THE EQUITY CONSEQUENCES OF PUBLIC IRRIGATION INVESTMENTS: THE CASE OF SURFACE IRRIGATION SUBSIDIES IN INDIA

Mona Sur and Dina Umali-Deininger[1]

South Asia Rural Development Unit. World Bank
1818 H St, N.W. Washington, D.C. 20433, USA

INTRODUCTION

Public investments in surface irrigation in India have been important in generating agricultural growth and in reducing the threat of poverty and food insecurity. The expansion of irrigation infrastructure and subsidized delivery of irrigation water, along with improved fertilizers and agro-chemicals, facilitated the rapid diffusion of modern high yielding varieties of crops. Irrigation also led to increases in cultivated area, higher cropping intensities and shifts in cropping patterns to higher value-added crops. Water from surface irrigation systems has provided additional benefits as a source of drinking water supply, and in generating power, for industry and residential consumers.

Over time the costs of providing and expanding surface irrigation have increased but revenues from irrigation have fallen short of expenditures. The accumulation of financial losses in the irrigation sector has contributed to mounting fiscal crises in Indian states (World Bank 1997, World Bank 2000a,b, World Bank 2001b, World Bank 2003a, Gulati and Sudnarayan 2003) Limited irrigation revenues have also resulted in inadequate expenditures on operation and maintenance (O&M), contributing to the deterioration of existing irrigation infrastructure. Furthermore, the under-pricing of surface irrigation water has encouraged inefficient use, contributing to environmental problems including salinity and waterlogging (Joshi and Tyagi 1995, World Bank 1999, Gulati and Sudanarayan 2003). The social justification of the subsidies are also increasingly debated, particularly how these subsidies are distributed across the population and whether they benefit the poor.

The equity consequences of public surface irrigation subsidies are the focus of this paper. Understanding the equity dimension of these subsidies in public surface irrigation systems[2] is important not only in determining whether the subsidies benefit the poor, but also in providing policy directions in designing cost-recovery strategies. In order to minimize or eliminate any adverse impacts of cost recovery measures on poor and vulnerable groups, it is necessary to identify how the various users of irrigation water are affected.

This paper is organized as follows. Section 1 reviews the structure of surface irrigation charges and the trends in irrigation expenditures and revenues in India. Section 2 discusses the measurement of irrigation subsidies and the data. Section 3 examines the incidence of surface irrigation subsidies and section 4 summarizes the magnitude of these subsidies. Section 5 elaborates the policy implications of the findings of the study.

[1] The views expressed in this paper are those of the authors alone and should not be attributed to the World Bank, its Executive Directors, or the countries they represent. Mona Sur can be reached via e-mail at msur@worldbank.org and Dina Umali-Deininger at dumali@worldbank.org.

[2] Henceforth, all references to surface irrigation systems relate exclusively to government managed surfaced irrigation systems.

WATER CHARGES, IRRIGATION EXPENDITURES AND REVENUES

Various Indian Finance Commissions have made recommendations on how to charge for irrigation water and have concluded that water tariffs should at least cover the cost of operation and maintenance (O&M) of irrigation systems plus a part of the capital cost. The Tenth Finance Commission recommended full recovery of O&M costs plus one percent of capital costs (Maria-Saleth, 1996b). The latest Government of India National Water Policy (2002) advocates for pricing water so as to initially cover the O&M costs of providing water, and recommends eventually charging for a part of the capital costs (Ministry of Water Resources 2002). Policy makers have also suggested that water rates should be revised every 5 years and should lie within the range of 5 to 12 percent of the gross revenue of farmers in the canal command area (Gulati, 1999).

Setting water charges is under the purview of state governments, and the standards adopted vary by state. The most common method of charging for surface irrigation water is on a per unit area by crop basis, with rates varying according to the relative water intensity of the crop (Table 1). Surface irrigation water charges may also vary by season, delivery method (individual or bulk), across regions, across schemes (minor vs major schemes), and/or within projects (reflecting dependability and continuity of irrigation services) (Maria-Saleth, 1997, World Bank 2001b,World Bank 2003a). In Tamil Nadu, irrigation fees are set as a proportion of the land tax charged to farmers. The use of volumetric pricing for surface irrigation is expanding, but remains limited to a few states (Maharashtra, Uttar Pradesh, Rajasthan). Some states impose betterment levies on canal irrigation water or an irrigation cess in addition to water charges (Maria-Saleth, 1997).[3]

Table 1. Water Charges for Selected Crops and States in India, as of September 2001 (Rs/Ha**).**

Crop	Maharashtra	Andhra Pradesh	Karnataka	Rajasthan	Uttar Pradesh
Sugarcane	4763[c]/3180[d]/8857[i]	875	1000	574	474
Paddy	180[e]/360[f]	494[a]/370[b]	250	198	287
Wheat	360	250	150	148	287
Cotton	548[g]/1088[h]	250	150	178	114
Maize	270	250	88	67	
Pulses			88	79	212
Vegetables	548[ci]/2040[ch]			109	287

Note: a-first crop, b-second crop, c-flow, d-drip & sprinkler, e-on contract, f-on demand, g-rabi, h-hot weather, i –kharif. Source: World Bank 2001a, World Bank 2003a.

Data from the 1990s reveal that the share of establishment costs (staff salaries and administration expenses) in total O&M expenditures on irrigation averaged 70% in six Indian states (Joshi and Hooja, 2000). As the share of establishment costs increased and funds spent on actual works were cut back, irrigation and drainage systems deteriorated, leading to greater water conveyance losses and reduced delivery efficiency. These in turn reduced the incentives of farmers to pay the irrigation charges, further increasing the difficulty of ensuring cost recovery (World Bank 1999, World Bank 2001b).

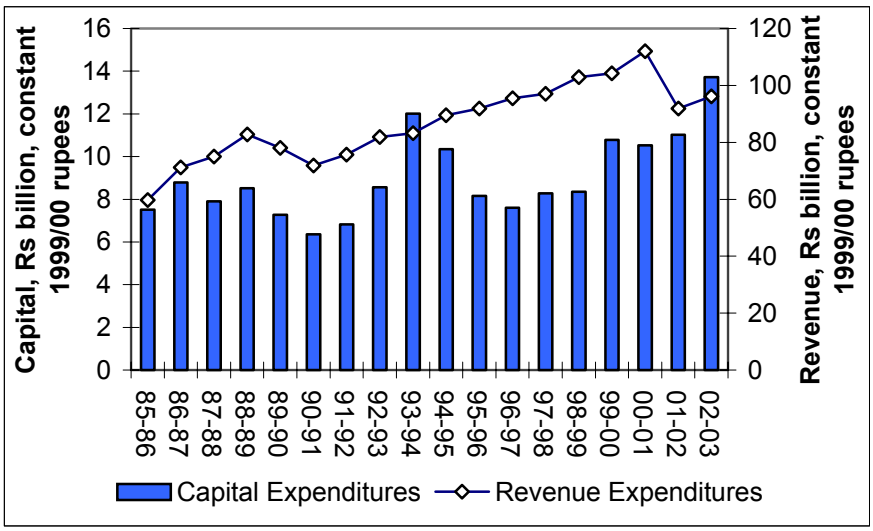
Water charges have also generally been set at very low rates and frequently states have failed to regularly revise water charges once they have been set.[4] Poor collection enforcement, a disconnect between the user charge payment and the provision of adequate and timely irrigation services, a lack of coordination between departments in the sector, and an understatement of area irrigated, especially under crops carrying higher rates, have also contributed to poor cost recovery in the sector (Raju and Amar Nath, 2001).[5]

[3] Irrigation cess is tax levied for irrigation.

[4] In recent years many states have revised and increased water rates. In 1997 water charges were tripled in Andhra Pradesh so that they would cover 75% of O&M needs. However, it has not been adjusted since then. By contrast, the Government of Maharashtra in 1998 issued an order that increases water rates automatically by 15% annually.

[5] Coordination problems stem from the fact that in some states, the responsibility for service provision and collection of water charges lie with different line departments. For example, in Karnataka and Andhra Pradesh, while irrigation service is provided by the irrigation department, water charges are collected by the revenue department.

Subsidies to surface irrigation across Indian states are sizeable and rising. Based on data from the 1980s and early 1990s, Dhawan (1997) estimates that nationally canal irrigation in India is subsidized to the extent of 95 per cent. Based on government expenditure budget reports, capital expenditures on irrigation at the national level almost doubled in real terms from about Rs 7.5 Billion in 1985/86 to Rs 13.7 billion in 2002/03 (constant 1999/2000 rupees) largely due to increasing costs of expanding irrigation projects to more difficult areas, and higher costs of borrowing (Figure 1). Revenue expenditures, which include O&M expenses, total staff costs[6] and other administrative costs of the irrigation departments, have also rose steadily, increasing in real terms from Rs 59.7 billion to Rs 96.1 billion during the same period. Revenue expenditures per gross irrigated hectare increased from Rs. 202/ha to Rs. 838/ha between 1988/89 and 1996/97 (constant 1999/00 rupees). This steady increase can be attributed to the rapid expansion in the number of staff employed in irrigation departments and a steep rise in staff salaries and allowances, most recently due to the large pay increase in 1996/97 following the recommendations of the Government of India Fifth Pay Commission. However, revenue receipts from major and medium irrigation have consistently fallen below expenditures. In 2000 revenue receipts covered only 10% of revenue expenditures. In the 10-year period between 1990-2000, revenue receipts as a share of revenue expenditures were less than 15% in 13 out of 14 states examined.



Source: World Bank State budget database.

Figure 1. Government Capital and Revenue Expenditures on Irrigation, 1985-86 to 2002-03 (Rs billion, constant 1999/2000 rupees).

MEASURING CANAL IRRIGATION SUBSIDIES

From an economic perspective, surface irrigation subsidies in a given year can be defined as follows: $S_1 = (E_{O\&M} + rK + \partial K) + D + V - R_s$ and $S_2 = (E_{O\&M} + rK + \partial K) + D + V - R_a$, with $R_i = R_i^f + R_i^{nf}$ for *i*=a, s, and $R_a = \alpha R_s$ where $0 \le \alpha \le 1$.

The terms in parentheses represent the supply cost of water. $E_{O\&M}$ represents O&M expenditures, r is the interest rate, ∂ is the depreciation rate, K is the cumulative capital outlay, D is the cost of the net environmental impact, V is the other net costs including social costs, R_s represents assessed water charges and R_a is actual revenue receipts. R_i^f corresponds to charges assessed/revenue receipts from farmers, while R_i^{nf} is charges assessed/revenue receipts from non-farm users of irrigation water. The subsidy as defined by S1 (or "planned" subsidy) captures the subsidy arising from government policies and reflects the government's water charging practices. S2 (or actual subsidy) also captures the subsidy arising from collection inefficiencies and the political economy of the irrigation sector. Due the lack of data for estimating the environmental and other impacts, the analysis in this study is confined to examining financial subsidies.

[6] This includes staff involved in O&M, construction, and general administration.

In the absence of reliable data on interest expenditures and capital costs incurred by state governments, the subsidy estimates have been calculated as the difference between O&M expenditures revenue receipts. Thus, in this analysis, S1 equals the O&M expenditures less assessed water charges and S2 equals O&M expenditures less actual water charges collected.

In most major and medium irrigation projects in India, irrigation water serves multiple users (e.g. domestic and industrial water consumers and power plants) and beneficiaries (e.g. flood control). Therefore in order to estimate the amount of the irrigation subsidy that is actually captured by farmers, it is necessary to allocate O&M costs among the various beneficiaries of the irrigation systems. Estimates of the subsidy accruing to farmers also need to take into account the fact that a large share of O&M costs arise from excessively high establishment costs due to excess staff. Thus, these excess costs function as a "transfer" to the irrigation service provider and are not received by farmers. The per hectare subsidy accruing to farmers is therefore $S^f = (E^f_{O\&M} - R^f_a)/H$ with $R^f_a = \alpha R^f_s$, where $0 \le \alpha \le 1$.

$E^f_{O\&M} = E_{O\&M} - E^{EC}_{O\&M} - E^{nf}_{O\&M}$ where $E^{EC}_{O\&M}$ is the "excess" O&M costs arising from larger than warranted establishment costs and $E^f_{O\&M}$ and $E^{nf}_{O\&M}$ are the O&M costs that can be allocated to the farmers and non-farm users/beneficiaries, respectively.

It is also assumed that the amount of subsidy accruing to different farmers is proportional to the irrigated area in their farms. In reality, farmers whose farms are situated at the head of the canal system in India have been found to receive greater benefits than tail-enders who frequently receive inadequate or erratic supplies of water. Further, wealthier and more politically connected farmers may receive a larger subsidy if their irrigated area is under-reported or collection efficiency is lower on their farms. In other words, $\alpha_L \le \alpha_s$ where α_L represents collection efficiency on large farms and α_s represents collection efficiency on small farms. Finally, while water requirements and water charges depend on the crops grown, due to unavailability of data the study assumes homogeneity in crop mix in estimating the subsidy accruing to different categories of farmers.

The data

The distribution of surface irrigation subsidies is estimated for major states and all-India using the 1998 (54th round) and 1999/2000 (55th round) Indian National Sample Survey NSS. In addition, actual levels of irrigation subsidies are calculated for five states, namely Rajasthan, Maharashtra, Andhra Pradesh, Karnataka and Uttar Pradesh, using state budget data. The study uses data from the 1998 NSS survey infer how the subsidies are distributed across farm households and to derive the subsidy per canal irrigated hectare. In addition to the standard modules, this round of the NSS included a questionnaire on Common Property Resources, Sanitation and Hygiene, which contained information on cultivation practices of households, the ownership of irrigation technology and the use of irrigation in cultivating 5 principal crops. Combined with the village questionnaire, his module of the survey can be used to identify households with access to irrigation and determine the distribution of irrigation by source, namely canals, electric pumps, diesel pumps, conjunctive (canals and pumps) and others.

It would be ideal to examine the distribution of subsidies among households ranked according to a measure of welfare such as income or expenditure. However differences in the sampling frame for the consumer expenditure survey of the 54th round of the NSS and the agricultural module made it impossible to match households (HH) in the two modules. As a result, we examine the distribution of subsidies across households using land ownership as an indicator of wealth, and social grouping (whether they are members of Scheduled Castes or Tribes).

Incidence of Surface Irrigation Subsidies

Table 2 summarizes the distribution of surface irrigation beneficiaries in 15 states and all-India in 1997/98. At the all-India level, only 13% of agricultural households use canal irrigation (either as their sole source of irrigation or conjunctively with groundwater or other sources). Agricultural households were also classified according to their farm size owned, namely: marginal farmers - those owning less than 1 hectare (Ha); small farmers - those with 1 to less than 2 Ha; medium farmers - those with 2 and less than 4 Ha; and large farmers - those owning 4 or more hectares.

Of the agricultural households with access to surface irrigation, 64% are marginal farmers, 19% are small farmers, 11% are medium farmers and 7% are large farmers.[7] Although marginal farmers constituted the majority of agricultural households in the country that use surface irrigation, they receive roughly 27% of surface irrigation subsidies (i.e. they operate 27% of the canal irrigated area). Approximately 32% of the subsidies accrue to large farmers, who represent 7% of households with access to irrigation, and less than 1% of all agricultural households in the country. Thus, although the distribution of household access to canal irrigation is equitable (when compared to the distribution of agricultural households in the rural population), the distribution of subsidies is quite regressive.

At the state level canal irrigation subsidies appear to be most regressive in Rajasthan, followed by Kerala and Bihar. In Rajasthan, only 10.4% of agricultural households benefit from canal irrigation subsidies and less than 3% of all agricultural households (consisting of large farmers) enjoy 65% of canal irrigation subsidies. In Kerala, while 12% of agricultural households have access to irrigation, less than 0.5% of agricultural households (mainly medium and large farmers) capture 34% of total canal subsidies. In Bihar 2% of agricultural households get approximately 47% of the benefits of canal irrigation subsidies. The distribution of canal irrigation subsidies appears to be least regressive in Tamil Nadu were 76% of the benefits go to marginal and small farmers who represent 94% of all households that use canal irrigation and 15% of all agricultural households.

Table 2. Incidence of Canal Irrigation Subsidies, 1997/98.

	% of Ag HHs with access to canals					Distribution of HH using canals (%)					Distribution of canal irrigated area (%)				
	All	Marginal	S.	M.	L.	All	Marginal	S.	M.	L.	All	Marginal	S.	M.	L.
Andhra Pradesh	19.92	13.36	3.36	1.67	1.53	100	67.07	16.87	8.37	7.69	100	34.32	22.84	16.73	26.11
Assam	2.04	1.15	0.52	0.3	0.08	100	56.16	25.28	14.73	3.83	100	32.16	22.46	24.29	21.09
Bihar	13.12	8.83	2.28	1.3	0.71	100	67.32	17.35	9.89	5.44	100	30.35	22.95	20.14	26.55
Gujarat	9.54	6.83	1.1	0.93	0.68	100	71.64	11.5	9.72	7.13	100	37.28	11.84	19.33	31.54
Haryana	19.83	6.53	5.91	4.05	3.34	100	32.94	29.81	20.4	16.85	100	24.04	18.49	20.53	36.94
Karnataka	15.63	7.38	3.77	2.77	1.72	100	47.17	24.14	17.69	11	100	17.15	21.52	25.77	35.56
Kerala	12.32	11.26	0.62	0.2	0.24	100	91.39	5.07	1.63	1.91	100	53.62	12.41	4.36	29.62
Madhya Pradesh	11.26	4.24	3.14	2.42	1.45	100	37.71	27.93	21.5	12.87	100	11.7	20.36	27.6	40.34
Maharashtra	4.67	2.07	1.47	0.76	0.37	100	44.43	31.4	16.32	7.85	100	21.62	33.39	23.51	21.48
Orissa	15.52	10.1	3.79	1.25	0.38	100	65.07	24.45	8.06	2.42	100	34.38	29.95	19.42	16.25
Punjab	16.8	5.09	5.19	3.09	3.43	100	30.28	30.89	18.4	20.43	100	9.01	19.56	22.1	49.34
Rajashthan	10.4	3.39	2.34	2.03	2.65	100	32.54	22.47	19.5	25.49	100	8.64	10.49	16.3	64.56
Tamil Nadu	15.4	12.6	1.92	0.71	0.18	100	81.81	12.44	4.58	1.17	100	52.18	24.12	14.49	9.21
Uttar Pradesh	12.46	8.96	2.16	0.95	0.39	100	71.91	17.37	7.59	3.13	100	39.8	24.11	20.03	16.06
West Bengal	16.45	13.73	1.84	0.8	0.08	100	83.47	11.19	4.84	0.5	100	55.65	24.65	16.81	2.89
All-India	12.69	8.16	2.36	1.33	0.85	100	64.28	18.58	10.48	6.66	100	26.7	20.71	20.35	32.23

Note: S. = Small, M.= Medium, L.= Large. Source: Authors' computation using 54th round of the NSS survey.

Only a small share of the poor are likely to benefit from irrigation subsidies. This is primarily because a large proportion of the rural poor are often landless and therefore are excluded from benefiting from irrigation subsidies. The 1999/00 NSS data indicate that only 28% of the rural poor in India had access to any type of irrigation (groundwater, surface, rivers, etc). The figures for the states of Maharashtra, Andhra Pradesh, and Karnataka are 11%, 13% and 11%, respectively. The numbers are higher in Rajasthan (43%) and Uttar Pradesh (66%).

[7] Households that reported cultivating crops are defined as agricultural households.

Few Scheduled Caste/Scheduled Tribe (SC/ST) households benefit from irrigation subsidies since less than 6% of rural SC/ST households use canal irrigation. In large part, this is due to the fact that a large majority of them reside in forest areas, where surface irrigation is not available. Nine percent of rural SC/ST households in Rajasthan use canal irrigation. The comparable figures for the other states examined in detail are 5.4% in Andhra Pradesh, 6.5% in Karnataka, 1.5% in Maharashtra and 9% in Uttar Pradesh.

The Magnitude of Surface Irrigation Subsidies

The magnitude of irrigation subsidies in terms of their costs to the state treasury is calculated for Andhra Pradesh, Karnataka, Maharashtra, Rajasthan and Uttar Pradesh (Table 3). In 1997/98, the total "planned" subsidy (S1) based on data from 1997/98 were Rs 733 million in Rajasthan, Rs 3.14 billion in Maharashtra, and Rs 1.3 billion in Andhra Pradesh. Collection efficiency ranged from a high of 85.2% in Uttar Pradesh to a low of 66.3% in Andhra Pradesh. Actual subsidies (S2) ranged from Rs 3.5 billion in Maharashtra to Rs 385 million in Karnataka. The differences in the size of the subsidy amounts reflect differences in the level of water charges and collection efficiencies between states.

The fiscal burden of these subsidies was quite significant in all five states examined. In 1997/98, the "actual" canal irrigation subsidies (S2) were equivalent to 2.6% of the fiscal deficit in Karnataka and 7% of the fiscal deficit in Andhra Pradesh. The corresponding figures for Maharashtra, Rajasthan and Uttar Pradesh are 6%, 2.8% and 3.7%, respectively. The opportunity costs of canal irrigation subsidies in terms of potential economic and social expenditures that were foregone were also high (Table 4). For example, data from 1997/98 reveal that canal irrigation subsidies in Maharashtra were equivalent to 29.1% of total expenditures (capital and variable expenditures) on health and 6.4% of education expenditures.

Table 3. The Magnitude of Canal Irrigation Subsidies in Selected States, 1997/98.

	Andhra Pradesh	Karnataka	Maharashtra	Rajasthan	Uttar Pradesh
O&M Expenditures (Rs Million)	2,438.0	578	4,308.4	915	3,783.9
Assessed Charges (Rs Million)	1,137.4		1,172.9	182	
Actual Collection (Rs Million)	754.6	193	816.1	155	1,007.0
Collection Efficiency, (Collection/Assesed), percent	66.3		69.6	85	85.2
Subsidy 1 (Rs Million)	1,300.6		3,135.5	733	
Subsidy 2 (Rs Million)	1,683.4	385	3,492.3	760	2,776.9

Note: S1 –planned subsidy. S2-actual subsidy. Source:Authors' computation.

Table 4. The Fiscal Burden and Opportunity Costs of Canal Irrigation Subsidies-1997/98.

State	Estimated O&M Subsidy $ million	O&M Subsidy as a Percent of			
		Fiscal Deficit	GSDP	Health Expenditures	Education Expenditures
Andhra Pradesh	45.3	7.0%	0.2%	17.7%	6.0%
Karnataka	10.4	2.6%	0.1%	5.3%	1.7%
Maharashtra	94.0	6.0%	0.2%	29.1%	6.4%
Rajasthan	20.5	2.8%	0.1%	8.5%	2.6%
Uttar Pradesh	74.7	3.7%	0.2%	19.4%	4.7%

Source: Data from World Bank 2001a, World Bank 2002, World Bank 2003a. GSDP is Gross State Domestic Product.

The level of subsidies captured by different groups of farm households were also estimated for Rajasthan and Maharashtra. The budget data required to calculate the surface irrigation subsidies accruing to farmers were most complete for the state of Rajasthan. Therefore, the example of Rajasthan is used to describe the calculation of irrigation subsidies accruing to different farm households. Table 5 provides estimates of the subsidy amounts received by farmers in Rajasthan and Maharashtra.

Table 5. Subsidies Received by Farmers in Rajasthan and Maharashtra.

	Rajasthan1/	Maharashtra
O&M Expenditures: Total (Rs Million)	435.07	3,519.48
O&M/ha (Rs/ha)	280.69	11,489.88
Assessed Charges (Rs Million)	182	410.7
Actual Collections (Rs Million)	155	246.5
Subsidy 1: Total (Rs Million)2/	253.07	3,108.78
Per ha (Rs/ha)	163.27	10,149.09
Subsidy 2: Total (Rs Million)3/	280.07	3,272.98
Per ha (Rs/ha)	180.69	10,685.15
Collection Efficiency (Collected/Assessed),%	85.16	60.02
Hectares (million ha)	1.55	0.31

Note: 1- Estimates factor out excess staff costs. 2/ S1 – planned subsidy. 3/ S2 - actual subsidy. Source:Authors' computation

In Rajasthan, 68% of agricultural households used irrigation and the vast majority of households that used irrigation relied on groundwater sources. Only 15% of the agricultural households used canal irrigation, which covered 22% of total irrigated area. The main canal irrigated crops in the state were wheat, oil seeds and cash crops.

Actual O&M spending in Rajasthan in 1997/98 was approximately Rs 915 million. Assessed irrigation charges and actual collections for the same period amounted Rs 182 million and Rs 155 million, respectively. Subtracting assessed charges and actual collections from O&M expenditures results in a "planned" subsidy of Rs 733 million and an "actual" subsidy of Rs 760 million. The "actual" subsidy exceeds the "planned" subsidy since collections efficiency is only 85%. Because of the unavailability of data on assessment of charges and collections from non-farm users/beneficiaries, the subsidy estimates are likely to be slightly upwardly biased.

In computing the subsidy that is captured by farmers, it is necessary to estimate the "excess" O&M costs ($E_{O\&M}^{EC}$) due to higher than warranted establishment charges as well as estimate the O&M costs that can be allocated to users/beneficiaries other than irrigators (farmers) ($E_{O\&M}^{nf}$). Estimates of the "excess" costs were based on the findings of a recent study on Institutional Strengthening and Restructuring in the irrigation sector in Rajasthan. This study included a rationalization of irrigation O&M expenditures and recommended a reduction in the staff share (which includes establishment expenditures) of O&M costs from 76% to 28% (as cited in Pricewaterhouse Coopers, 2000). The recommended share of staff costs (28% of O&M costs) represented a 53% reduction in staff costs. To calculate the O&M costs less the "excess" institutional costs, staff costs were reduced by 53% and the O&M expenditures adjusted to reflect the lower staff costs. The O&M costs net of the "excess" costs totaled Rs 524.18 million.

In order to determine the share of O&M costs that can be allocated to farmers, it is assumed that the share of O&M costs that farmers are responsible for is proportional to the volume of surface water that is allocated to farmers for irrigation purposes. While this assumes that the per-unit value of irrigation water is constant across uses and ignores non-consumptive uses of water (such as the use of irrigation water in the generation of hydro-electric power), this was the preferred method in the absence of data on the per-unit value of water in different uses.

Data from Rajasthan revealed that 83% of surface water was used for irrigation. Assuming that farmers are responsible for 83% of O&M expenditures, the O&M costs that can be allocated to farmers ($E^{f}_{O\&M}$) is Rs 435.07 million. Calculating the subsidy as the difference between the O&M costs allocated to farmers and actual collections from farmers, the average "actual" subsidy (S2) was Rs 180.69/ha. If we assume 100% collection efficiency ($\alpha = 1$) as opposed to the actual rate of collection efficiency (approximately 85%), this subsidy would decrease to Rs. 163.27/ha (the "planned" subsidy, S1).

In Maharashtra 82% of the total surface water volume is utilized for irrigation implying that the O&M share of farmers is equal to Rs 3,519 million. Subtracting the assessed irrigation fees and actual fees collected from this amount, respectively, gives rise to a "planned" subsidy (S1) of Rs 10,149/ha and an "actual" subsidy (S2) of Rs 10,685/ha. These estimates are not adjusted for "excess" costs because of a lack of relevant data.

The subsidy estimates for Rajasthan and Maharashtra were combined with data on the distribution of canal irrigated area to compute the subsidy amounts received by different categories of farmers. These results are summarized in Tables 6 and 7. In Rajasthan the average "planned" subsidy per household was Rs 693.56 and the average "actual" subsidy received per household was Rs 766.74. The "planned" and "actual" subsidy for the average marginal farmer in Rajasthan was just over a quarter of the average household subsidy and about one tenth of those received by the average large farmer. Owing to farm sizes that were almost three times as large as the average farm in the state, large farmers representing less than 3% of all agricultural households, and 25% of all canal users captured 65% of canal irrigation subsidies in the state. In Maharashtra marginal and small farmers represented 76% of all households using canal irrigation. These marginal and small farmers with access to canal irrigation operated 55% of total canal irrigated area and received a "planned" subsidy (S1) of Rs 5,534.03 and Rs. 12,092.85 per household, respectively (Table 6). In Maharashtra the "planned" and "actual" subsidy received by the average marginal farmer was half the average household subsidy and about one sixth than that received by the average large farmer (Table 7).

Table 6. Subsidies Received by Agricultural Households in Rajasthan.

	Average farm size ha	% of Agricultural HHs using canals	Distribution of HH using canals (%)	Distribution of Canal Irrigated Area	Planned Subsidy (S1)/HH	Actual Subsidy (S2)/HH
All	2.71	10.40	100.00	100.00	693.56	766.74
Marginal	0.51	3.39	32.54	8.64	184.19	203.62
Small	1.40	2.34	22.47	10.49	323.97	358.15
Medium	2.78	2.03	19.50	16.30	579.69	640.85
Large	7.86	2.65	25.49	64.56	1756.77	1942.12

Note: HH- households. S1 –planned subsidy. S2-actual subsidy.
Source:Authors' computation.

Table 7. Subsidies Received by Agricultural Households in Maharashtra.

	Average farm size ha	Percent of Agricultural HHs using canals	Distribution of HH using canals (%)	Distribution of Canal Irrigated Area	Planned Subsidy (S1)/HH	Actual Subsidy (S2)/HH
All	2.00	4.67	100.00	100.00	11371.55	11972.17
Marginal	0.50	2.07	44.43	21.62	5534.03	5826.32
Small	1.36	1.47	31.40	33.39	12092.85	12731.57
Medium	2.55	0.76	16.32	23.51	16379.30	17244.43
Large	6.80	0.37	7.85	21.48	31111.66	32754.91

Note: HH- households. S1 –planned subsidy. S2-actual subsidy.
Source:Authors' computation.

Tables 8 and 9 report subsidy estimates accruing to SC/ST households. Forty-three percent of households with access to canal irrigation in Rajasthan were members of scheduled castes or tribes. . These households received approximately 24% of all canal irrigation subsidies in the state. These households on average received a "planned" canal irrigation subsidy (S1) of Rs 379.53 compared to an average "planned" subsidy of Rs 931.66 enjoyed by non-scheduled caste/tribe households. The average "actual" subsidy (S2) received by SC/ST households totaled Rs. 419.57 compared to an average "actual" subsidy of Rs 1,029.96 received by non-SC/ST households. The large difference in average "planned" and "actual" subsidies between SC/ST households and non-SC/ST households in Rajasthan was due to the greater access to irrigation by non SC/ST medium and large farmers. Nineteen percent of households with access to canal irrigation in Maharashtra are members of scheduled castes or tribes and these households receive approximately 11% of all canal irrigation subsidies (Table 9).

Table 8. Subsidies Received by Agricultural Households Belonging to Scheduled Tribes/Scheduled Castes in Rajasthan.

ST/SC HH	Average farm size, ha	Percent of Agricultural HHs using canals	Distribution of HH using canals (%)	Distribution of Canal Irrigated Area	Planned Subsidy (S1)/HH	Actual Subsidy (S2)/HH
All	1.72	4.49	43.12	23.60	379.53	419.57
Marginal	0.50	2.17	20.87	4.35	144.40	159.63
Small	1.37	1.02	9.76	4.50	319.60	353.32
Medium	2.74	0.87	8.37	7.13	591.17	653.54
Large	7.20	0.43	4.12	7.62	1283.18	1418.56
Non SC/ST HH						
All	3.29	5.92	56.88	76.40	931.66	1029.96
Marginal	0.53	1.21	11.67	4.30	255.37	282.31
Small	1.42	1.32	12.70	6.00	327.33	361.86
Medium	2.79	1.16	11.13	9.17	571.06	631.31
Large	8.01	2.22	21.37	56.94	1848.03	2043.01

Note: HH- households. S1 –planned subsidy. S2-actual subsidy.
Source:Authors' computation.

Table 9. Subsidies Received by Agricultural Households Belonging to Scheduled Tribes/Scheduled Castes in Maharashtra.

ST/SC HH	Average farm size, ha	Percent of Agricultural HHs using canals	Distribution of HH using canals (%)	Distribution of Canal Irrigated Area	Planned Subsidy (S1)/HH	Actual Subsidy (S2)/HH
All	1.70	0.87	18.56	11.31	6927.61	7293.51
Marginal	0.51	0.65	13.84	5.30	4354.41	4584.40
Small	1.32	0.14	2.93	3.27	12697.92	13368.60
Medium	2.52	0.08	1.80	2.74	17332.85	18248.34
Large	6.71	0.00	0.00	0.00		
Non SC/ST HH						
All	2.09	3.80	81.44	88.69	12384.51	13038.63
Marginal	0.50	1.43	30.59	16.32	6067.61	6388.09
Small	1.38	1.33	28.47	30.12	12030.62	12666.06
Medium	2.56	0.68	14.52	20.77	16261.27	17120.16
Large	6.81	0.37	7.85	21.48	31111.66	32754.91

Note: HH- households. S1 –planned subsidy. S2-actual subsidy.
Source:Authors' computation.

CONCLUSION

There are three main findings of this study. First, in the selected states, namely Andhra Pradesh, Karnataka, Maharashtra and Uttar Pradesh, the study found that canal irrigation subsidies (defined as the difference between O&M expenditures and the actual collections of water charges) were sizeable. In 1997/98 these subsidies ranged from about $10 million to $94 million or 3 to 7 percent of the fiscal deficits of the states examined. These subsidies have a high opportunity cost in terms of potential social and economic expenditures that are foregone.

The results of this study also showed that accounting for "excess" costs (attributable to higher than warranted staffing and establishment expenses of Irrigation Departments) as well as the cost shares of other users of irrigation systems, resulted in significantly lower estimates of the amount of the irrigation subsidy that was actually received by farmers. In Rajasthan, once "excess" costs and expenditures attributable to other non-irrigation purposes were subtracted from total O&M expenditures, the subsidy that farmers receive declines by as much as 60%. This implies that in formulating water pricing policies, a more accurate accounting and allocation of costs becomes critical to ensure that farmers are levied only their fair share of the "legitimate" costs.

Finally, this study finds that the vast majority of rural households in India do not directly benefit from irrigation subsidies since they do not use canal irrigation.[8] Overall only 13% of agricultural households in India use canal irrigation. Few poor or SC/ST households benefit from canal irrigation subsidies. The major beneficiaries are medium and large farmers.

The results of this study suggest that in addition to the fiscal and operational concerns, the fact that the majority of these subsidies are benefiting non-poor households (depending on the state, 30-80% of these subsidies are benefiting medium and large farmers) adds to the justification for addressing the issue of canal irrigation subsidies. The results also imply that measures for cost recovery from different groups of users of canal irrigation will need to address two issues: what costs can users/beneficiaries be legitimately held responsible for, and what is the appropriate cost sharing method to recover the "legitimate" costs of irrigation services from the multiple users and beneficiaries of canal irrigation water?

Addressing the "excess" costs will entail coming up with estimates of the least cost of providing reliable and sustainable irrigation services. This exercise will need to be location and state specific. It will also entail greater attention to the composition of these costs to come up with benchmarks for acceptable shares of expenditures going to works, staff/establishment. In order to identify inflated or inadequate expenditures, as the case may be, it will be important to have good information systems that will be able to be track the data and allow transparency. These estimates of the least cost of service provision will be essential to address the issue of "excess" costs. Depending on the case, addressing these high costs will probably entail rationalization of the institutional and staffing costs of irrigation service providers.

Rationalization of water tariff rates will also be needed to ensure that water charges are sufficient to cover O&M costs. Without sufficient revenues from water charges, service providers are unlikely to be able to afford O&M expenditures required to provide reliable services. As water delivery becomes uncertain and unreliable farmers will be reluctant to pay for irrigation, further eroding the revenue base.

Problems with collection efficiency will also need to be addressed in order to ensure that water charges do not fall below assessed tariffs, particularly among medium and large farmers as they are the major beneficiaries among users.

[8] While only a very small faction of households directly capture canal irrigation subsidies, there are many indirect beneficiaries of these subsidies including landless households that rely on agricultural wage employment in canal command areas as well as consumers of food and other goods produced with canal irrigation water who may benefit from lower commodity prices.

In some states such as Andhra Pradesh, where water charges are assessed jointly by the Irrigation and Revenue Department, but collections continue to be the sole responsibility of the Revenue Department, there is a need to address the disconnect between service provision and collection of charges. Even if the Revenue Department collects water charges, it is necessary that they provide accurate and timely data on collections to the Irrigation Department in order for the Irrigation Department to evaluate its performance by linking service provision to collection. Data disaggregated by Water User's Association (where relevant), location in the canal system and by farm size is critical in order to identify where cost recovery is low and measures to address the problem are needed.

As part of the process of water tariff reform, the impact on different groups of users and particularly the poor and vulnerable households should be carefully examined. Recent estimates indicate that canal irrigation costs under the currently prevailing tariff structures in Indian states account for only a small fraction of household gross farm income. For example, data from AP show that irrigation costs accounted for less than 5% of gross income of farmers that exclusively use canals for irrigation (World Bank, 2001). For these households, an incremental increase in charges is unlikely to have a large impact. For conjunctive users the share of irrigation costs as a fraction of gross income is much higher, and a tariff increase may have a much more substantial impact on household welfare.

The impact of increasing water charges on the incomes of poor and vulnerable households using canal irrigation is not obvious a priori. For example, if higher charges are accompanied by improvements in the timing and supply of irrigation water resulting from better operation and maintenance afforded by the increased revenues, the productivity benefits could compensate for the loss of the irrigation subsidy. Under the current scenario of poor operation and maintenance and inadequate funds to expand irrigation systems, poor households are probably the ones who are most adversely affected since these farmers, unlike their wealthier counterparts, are least likely to afford the sizeable investments required to acquire pumps necessary to obtain ground water for irrigation. These farmers are also more likely to be located in the tail-end of the canal system where water supplies are inadequate or erratic. Options for minimizing the impact of the reform process on poor and vulnerable households could involve both tariff (such as tiered pricing based on farm size) and non-tariff measures (for example investment grants).The appropriate interventions would need to be carefully evaluated.

Past experience indicates that eliminating subsidies is politically challenging and few state governments have been willing to take the risk. Since much of the canal irrigation subsidy goes to the bureaucracy (through "excess" costs or underreporting of irrigated area) and to better-off (possibly more politically powerful) farmers makes it all the more difficult, politically, to eliminate these subsidies. However, failure to address these subsidies has serious fiscal, equity, and environmental ramifications for Indian states.

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