — an increase of 38 percent. Bihar is known for its high density of population, high unemployment levels, and a fast-expanding bureaucracy. Haryana is characterized by low density of population and by a more efficient bureaucratic setup (relative to Bihar). Hence, it was expected that an analysis of these two States would throw some light on different practices followed and the problems faced in the two environments.

India is a union of 23 Federal States and 8 Union Territories. The total geographical area of India is about 328 million hectares (ha). Though India is the seventh largest country in the world in terms of area, its population makes it the second most heavily populated country (after China) in the world.

Economic Development in India

India has adopted the path of planned economic development with the objectives of removing poverty, building a strong and self-reliant economy, and creating a social system based on equity and justice. The rate of growth of GDP has accelerated over the past decade or so, and the Sixth Plan (1980-85) target of aggregate growth of 5.2 percent has been achieved. The Seventh Five Year Plan (1985-90) has targeted growth of the economy at an average annual rate of 5 percent. The sectoral growth rates expected over the Seventh Plan are: 4 percent per annum for agricultural output; 8.3 percent per annum for mining and manufacturing; 12 percent per annum for electricity, gas and water supply; and 8 percent per annum for transport services. Agriculture, which accounted for 37 percent per annum of the National Income in 1984-85, is projected to contribute about 33 percent to

National Income in 1989-90. The Plan Outlay in the public sector during 1985-90 would be Rs 1,800 billion (approximately US\$150 billion).¹ The share of major sectors in public sector outlays during the Seventh Plan is expected to be as follows: agriculture 6 percent, irrigation and flood control 9 percent, energy 30 percent, industry and minerals 12 percent, transport 13 percent, and social services 26 percent.

India's Gross National Product (GNP) at factor cost was Rs 1,884.6 billion (approximately US\$157 billion) at current prices in 1984-85. At 1970-71 prices the GNP was Rs 612 billion (US\$51 billion). Per capita Net National Product (NNP) in 1984-85 was Rs 2,343 (US\$195) at current prices and Rs 772 (US\$64) at 1970-71 prices. Annual growth rates for per capita income, at constant prices, have ranged from 1.1-2.9 percent during the 1970s to 0.2-5.5 percent during the 1980s. The index of industrial production (Base 1970 = 100) increased from 167.3 in 1981-82 to 194 in 1984-85. Gross domestic savings as a percentage of GDP increased from 16.8 in 1970-71 to 22.1 in 1984-85.

The all-India production of food grains increased from 121 million tons in 1975-76 to 146.2 million tons in 1984-85, i.e., an increase of 20.8 percent over the decade.² Index numbers (triennium ending 1969-70 = 100) in 1984-85 increased to 155 for agricultural production, 150 for rice, 245 for wheat, 110 for pulses, 146 for sugarcane, and 303 for potato. The trend in growth rate of production of food grains from 1954-1985 has been 2.7 percent per annum, slightly higher than the population growth rate. The average yield rate (kilograms/ha) for rice increased from 1,123 in 1970-71 to 1,425 in 1984-85; wheat from 1,307 to 1,873; and potato from 9,976 to 14,815. In this same period the total irrigated area (cumulative utilization) increased from 38 to 61 million ha; total consumption of chemical fertilizers (in NPK, i.e., nitrogen, phosphorus, potassium) from 2.18 to 9.55 million tons; and total area under high yielding varieties (HYV) from 15 to 62 million ha, respectively. In 1984-85 almost 60 percent of the total area under rice and 83 percent of the total area under wheat were under HYV seeds. Similarly, in 1982-83, 42 percent of the total area under rice, 72 percent of the total area under wheat, and 79 percent of the total area under sugarcane were irrigated.

The area under irrigation increased at the rate of 0.7 million ha/year during the First Plan period (1951-56), and the growth rate accelerated to 1.6 and 2.2 million ha/year during the Fifth and Sixth Plan years, respectively.³ Table 6.1 gives data on ultimate irrigation potential, potential created, and potential utilized for surface and groundwater resources. Out of an area of about 304 million ha, net sown area was estimated in 1980-81 at 140 million ha and gross cropped area at 173 million ha. The ultimate irrigation potential from major, medium and minor irrigation schemes is estimated at 113.5 million ha. Of this, 58.5 million ha is from major and medium schemes (surface water), 15 million ha from minor surface water schemes, and 40 million ha from minor groundwater schemes.⁴

¹For details, see Government of India: Seventh Five Year Plan; Economic Survey 1985-86.

²For details, see Economic Survey 1985-86; Government of India.

³For details, see the Seventh Five Year Plan, p. 72.

⁴According to the classification adopted in 1978, projects having a Culturable Command Area (CCA) of more than 10,000 ha each are classified as major schemes while those having a CCA of 2,000-10,000 ha each and those having a CCA of less than 2,000 ha each are classified as medium and minor schemes, respectively.

Table 6.1. Irrigation potential and utilization in India, Bihar, and Haryana (million ha).

	Ultimate potential			Potential created/ utilized		
	All India	Bihar	Haryana	All India	Bihar	Haryana
1. Surface water	73.5	8.4	3.1	40.2 (85)	4.0 n.a.	2.0
- major & medium	58.5	6.5	3.0	30.5 (83)	2.8 (76)	2.0
minor	15.0	1.9	0.1	9.1 (93)	1.2 n.a.	^a
2. Groundwater	40.0	4.0	1.5	27.7 (94)	2.1	1.4
Total	113.5	12.4	4.6	67.9 (89)	6.1	3.4

^aNegligible.

Notes:

1. Figures in parentheses give percentage of potential that has been utilized.

2. Data for Haryana are for gross irrigated area from canals in 1983-84 in the case of major, medium, & minor projects

Sources:

Seventh Five Year Plan, p. 12

Central Water Commission (1982)

Government of Bihar, Irrigation Department

A Comparative Profile of Bihar and Haryana

Table 6.2 gives some data on demographic and other variables for Bihar, Haryana, and all-India. According to this profile, Bihar can be seen as a heavily populated, rural State with a low per capita income. In Bihar, 32 percent of the gross cropped area is irrigated, compared with 58 percent for Haryana. In 1975-76, the per capita income in Bihar of Rs 661 (at current prices) was 35 percent lower than the all-India average. The per capita income in Haryana for the same year was Rs 1,333, about 30 percent higher than the all-India figure. By 1980-81, the relative position of Bihar had worsened when at Rs 870, it was only 57 percent of the all-India figure of Rs 1,537 at current prices. The per capita income of Haryana was Rs 2,331 in 1980-81, 52 percent above the all-India average.

Table 6.2. **A** comparative profile of India, Bihar, and Haryana (1980-81).

Item	Unit	All-India	Bihar	Haryana
Area	000 sq km	3183 (100%)	174 (5.3%)	44 (1.38%)
Population (1981)	million	684.0 (100%)	69.8 (10.2%)	12.9 (1.9%)
Population growth rate (1971-81)	%	2.5	2.4	2.9
Rural population	%	76.3	87.6	78.1
Ratio of agricultural workers to rural population	%	28.2	26.8	5.8
Population density	person per sq km	212	402	291
Number of towns	no.		161	84
Number of villages (approximately)	thousands	576 (100%)	77.959 (13.5%)	7.604 (1.3%)
Average size of land holdings	ha	2.0	1.11	3.58
Total geographical area	million ha	304	17.3	4.4
Net area sown	million ha	140	8.3	3.6
Total cropped area	million ha	173	11.1	5.5
Intensity of cropping	percentage	124	134	153
Net irrigated area (total)	million ha	38.8	3.0	21
Net irrigated area by canals	million ha	15.3	1.2	1.2
Net irrigated area by tube wells	million ha	9.5	0.8	0.9
Gross irrigated area	million ha	49.6	3.6	3.3
Per capita income (current prices)	Rs	1537	870	2331

Source: See Appendix Tables.

The total production of food grain in Bihar increased from 9.2 million tons in 1975-76 to 10.32 million tons in 1984-85, an increase of 12.2 percent over the decade. The corresponding figures for Haryana are 5.0 million tons to 6.8 million tons, i.e., an increase of 36 percent.

Irrigation development in Bihar. Before 1951, there was only one major scheme, the Sone Canal Irrigation System. The irrigation development achieved by 1951 from major and medium schemes was 0.4 million ha. In the year 1968, a new barrage was commissioned at Inderpuri, eight kilometers (km) upstream of the old anicut (diversion). The new barrage supplies water through newly constructed canals into eastern and western low level canals.

After the start of planned development, 19 major and 86 medium schemes were taken up from 1951 to 1980. During the Sixth Plan, an outlay of Rs 8,500 million was provided to create an additional potential of 665,000 ha (i.e., Rs 12,800/ha). There were 42 major and 87 medium schemes during the Sixth Plan, in addition to 10 modernization schemes.

According to the Central Water Commission, the cumulative potential created by major and medium schemes by 1981 was to be increased to 2.532 million ha. Estimated utilization was only 1.8 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 at Rs 7,640 million, i.e., an estimate of Rs 3,020/ha of potential created and Rs 4,440/ha of potential used. Table 6.3 gives details of capital costs of some major projects.

Table 6.3. Capital costs and potential created of a number of major irrigation projects in Bihar.

Name of the project	Year of completion (period of construction)	Estimated cost/outlays (Rs million)	Ultimate potential ('000 ha)	Potential created by June 80 ('000 ha)	Potential utilized by June 80 ('000 ha)	Capital cost/ha of ultimate potential
Kosi Barrage	1962-63 (57-58 to 62-63)	456 ^a				a
Eastern Kosi Canal	1985 (1957-58)	1224 ^b	434	342	185	3048
Rajpur Canal	1985 (1961-85)	1105	125	123	n.a.	6905
Western Kosi Canal	1987 (1971-87)	1560	314	Nil	n.a.	5131
Gandak ^c	1964-1985	4160	1710	n.a.	n.a.	2433
Subarnarekha	1983-1990	4810	200			24050
North Koel Reservoir	1978-	1140	131			8702
Sone Modernization (Phase I)	1985-1990	2470				

^aThe cost of the Kosi Barrage has been allocated to the three canal systems on the basis of ultimate potential, i.e., Rs 228 million for Eastern Kosi; Rs 65 million for Rajpur Canal and Rs 163 million for Western Kosi Canal.

^bAlthough the estimated cost was Rs 1,041 million, the expenditures incurred have been: Rs 991 million up to 1980-81; Rs 110 million during 1981-82 and the Sixth Plan outlay of Rs 579 million.

^cThe cost of a hydro-electric power plant of 7,500 kw in Nepal has not been excluded which may be approximately Rs 60 million.

Source: Central Water Commission: Report on the Status of Irrigation Development in India, 1981, New Delhi.

Irrigation development in Haryana. Before 1951, the only main project existing in the State was the Western Yamuna Canal System, one of the oldest canal systems in the country. The irrigation development from preplan major and medium schemes was 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. One major scheme undertaken during 1951-64 was the Bhakra-Nangal Project (portion in Haryana) which was completed in 1963-64, adding potential irrigation of 676,000 ha. Cumulative potential added from major and medium schemes upto 1980-81 was estimated at 1.785 million ha, while the cumulative utilization was estimated at 1.66 million ha. The outlays and potential created of some major and medium projects are given in Table 6.4.

Table 6.4. Capital costs of major and medium irrigation projects in Haryana.

	Potential created ('000 ha)	Potential utilized ('000 ha)	Expenditure (total) (Rs million)	Expenditure (Rs/ha) potential created
<i>During Fifth Five Year Plan (1973-78)</i>	181	37	1100	6074
<i>Sixth Plan (1980-85)</i>				
Major schemes (ongoing)	14		1845	24930
Medium schema (ongoing)	11		58	5212
Major schemes (new)	21		400	14810
- Nehru Lift Irrigation Scheme	155		943	6084
- Laharu Lift Irrigation Scheme	66		3 w	4545
- Sewani Lift Irrigation Scheme	46		221	4800
- Sutlej-Yamuna Link	215		1010	3675
Total "fall major & medium schemes	998		3958	3966

Source: Central Water Commission, Government of India: Report on the Status of Irrigation Development in India, 1981.

GENERAL POLICIES REGARDING IRRIGATION FINANCING

Historically, in India, two contradictory positions have been taken with respect to the levels at which water rates are fixed (Ansari 1968). The Planning Commission has emphasized the need for raising rates so as to augment irrigation revenues. Certain academic and even certain official and semiofficial circles, on the other hand, argued that the level of irrigation charges should be kept low even if this implies that full irrigation costs may not necessarily be recouped. Two major arguments are advanced

for assessing charges which do not cover **costs**. First, because the benefits of investment in major irrigation projects are spread over a wide range of people, with some people realizing direct benefits and others only indirect benefits, the full recoupment of **costs** from direct beneficiaries may not be **justified**.⁵ If appropriate charges *can* be levied on the indirect beneficiaries, irrigation can still be a paying proposition. If, however, the indirect benefits are in part or wholly not chargeable, there would seem to be a case for the State's subsidizing of irrigation in the overall social interest.

Second, water rates should be kept low **so** that farmers **are** motivated to exploit the full irrigation potential. This argument implies that under-utilization of irrigation potential (of major projects) is due to high water rates. Therefore, by lowering rates better utilization *can* be achieved. **Against** this argument, it is generally contended that low water rates result in overirrigation and/or wastage of water. Besides, lower water rates for crops which are irrigation-intensive (e.g., rice, sugarcane) relative to those which are not (e.g., wheat, sorghum, millet) would result in the use of irrigation for crops which need not be optimum from the view point of society.

Thus, the level of water rates has to be determined not only from the narrow viewpoint of an accountant for whom cost recovery and financial returns are objectives in themselves. The level of, and changes in, water rates have to be related to the benefits obtained from the use of irrigation, and have to be considered in the context of overall macro policies relating to agricultural prices, input pricing, trade policies and tax or subsidy policies.

According to the Irrigation Commission "from the irrigator's point of view, therefore, water rates should be related to the benefit which irrigation confers rather than to the cost of irrigation projects" [Government of India 1972(1:268-269)]. Because irrigation requirements of crops vary according to season and region, the quantity of water supplied is also relevant in determining water rates. **As** irrigation projects differ widely in their capacity to meet the irrigation requirement of crops, adequacy and dependability of supply become important considerations in **fixing** irrigation rates. The Irrigation Commission came to the conclusion that "with **so many** considerations involved, there *can* be no precise formula for fixation of water rates, which must therefore **remain** a matter of administrative decision."

The Irrigation Commission recommended the following principles for guidance:

- i) Water rates should be levied on a 'crop basis' except in the case of irrigation from tube wells;
- ii) The rate should be related to the **gross** income from the crop and not to the cost of the project. It should range between **5-12** percent of **gross** income, the upper limit being applicable to each crop;⁶

⁵Indirect benefits arise from expanded business opportunities for agro-processing industries and form larger quantities of lower priced (than otherwise would have been possible) food available to urban consumers.

⁶As noted by the Irrigation Commission, (Government of India, 1972:268) "the value of irrigation water is the net gain which the farmer derives from its use. But irrigation is only one of the basic inputs used by a farmer and it is difficult to evaluate the precise contribution it **makes** to his net gain. In view of this difficulty, the Maharashtra Irrigation Commission (1960-62) had suggested that water rates on a crop basis should be fixed at **6-12** percent of the gross income, which is easier to calculate."

- iii) The rates should be within the paying capacity of irrigators and should aim at ensuring full utilization of available supplies;
- iv) Among regions with a similar class of supply, there should be the minimum disparity, if any, in the rates charged;
- v) For fixing rates, irrigation should be divided into A, B, and C categories on the basis of the quantity and timeliness of supply. Lower rates may be fixed where, on account of good rainfall, the demand for irrigation water is less or where the supply is inadequate and uncertain; and
- vi) The general level of rates in a State should be such that, taken as a whole, the irrigation schemes do not impose any burden on the general revenues.

The irrigation Commission calculated the ratio of water rate to gross value of output for rice and wheat in a number of States (in the late sixties) and found that "the irrigation rates actually in force in different States are exceedingly low." For example, in Bihar, the water rate as a percentage of gross value of produce was 7 for rice and 2.7 for wheat. The corresponding figures for Haryana were 3.1 for rice and 1.1 for wheat.

Apart from raising water rates, the Government can also claim a share of the unearned increase in land values as a result of irrigation. All the States have enacted legislation for raising this levy which was determined by the difference between the market value of irrigated and nonirrigated land in the project area or in its vicinity. The Acts, however, have not been implemented by most of the States, and in some no assessment has been made, let alone any recovery. The main obstacle in enforcing the Betterment Levy Act has been the difficulty in assessing the increase in the value of land as a result of irrigation. It is contended that tenancy laws conferring permanent ownership rights upon tenants, and the implementation of other land reform measures, such as the abolition of intermediaries, fixation of fair rent, ceilings on land holdings, and regulation of transfer to prevent fragmentation of holdings, have all affected the market value of land. Hence, it becomes difficult to assess the increase in land prices attributable to irrigation [Government of India (1972:280)]. Apart from the procedural difficulties, implementation of a Betterment Levy is also constrained by the lack of political will in taxing better-off farmers

CAPITAL COSTS OF IRRIGATION

Although much data on capital costs are available, the figures are not comparable across projects or states. This is because: a) irrigation projects differ in terms of type of structure (storage versus diversion), size of system, type of scheme (modernization scheme, gravity flow, or lift irrigation schemes) and the duration of construction; b) capital expenditures are incurred over a long period, sometimes over 15-20 years, and, on account of price changes in cost of materials and labor, the expenditures in different years cannot be added; and c) irrigation potential created or utilized may be

a subjective concept, and the figures of potential area that ~~can~~ be (and when) irrigated vary from one project to another. Subject to these limitations, some data on capital costs of irrigation projects are presented below.

Capital Costs of Surface Irrigation Projects

Here, a distinction is to be made between major and medium projects, and minor projects. According to a recent estimate (Vohra 1986) the cost of creating one ha of irrigation potential (in India) through the major and medium irrigation route stood at Rs 1,200 in the First Plan (1951-56); it rose to as much as Rs 19,271 during the Sixth Plan (1980-85). It is now projected to be as high as Rs 26,872 in the Current (Seventh) Plan. Although these figures are not comparable due to price changes over time, recent figures do indicate the order of magnitude involved. Thus, on average, at 1984-85 prices, the capital cost of an additional hectare of area to be irrigated (potential created) would be around Rs 27,000 (US\$2,250).

Major and Medium Projects in Bihar

According to the latest estimates, a total expenditure of Rs 7,135 million was spent on creating an additional potential of 427,000 ha. This gives an average figure of Rs 16,710/ha of potential created. However, it has been found that out of the cumulative irrigation potential created of 2.88 million ha by the end of the Sixth Plan, the cumulative utilization was only 2.18 million ha, i.e., 76 percent. If this is taken into account, the capital costs of major and medium irrigation projects would be Rs 22,000 (US\$1,832) per ha of potential actually utilized. An estimated expenditure of Rs 6,023 million is expected to be spent on 3 major and 20 medium schemes during the Seventh Plan (1985-90).

Table 6.3 presents data on capital costs and potential created of a number of major projects over approximately the last twenty years. Some of these projects, e.g., Kosi and Gandak Canal Systems, have been under construction for 20-25 years, and hence, these figures cannot be used unless a breakdown of the capital cost of each year is available and these figures can be re-estimated at 1984-85 prices. The only figure which seems to be usable is that of Subarnarekha Project which has recently been taken up and the cost estimate is based on 1984-85 prices. This gives a capital cost of Rs 24,050 (US\$2,000) per ha of potential created at 1984-85 prices.

Expenditures on Command Area Development Programs

It has been suggested by the Government of Bihar that the main reasons for the gap between potential created and potential utilized is nonavailability of 5-8 ha field channels, specially in the Kosi and Gandak command areas. Hence, the government has proposed some activities under the CADA programs which involve expenditures on direction and administration, surveys, demonstration and training, construction of field channels and field drains, on-farm development work, and land

levelling. During the Sixth Plan, investments of Rs 775/ha on construction of field channels and Rs 120/ha on infrastructural items were made (Table 6.5). Even with these investments and the establishment of Command Area Authorities, the construction of field channels is not matching the creation of additional potential every year.

Table 6.5. Expenditure on command area development programs in Bihar

Expenditure	Capital expenditure		Revenue Expenditure	
	1984-85	1980-85	1984-85	1980-85
Direction & administration			7.4	23.6
Survey etc.			24.0	112.0
Trial, demonstration, training			7.0	
Grant and loan for construction of field channels	94.0	310		
On farm development subsidy	22.0	430		
Physical achievements				
Soil surveys etc.(000 ha)			200	1118
Construction of field channels (000 ha)	255	943		
Capital expenditures per ha				
Construction of field channels	370	330		
Subsidy on on-farm development		445		
Subtotal		775		

Source: Government of Bihar, Irrigation Department, Formulation of Draft Seventh Plan for Command Area Development in Bihar (1985-90).

The main difficulty in construction of field channels is non-availability of land. At present, farmers are expected to donate land for these channels, and this is not forthcoming as per program. Whatever land has been obtained is along the periphery of the plots, resulting in longer channels involving higher costs and increased conveyance and seepage losses. In view of these difficulties, it is being suggested in government circles that the land acquisition cost of field channels should be borne by the government to accelerate the construction program. This would further raise the capital cost of providing irrigation through surface projects. To recapitulate, the total cost of utilizing potential created in Bihar, at 1984-85 prices, is around Rs 25,000/ha or approximately US\$2,100/ha.

Capital Costs of Major and Minor Projects in Haryana

Table 6.4 gives data on capital costs of some recent projects undertaken in Haryana. The average cost of projects undertaken during 1973-78 was Rs 6,074/ha of potential created and Rs 29,730/ha of

potential utilized. The average cost of ongoing major schemes during the Sixth Plan (1980-85) was estimated at Rs 24,930/ha of potential created. The corresponding figure for medium schemes was Rs 5,272/ha. Estimated expenditure on new major schemes was Rs 14,810/ha of potential created. The capital costs for a number of major and medium lift irrigation schemes ranged between Rs 3,675 and Rs 6,084/ha. However, it is difficult to judge these figures because many of these are not new schemes (i.e., where irrigation is being provided for the first time), and it is difficult to estimate the potential actually utilized. Thus, a representative figure for Haryana will be an average of ongoing and new major schemes undertaken during the Sixth Plan, i.e., a capital cost of Rs 22,230 or US\$1,850/ha of potential created.

Minor Irrigation Projects in Bihar

Table 6.6 gives data on capital expenditures incurred on minor irrigation development in Bihar during 1980-85. Out of the estimated 1.1 million ha of potential created, 0.8 million ha is through groundwater schemes. Since the cost of groundwater schemes is not given separately, it is assumed that this average figure of Rs 2,786/ha would be true for small-scale private tube wells. This cost excludes the capital cost of rural electrification which is incurred by the State Electricity Board and is not being accounted for by the Minor Irrigation Department. According to a recent study (Bhatia 1986), the capital costs of generation and transmission for energization of an electric pump-set are Rs 20,000 per kilowatt (kw) or Rs 40,000 per pump-set of 2 kw. Since the demand for pumping will coincide with other loads, it would not be possible to use this generation and transmission capacity created for meeting the demand of pumpsets.

Table 6.6. Capital expenditures incurred on minor irrigation works in Bihar during the Sixth Plan (excluding costs of electrification).

	Groundwater	Surface water	Total
1. Ultimate potential (million ha)	4.0	1.9	5.9
2. Potential created before 1980-85 (million ha)	2.1	1.2	3.3
3. Potential created during 1980-85 (million ha)	0.8	0.3	1.1
4. Expenditure incurred (1980-85) by Minor Irrigation Department (Rs million)			2315
5. Liability in the form of a bank loan, electricity bill, subsidy and payments to contractors etc.			750
6. Total expenditures (4+5)			3065
7. Total expenditures per ha of potential created			2786
8. Capital costs per ha of potential created (excluding electricity bill etc.)			2105

Source: Government of Bihar: Seventh Five Year Plan, Minor Irrigation Department

However, to allow for some utilization for other purposes, only 50 percent of the total cost is attributed to water pumping, i.e., the capital cost included is Rs 20,000 per pumpset. To this one should add the cost of subtransmission (i.e., 11-kilovolt, low-tension line) and connection which would be around Rs 10,000 per pump-set, particularly in Bihar where a large number of villages have not yet been electrified. This gives a total capital cost of electrification of a pump-set at Rs 30,000. The area irrigated by a 2-kw pumpset depends on a number of factors such as farm size, fragmentation of holdings, and cropping pattern. If only supplementary irrigation is provided for rice, a 2-kw pump-set can easily irrigate 2 ha of wheat. Given the fact that 76 percent of the total number of holdings are below 1 ha and the number of fragments per holding are between 17 and 20, it is very unlikely that, on average, an electric pumpset will effectively irrigate more than 1 ha. Thus, the capital cost to society of providing irrigation to 1 ha would be Rs 52,800 or US\$4,400 when total capital costs incurred are taken into account. Obviously, the capital cost to the farmer would be very low, since he is not required to pay for the costs of connection and low-tension distribution lines or for the high capital costs of generation and transmission through tariffs which reflect long-run marginal costs of supplying electricity to the rural areas.⁷

State tube wells. Since the existing state tube wells were constructed before 1980-81, data on capital cost of these will not be of much use. In a new project for construction of 500 state tube wells in Bihar (which was evaluated in 1986), the capital cost of one tube well is Rs 75,230. The potential area to be irrigated is 50 ha per tube well, i.e., a capital cost of Rs 1,500/ha of potential created. During the last 5 years, an average tube well irrigated around 20 ha, giving a figure of Rs 3,760/ha of actual irrigated area. However, these costs do not include capital costs of generation, transmission, and distribution. For a 1.5-2 cusec tube well, the pump-set would have to be about 10 horse power (hp) or 7.46 kw under conditions in Bihar, where the water table is quite high. This would give a capital cost of generation and transmission of Rs 150,000. This capital cost could be shared with other consumers of electricity if water pumping is done during hours which do not coincide with the system peak. Since demand for water pumping is seasonal and farmers require water during a given period, very much staggering of the pumping load may not be possible. Assuming that about half the capital cost is attributed to other uses, this would give a capital cost of Rs 85,000 (including Rs 10,000 for cost of connection) per tube well or Rs 4,250/ha. Thus, the estimated capital cost of providing irrigation through state tube wells is Rs 8,260/ha when considered from the viewpoint of society (i.e., when total costs are included).

A Comparison of Costs

A comparison of capital costs of an irrigated ha is presented in Table 6.7. It may be noted that from the viewpoint of society, use of groundwater through state tube wells has the lowest capital cost per ha, followed by surface irrigation through major and medium projects.⁸ However, as will be discussed

⁷Electricity tariffs for agriculture are very low and do not cover even 15-20 percent of the real cost of providing electricity. Besides, there is large-scale theft of electricity (through unauthorized tapping of wires), particularly in Bihar. These are the main reasons for the huge losses incurred by the State Electricity Board. The losses for Bihar and Haryana in 1982-83 were Rs. 927 million and Rs. 29 million, respectively. Accumulated arrears of interest up to 1982-83 were Rs. 2,016 million and Rs. 150 million, respectively. See Finance Commission (1984).

⁸Data on surface irrigation through minor projects were considered not reliable enough (both capital and potential created) to be used for comparison.

in the next section, O&M expenses (including electricity charges) for state tube wells range between Rs 1,724 and Rs 4,257 per ha for potential created and gross irrigated area, respectively.

Table 6.7. A comparison of capital costs of surface and groundwater projects undertaken during 1980-85.

	Rs per ha of potential created	Rs per ha of potential utilized
<i>Surface irrigation</i>		
<i>major & medium projects</i>		
Bihar	16710	22000
(including command area development)	17610	22900
Haryana	22230	n.a.
<i>Groundwater projects</i>		
<i>(excluding electrification)</i>		
Bihar		
State Tube Well Corporation	1500	3760
Minor irrigation (of which		
80 percent is groundwater)	2786	2186
<i>Groundwater projects</i>		
<i>(including electrification; i.e., cost to society)</i>		
State tube wells	5750	8010
Private tube wells	32786	32786

Source: Tables 6.3, 6.4, 6.5.6.6.

OPERATION AND MAINTENANCE COSTS

Allocations by State governments for O&M of irrigation projects has been the concern of a number of government committees or commissions⁹. According to the Public Accounts Committee (1983), which examined the planning process and monitoring mechanism in relation to irrigation projects, “maintenance of existing irrigation systems 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.”

The Irrigation Department (Central Government) in a note sent to the Seventh Finance Commission in November 1977 suggested that the department considered that neglecting maintenance of irrigation and drainage system was the main reason for underutilization of irrigation potential. The department reported that a Central Water Utilization Team had found O&M budgets to be grossly

⁹As estimated by the Irrigation Commission (1972), public irrigation work in Bihar and Haryana were making losses in 1967-68.

inadequate in many **cases** and the systems to be gradually deteriorating. The **Finance** Commission (1983) examined the data submitted by the Union Ministry of Irrigation and found that maintenance expenditures incurred **varied** widely, 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/ha** on the Gangapur project, whereas for Jayakwadi project it was as high as **Rs 171.7/ha** for the same year. In Punjab, the variation was from a minimum of **Rs 9.10/ha** on the Upper Doab Canal System to **Rs 38.66/ha** on the Bhakra Canal System. Some States suggested to the Eighth Finance Commission certain norms of expenditure for maintenance of multipurpose, major and medium irrigation works for the period 1984-85 to 1988-89. Bihar suggested a norm of **Rs 120/ha of gross irrigated area** for the plains, while Haryana suggested **Rs 75/ha** of irrigated area. The figures suggested by other States were: **Rs 127/ha** of irrigated area in Uttar Pradesh **Rs 100** each per hectare of irrigation potential in Gujarat and net irrigated area in Tamil Nadu.

O&M Expenses in Bihar

Data on O&M expenses have been obtained a) from the Annual Budget papers of the Government of Bihar for the year 1984-85 and b) from the Irrigation Department, Government of Bihar for the period 1980-81 to 1984-85 for major irrigation projects. Table 6.8 presents data on O&M expenses

Table 6.8. Expenses and receipts from irrigation projects in Bihar: 1984-85.

	Total (Rs million)	Per ha of irrigated area ^a	
		Rs	US\$ ^b
<i>Expenses</i>			
Operation and maintenance	117.7	11.4	1.1
Revenue establishment	70.7	34.3	2.8
Total (including 4.5 million for direction & administration)	242.8	117.9	9.6
<i>Receipts</i>			
Sale of water for irrigation	126.4	11.4	1.1
Other receipts	n.a.	n.a.	n.a.
Total receipts	126.4	11.4	1.1
Net revenue after deducting cost of collection	51.7	21.1	2.3
Net revenue as percent of O&M costs	33.2	33.2	
Net receipts after deducting cost of collection and O&M costs	-116.4	-56.5	-4.5

^a Assuming irrigation potential utilized in 1984-85 as 2.06 million ha.

^b Assuming US\$1 = Rs 12.

Source: Government of Bihar, Budget 1985-86:77-80, 186-192.

for 1984-85, indicating that **Rs 167.6** million was allocated for multipurpose projects and irrigation projects. Taking the figure of irrigation potential utilized in 1984-85 at **2.06** million ha, this gives an estimated O&M allocation of Rs 81.4 (US\$6.8) per ha. The budget also provides information on expenditure on revenue establishment which was estimated at **Rs 70.7** million or Rs 34.3/ha.

Similar data for a period of five years are available for four major projects (Sone, Kosi, Badua and Chandan), and are presented in Table 6.9. The costs of establishment (salaries and wages) have risen significantly over the last five years, particularly during the last two years. The increase in 1984-85 over 1980-81 was **260** percent for expenses on irrigation establishment.

Table 6.9. Costs of establishment, works and costs of revenue collection from **Major** Irrigation Projects^a in Bihar (Rs. million).

	1980-81	81-82	82-83	83-84	84-85
A. 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
B. Irrigated area; potential utilized (cumulative) (million ha)					
	1.18	1.26	1.34	1.42	1.52
C. Costs per ha (Rs)					
-- 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	42.1	41.8
Total	64.9	81.8	94.0	96.4	95.1

^aThe irrigation projects included are: Sone, Kosi, Badua and Chandan.

Source: Department of Irrigation, Government of Bihar.

It is reported that recently there has been a change in the practice of allotting major repair and maintenance work to contractors. Jobs which were earlier given to contractors are now being undertaken by the Irrigation Department itself. This 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 have declined during that year. The subtotal of expenses on establishment and works relating to O&M have increased from Rs 59.3 million in 1980-81 to Rs

81.1 million in **1984-85**; an increase of 37 percent in current prices. These increases in costs would be much lower if adjustments are made for changes in prices (wages) of field labor and materials.¹⁰

The adjustment by Wholesale Price Index for all commodities gives the following results: a) The establishment component of O&M costs has increased by 173 percent in real terms over the 5-year period; b) the works component has declined by 23 percent in real terms; and c) the subtotal of O&M expenses has increased by 4 percent in real terms; d) the revenue establishment expenses have increased by 62 percent in real terms (instead of by 113 percent in nominal terms); and e) the sum of O&M costs and revenue establishment expenses has risen by 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 utilized for these projects), O&M expenses are (Rs/ha) 50.2 for 1980-81 and 53.3 in 1984-85, showing a remarkable stability." However, expenses on revenue establishment have increased significantly: **184** percent over the 5-year period. The costs of revenue establishment which were Rs 14.7/ha in **1980-81** have increased to **Rs 41.8/ha** in 1984-85. This gives a total expense of Rs **95.1/ha** on O&M costs and revenue establishment in **1984-85**, showing an increase of **47** percent over the 5-year period. Note that expenses on revenue establishment, which were about one-half of the total O&M expenses in **1980-81**, have increased to about 78 percent of the latter in **1984-85**. As between expenses on establishment and works, the share of works has declined from about 85 percent in 1980-81 to about 60 percent of the total in **1984-85**. This decline may be reflecting either a change in policy (where more work is being done departmentally) or a genuine reduction in expenses on repairs on account of increasing expenses on maintaining the establishment. Since salaries and wages for regular employees of the department would be the first charge on funds allocated to O&M, it is quite likely that a threefold increase in establishment is 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 on revenue establishment in the case of Sone Canal, the oldest system in the State (Table 6.10). While establishment costs and expenses on revenue collection have each almost doubled over the 5-year period, the expenses on works have increased only marginally (5%). The figures for the **Kosi** project also show the same pattern: a stagnation (actually a decline from Rs 33.6 million to **Rs 30.1** million) in the expenses shown under 'Works' and an increase of more than 700 percent in O&M establishment costs (Table 6.11). Establishment costs of revenue collection have also increased by 125 percent from **Rs 10.7** million to **Rs 24.1** million over the 5-year period. Thus, these phenomenal increases in establishment expenses need to be analyzed in-depth and it would be necessary to evaluate the reductions in 'Works' costs and their implications for the equality of O&M functions performed by (or on behalf of) the Irrigation

¹⁰The index of O&M charges increased by 62 percent in 7 years, 1975-76 to 1981-82. It was found that the index of the wholesale prices (WPI) for all commodities also increased by about 62 percent over the same period, although year to year variations are somewhat different. Hence, the WPI for all commodities has been used to deflate O&M expenses as well as receipts for the period 1980-81 to 1984-85. The WPI shows an increase of 13.5 percent over the 5-year period.

¹¹It may be pointed out that these figures of potential utilized seem to be overestimates as these have been obtained by i) approximating the canal irrigated areas in Northeast alluvial plains with those of Kosi, and those in Southwest alluvial plains with those of Sone and ii) adding the 'entire' increase in potential utilized in the State during this period to these four projects.

Department. The increase in establishment costs of O&M as well as revenue collection is very high, even when adjustments for price changes are made. In fact, the reductions in expenditure on 'Works' in real terms would be even higher, i.e., 20 percent for Sone and 32 percent for Kosi projects, respectively.

Table 6.10. Costs of establishment, works and revenue collection^a for Sone Canal Project (in Rs million).

	1980-81	81-82	82-83	83-84	84-85	Percentage increase (1984-85 over 1980-81)
1. Establishment costs	5.9	5.9	8.0	8.5	11.1	88
2. Works	12.8	14.3	14.0	15.3	13.4	5
3. Subtotal (1+2)	18.7	20.2	22.0	23.8	24.5	31
4. Cost of revenue collection	19.1	23.0	28.3	39.3	39.5	106
5. Total (3+4)	37.8	43.2	50.3	63.1	63.0	66

^aThese figures are marginally different from those obtained from the Budget papers.

Source: Irrigation Department, Government of Bihar.

Table 6.11. Costs of establishment, works and revenue collection^a for Kosi Project (in Rs million).

	1980-81	81-82	82-83	83-84	84-85	Percentage increase (1984-85 over 1980-81)
1. Establishment costs	2.5	8.6	11.4	20.5	20.8	132
2. Works	33.6	32.0	34.1	26.5	30.1	-11
3. Subtotal (1+2)	36.1	40.6	45.5	47.0	50.9	41
4. Cost of revenue collection	10.7	14.2	23.7	21.4	24.1	125
5. Total (3+4)	46.8	54.8	69.2	68.4	75.0	60

^aThese figures are marginally different from those obtained from the Budget papers.

Source: Irrigation Department, Government of Bihar.

Financial performance of State tubewells in Bihar. The Bihar Water Development Corporation has been responsible for the construction and operation and maintenance of public tube wells with a discharge capacity varying from 1.5-2 cusecs. The Corporation is responsible for the installation of electric pumps,

the construction of channels, the maintenance of completed works, the supply of irrigation to fields, and the assessment and realization of water rates. Till 1985, the Government of Bihar had contributed Rs 100 million towards its share capital. The Corporation has a plan of creating an additional potential of 90,000 ha during the Seventh Plan (1985-90). A provision of Rs 450 million has been made for 1985-90 which includes Rs 140 million towards increased share capital of the Government of Bihar.

The performance of public tube wells has not been satisfactory in Bihar. As shown in Table 6.12, out of 5,311 statetube wells constructed up to 1984-85, about 400-500 have not been energized for the last 3 years. The average number of working tube wells has declined from 3,469 in 1980-81 to 2,167 in 1984-85. This shows that in 1984-85, only 44 percent of energized tube wells (and 40 percent of total constructed) were in working condition. The main reasons for nonfunctioning are given as noneffective management, lack of power, and lack of maintenance of pump-sets and channels. As a result, the total area irrigated by state tube wells has declined from 77,000 ha in 1980-81 to 35,000 ha in 1984-85. In 1984-85, area irrigated per working state tube wells was 16.2 ha as against the estimated command area of 40 ha.

Table 6.12. Financial performance of public tube wells in Bihar.

	Unit	1980-81	81-82	82-83	83-84	84-85
	1	2	1	4	5	6
1. Number of tube wells constructed (cumulative)	Number	5281	5311	5311	5311	5311
2. Tube wells in working condition (cumulative)	Number	3469	3364	3452	2812	2167
3. Total area irrigated	000 ha	77	83	100	50	35
4. Area irrigated per TW ^a	ha	22.2	24.7	29.0	17.x	16.2
5. Total revenue collection	Rs million	Nil	0.77	0.61	0.55	0.56
6. Revenue collection per TW	Rs	Nil	230	177	196	254
7. Revenue collection per ha	Rs	Nil	9.3	6.1	11.0	15.7
8. Establishment expenses of Bihar Water Development Corporation (total)	Rs million	62	60	82	77	90
9. Estimated electricity expenses (total)	Rs million	46	46	48	49	54
10. Total expenses (8+9)	Rs million	108	106	130	126	149
11. Electricity expenses per TW	Rs	13260	13674	13900	17425	27226
12. Total expenses per TW	Rs	31133	31510	37660	44800	68760
13. Total expenses per ha	Rs	1402	1276	1300	2517	4243
14. Net losses (7-10)	Rs million	108	105	129	125	14X
15. Revenue collection as percent of total expenses	%	0	0.7	0.5	0.4	114

^aTube well

Source: Bihar Water Development Corporation, Patna.

An analysis of O&M costs shows that during 1984-85, Rs 90 million was spent on the establishment expenses of the Corporation while Rs 59 million was the estimated electricity expenditure.¹²

O&M Expenses in Haryana

The working expenses (direct and indirect) for irrigation projects in Haryana are presented in Table 6.13. During the period 1975-76 to 1981-82, these expenses have increased (at current prices) from Rs 115 million to Rs 207 million, i.e., an increase of 80 percent over the 7-year period. However, the estimated index of O&M charges, accounting for changes in prices of field labor and materials (cement, steel structure, paints, etc.), increased from 100 in 1975-76 to 162 in 1981-82. When total working expenses are deflated by this index used by the Eighth Finance Commission in its report (1984), the increase in working expenses in real terms has been quite low (only 1%). This shows that the near doubling of total working expenses in Haryana is mainly due to changes in prices of labor and materials.

Table 6.13. Gross receipts and working expenses of irrigation projects in Haryana: In real terms, 1977-78 to 1981-82 (Rs million).

Year	Gross Receipts (Current Prices)	Working Expenses (Current Prices)	Index of Wholesale Price (1975-76 = 100)	Gross Receipts deflated by Wholesale Price Index (1975-76 = 100)	Estimated Index ^a of O&M Charges (1975-76 = 100)	Working Expenses deflated by Index of O&M Charges	Percent of Receipts to Working Expenses
1	2	3	4	5	6	7	8=5:7
1975-76	85	115	100	85	100	115	74
1976-77	111	101	102	109	107	94	116
1977-78	XY	116	107	83	111	105	19
1978-79	95	001	107	89	118	111	10
1979-80	80	164	126	63	001	125	50
1980-81	101	181	148	68	142	127	54
1981-82	10X	207	163	66	162	128	52
Percent increase							
1981-82 over 75-76		27%	80%	63%	62%	11%	

^aThis is a consolidated index as estimated by the Eighth Finance Commission. It assumes that 80% of the maintenance costs are accounted for by field labor and 20% by materials such as cement, steel structures, paints and varnishes etc.

¹²It may be noted that due to shortage of funds, the BWDC does not pay the State Electricity Board the charges which are due for operation of the TWs. These charges were estimated at Rs 27,226 per TW out of a total estimated O&M expenses of Rs 68,760 per TW. The deficit for BWDC would partly explain the commercial losses of Rs 927 million of the Bihar State Electricity Board for the year 1982-83.

During the same period, gross irrigated area from government canals increased from 1.69 to 1.86 million ha, an increase of 10 percent. The estimated working expenses at current prices increased from Rs 68/ha in 1975-76 to Rs 113/ha in 1982-83, an increase of 66 percent. (These were 3 times those of 1973-74). However, when the increase in prices of field labor and materials is taken into account, the working expenses in real terms have not increased at all during the period 1975-76 to 1982-83.

Comparison of O&M Expenses

Table 6.14 presents a comparison of O&M expenses in government-managed irrigation systems for 1984-85. In Bihar, O&M expenses range between Rs 44.7/ha in Sone Canal and Rs 120/ha for the Kosi project. In contrast, in Haryana, on average, O&M expenses (after deducting 10% for revenue establishment) are Rs 120/ha. However, since cost of revenue establishment is relatively higher in Bihar, the sum of O&M expenses and revenue establishment is Rs 117/ha for Sone and Rs 177/ha for Kosi. The O&M expenses for state tube wells are very high at Rs 4,257/ha of irrigated area (potential utilized).

Table 6.14. A comparison of O&M expenses and receipts in government-managed irrigation systems (1984-85).

	Rs per heddre of potential utilized				
	O&M expenses	Cost of Revenue establishment	Gross Receipts	Net Receipts	Net Receipts as percent of O&M Expenses
<i>Bihar</i>					
<i>Surface Irrigation</i>					
Major irrigation projects	81.4	34.3	61.4	27.1	33
Four major projects	53.3	41	n.a.	n.a.	n.a.
Sone canal	44.7	72	110	38	85
Kosi project	120	57	45	-12	Negative
<i>Groundwater</i>					
State tube wells	4257	a	16	16	0.4
<i>Haryana</i>					
(working expenses, direct, and indirect)	133	a	51	51	38

^aIncluded in O&M Expenses.

- Notes: 1. Sources: See Tables 6.9, 6.10, 6.11, and 6.13.
 2. Figure for Haryana for 1982-83 has been converted to 1984-85 prices by using Wholesale Price Index for all-commodities which corresponds to prices of field labor and materials.
 3. For Sone, irrigated area is taken as 0.548; for Kosi as 0.425 per ha at 76 percent utilization of ultimate potential.

Details of O&M Expenses and Costs of Revenue Establishment

Table 6.15 gives details of expenditure on irrigation projects (excluding multipurpose projects) in Bihar for 1984-85. According to this, establishment costs, i.e., salaries of workers and officers, account for two-thirds of the total current expenses. Revenue establishment accounts for about 60 percent of these establishment costs which are predominantly (90percent) salaries and wages. Motor vehicles account for about 2 percent of the total while machinery, tools, and plant account for less than one percent of the total expenses. The Irrigation Department spent about one-third of the total allocation, i.e., Rs 32.1 million, on repair and maintenance. Senior officials (superintending engineer and executive engineer) said that at the field levels, approximately 10 percent of this cost is incurred on fixed expenditure on labor and vehicles, 40 percent on earthwork in canals, 25 percent on repair of structures, 15 percent on repair and maintenance of buildings, and around 10 percent on new buildings and quarters. Of the total allocation for repair and maintenance, about 50 percent is spent on materials (cement, steel, bricks, sand) and the rest on labor. Thus, almost 80 percent of the total O&M expenses are essentially payment of salaries to officers, wages to laborers, and office expenses. (See Tables 6.16 and 6.17 for further details for major irrigation projects as well as for the Kosi project.) The estimated number of senior staff on O&M work in the State of Bihar are: 15 chief engineer, 100 superintending engineers, 200 executive engineers, 600 assistant engineers, and 1,800 junior engineers. Because of the prevailing unemployment situation, there are strong political pressures to recruit more staff at the officer as well as the worker levels.

Table 6.15. Details of expenditure on irrigation projects (excluding) multi-purpose projects in Bihar: 1984-85 (in Rs million).

	Total	Percent of Total
1. Establishment (including revenue establishment) ^a		
- salaries and allowances of officers	5.1	5
- salaries and allowances of workers	53.9	54
- office expenses	6.3	6
- total establishment	<u>65.3</u>	<u>65</u>
2. Repairs & maintenance	32.1	32
3. Machinery, tools & plant	0.3	1
4. Motor vehicles	1.7	2
5. Total	<u>99.4</u>	<u>100</u>

^aDetails of revenue establishment are as follows: salaries of officers Rs 0.5 million; salaries of workers Rs 34.2 million and office expenses etc., Rs 4.8 million.

Source: Government of Bihar, Irrigation Department: Details of Budget 1985-86, Patna 1985.0. — less than 0.5 percent. Also see Table 6.1h.

Table 6.16. Details of expenditures on irrigation projects^a (excluding multipurpose projects): 1984-85 (in Rs thousands).

	Salaries of officers (including D.A.)	Salaries of workers (including D.A.)	Office expenses	Travel expenses	Payments for commercial services	Machinery (tools & plant)	Others	Sub total of estab. expenses	Motor vehicles	Main-tenance and repairs	Total	Percent of column total
	1	2	3	4	5	6	7	8	9	10	11	12
Direction and administration	665	2791	306	264			271	403	143	-	4446	4
Revenue establishment	518	34229	483	1030	1953	294	965	39472	-	-	39472	40
Sone and other South Bihar irrigation projects	1583	9125	130	195	28	111	-	11172	764	11594	23530	24
Kamla and other North Bihar irrigation projects	774	2488	35	114	-	150	-	3561	40	2177	5778	6
Chhota-nagpur and Santhal Pargana irrigation projects	150	815	15	20				1000	347	5393	6740	7
South Bihar irrigation projects	1419	4457					220	6096	450	12958	19504	19
Total	5109	53911	969	1623	1981	555	1456	65604	1744	32122	99470	
Percent of row total	(5)	(54)	(1)	(2)	(2)		(2)	(66)	(2)	(32)	(100)	

Source: Government of Bihar, Irrigation Department: Details of Budget 1985-86, Patna 1985, pp.— less than 0.5 percent.

Table 6.17. Details of Expenses on Establishment: Kosi Project, 1985-86 (Budget Estimates) - (in Rs thousands).

	Salaries of officers	Salaries of workers	Main-tenance allowance of officers	Main-tenance allowance of workers	Travel ex-penses	Office ex-penses	Total	Percent of column total
Kosi Barrage and main works	295	14505	90	2653	206	51	17800	53
Repair and maintenance (western bank)	150	1385	50	350	40	25	2000	6
Repair and maintenance (eastern bank)	325	1650	99	370	61	45	2550	7
Repair and maintenance of main canals and branches	740	7690	210	2120	215	295	11270	34
Sub-total	1510	25230	449	5493	522	416	33620	
Percent of row total	5	75	1	16	2	1		100

Source: Government of Bihar, Irrigation Department Detailed Budget for 1985-86, Patna, 1985.

Since revenue establishment accounts for a major share of total current expenditures in Bihar, further disaggregated information on these expenditures has been provided in Table 6.18. Salaries of workers account for about 70 percent of the total expenditures, while their living allowances take up another 15-20 percent. Travel expenses and payments for commercial services account for 2 and 3 percent, respectively. The share of salaries and living allowances of officers is rather low at less than 2 percent of the total expenditures. There are a large number of people working for revenue collection at the *tehsil* (an administrative and revenue unit consisting of a number of villages) level as well as at the *circle* level. There are officers (*zilladars*) and revenue clerks for assessment and collection work. The number of posts sanctioned is determined by the number of water charge receipts to be prepared.

Table 6.18. Details of expenditures on revenue establishment for Bihar irrigation projects :1985-86, (in Rs thousands).

	Irrigation projects		Multipurpose river valley projects	
	Total	Percent	Total	Percent
1. Salaries of officers	610	2	228	
2. Living allowances of officers	167		56	
3. Salaries of workers	29794	70	24008	67
4. Living allowances of workers	8126	19	6347	18
5. Travel expenses	965	2	603	2
6. Office expenses	396	1	435	1
7. Payments for commercial & special services	1838	5	1055	3
X Rents & taxes	540	1	n.a.	n.a.
9. Machinery, tools and plant	284		n.a.	n.a.
10. Others			3372	9
11. Total	42720	100	36104	100

- Below 0.5 per cent.

Source: Government of Bihar, Irrigation Department, Detailed Accounts of Receipts and Expenditures for 1985-86; 1985.

Because Bihar has a large number of small farms (about 76% of the total are less than 1 ha), it takes a large number of people to prepare the receipts and then approach farmers for collection of money. Because of high population density and large scale unemployment, there are strong political pressures to provide employment in the Irrigation Department. As a result, the number of people

actually working exceeds the number of sanctioned posts. The State Government has **recently** appointed a Committee to review the functioning of revenue administration in the **Irrigation** Department. This Committee is considering a number of suggestions which will rationalize the **structure** of revenue administration and improve its efficiency.

In the case of Haryana, revenue establishment costs account for 17 percent of the total for multipurpose projects and 10 percent of the total for irrigation projects. Salaries of officers (excluding revenue staff) accounted for about 33-39 percent of the total (Table 6.19). Repair **and** maintenance accounted for about two-thirds of the total expenses on O&M. However, these maintenance expenses include the wages of workers and technical personnel at the lower level. Hence, these expenses do not really reflect the quality of maintenance work carried out in the canal system.

Table 6.19. Details of O&M expenditures on irrigation projects in Haryana: 1984-85.

	Multipurpose river projects (Bhakra-Nangal)			Irrigation projects		
	Rs million	% of total (excluding revenue estab.)	% of total (including revenue estab.)	Rs million	% of total (excluding revenue estab.)	% of total (including revenue estab.)
1. Salaries of officers ^a						
- Chief Engineer, Supd. Engineers	1.6	3	2	1.3	7	6
- Executive Engineers	21.9	36	30	29.7	26	24
- Total	23.5	39	32	37.0	33	30
2. Extension & improvement, maintenance	37.0	61	51	75.2	67	60
3. Subtotal	60.5	100	83	112.2	100	
4. Revenue establishment	11.7		17	12.3		10
5. Total	72.2		100	124.5		100

^aIncludes salaries of Chief Engineer, Superintending Engineers and Executive Engineers. Salaries of **workers** are included under **Repair & Maintenance**.

Source: Government of Haryana, Budget 1985-86, vol.II.

Adequacy of O&M Expenses

As mentioned earlier, the Public Accounts Committee (1983) and the Irrigation Department (Central Government) think that "maintenance of existing irrigation systems is not getting the attention of the states as required" and "one of the main reasons for under-utilization of irrigation potential was that the maintenance of irrigation and drainage systems was neglected." From the

analysis of O&M expenses in the last section, one can conclude that expenditures on repair and maintenance of structures and canals have declined while expenses on staff salaries and wages have increased over time. In fact, the pressures at the field level are such that only a minimum of repairs is carried out with the money that is left after payments of wages have been made.

Given the fact that relatively old structures need more maintenance and repair, the impact of neglect of basic repairs is difficult to estimate in the case of old systems such as the Sone canal. It is essential to conduct detailed studies on O&M expenses, on the type of repairs and maintenance done, and on the impact of lack of repairs on productivity of irrigation projects. Such investigations alone can provide information for corrective action.

However, since such data on the impact of existing levels of O&M expenses are difficult to obtain, it may be useful to review the "estimates" of norms of expenditure on irrigation projects. The Irrigation Commission (1972) used Rs 15/ha as the figure for O&M expense in 1970-71.

The Finance Commission (1973) agreed with the Union Ministry of Irrigation that Rs 25-30/ha might be taken to represent a reasonable limit for maintenance of irrigation works. Accordingly, in the early seventies, the Finance Commission worked out the financial requirements of States for maintenance of irrigation works at the rate of Rs 25/ha irrigated by government sources of irrigation, whether by canals, tanks, or government wells including tube wells. If adjustment for changes in prices of labor and materials is made, the norm adopted by the then Finance Commission would indicate a level of approximately Rs 50/ha (in 1981-82) for maintenance of irrigation works.

The Eighth Finance Commission report provides a discussion of the norms of expenditure proposed by the Seventh Conference of Irrigation Ministers of States held in December 1982. Based on the recommendations of this conference, the Union Ministry of Irrigation proposed the following norms for maintenance:

- a) Operation and maintenance expenses of irrigation systems may be placed at Rs 100 per hectare of culturable command area, where irrigation intensities are less than 100 percent, and Rs 100 per hectare of potential/irrigated area, where irrigation intensities are more than 100 percent. This provision should be exclusive of regular establishment charges.
- b) For special repairs, provision should be made at the rate of 20 percent of the annual grants for normal operation and maintenance.
- c) Regular establishment required for maintenance of canals should be financed separately. Based on typical studies carried out by the Central Water Commission a provision of Rs 50 per hectare of irrigated area may be made till more data become available from the States.
- d) The States should also review and revise their water charges upwards with regular periodicity to ensure that the costs of operation and maintenance are met fully, and a return on capital investment of at least one percent is realized.

The Eighth Finance Commission (1984) thought that the norms suggested by the Ministry of Irrigation (which worked out to Rs 170/ha of irrigated area in the plains) were quite high. According to the Commission, the norm of **Rs 50/ha** fixed by the Seventh Finance Commission would work out to about **Rs 88** in 1983-84 after taking into account the trend in increase in prices of labor and materials used in O&M. The Commission observed that the Note of the Ministry of Irrigation sent to the Seventh Finance Commission on 2 November 1977, alluded to the emphasis laid by the World Bank on operation and maintenance strictly in accordance with sound engineering principles. Hence, the **Rs 50/ha** recommended by the Seventh Finance Commission was considered to reflect the **needs** of funds for proper maintenance. Thus, the Eighth Finance Commission considered that **Rs 88/ha** in 1983-84 was adequate for maintenance. The Commission further noted that "the sum of **Rs 50/ha** of irrigated area seem to be rather excessive when we consider the fact that in the case of roads and buildings, provision for regular establishment is being made at 16 percent of the provision for normal repairs." Keeping all these aspects in view, the Eighth Finance Commission decided to provide a consolidated amount of **Rs 100** per hectare of gross irrigated area for maintenance, including normal repairs, special repairs, and regular establishment. In addition, the Commission recommended the provision of funds at **Rs 30/ha** for maintenance of the unutilized potential existing at the end of 1983-84. This figure is much lower than the norms recommended by the Union Ministry of Irrigation. Even with these estimates of working expenses, the Commission estimated that the States would incur a loss of **Rs 400** million during the five years 1984-85 to 1988-89.

Compared with the above norms of **Rs 100/ha** inclusive of regular establishment charges, the average O&M expenses incurred on four major irrigation projects in Bihar during 1980-81 to 1984-85 were **Rs 50/ha**, about two-thirds of which were for establishment. If revenue establishment is also included, these costs would be **Rs 95/ha**. In Haryana, working expenses were around **Rs 110/ha** in the early eighties. Assuming that these are inclusive of revenue administration, these estimates are quite near the norms suggested by the Eighth Finance Commission. However, in the case of Bihar, the average expenditure on O&M during the early eighties was much lower (**Rs 22-38/jha**) compared with the norm of **Rs 88/ha**, excluding costs of regular establishment.

FARMERS' ABILITY TO PAY FOR IRRIGATION SERVICES

Role of Price Policies for Output

The objectives of agricultural price policies as included under the terms of reference of the Agricultural Prices Commission, 1955, are: a) to provide incentives to the producer for adopting improved technology and for maximizing production and b) to ensure rational utilization of land and other production resources. In designing policies, 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 must be considered. According to the revised terms of reference (1978), the Agricultural Prices Commission is required to take into account the changes in the terms of trade between the agricultural and the nonagricultural sector.¹³ The Commission considers the cost of production, demand, and supply of

¹³For a detailed discussion of issues relating to agricultural prices and terms of trade, see Tyagi (1982), Kahlon and Tyagi (1983), Mishra (1985), Rath (1985).

agricultural commodities and discusses various aspects of policy with the ministries concerned, Planning Commission, and State Governments before it is put up for the approval of the Union Cabinet. Thus, the final decision is taken at the Cabinet level (Tyagi 1982).

Although, in theory, all **efforts** are made to ensure that fanners get remunerative prices, in practice, the price that the fanner gets for his produce depends upon the organizational and operational efficiency of the market structure. According to Kahlon and Tyagi (1983), "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 fanner to realize at least the minimum support price." The analysis of data on procurement prices and open market prices during the harvest season shows that in the States where infrastructure facilities are good (e.g., Punjab, Haryana, Western Uttar Pradesh), market prices for wheat were higher than procurement prices fixed by the government, but in Rajasthan wheat was quoted at prices which were about 20 percent lower than the procurement prices. Similarly, in the case of rice, whereas in Andhra Pradesh, Punjab, and Haryana, the open market prices remained either equal to or higher than the procurement prices during the late seventies, in Madhya Pradesh and Orissa the prices of unmilled rice were occasionally lower than the procurement price (Kahlon and Tyagi 1983:15). The phenomenon of fanners getting prices which were 14-18 percent lower than the procurement prices for rice has been reported in a few surveyed districts in Eastern Uttar Pradesh, for the agricultural year 1985-86.¹⁴

Thus, it is quite likely that fanners in Bihar are receiving prices which are much lower than the support prices and/or procurement prices announced by the government on account of inadequate infrastructure for purchase and storage of food grains. In contrast, farmers in Haryana are able to receive remunerative prices for their agricultural output, mainly on account of government **infrastructure facilities**. These **differences** have to be kept in mind while 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 versus import prices. Government policy on agricultural prices may be so designed as to protect **consumers** from high prices rather than allowing the producers to get higher prices through sales in deficit regions within the country or abroad (i.e., agricultural exports). The first objective may be achieved by "zoning," i.e., by restricting the movement of agricultural commodities from one state-zone to another.¹⁵ In the case of wheat and rice, restrictions on imports and/or exports of food grains may result in domestic prices which 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 metric ton.

¹⁴J. P. Singh, Personal Communication.

¹⁵Zonal restrictions were followed from time to time in India restricting free movement of food grains.

The negative values of nominal **rates** of protection show taxation of agriculture **rather** than protection **of** agriculture. This is also a method by which returns to the use of irrigation **can** be affected indirectly by macro policies of **trade** restrictions, 'zoning,' and other administrative controls. These should also **be** taken into account while analyzing various alternatives for **raising resources** from the agricultural sector. **This** is only **to** emphasize that **raising** of irrigation fees is only one (direct) method. Transferring resources from agriculture (or irrigated agriculture) 'to rest **of** the economy' can be done through policies which affect prices **of** outputs and inputs as well **as** through policies of direct and indirect taxation **of** incomes accrued or realized in the agricultural sector.

Terms of Trade between Farm and Non-farm Sectors

Changing the terms-of-trade between farm and nonfarm sectors is also one of the ways of transferring resources from one sector to another. By changing 'administered' prices of outputs and **inputs**, the government **can** influence resource flows from the farm sector to the government and/or to the manufacturers of agricultural inputs and implements and other commodities purchased by **the farmers**. A detailed analysis **of** commodity terms-of-trade in India has been reported in Rath (1985).

Table 6.20. Commodity terms of trade between farm and non-farm sectors in Bihar and Haryana (Rs/ha).

	Ratio of farm harvest prices to prices of inputs purchased from "on-farm <i>senor</i> "				Ratio of farm harvest prices to prim paid by rural households for goods of household consumption	
	(Index: 1961-62 = 100)				(Index: 1960-61)	
	Bihar		Haryana		Bihar	
	Rice	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	118	89	81	107	88	68
1979-80	111	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

Notes:

1. Source: Rath (1985)

2. Data on ratio of farm harvest prim to prim of **household** goals were not available for Haryana.

As may be noted in Table 6.20, the ratio of farm harvest prices to prices of inputs purchased from non-farm sectors has been on the decline since 1974-75 and has fallen to very low levels in 1980-81 and 1981-82. This is true for rice and wheat in Bihar and *Bajra* and wheat in Haryana. Although this ratio has been slightly higher in Bihar in 1982-83, it has declined or remained stagnant in the case of the two crops in Haryana.

Similar trends may be noted in the ratio of farm harvest prices to prices paid by rural households for goods of household consumption. The ratio of these prices has not only declined continuously (with the exception of the period 1977-78) since 1974-75, but has fallen much below that prevailing in 1960-61. Thus, the changes in farm harvest prices have not kept pace with increases in prices of inputs and other commodities purchased by farmers, and there has been a definite erosion in the 'purchasing power' of goods produced by the farm sector. These factors should be taken into account when considering raising of irrigation service fees to recover O&M expenses and capital costs. Such comprehensive analyses alone can ensure that both the productivity and 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 service fees, 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 taxes paid by the farmer depends on the quantity and type of commodities purchased which, in turn, depend on the level of income or expenditure. An attempt has been made here to estimate the amount of indirect taxes paid by farmers who use canal irrigation as well as by farmers who do not use irrigation. The difference in the amount of indirect taxes paid by the two categories of farmers will provide an estimate of indirect taxes which could be attributed to provision of gravity irrigation. This difference in the total taxes paid will be considered as the indirect flow of financial resources as a consequence of higher incomes/expenditures generated by the use of irrigation.

Table 6.21 provides details of the assumptions made in calculating the incidence of indirect taxes. First, the area under the two categories of farms (1 ha and 2 ha) receiving canal irrigation in Bihar has been estimated. Thus, the total net area irrigated by canals (1.18 million ha) is divided as 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 gives the estimated number of households in each farm size as 0.48 and 0.35 million, respectively. Second, net income in each category is calculated based on the data used in Table 6.22. Per capita income or expenditure is then calculated assuming a) a family size of 6 adult-equivalents, b) that nonagricultural income will be, on average, equal to farm savings, and, thus, c) that net income from agriculture represents total consumption expenditure of the family. The amount of taxes paid per annum have been calculated using the estimates of per capita expenditure and the estimates made in a study conducted by the National Institute of Public Finance and Policy (NIPFP), New Delhi. This gives 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 annum. The estimated tax for a 2-ha irrigated farm is Rs 1,848 which is about 13.2 percent of the total income or expenditure per annum.

Table 6.21. Net income and incidence of indirect taxes in canal-irrigated farms in Bihar.

	Unit	Irrigated by canals		Unirrigated	
		1 ha	2 ha	1 ha	2 ha
1. Area under each category of farms	million ha	0.48	0.70	0.48	0.70
2. No. of farms in each category	million	0.48	0.35	0.48	0.35
3. Net income in each category of farm	Rs per ha per year	7012	14024	3869	7738
4. Per capita per income per expenditure ^a per annum	Rs	1169	2337	645	1290
5. Per capita income per expenditure in each category per month	Rs	91	194	54	108
6. Amount of tax Rs per capita per annum ^b					
Central taxes	Rs	13	196	24	73
State taxes	Rs	42	112	16	42
Total	Rs	115	308	40	115
7. Total tax per annum for each farm family	Rs	690	1848	240	690
8. Total tax per annum for all the farms in each category	million Rs	331	641	115	241
9. Tax as percent of income over expenditure		9.8	13.2	6.2	8.9

^aTaking a family size of 6 and assuming that non-agricultural income will balance savings and net income from agriculture will represent total consumption expenditure.

^bThe estimated tax incidence is determined on the basis of average expenditure per m u m in each category.

^cIt is assumed that the level of incidence in 1983-84 will remain the same as in 1973-74.

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

The corresponding figures for unirrigated farms are Rs 115 for a 1-ha farm and Rs 241 for a 2-ha farm. These families pay 6.2 and 8.9 percent, respectively, of their annual income as indirect taxes. When these figures of tax payments per family are multiplied by the total number of farm families in each category, we get the estimates of total indirect taxes paid by these groups (Table 6.23). The total estimated taxes paid by farm families using canal irrigation are Rs 978 million (Rs 331 million + Rs 647 million). The corresponding figure for families not using irrigation would be Rs 356 million (Rs 115 million + Rs 241 million). Thus, the additional tax liability attributed to irrigation is Rs 622 million (Rs 978 million - Rs 356 million). According to the assumptions made and the estimates of tax incidence used in this study (based on the NIPFP study of 1973-74), around Rs 400 million is due

Table 6.22. Irrigation charges and net income (i.e., Returns to own farm resources) for a one-hectare farm in Bihar (using Cost of Cultivation Data).

	Rice					
	1	2	3	4	5	6
Canal	Un- lrr- gation	Un- lrr- gated	Canal lrr- gation	Un- lrr- gated	Wheat Canal lrrigation ^a	Rice plus Unirrigated ^b
Net Additional Income or Benefits from Irrigation						
(5-6)						

1.	Irrigation costs (Rs per ha)	74.7	-	79.24	-	130	-	-
2.	Net income (Rs/ha)	3284	1542	5325	3324	7012	639	4373
3.	Gross production (Rs/ha)	4616	2781	6612	4940	9244	4411	-

^aFor canal irrigation, the intensity of cropping was 170, i.e., 1 ha paddy+ 0.7 ha wheat.
^bFor unirrigated farm, the intensity of cropping was 13, i.e., 1 ha of paddy+ 0.33 ha wheat.

Source: Table 6.24.

Table 6.23. Incidence of indirect taxes on irrigated farms and total tax revenues in Bihar.

	Irrigated farm			Unirrigated farm			Additional taxes, i.e., taxes on irrigated farms minus taxes on unirrigated farm total
	1 ha farm	2 ha farm	Total	1 ha farm	2 ha farm	Total	
1. Incidence of central taxes	210	412	622	69	153	222	400
2. Incidence of State taxes	121	235	356	46	88	134	222
3. Total incidence of indirect taxes in 1984-85	331	647	978	115	241	356	622

Source: Table 6.21.

to indirect taxes levied by the Central Government (excise duties and customs duties) and Rs 222 million to State taxes (i.e., State excise, sales taxes, sales tax on motor fuel, motor vehicles tax, taxes on goods and passengers, entertainment tax, and electricity duty). These estimates have to be seen in the context of the following figures: In 1984-85, the share of Bihar from total Union excise duties was Rs 5,165 million; total State (Bihar) tax on commodities was Rs 4,372 million; and total revenue from indirect taxes in Bihar was Rs 9,537 million.

Estimates of Farmers' Ability to Pay for Irrigation Services

In this section, three approaches¹⁶ are used to analyze the ability of farmers to pay for irrigation services. Under the first approach, irrigation's net benefits to water users (exclusive of payments related to irrigation services) are estimated. Benefit recovery ratios (the proportion of these net benefits which must be paid directly or indirectly) are calculated for alternative policies with respect to water charges. The second approach involves estimating the net income earned from irrigated cropping and comparing it with the magnitude of direct and indirect payments for water which would be required under alternative policies. The third approach compares irrigation-related payments with **gross** income earned from irrigated production. To facilitate comparisons with similar studies in other countries, all values have been calculated in terms of equivalent amounts of unmilled rice per hectare per year.

Table 6.24 presents data on gross income, farm expenditure, and net income of irrigated and unirrigated farms in Bihar. These data have been 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, which found that the intensity of cropping on a 1-ha farm in the region was 180, i.e., for a representative farm, one could assume 1 ha of rice plus 0.8 ha of wheat. Gross income on the 1-ha irrigated farm was estimated at Rs 8,438 compared with Rs 4,450 on an unirrigated farm. The estimate of net income per hectare per year has been presented as returns to all family resources (including land, labor, capital, and management) under the assumption that the family owns all the land farmed. Net income (returns to farm family resources) has been estimated at Rs 5,774/ha/year on irrigated farms, compared with Rs 3,263/ha/year on unirrigated farms. The net benefits of irrigation (i.e., after deducting increased production costs) are Rs 2,511/ha/year. Irrigation costs (or water rates or irrigation service fees) have been estimated at Rs 72/ha/year for this crop rotation. Then, irrigation costs are 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 have also been calculated from data obtained by the Ministry of Agriculture, New Delhi, under the studies on cost of cultivation of major crops. Analysis of farm-level data for the Sone Canal region is presented in Tables 6.22 and 6.25. The irrigation cost from these surveys is estimated at Rs 130/ha/year on canal-irrigated farms. Using an estimated intensity of cropping of 170 (i.e., 1 ha rice + 0.7 ha wheat), the net income (i.e., returns to farm family resources) on an irrigated farm has been estimated at Rs 7,012/ha/year. The estimate of net income on an unirrigated farm is Rs 2,639 taking an intensity of cropping of 133 (i.e., 1 ha rice + 0.33 ha wheat). This gives an estimated net benefit of Rs 4,373/ha/year from irrigation. It may be noted that this estimate of net benefit of irrigation is almost 75 percent higher than that estimated from NCAER (1985) data. Both these estimates have been used in evaluating alternative policies as indicated in Table 6.22 and Tables 6.26 through 6.30.

Similar estimates of water rates for canal irrigation and net income have been obtained from data given in a report on Economics of Farming in Haryana (1981-82) brought out by the Economic and Statistical Organization of the Government of Haryana. The estimates of water rates (Rs

¹⁶These approaches are adopted from the First Report of the Regional Study on Irrigation Service Fees by L. Small, M. Adriano, and F. Martin (1986).

Table 6.24. Gross income, farm expenditure, and net income of irrigated and non-irrigated farms in Bihar (Rs/ha).

	Irrigated			Unirrigated			Additional Net Income or Benefits from Irrigation
	Rice (1.0 ha)	Wheat (0.8 ha)	Total	Rice (1.0 ha)	Wheat (0.8 ha)	Total	
Gross Income ^a	5217	3221	8438	2434	2016	4450	3988
<i>Farm Expenditure</i>							
Fertilizers			1646			115	
Irrigation cost			72				
Cost of materials (seeds, manure, fertilizers etc.)			2676			795	
Total paid out expenses ^b			2664			1187	
Net income (returns to farm family resources)			5774			3263	2511

^aIt is assumed that the intensity of mopping on a 1-ha farm is 180 (i.e., 1.0 ha of rice and 0.8 ha of wheat).

^bInclude paid-out cash expenses on purchased inputs only.

Source: NCAER (1985): Agro-economic and Socio-economic Survey of the Sone River Basin, 1985

105/ha/year) and net benefit of irrigation (Rs 3,864/ha/year) are presented in Table 6.26

Table 6.25. Irrigation costs, crop yields and net income by source of irrigation in Bihar.

		Canal irrigation	Tube wells etc.	Unirrigated
<i>RICE</i>				
No. of farms		23	22	14
Average area under crop (ha)		3.39	0.92	
Average cost of irrigation	Rs/ha	74.7	250.58	
	Kg rice per ha	46.7	156.6	
Yield (kg/ha)		2154	2280	1415
Net income ^a	Rs/ha	3284	3333	1542
	Kg rice per ha	2053	2083	964
<i>WHMT</i>				
No. of farms		17	35	8
Average area under crop (ha)		2.6	0.92	
Average cost of irrigation	Rs/ha	79.24	329.15	
	Kg rice per ha	49.5	205.7	
Yield (Kg/ha)		2897	2254	2160
Net income	Rs/ha	5325	3254	3324
	Kg rice per ha	3328	2034	2076

^aNet Income is defined as returns to own farm resources which correspond to Farm Business Income (Gross Income - Cost A2) as defined in the Farm Management Studies.

Source: Ministry of Agriculture, Government of India, Cost of Cultivation Studies, 1982-83. The data are for selected villages in Zone IV which includes *tehsils* in the Sone Command including Sasaram, Aurangabad, Hilsa, Arrah and Biharsharif

Table 6.26. Irrigation charges and net income in selected farms in Haryana.

	Irrigated	Unirrigated	Difference of irrigated over unirrigated
1. Gross income	8027	2664	5363
2. Farm expenditure (purchased inputs only)	2023	524	1499
3. Net income	6004	2140	3864
4. Water rates	105		
5. Tube well, pumping sets etc.	737		
Sub-total of irrigation costs (4+ 5)	842		
Irrigation costs as percent of gross income	10		
Irrigation costs as percent of farm expenditure	42		
Irrigation costs as percent of net income	14		
Water rates as percent of additional income	3		
Irrigation costs as percent of additional income	22		

Source: Economic & Statistical Organization, Government of Haryana, Economics of Farming In Haryana 1981-82. April 1985.

Recovery of O&M costs. These estimates of water rates and net income for Bihar and Haryana have been brought together in Table 6.27. Irrigation charges or water rates for canal irrigation range from 43 kg unmilled rice per hectare per year in Bihar to 98.1 kg in Haryana. Net returns to farm family resources range between 3,458 kg unmilled rice per hectare per year in Bihar and 5,709 kg in Haryana. Similarly, benefits from irrigation range between 1,504 kg unmilled rice per hectare per year in Bihar and 3,709 kg in Haryana. Total direct and indirect irrigation-related payments¹⁷ by water users under alternative policy assumptions have been presented in Table 6.28. The first column of the table shows the average or typical amounts farmers are charged under current policies. The estimated water rates are equivalent to 43-81 kg unmilled rice per hectare per year in Bihar depending on the source of data used. For Haryana¹⁸, the actual payment is equivalent to 98 kg unmilled rice per hectare per year.

¹⁷It should be mentioned that in India, under gravity irrigation system water charges are paid in cash only. There are no contribution, made in labor (or food grains) except in the case of some emergencies.

¹⁸These estimates of irrigation-related payments are nearer to those in Nepal and Thailand (based on an implicit tax of 6.2 percent on price of unmilled rice) which are 75 kg unmilled rice per ha per year for Nepal and 85 kg unmilled rice per ha per year for Thailand. These are much lower than the values for Korea the Philippines and Indonesia. See Small et al. (1986).

Table 6.27. Irrigation charges and additional net income from irrigation (excluding irrigation charges from canal irrigation) in Bihar and Haryana.

	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/ha/year	kg rice/ha/year ^a	Rs/ha/year	kg rice/ha/year	Rs/ha/year	kg rice/ha/year	Rs/ha/year	kg rice/ha/year
<i>Estimate I</i>								
Bihar (1983-84)	12	43.1	5774	3458	3263	1954	2511	1504
	(130)	(81.3)	(7012)	(4383)	(2639)	(1649)	(4373)	(2733)
Haryana (1981-82)	105	98.1	6109	5709	2140	2000	3969	3709

^aFarm harvest prices of unmilled rice have been used in computing kg rice per ha. These were Rs 1.67 per kg in 1983-84, Rs 1.60 per kg in 1982-83 in Bihar, and for Haryana they were Rs 1.36, 1.26 and 1.07 per kg each in 1983-84, 1982-83 and 1981-82, respectively.

Figures in parentheses are for data from cost of cultivation studies. These data are for 1982-83.

Sources: Tables 6.21 and 6.24.

Table 6.28. Total direct and indirect irrigation-related payments by water users under alternative policy assumption in Bihar and Haryana, (Kg rice per ha per year^a).

	Actual	Actual modified to set irrigation service fees equal to O&M cost ^b	Actual modified to set irrigation service fees equal to O&M plus full recovery of capital cost ^c
Bihar ^d (1983-84)	43.1	80.8	1464
	(81.3)	(80.8)	(1464)
Haryana ^e	98.1	89.1	1869

^aFarm harvest prices of rice used for computing kg rice per ha are: Rs 1.67 per kg in 1983-84 and 1.60 per kg in 1982-83 in Bihar; for Haryana, they were Rs 1.36, 1.26 and 1.07 per kg each in 1983-84, 1982-83 and 1981-82, respectively.

^bO&M costs for Bihar are for 1983-84, Rs 135 per ha consisting of Rs 93.4 per ha for Operation & Maintenance and Rs 41.6 per ha. O&M costs for Haryana are for 1982-83 as given in Table C.3 i.e., Rs 113 per ha for total working expenses on irrigation projects.

^cCapital costs used are: Rs 22900/ha for Bihar; Rs 22230/ha for Haryana (See Text). Capital Recovery Factor (CRF) used to amortize capital costs is:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1} \quad \text{where } i \text{ is the interest rate (10\%) and } n \text{ is the life of the project (50 years).}$$

$$= \frac{0.10}{0.100859} = 9.91481$$

These figures give amortized (annual) capital costs of Rs 2312 per ha for Bihar and Rs 2242 per ha for Haryana.

^dFigures 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.

^eFor Haryana, the irrigation rates are for 1981-82 while O&M costs are for 1982-83. These have been converted to Kg rice/ha using farm harvest prices of the corresponding year. On account of this, the quantity of rice 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/ha.

Sources: Tables 6.22 and 6.27.

The second column of Table 6.28 shows the estimated amounts that would be needed if current policies are modified so that irrigation service fees per hectare would equal the costs of O&M. **This** represents the level of payments that would be necessary to provide full recovery of O&M costs via an irrigation service fee, assuming that collection rates are 100 percent. The last column of the table indicates the charges necessary for the per hectare amounts charged to equal the full cost of both O&M and capital investment. It should be noted that increases in irrigation fees amounting to 97 percent are indicated in Bihar if one uses the irrigation charges paid by farmers indicated in the National Council of Applied Economic Research survey. However, for recovering O&M costs, no increase is indicated if the actual irrigation charges are 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 does not indicate any increase in water rates (it suggests a decrease of 9 percent) but would require higher collection efficiencies. However, water rates would have to be increased substantially (i.e., 18-34 times in Bihar and 19 times in Haryana) if full cost of both O&M and capital investment is to be recovered.

Table 6.29. Estimated benefit recovery ratios under alternative financing policies (in percent).

	Actual	Actual modified to set ^b irrigation service fees equal to O&M cost	Actual modified to set ^b irrigation service fees equal to O&M cost plus full recovery of capital cost
Bihar ^a	2.9	5.4	97.4
	(3.0)	(3.1)	(55.9)
Haryana	2.6	2.8	59.3

^aFigures in parentheses are based on data on cost of cultivation studies conducted by the Ministry of Agriculture, New Delhi

^bO&M costs are Rs 135 for Bihar and Rs 113 for Haryana (per ha) amortized capital costs are Rs 2,310 for Bihar and Rs 2,242 for Haryana (per ha)

Sources: Tables 6.22, 6.27 and 6.28.

Benefit recovery ratios. From the figures given in Tables 6.22 and 6.27, estimated benefit recovery ratios under alternative policies for Bihar and Haryana have been displayed in Table 6.29. Under actual policies (and water rate levels), the estimated benefit recovery ratio is around 3 percent for Bihar and 2.6 percent for Haryana.¹⁹ For full recovery of O&M costs, the estimated benefit recovery ratios rise for both the States, although marginally for Bihar (Estimate II in parenthesis) and Haryana. The last column in Table 6.29 shows that the benefit recovery ratio would be almost 100 percent in Bihar if the net benefit to irrigation is similar to that estimated in the National Council of Applied Economic Research survey. However, with a higher figure of net benefit of irrigation (based on cost of cultivation study), the benefit recovery ratio to cover full costs of O&M and capital investment is 55.9 percent for Bihar, and for Haryana, 59.3 percent.

¹⁹These may be compared with 5 percent for Nepal, 10 percent for the Philippines and 26 percent for Korea reported in those studies in this volume

Based on the estimates presented in Table 6.29, it can be said that in both the States, wherever there is a reasonable irrigation service, the incremental benefits derived from irrigation will be adequate to make possible the full recovery of irrigation O&M costs and still leave the farmers with significant increases in net income due to irrigation. Table 6.29 also indicates that the benefits of irrigation are not high enough to make possible the full recovery of O&M plus capital costs and leave enough margin for the farmer to use irrigation²⁰.

Net income from irrigation. In Table 6.30, the estimates of net income (derived in Tables 6.24, 6.22, and 6.26) 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. 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 (Estimate I, using the National Council of Applied Economic Research Survey). The percentage of net income needed to cover O&M costs remains less than 2 in both States. However, raising irrigation service fees still further to cover the full capital costs as well as O&M costs leads to irrigation charges generally in the range of 35-43 percent of net income of the farmers. The implications of the figures of Table 6.30 are generally consistent with conclusions drawn from Table 6.29, namely, that farmers generally have the ability to pay for the full cost of irrigation O&M through irrigation service fees, but the payment of the full capital cost is not feasible.

Table 6.30. Total direct & indirect irrigation-related payments by water users as a percent of the net returns to the farm family resources^a under alternative policy assumption (percent).

	Actual	Actual modified to set irrigation service fees equal to O&M cost	Actual modified to set irrigation service fees equal to O&M plus full re- covery of capital cost
Bihar ^b	1.2 (1.8)	1.9 (1.9)	42.8 (34.9)
Haryana	1.7	1.9	39.2

^aNet 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.

^bFigures in parentheses are based on data from cost of cultivation studies.

Source: Table 6.22.

Payments as a percentage of gross income. Comparisons of payments for irrigation services with gross income are conceptually less meaningful than either of the previous two approaches to analyze farmers' ability to pay, but they avoid the need for data on farm income, which often are limited to a

²⁰In this case, the situation in Indian States is similar to those in Nepal and the Philippines assuming moderate capital costs.

few specific surveys or projects. Estimates of the typical percentages of gross income which are required as payments for irrigation under the three alternative policy situations are presented in Table 6.31. Under the actual policies, these range between 0.9 and 1.4 percent, and if water charges are raised to cover O&M costs the range is between 1.4 and 1.6 percent. However, about 30 percent of the gross value of output would have to be paid if irrigation service fees are raised to cover O&M costs as well as full capital investment.

Table 6.31. Total direct & indirect irrigation-related payments by water users as a percent of gross production^a under alternative policy assumption (in percent).

	Actual	Actual modified to set irrigation service fees equal to O&M cost	Actual modified to set irrigation service fees equal to O&M plus full recovery of capital cost
Bihar ^b	0.9 (1.4)	1.6 (1.5)	28.9 (26.5)
Haryana	1.3	1.4	29.3

^aGross production refers to gross value of output on a one-ha irrigated farm assuming two crops of rice and wheat. In Bihar, the intensity of cropping is 180, i.e., 1 ha of rice + 0.8 ha of wheat. In Haryana, the intensity of cropping is 170, i.e., 1 ha of rice + 0.7 ha of wheat.

^bFigures in parentheses are for data from cost of cultivation studies of the Ministry of Agriculture, New Delhi.

Sources: Tables 6.22 and 6.21.

Table 6.32. Water rates, gross value per ha and cost of irrigation in Bihar and Haryana in the late sixties (1969-70/1970-71).

		Bihar		Haryana	
		Rice	wheat	Rice	Wheat
1.	Water rate (Rs per ha)	37.5	225	24.4	14.5
2.	Yield per ha (Kg)	926	940	1433	1822
3.	Harvest price at farm level (Rs per quintal)	59.63	87.02	53.96	69.27
4.	Value of produce per ha (Rs)	553	818	773	1262
5.	Water rate as percent of gross value of produce	7.0	27	3.1	1.1
6.	Gross value of produce per ha ¹ (Rs)	1207			
7.	Estimated cost of O & M plus capital charges for irrigation projects ²	123		66	
8.	Water rates ³ (as modified to cover O & M plus capital charges) as percent of gross value of produce	10.2		4.0	

Notes:

¹ Gross value of produce has been estimated by assuming two crops of rice and wheat on an irrigated farm. In Bihar, the intensity of cropping is 180, i.e., 1 ha of rice plus 0.8 ha of wheat. In Haryana, it is 170, i.e., 1 ha of rice plus 0.7 ha of wheat.

² The O&M costs (for 1970) were estimated at Rs 15 per ha. The capital costs for continuing schemes for Bihar were estimated at Rs 1,067 per ha, the amortized value of which at 10 per cent interest and 50 year life was Rs 108 per ha. The capital costs of continuing schemes for Haryana were estimated at Rs 507 per ha, the amortized value of which was Rs 51 per ha. Thus, the O&M plus capital costs of Bihar and Haryana were estimated at Rs 123 per ha and Rs 66 per ha, respectively.

³ These water rates for rice are marginally different from those used in Table 6.33 due to differences in sources of data.

Source: Government of India, Report of the Irrigation Commission, 1972, vol. I, pp. 270-271.

It is interesting to compare these estimates with those obtained around 1970 and reported by the Irrigation Commission (1972). As shown in Table 6.32, water rates in Bihar were 7 percent of the gross value of produce in the case of rice and 2.7 percent in the case of wheat, giving a weighted average of 4.6 percent. This figure is much higher than the estimates ranging between 0.9 and 1.4 percent in the early eighties. This shows that in the early seventies, a much higher proportion of gross value of produce was collected as water charges, and this ratio has declined significantly over the decade. Similarly, water rates of Rs 55/ha were much higher than the estimated O&M costs of Rs 15/ha. In Haryana, water rates were relatively lower for both crops, and the weighted average (assuming intensity of cropping of 170) was Rs 34.6/ha which was only 2.1 percent of the gross value of produce. This ratio has declined to 1.3 percent over the decade (Table 6.31).

As shown in Table 6.32, in the early seventies, water rates as modified to cover O&M charges and annualized capital costs of irrigation projects would have been 10.2 percent of the gross value of produce in Bihar. This percentage is much lower than the range of 26.5-28.9 percent estimated for the early eighties. The corresponding figures for Haryana are 4.0 percent for the early seventies and 29.3 percent for the early eighties. This shows that the increase in gross value of produce has been much less than the increases in O&M expenses and capital costs. In other words, the increases in capital costs of surface irrigation projects have been so high that covering these costs by raising irrigation service fees would not be possible. Although these figures may not be strictly comparable on account of differences in assumptions and sources of data, they do point toward the trends in increases in costs of irrigation vis-a-vis the gross value of output from irrigated agriculture.

Table 6.33. Water rates in Bihar for perennial and non-perennial crops (Rs per season per ha).

	Perennial (Sone Canals)		Non-perennial (Canals other than Sone)	
	Kharif (Rice)	Rabi (Wheat)	Kharif (Rice)	Rabi (Wheat)
<i>At current prices</i>				
1965-66 (since 1953)	25	12	20	10
1972-73 (since 1966)	40	22	20	17
1973-74	52	30	21	22
1974-75	78	45	41	35
1982-83	78	45	41	35
1984-85	90	51	47	38
<i>In real terms (adjusted for wholesale prices of rice & wheat 1970-71 = 100)</i>				
1966 to 1972				
1973-74	37	28	19	20
1974-75	43	25	22	19
1982-83	30	21	16	16
1983-84	27	21	14	16
1984-85	33	24	18	19

Sources. 1. Central Water Commission, Government of India, for water rates.

2. Wholesale price indices for rice and wheat are from the Economic Survey (1985-86) as reported in Table 6.41.

The conclusions from the above analysis can be summarized as follows:

- a) Increasing irrigation service fees or water rates to cover O&M costs results in moderate increases in the proportion of the **gross** value of output (or net irrigation benefit) that must be paid.
- b) Attempting to **raise** the irrigation service fees further to cover the full capital cost, would require payment of a very **high** proportion of the crop — between 27-30 percent.
- c) Raising irrigation services fees to cover both O&M costs and capital investment may result in disincentives for use of water for irrigation resulting in lower output, incomes, and employment. Hence, policies regarding water rates should be thoroughly evaluated in terms of their impact on welfare of the farmers, incentives to use water and other inputs, and on agricultural output, employment, and income distribution.

METHODS OF FINANCING IRRIGATION SERVICES

The water charge for a crop is usually a charge per hectare of **area** under the crop. The crop-area basis has been adopted for irrigation water charges **because** it is convenient for measurement. Besides, in almost all irrigation systems, facilities for measuring water quantities on a volume basis are absent. The advantages and disadvantages of the crop method have been discussed by experts and field engineers. According to them "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**" (Malhotra 1985:63; Malhotra 1982; Government of India 1972).

The most prevalent method of water charges, both in Bihar and Haryana, is the crop method under which water charges are levied on **an** area basis for different crops irrigated in any year²¹. Table 6.33 gives figures for water **rates** for two major crops — rice and wheat — over time in Bihar. It may be noted that in 1984-85, the water rate (or **irrigation** charge) for rice (*Kharif*) was 80 percent higher than that for wheat in **perennial** canals such as the Sone canal system. The water rates for nonperennial canals (other than Sone) were nearly **equal** for rice and wheat. The water rate for rice has increased from Rs 25/ha during 1953-65 to Rs 90/ha in 1984-85. The corresponding figures for wheat are Rs 12/ha and Rs 51/ha. **Thus**, in nominal terms, the water rate for rice has increased 3.6 times over the last 20 years, while for wheat it has increased 4.25 times over the same period. **The** data **also** show the stickiness in revising water rates. These did not change at all over a 13-year period 1953- 1965 or during the decade 1974- 1983. The most recent increase has **been** of 13 to 15 percent in the year 1984-85.

²¹In Haryana, some experiments have been made with the *Wari-metric* method which is said to be a proxy for the volumetric method under conditions where the *Warabandi* (rotational) system of water distribution is used. The *Wari-metric* method of assessment was introduced on Sotha Distributary in the Hissar District with effect from Kharif 1976. "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 so that the level of taxation remained the same as with the 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 a cultivator received his water." Under *Wari-metric* method, field-to-field collection of crop data for preparation of water bills is not necessary, as the water bill can now be prepared with data already available in the office.

The experience of the Sotha Distributary, where the *Wari-metric* method is still continuing, has not been critically evaluated. The experiment did not provide any apparatus for observing whether this method provided any inducement to cultivators for better and more economic use of water. However, the "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" (Malhotra 1985, p. 73.).

However, when the changes in water rates are adjusted for changes in the wholesale prices of rice and wheat, respectively, one finds that the water rates in real terms have not increased at all during the last decade. In fact, these have declined by 11 percent for rice and 14 percent for wheat in the case of perennial canals.

Water rates in Bihar are charged on the basis of a season (involving three waterings) or of a single watering²². The rates for a single watering are about 80 percent of those for the season in the case of rice, but are almost equal in the case of wheat (Table 6.34). The water rates to be charged by the State tube wells for 3 waterings to rice (in 1986-85) were Rs 125/ha, about 37 percent higher than those for canal irrigation. The water rates for wheat under State tube wells may turn out to be higher by 40-140 percent, depending on the number of waterings required.

Table 6.34. Water rates in Bihar for crops in three seasons for Perennial Flow Canals.

	1951	1953-65	1966-72	1973	1974-83	1984-85
Kharif						
1. <i>Sone Canals (perennial)</i>						
Long lease	11.12	22.24	37.07	49.42	74.13	
Season	12.36	24.71	39.54	51.89	77.84	90.50
Single watering	6.18	12.36	22.24	29.65	44.48	51.15
2. Non-perennial canals						
Long lease	n.a.					
Season		19.77	19.77	27.18	40.77	47.50
Single watering		12.36	12.33	17.30	25.95	29.90
Rabi						
1. <i>Sone Canals (perennial)</i>						
Season	8.03	12.36	22.24	29.65	44.48	51.15
Single watering			19.77	27.18	40.77	46.95
2. Non-perennial canals						
Season	n.a.	9.88	17.30	22.24	35.36	38.50
Single watering			12.36	17.30	25.95	29.90
Hot weather						
1. <i>Sone Canals (perennial)</i>	n.a.					
Season		44.48	69.19	91.43	137.15	159.50
Single watering		14.83	24.71	32.12	48.19	55.35
2. Non-perennial canals						
Season		9.88	44.48	59.30	88.96	103.50
Single watering		3.71	14.83	19.77	29.65	34.10

Source: Central Water Commission, Ministry of Irrigation, Government of India.

²²About 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 or by force. On account of this, there was abnormal growth of litigations. Hence, the long-lease system was replaced by seasonal or single waterings.

Table 6.35 presents data on water rates in Haryana. It may be noted that water rates have been raised only once during the last decade or so. In real terms (i.e., after adjusting for changes in wholesale prices of rice and wheat) the water rate for rice in 1983-84 was only Rs 25/ha compared with Rs 74/ha at current prices. Similarly, for wheat, although the nominal water rates have remained between Rs 45-62/ha, in real terms these have declined to a range of Rs 15-21/ha.

Table 6.35. Water rates in Haryana for storage schemes and diversion schemes.

At current prices	Storage scheme		Diversion schemes ^a	
	(Bhakra-NagallProject)		(Flow irrigation)	
	Kharif (Rice)	Rabi (Wheat)	Kharif (Rice)	Rabi (Wheat)
1966-67 (since 1949-50)	24	15	24	15
1975-76 (since 1966-67)	74	62	74	45
1983-84	74	62	74	45
<i>In real terms</i> (adjusted for wholesale prices of rice and wheat 1970-71 = 100)				
1975-76	41	35	41	25
1983-84	25	21	25	15

^aThe schemes included are Western Jamuna Canal (WJC) Remodeling Scheme, Laharu Lift Irrigation Scheme and Jui Lift Irrigation Scheme.

Sources: Central Water Commission, Statistics Directorate, New Delhi. For water rates, Wholesale Price Indices are from Economic Survey Reports.

Assessment, Billing, and Collection Procedures

Every year, in Bihar, the irrigated area of each farmer under each crop is assessed by revenue staff in the field. A collection peon moves from door to door to contact each farmer for collection of arrears and current charges with a blank receipt book. The farmer can make payment in full or in part, and the collection peon is required to issue a receipt for the amount paid. Certificate proceedings (in courts) are initiated against farmers for pending charges, and warrants are issued against defaulters. In such cases, surcharge and interest are also realized from the farmers along with the outstanding charges.

In Bihar, there is an elaborate organization for irrigation revenue administration in the Irrigation Department. At present the Revenue Administration of the Irrigation Department is organized in a pyramidal structure. The tehsil constitutes the lowest unit of the organization. Two or more tehsils comprise a Revenue Circle or *anchal*. Several anchals comprise a Division. On average, there are seven to eight Circles in a Division. The Directorate of Revenue Administration consists of 18 such Divisions and is a part of the Secretariat Complex of the Irrigation Department of the Government of Bihar.

In 1984-85, in Bihar, the numbers of *sangrahaaks* (collection peons) *moharrirs* and *amins* were 2,494, 840 and 246, respectively. In addition, there were 98 *tehsildars* who supervised the work of revenue collection. In 1983-84, the number of field staff was much larger: 3,170 collection peons, 1,234 *moharrirs*, 159 *tehsildars*, and 427 *amins*. Invariably, it has been found that *persons* actually employed are in excess of the sanctioned numbers. In September 1984, an evaluation showed that the excess staff comprised 197 clerks, 45 *moharrirs*, and 143 *amins*.

A recent review of the revenue administration carried out by the Directorate has suggested that there is urgent need to: a) redefine the jurisdiction of the existing 18 divisions to bring about a balance between assessed area in each division, b) review existing work loads of field staff and supervisory staff, and c) suggest norms for work load of permanent and seasonal staff.

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." Although the rules provide a number of checks on the work of Irrigation Booking Clerks by the *zilladar*, the Deputy Collector, the Sub-Divisional 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.

Collection efficiency and costs. Table 6.36 presents data on current charges, arrears, and collection of irrigation fees in Bihar for the years 1982-83 to 1984-85. It may be noted that the arrears of irrigation charges are between Rs 225-250 million for the last three years. These are around three times more than the current charges in these years. In 1982-83, current charges for irrigation totaled Rs 71 million while the charges for industrial water supplied to Bokaro Steel Limited were Rs 26 million. The assessed charges for irrigation have declined to Rs 62.4 million in 1984-85, partly because of a decline in area irrigated and partly because of lower average rates. The assessment for industrial water supply in 1984-85 is also much lower at Rs 10.2 million, a reduction of 60 percent in two years.

As described earlier, the Government of Bihar has an elaborate setup of revenue administration in the Irrigation Department. Expenditure on revenue establishment, which represents the cost of collection of water rates, was Rs 60 million in 1982-83 and increased to Rs 63.7 million in 1984-85 (Table

Table 6.36. **Year-wise** demand, collection and expenses on revenue administration in Bihar : 1982-83 to 1984-85 (in Rs million).

	1982-83			1983-84			1984-85		
	Irrigation	Bokaro Steel	Total	Irrigation	Bokaro Steel	Total	Irrigation	Bokaro Steel	Total
1. Arrears ^a	223.0	0	223.0	256.0	2.3	258.3	251.9	0	251.9
2. Current demand	71.0	26.0	97.0	73.5	12.4	85.9	62.4	10.2	72.6
3. Total demand (including arrears) (1 + 2)	294.0	26.0	320.0	329.5	14.7	344.2	314.3	10.2	324.5
4. Target of collection	n.a.	n.a.	n.a.	327.7	16.5	344.2	184.3	n.a.	184.3
5 Total collection (actual)	53.4	23.7	77.1	49.5	14.7	64.2	48.3	9.5	57.7
6 Expenditure on revenue establishment ^b	60.0	0	60.0	59.0	0	59.0	63.7	0	63.7
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
8 Expenditure on revenue expenditure as percent of annual collection	112	0	78	119	0	92	132	0	110
9 Actual collection as percent of target	18	92	24	15	89	19	26	n.a.	31
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		

^aThe figures of arrears from one year to the other are not consistent with those obtained from estimates of demand and collection.

^bFigures of expenditure on revenue establishment are marginally different from those obtained from budget papers

Source: Government of Bihar, Irrigation Department.

6.36). 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 from irrigation projects. Because revenue from industrial water supply to the Bokaro steel plant was a significant proportion of the total revenues (31 percent), the total collection from irrigation charges at Rs 53.4 million was about 10 percent less than the expenditure on revenue establishment of Rs 60 million. Since collection of charges from Bokaro Steel Limited does not require any revenue establishment, one can conclude that if water charges were abolished and the Directorate of Revenue Administration disbanded, the State Government would have benefited to the extent of Rs 6.6 million (Table 6.36).

The figures for 1983-84 and 1984-85 also show the same thing, i.e., the costs of collection of irrigation charges are higher than the revenues obtained from farmers for providing irrigation services²³. In fact, the deficit has increased from Rs 9.5 million in 1983-84 to Rs 15.5 million in 1984-85. Thus, abolition of water charges, and retrenchment of the staff on revenue administration would have provided the State Government with additional funds of Rs 31.6 million during the years 1982-83, 1983-84, and 1984-85. This would have been over and above the Rs 47.9 million collected from Bokaro Steel Limited during the 3-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 towards providing irrigation services. Hence, it would be unfair to raise water rates to cover the ever-increasing expenditure on revenue administration when this expenditure does not result in improvement in irrigation services, but reflects a welfare measure to provide employment which, as such, is politically motivated. It is in this context that the possibilities of collecting water rates along with land revenue or through enhanced land revenue on irrigated land should be considered. If this is politically difficult, it may be useful to explore the possibility of recovering irrigation charges through a tax on the use of fertilizers, after a careful analysis of the impact of this tax on the incentive to use fertilizers and resulting impacts on crop yields.

It should be noted that irrigation charges actually collected in 1982-83 were Rs 37.60/ha as compared with the current charges (average) of Rs 50/ha. The actual collection declined to Rs 33.40/ha in 1983-84 and Rs 36.50/ha in 1984-85 (Table 6.36). This is to be compared with Rs 49/ha and Rs 47/ha of current charges in the two years, respectively. As compared with these figures, the expenditure on revenue administration was Rs 42.20/ha in 1982-83, Rs 40/ha in 1983-84 and Rs 48.10/ha in 1984-85. This shows that in 1984-85, the revenue expenditure per hectare was higher than even the assessment of irrigation charges. Hence, even if the rate of collection were 100 percent for current charges, the State Government would have incurred a deficit. Given that the actual collection from irrigation was Rs 14 million short of current charges, collection efforts resulted in increasing the arrears rather than decreasing them.

O&M expenses and receipts for two major projects. Table 6.37 contrasts the situation of net receipts in the case of two major projects, Kosi and Sone canals. Eastern Kosi Canal and the Rajpur Canal, which were begun during the First Plan (1951-56) and the Third Plan (1960-65), respectively, were completed during the Sixth Plan (1980-85). The Sone canal system, which existed before 1951, was strengthened by building the Sone Barrage and remodeling works by 1972-73. Sone High Level Canal, which was begun during 1966-69, was also completed at the end of the Sixth Plan. The total O&M costs of Kosi are almost twice those for Sone, even though the irrigation potential created and utilized is estimated to be lower in the Kosi canal systems²⁴. The share of establishment costs to total O&M is around 40 percent in the Kosi system and 45 percent in the Sone system.

²³It may be noted that in Bihar, the cost of establishment for collection of land revenue is also higher than the actual collection of land revenue

²⁴Data on potential created and utilized by each project were difficult to obtain. Sone Canal is estimated to be irrigating about 0.50 million ha. The potential created by Eastern Kosi Canal and Rajpur Canal are estimated at 0.46 million ha. The potential utilized up to 1980 was about 50 percent of the total created. This is the major reason for relatively higher unit costs of the Kosi system.

Table 6.37. **Expenses^a** and receipts for Kosi and Sone River Projects: 1984-85 (in Rs million).

	Kosi	Sone
<i>Expenses</i>		
Establishment costs	20.8	11.1
Works	<u>30.1</u>	<u>13.4</u>
Total O&M costs	<u>50.9</u>	<u>24.5</u>
<i>Receipts</i>		
Gross receipts	19.0	60.6
Cost of revenue establishment	24.1	39.5
Net receipts	-5.1	21.1
Net receipts as percent of O&M costs	Negative	86
Percentage increase in water charges (actually collected) to cover O&M costs	295	16

^aThese figures are marginally different from those obtained in the Budget papers.

Source: Irrigation Department, Government of Bihar.

Gross receipts from the Kosi system are only Rs 19 million compared with Rs 60.6 million in Sone. After deducting the cost of revenue establishment, the net receipts are negative (Rs -5.1 million) for Kosi, but positive (Rs 21.1 million) for Sone. Net receipts covered 86 percent of the total O&M costs in the Sone system. It has been estimated that in order to cover the entire O&M costs, gross receipts (or water charges actually collected) would have to go up by 300 percent in the case of the Kosi system. The corresponding estimated increase necessary is only 16 percent for the Sone canal system.

The financial performance of state tube wells is shown in Table 6.38. While total O&M expenses increased from Rs 106 million in 1981-82 to Rs 149 million in 1984-85, total revenues collected by the Bihar Water Development Corporation 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 total O&M expenses. Average revenue was Rs 15.7/ha while the area irrigated per state tube well was 16.2 ha. The estimated revenue per tube well was Rs 254 as against an estimated O&M cost of Rs 4,244.

Table 6.38. Financial performance of public tube wells in Bihar.

	1981-82	1984-85
No. of tube wells in working condition	3364	2167
Total revenue collection (Rs. million)	0.77	0.56
Total expenses on O&M (Rs. million)	106	149
Net losses (Rs. million)	105	148
Revenue collection as percent of total expenses	0.7	0.4
Area irrigated per TW (ha)	24.7	16.2
Revenue per ha (Rs)	9.3	15.7
O&M expenses per ha (Rs)	1276	4244

Source: Bihar Water Development Corporation, Patna.

Table 6.39. Net receipts from multipurpose and major and medium irrigation schemes (excluding flood control schemes) in 1981-82, (in Rs lakhs).

State	Gross receipts	Working expenses	Net expenses
Andhra Pradesh	2534 ^a	2172	+ 362
Assam	55	61	6
Bihar	729	1901	-1 172
Gujarat	7x5	1169	- 384
Haryana	10x2	1880	- 798
Himachal Pradesh			
Jammu & Kashmir	24	173	- 148
Karnataka	832	1096	- 264
Kerala	131	624	- 493
Madhya Pradesh	587	1312	- 725
Maharashtra	1325	1394	- 69
Manipur	5	6	- 1
Meghalaya			
Nagaland			
Orissa	408	861	- 453
Punjab	1064	1835	- 771
Rajasthan	866	1746	- 880
Sikkim			
Tamil Nadu	348 ^b	1064	- 716
Tripura			
Uttar Pradesh	3941	2565	+ 1376
west Bengal	85	1553	- 1468
Total	14801	21412	- 6610

^aIncludes an estimated amount of Rs 2372 lakhs attributable to irrigation but shown under Land Revenue

^bIncludes Rs 2.54 lakhs attributable to irrigation but shown under Land Revenue.

Source: Government of India: Report of the Eighth Finance Commission, 1984, Annexure III-19, p 199

In contrast, gross receipts, both direct and indirect, increased by 27 percent, at current prices, over the seven-year period indicating that these have declined significantly in real terms (deflating by wholesale price index of all-commodities). Compared to Rs 85 million in 1975-76, these 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 hectare, at current prices, averaged Rs 35 in 1973-74, Rs 50 in 1975-76, and Rs 43 in 1982-83. In real terms, gross receipts per hectare declined from Rs 50 in 1975-76 to Rs 26 in 1982-83, i.e., almost by one-half over an eight-year period.

A juxtaposition of these O&M costs and expenses on revenue collection with the receipts from irrigation projects provides valuable insights into irrigation financing in the State of Bihar. Table 6.8 shows that the total receipts from irrigation projects (including multipurpose projects) was Rs 126.4 million in 1984-85. After deducting the cost of revenue establishment of Rs 70.7 million, 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, net receipts from the operation of irrigation projects was negative, i.e., Rs -116.4 million or Rs -56.5 per ha. These figures have to be seen in the context of net receipts of Rs -117.2 million (Rs 73 million - Rs 190 million) for Bihar in 1981-82 as reported by the Eighth Finance Commission (Table 6.39).

Table 6.40 shows gross receipts (at current prices) from irrigation works in Haryana. Note that while gross receipts increased by 42 percent over the decade 1973-74 to 1982-83, gross receipts per hectare increased only by 23 percent. In real terms (i.e., deflated by Wholesale Price Index 1975-76 = 100)

Table 6.40. Gross receipts and working expenses of irrigation projects in Haryana : at current prices; 1973-74 to 1982-83.

	Gross receipts per ha (Rs)	Working expenses per ha (Rs)	Gross area irrigated (million ha)	Gross receipts (direct & indirect) (Rs million)	Working expenses (direct & indirect) (Rs million)	Gross receipts as percent of working expenses
1	2	3	4	5=3 4	6=3 2	7=4 2
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	12	66
1977-78	1.540	99	116	17	58	15
1978-79	1.667	95	131	73	57	19
1979-80	1.673	100	164	49	40	90
1980-81	1.818	101	181	56	56	100
1981-82	1.892	108	207	52	57	109
1982-83	1.865	111	211	38	43	113
Percent increase 1982-83 over 1973-74	15	42	229	--	23	190

Source: Statistical Abstract of Haryana (1983-84); Government of Haryana, 1985.

gross receipts, instead of increasing, have declined from Rs 85 million in 1975-76 to Rs 66 million in 1981-82 (Table 6.12). Gross receipts per hectare, at current prices, remained around Rs 50/ha in 1982-83. Gross receipts covered only 52 percent of O&M expenses in 1981-82 and only 38 percent of O&M expenses in 1982-83.

Resource Flows Related to Irrigation Financing: A Comprehensive View

It is important to take a comprehensive view of resource flows related to irrigation financing in India. This requires estimates of capital and current flows into the agricultural sector in terms of investments and O&M expenses incurred on government-managed irrigation systems. It also requires estimates of subsidies on the use of fertilizers, electricity (for water pumping), and diesel oil (for pump-sets and tractors). Resources flow out of the rural sector through payments of land revenue, agricultural income tax, irrigation charges, tax on commercial crops, and indirect taxes on commodities used by households and rural enterprises.

In Table 6.41 an attempt has been made to estimate total resource flows related to irrigation financing in Bihar for the year 1984-85. These estimates have to be taken as preliminary and need further refinement. However, these estimates do provide order-of-magnitude numbers to put in perspective various policy alternatives relating to irrigation financing.²⁵ Total O&M expenses including revenue establishment were Rs 242.8 million on surface irrigation projects. Total O&M expenses including electricity charges for public tube wells are estimated at Rs 149.6 million. Thus, current expenditure on government-managed irrigation systems is Rs 392.4 million for 1984-85. As against this, collections from irrigated farm sector are: Rs 126.4 million as irrigation charges and Rs 622 million as additional indirect taxes paid by farmers using canal irrigation (Tables 6.23 and 6.41).

Thus, net financial flows from the canal-irrigation sector are Rs 505.6 million. When public tube wells are also considered, net flows are reduced to Rs 356.0 million on account of their high O&M costs but very low irrigation benefits. If gross collections of land revenue are also considered, the area irrigated by canals (1.18 million ha) has contributed about Rs 27 million (an average of Rs 23/ha). Thus, the total estimated current resource flows (revenues) to the Central and State governments on account of canal irrigation were much higher than the current expenditures.

Gross receipts obtained directly from farmers through charging irrigation fees were only 17 percent of the total receipts from this sector. Similarly, net resource flows into irrigation (Rs 116.4 million \times Rs 242.8 million - 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 etc., and efforts to raise more resources from this sector need not be confined to a mechanical approach which suggests raising irrigation fees to cover O&M expenses plus a percentage of capital costs.

²⁵The analysis here is confined to current (annual) revenues and expenditures owing to lack of data on transfers of a capital nature (e.g., plan funds).

Table 6.41. Resource flows related to irrigation financing in Bihar: A comprehensive view (current revenues and expenditures only).

		Annual flow (Current revenues) & expenditures)
A RESOURCE FLOWS INTO AGRICULTURE (1984-85)		
<i>Irrigation sector</i>		
1.	<u>Surface irrigation projects</u>	(Rs million)
	O&M expenses	167.6
	Direction & administration	4.5
	Revenue establishment	70.7
	Sub-total	242.8
2.	<u>State tube well projects</u>	
	O&M expenses (including revenue establishment)	90.3
	Electricity charges	59.3
	Sub-total	149.6
3.	<u>Private tube wells</u>	
	Subsidy on electricity charges ^a	868.0
4.	<u>Fertilizer subsidy^b on imported fertilizers used on irrigated land</u>	314.0
5.	Sub-total for the government-managed irrigation (1+2)	392.4
6.	Sub-total for the government-managed irrigated agriculture	476.1
7.	Sub-total for the entire irrigation sector (1+2+3)	1260.4
8.	Total for the irrigated agricultural sector	1574.4
B RESOURCE FLOWS OUT OF AGRICULTURE IN BIHAR 1984-85		
(Rs million)		
		Current revenue/expenditure flow
1.	<u>Land revenue & ag. income tax</u>	
	Gross collections	84
	Cost of collection	93
	Net revenues	-9
2.	<u>Irrigation Sector</u>	
	Direct Receipts	
	Gross collections of irrigation charges	1264
	Other receipts	n.a.
	Subtotal	126.4
	<u>Indirect Receipts</u>	
	Cess on commercial crops	n.a.
3.	<u>Indirect Taxes/Revenues</u>	
	Additional incidence of indirect taxes on households (canal irrigated farms only)	622
	Share of indirect taxes on agro-processing industries	
	Share of direct taxes on manufacturing	
	Export revenues attributable to irrigation	
	Reduction in import revenue to irrigation	n.a.
4.	Subtotal (2+3)	748.4
C. NET FINANCIAL FLOWS (excluding land revenue)		
1.	Net financial flows for canal irrigation	748.4-248.8 = 505.6
2.	Net financial flows for government-managed irrigation	748.4-392.4 = 356.0
3.	Net financial flow for the total irrigation sector	116.4
4.	Net financial flows for irrigated agriculture	

^a It is assumed that the entire losses of State Electricity Board are on account of rural electrification, i.e., mainly for state and private tube wells. According to the Report of the Committee on Power of the Government of India (1980), Rural electrification losses in 1976-77 were Rs 1,568 million compared with overall losses of Rs 1,118 million.

^b Fertilizer consumption (total NPK) in Bihar was estimated at 0.225 million tonnes, i.e., 2.7 percent of the all-India consumption of 8.2 million tonnes. Total fertilizer subsidy was estimated at Rs 18,320 million, i.e., Rs 2,234 per tonne of NPK. Hence the fertilizer subsidy for 0.225 million tonnes was Rs 503 million. If subsidy on only imported fertilizers is considered. It was Rs 1744 per tonne or Rs 392 million it is further assumed that 80 percent of the total fertilizer consumption is on irrigated land. Further, this fertilizer subsidy is distributed between government-managed irrigation system and private tube wells on the basis of area irrigated, i.e., a ratio of 1:2.

Sources: see Tables 8 and 23, 8th Finance Commission Report (1984:182).

SUMMARY AND CONCLUSIONS

The objective of the study was to review the trends in resource mobilization and O&M expenses of government-managed irrigation systems in two ~~States~~ of India — namely, Bihar and Haryana. It was also considered important to take a systems' view of resource flows from ~~canal~~ irrigation by quantifying the indirect resource transfers (e.g., indirect taxation, ~~fixation of~~ "administered" prices for outputs and inputs) arising from government policies. The ~~main~~ conclusions of the study ~~are~~ summarized below:

- i) Although irrigation fees for canal irrigation have increased in nominal terms, they have not changed at all over the last decade in real terms, i.e., when changes in prices of rice and wheat are taken into account;
- ii) In Bihar, arrears of irrigation charges were between **Rs 225-258 million** ~~in~~ the last 3 years. These are around three times more than the current charges in these years. Assessed charges for irrigation have declined from **Rs 71 million** in **1982-83** to **Rs 62.4 million** ~~in~~ **1984-85**, partly due to a decline in area irrigated and partly due to lower average rates. The assessment for industrial water supply has also declined, the assessment for **1984-85** at **Rs 10.2 million** ~~is~~ 60 percent lower ~~than~~ that in **1982-83**.
- iii) In **Bihar**, the Government has an elaborate setup of revenue administration in the Irrigation Department. The ~~costs~~ of this revenue administration are so high that in **1984-85** the ~~expenditure~~ on revenue establishment (i.e., cost of collection) at **Rs 63.7 million** was ~~higher than the revenues~~ obtained from providing irrigation services (**Rs 48.2 million**). ~~Thus~~, abolition of water charges ~~and~~ retrenchment of the staff on revenue administration would have provided the State Government with additional funds of **Rs 31.6 million** during the 3 years **1982-83** to **1984-85**. ~~This suggests that~~ the main purpose of a large revenue administration bureaucracy is to provide employment for people rather than to ~~collect~~ irrigation charges. It is in this context that the possibilities of collecting water rates along with land revenue or through ~~enhanced~~ land revenue for irrigated land should be considered. ~~If this is found difficult, politically, it may be useful to explore the possibilities of recovering irrigation charges through a tax on the use of fertilizers, after a careful consideration of the impact of this tax on the incentive to use fertilizers and resulting impacts on crop yields.~~
- iv) In Haryana, an analysis of data on ~~gross~~ receipts shows that receipts at current prices have increased by **42 percent** over the decade **1973-74** to **1982-83**. Gross receipts per hectare have increased by about **23 percent**, i.e., from **Rs 35/ha** in **1973-74** to **Rs 43/ha** in **1983-84**. Gross receipts ~~as~~ a percentage of working expenses of irrigation projects have shown wide variations over time; they were about **89 percent** in **1973-74**, **56 percent** in **1980-81**, and **38 percent** of working expenses in **1982-83**.
- v) In Bihar, ~~gross~~ receipts from irrigation cover, on average, only **75 percent** of **O&M** expenses; the range being **37 percent** for Kosi and **247 percent** for Sone. Receipts, net of ~~cost~~ of revenue collection, cover about **33 percent** of **O&M** expenses, on average, the ~~range~~ being negative for Kosi to **85 percent** for Sone. ~~Annual~~ collection of irrigation charges has been ~~around~~ **60-80 percent** of ~~annual~~ charges and around **20 percent** of the total charges (including arrears).

- vi) O&M expenses in government-managed surface irrigation projects in Bihar average Rs 81/ha (ranging between Rs 45 and Rs 120, depending on the type of project) and Rs 133/ha in Haryana. **Thus**, in Bihar, O&M expenses, on average, are 20 percent lower than those considered desirable (and hence recommended) by the Eighth Finance Commission.
- vii) **An** analysis of per hectare O&M expenses in Bihar shows that they have declined in real terms over the last five years. In addition, there has been a significant increase in the "Establishment" component of O&M costs, while the "Works" component has declined. There is a need to analyze whether the decline in "Works" costs indicates only procedural shifts or a decline in the upkeep of the canals and other structures. The cost of revenue establishment for collecting irrigation charges has almost doubled over the last five years. In Haryana, O&M expenses have risen (by 11 percent) in real terms but have fallen in per hectare terms over the 7-year period 1975-76 to 1981-82. In the case of STWs, in Bihar, O&M expenses are not only high but have increased very fast: Rs 1,402/ha in 1980-81 to Rs 4,244/ha of irrigated area in 1986-85.
- viii) An analysis of the financial performance of state tube wells in Bihar shows that the total revenues collected by the Bihar Water Development Corporation, in 1984-85, were Rs 0.56 million as compared with O&M expenses of Rs 149 million, showing a net loss of Rs 148.4 million. **Thus**, revenue collections accounted for a meager 0.4 percent of the O&M expenses in 1984-85.
- ix) At the present levels of irrigation charges (or water rates) farmers are paying a small proportion of the net benefit that is due to irrigation. They are also paying a rather small component (less than 3 percent) of the net income (i.e., returns to farm family resources) from irrigated agriculture. The proportion of irrigation-related payments to gross value of output is also very low (less than 2 percent).
- x) If irrigation charges are raised to cover O&M expenses of irrigation works, it would result in moderate increases in the proportion of net benefit due to irrigation (or net income) being diverted for irrigation-related payments. However, if water rates are raised to cover full O&M costs and capital investment, it would result in a substantial (50-90 percent) share of net benefits being diverted to irrigation-related payments. It would be necessary to evaluate welfare and disincentive effects of raising irrigation fees to cover O&M expenses as well as full capital cost. It is in this context that prospects of "full cost recovery" need to be considered and analyzed. Since 80 percent of O&M expenses are on salaries and wages, and expenses on the entire revenue administration seem to be for the purpose of creating employment it is unfair to ask the farmers to bear the burden of these (ever-increasing) expenditures. Given the fact that 55 percent of the capital costs of reservoir-type irrigation projects are labor-related payments and there are significant "leakages" in other costs, it is important to consider why the farmers should bear the brunt of it.
- xi) Canal irrigation provides substantial increases in incomes which result in higher expenditures and payments of additional indirect taxes to Central and State governments. According to the estimates made in this study, such indirect resource transfers are much higher (around two-and-

one-half times **gross** O&M expenditures) than direct transfers or payments received in return for irrigation services. Thus, there is a need to explore the possibilities of raising financial resources indirectly through commodity **taxes**, and efforts to raise more **resources** from gravity irrigation system need not be confined to a mechanical (an accountant's) approach which suggests raising irrigation fees to cover O&M **expenses** plus a percentage of capital **costs**.

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GLOSSARY OF TERMS

Amin:	The person who takes measurement of the irrigated land surveyed by <i>patrol</i> .
Anchal	Circle; it is generally coterminous with irrigation subdivision under an assistant engineer.
Bajra:	A kind of millet crop (pearl millet).
<i>Irrigation Potential Created</i>	The irrigation potential created by a project at a given time during or after its construction is the aggregate gross area that <i>can</i> be irrigated annually by the quantity of water that could be made available by all the connected and completed works up to the end of the water courses or the last point for the water delivery system up to which the government is responsible for construction.
<i>Irrigation Potential Utilized:</i>	Irrigation potential utilized is the gross area actually irrigated by a project during the year under consideration.
Kharif:	Crops grown during the monsoon.
Khatiani:	Listing of area irrigated by each farmer indicating each plot surveyed.
Moharrir:	The person who prepares <i>khatiani</i> and <i>parcha</i> , i.e., collectible charges.
Parcha:	Charges notice.
Patrol:	The person who surveys the land irrigated to prepare <i>panji sudkar</i> .
Rabi:	Crops grown during Winter.
Sangrahaak:	Peon for collection of land revenue.
Sudkar Area:	Verified area (irrigated).
Sudkar Panji:	Register showing verified area irrigated.
Tehsildar:	Irrigation Revenue Inspector in charge of collection of water charges at circle level.

- Ultimate Irrigation:** The ultimate irrigation potential is the gross area that can be irrigated from a project in a designated year for the projected cropping pattern and assumed water allowance on its full development.
- Warabandi:** System of rotational water supply,
- Wari:** Turn,
- Wari-metric:** A system of irrigation charges where water rates are based on the number of turns a farmer receives water for irrigation during a season.
- Zilladar:** Circle officer under whom there are two sections: one in charge of assessment and the other in charge of collection.