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Dr. Ashok K. Mitra, Professor, Gokhale Institute of Politics and Economics, Pune.

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Contents

IRRIGATION MANAGEMENT AND PRICING OF IRRIGATION WATER

Ashok K. Mitra*

Introduction

Irrigation has played a crucial role in the remarkable growth of agricultural production in India. Massive investment in irrigation to the tune of around Rs. 60,000 crores (at 1988-89 prices) during the period 1950 to 1990 and the consequent creation and expansion of irrigation facilities to the tune of about 80 million hectares (mh) of gross irrigated area have enabled the country to keep the pace of the growth of food production ahead of the growth of population and attain self sufficiency in cereal production. Indeed the cereal production is reported to have reached a level (around 177 million tonnes in 1994) that has opened up the possibility of export of cereals in the years to come. Needless to emphasise that irrigation will continue to play a key role in future strategy of growth in agricultural production in India. Despite such massive investment in irrigation sector and inspite of such impressive growth of agricultural production, such a development is also associated with a host of problems which appear to create a shadow of doubt about its future potentialities. In point of fact a look back at the course of irrigation development reveals that it is beset with the problems of increasing disparities (both inter regional and inter personal) and growing inefficiencies with which the systems are operated. These problems are clearly related to the pattern of investment and creation of network irrigation systems as well as to the organisation of water management institution for such systems created.

In this paper an attempt has been made to examine the issues related to the management of the existing irrigation systems. In so far as the investment in irrigation in design and construction of irrigation structure and network of distribution systems affects the management of the systems, the same is also touched in our discussion, but only briefly and indirectly. Since the management of irrigation in-

* Dr. Ashok K. Mitra is a Professor at the Gokhale Institute of Politics and Economics, Pune. The views expressed in the paper are author's own and do not necessarily reflect those of the Institute to which the author belongs.

volves not only technical, engineering and organisational aspects, but also the aspect of financing cost of operation and maintenance, the question of pricing of water for irrigation inevitably comes into discussion in this paper. In recent decade the country has experienced rapid expansion of minor irrigation led mainly by groundwater development. In view of this development we also bring into discussion the management, cost and financing of minor irrigation (especially groundwater) development in this paper.

The context

Even though there is ample need as well as scope for both expansion and improvement in efficiency and one need not therefore pose the issue of irrigation development in terms of 'expansion versus efficiency', the exigencies of the situation demand that utmost importance be given to the improvement in the efficiency of the existing irrigation systems. Large scale irrigation projects have been the characteristics of irrigation development in India. Even though in recent years, in relative terms, the importance of these projects has declined as a result of rapid expansion of groundwater development, the absolute scale of activity has risen steeply. Presently, the existing major and medium irrigation (MMI) systems in India are state managed. Besides, management, the state has direct responsibility for the maintenance of all surface irrigation systems in India right from the main storage down up to the field channels. Evidence of steadily declining performance of the existing irrigation systems due to sheer neglect of financial parameters, being noticed in the recent years, has become the cause for worry. The whole development calls for critical review and examination of the management systems in its technical, organisational and institutional aspects as well as in its financial parameters including pricing of water. The minor irrigation, led mainly by groundwater development, has in relative terms acquired importance in the overall irrigation development in India during the last decade or so. Since it is widely contended that owing to subsidised electricity and other means of energising the water lifting devices (mainly pumpsets), efficiency in the use of groundwater leaves much to be desired, the whole issue of cost of operation and maintenance of ground water irrigation also calls for critical evaluation. It is in the above context that the present paper proposes to deal with the issue of how best to manage water for irrigation with a view to not only improve technical efficiency of the existing systems, but also to resolve conflicts arising out of inequitious access to

water distributed across canal command. Besides, the most vexed and complex problems of financing the operation and maintenance of the surface irrigation systems as well as financing of capital operation and maintenance cost of groundwater irrigation systems and the conflict of interests in raising such finances and consequent pricing of water along with the remedial measures to tackle these problems are the matters of analysis and discussion in this paper.

The paper is mainly based on the analysis of secondary data and other relevant information. The paper also draws considerably on the earlier works done and information complied in various project reports, committee reports and government reports. The central theme of the paper being management, financing of operation and maintenance of the existing state managed surface irrigation systems and the pricing of water for irrigation, critical review and observations on the existing practices and mechanisms regarding these will form the main basis of analysis and discussion.

The layout of the paper is as follows. The first section of the paper deals with a brief overview of irrigation development in India during the period of 1950 to 1990, both in its physical and financial dimensions. The second section deals with the review of the existing management practices with special reference to the surface irrigation systems. In the third section we take up the discussion on the problems of irrigation sector mainly relating to operation and maintenance with a view to understand the nature of technical problems as well as the conflict of interests and hence the need for organisational/ technical systems. The fourth section deals with the cost aspect of operation and maintenance and financing the same in the case of surface irrigation systems and financing capital and operation and maintenance cost in the case of groundwater irrigation. The fifth section deals with the related issue of pricing of irrigation water. In the sixth section we take up the issue of irrigation sector reforms in the light of discussions in the earlier sections, mainly in terms of organisational/institutional set up and financing of operation and maintenance and with a view to examine if the conflict of interests could be resolved through such reforms. Finally, in the seventh and the last section we make some concluding observations having policy implicatioins on the basis of the observations made in the earlier sections.

SECTION I

Irrigation Development and Investment in Irrigation in India (1950-1990)

1.1 Overall Development

As mentioned earlier, there has been considerable increase in the irrigated area over the last four decades. By the end of Seventh Five Year Plan the country achieved irrigation potentials of 29.9 million hectares and 46.6 million hectares under major, medium and minor irrigation projects respectively.

As revealed by data presented in Table 1, taking into account the estimates at the end of 1991-92 and actual in 1993-94, the total irrigation potential created is estimated to be 82.9 million hectares comprising 31.2 million hectares under major and medium irrigation and 51.7 million hectares under minor irrigation. Further, likely addition in 1994-95 is of the order 2.2 million hectares (0.7 million hectares and 1.5 million hectares under major, medium and under minor projects respectively) and the targets for 1995-96 is 2.4 million hectares (0.8 million hectares under major, medium and 1.6 million hectares under minor projects). If the 1994-95 and 1995-96 expectations

Table 1 : Development of Irrigation Potential and Its Utilisation (Million hectares)

Types	At the end of 7th plan	During 1990-92	At the end of 1992-92	Actuals 1993-94	Likely additions 1994-95	Target for 1995-96
Major and Medium						
Potential	29.9	0.8	30.7	0.5	0.7	0.8
Utilisation	25.5	0.9	26.4	0.5	0.6	0.8
Minor						
Potential	46.6	3.7	50.3	1.4	1.5	1.6
Utilisation	43.1	3.4	46.5	1.2	1.1	1.3
Total						
Potential	76.5	4.5	81.0	1.9	2.2	2.4
Utilisation	68.6	4.3	72.9	1.7	1.7	2.1

Source: Five Year Plan documents, Planning Commission and Economic Survey, Government of India, New Delhi, 1995-96.

materialise, the total irrigation potential created would be around 87.5 million hectares comprising 32.7 million hectares of major and medium irrigation and 54.8 million hectares of minor irrigation. The target of ultimate irrigation potential of 113.5 million hectares from all sources of water, comprising 58.8 million hectares under major and medium irrigation projects and 55 million hectartes under minor irrigation projects, is to be achieved by 2010[1]. This means that the additional 25 million hectares under major, medium will have to be brought under irrigation within a period of fifteen years, which works out to addition of around 1.67 million hectares per annum. Looking at the past performance during the first half of nineties the task appears to be difficult. As regards minor irrigation the target of 55 million hectares appears to have already been achieved.

1.2 Irrigation Development: Sourcewise and by Major Crop Groups

In order to appreciate the problems associated with irrigation development and management, it is necessary to examine further the break up of the major, medium and minor irrigation into the sources of water for irrigation, specially the minor. Table 2 presents the estimates of sourcewise irrigation.[2]

The net irrigated areas is seen to have increased from around 21 thousand hectares to around 47.5 thousand hectares, an increase of around 26.5 thousand hectares over four decades from 1950 to 1990. The rate of increase appears to have accelerated from decade to decade. Out of the components of net irrigated areas, while the area under canal irrigation is seen to have doubled that under well irrigation is seen to have increased 4 times; as a result the area under well irrigation, which was smaller than the area under canal irrigation in 50s, turned out to be larger (one and half times) than the area under canal irrigation. In relative terms well and canal irrigation which accounted for 28.67 per cent and 39.78 per cent respectively of the net irrigated area in 1950-51 accounted for 51.03

1. In recent years there has been persistent demand for the revision of the estimates of ultimate irrigation potentials, specially under minor irrigation, in view of the new information being made available for carrying out such revisions. In response a number of revised estimates are available, but the reliability of such estimates are yet to be established.

2. Data for the sorucewise irrigation are not available beyond 1990-91. Gross irrigated area reported is seen to be smaller than the estimates of irrigation potential for the corresponding period. We shall have occasion to comment on this later sections.

per cent and 35.63 per cent resepctively in 1990-91. Irrigation from well has increased at a faster rate in the decades 60s, 70s, and 80s. Increase in area under canal irrigation has been particularly slow during eighties. In absolute terms though there has not been any significant change in the irrigated area under tank and under other sources between 1950-51 and 1990-91, in relative terms the tank irrigation sources has declined considerably from around 17 to 18 per cent in 1950 and 1960 to around 6 per cent of the net irrigated area in 1990-91. The gross irrigated areas is seen to have increased two and a half times between 1950-51 and 1990-91 slightly larger than what is observed in the case of net irrigated areas. The irrigation intensity, which is the ratio of gross irrigated area to the net irrigated area expressed in percentage term increased from 108 to 118 from 1950-51 to 1990-91.

Table 2 : Irrigated Area, Total and Sourcewise, in Different Decades

('000 Hectares)

	Gross Irrigated Area	Net Irrigated Area	Under Canal	Under Wells	Under Tanks	Under Other Sources
1950-51	22563	20853	8295	5978	3613	2967
1960-61	27980	24661	10370	7290	4561	2440
1970-71	38195	31103	12838	11887	4112	2266
1980-81	49775	38720	15292	17695	3182	2551
1990-91	55900	47430	1690	24206	3245	3079

Source: Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, New Delhi, 1990.

Table 3 : Irrigated Area Under Major Crop Groups in Different Decades

('000 Hectares)

	Foodgrains	Non-Foodgrains	% Share of Irrigated Foodgrains
1950-51	18317	4246	81.18
1960-61	22065	5915	78.85
1970-71	30117	8019	78.97
1980-81	37850	11636	76.48
1990-91	44500	11400	79.60

Source: Indian Agricultural Statistics, - Vol. 1, 1985-86 - 1989-90, Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, New Delhi, 1990.

The second aspect of irrigation development is area irrigated under major crop groups. Estimates presented in Table 3 show that food grains continued to account for around 80 per cent of the total irrigated cropped area in 1990-91, though there has been very marginal decline in its proportion in total irrigated area, particularly in sixties, seventies and eighties. So, it is clear that foodgrains continued to occupy the bulk of the irrigated area and there is no evidence of any increase in the irrigated area under non-food grains at the expense of foodgrains.

1.3 Irrigation Development : Statewise

All India estimates incorporate diverging regional estimates in a country of continental dimension like India. For a desegregated level picture we look into the statewise estimates of irrigated area.

Estimates presented in Table-4 show that among the 4 Southern states, except in Tamil Nadu, the net irrigated area in the remaining 3 states of Andhra Pradesh, Karnataka and Kerala increased reasonably between early eighties and late eighties. However, the gross irrigated area during the corresponding period seem to have declined not only in Tamil Nadu but also in Kerala. In the case of Punjab the net irrigated area, which remained stagnant between early eighties and mid-eighties, showed a significant increase between mid-eighties and late-eighties. To an extent this is also seen to be the case in Haryana. In both these states the gross irrigated area increased to some extent between different periods. In the case of Bihar, Madhya Pradesh and to an extent Rajasthan, Uttar Pradesh and Himachal Pradesh both net and gross irrigated areas are seen to have increased reasonably between early eighties and mid-eighties and between mid-eighties and late-eighties. The states of Gujarat, Jammu and Kashmir, Maharashtra, Orissa and West Bengal, on the other hand, show either stagnancy or decline in the net and gross irrigated areas between different periods. We thus see a great deal of variation in irrigation development from state to state which remains concealed in the all India estimates[3]. The increase in aggregate net irrigated area for all India during eighties seems to have been contributed largely by Punjab, Haryana, Bihar, Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Rajasthan and Uttar Pradesh. Irrigation intensity is found to be the highest in Punjab (ranging between 200 and 175), followed by Himachal Pradesh, Jammu and Kashmir, Kerala, Haryana, Bihar, Uttar Pradesh and Andhra Pradesh.

3. Estimates for Assam are based on 1953-54 data; data for later years are not reported.

For states like Madhya Pradesh and West Bengal there is very marginal or no difference between the net irrigated and gross irrigated areas indicating an irrigation intensity of 1.

Table 4 : Net Irrigated Area and Gross Irrigated Area (NIA, GIA), Statewise

(Hectares)

States	1 Early Eighties		2 Mid Eighties		3 Late Eighties	
	NIA	GIA	NIA	GIA	NIA	GIA
Andhra Pradesh	3698800	4751276	3536929	4389001	3970704	5064006
Assam	572000 *	572000 *	572000 *	572000 *	572000 *	572000 *
Bihar	2612438	3500693	2853259	3811380	3280939	4139677
Gujarat	2222033	2644700	2107967	1773683	2248000	2636067
Haryana	2264833	3536323	2258133	3698154	2589067	4070093
Himachal Pradesh	93021	161709	95533	169922	98979	173361
Jammu & Kashmir	315502	404368	308530	414839	274201	427537
Karnataka	1515786	1846256	1728179	2120069	2013131	2493934
Kerala	254618	389372	288766	415964	317544	398508
Madhya Pradesh	2616357	2707508	3114087	3216910	3543409	3653617
Maharashtra	1937133	2424300	1980600	2451333	958500 **	2435000 **
Nagaland	65520	72369	51447	55679	56107	57279
Orissa	1810899	2006000 *	1604000	2100476	1809333	2245750
Punjab	2500055	6129211	2569048	6483902	3823273	6825418
Rajasthan	3132300	3941151	3244805	4014484	3481006	4273929
Tamil Nadu	2527293	3135468	2498950	3196939	2436299	2954265
Uttar Pradesh	9768297	11964455	10046790	13016452	10181717	14136056
West Bengal	1906844 **	1906844 **	1933981	1933981	1911000 *	1912500 **

Source 1 Indian Agriculture Statistics Vol 1, 1985 86 1989 90, Ministry of Agriculture, Government of India, New Delhi 1990

2 Indian Agriculture in Brief Ministry of Agriculture, Government of India, New Delhi, June 1994, May 1992, April 1990, April 1988, November, 1986.

Note : 1. Average of 1981-82, 1982 83 and 1983 84

2 Average of 1984 85, 1985 86 and 1986-87

3. Average of 1987-88, 1988 89 and 1989 90

* : Average Based on One Year. ** : Average Based on Two Years.

In so far as percentage of irrigated area to total area under crop is concerned, Punjab is the leading state with a little more than 90 per cent to total cropped area under irrigation and there has been slight increase in the same from early eighties to late eighties (Table 5). Haryana is the only other state showing more than 60 per cent of the total cropped area irrigated. The same increased from around 63 per cent in early eighties to around 75 per cent in late eighties. The third state is Uttar Pradesh which shows an increase in the

proportion of irrigated area from 48 per cent in early eighties to around 56.5 per cent in late eighties. The states showing around 40 per cent of the total cropped area irrigated are Andhra Pradesh, Bihar, Jammu and Kashmir and Manipur. Tamil Nadu shows a decline in the same from 47 per cent to 43 per cent between early eighties and late eighties. Among the major states Gujarat, Karnataka, Orissa, Rajasthan and West Bengal show between 20 and 25 per cent of the total cropped area irrigated in different periods. Again among the major states Assam, Kerala, Madhya Pradesh and Maharashtra show a lower proportion of total cropped area as irrigated (varying between 11 and 15 per cent in different periods).

Table 5 : Percentage of Irrigated Area to Total Area Under All Crops, Statewise

(Per unit)

States	1 Ealry Eighties	2 Mid Eighties	3 Late Eighties
Andhra Pradesh	36 37	36 57	39.30
Arunachal Pradesh	N A	N A	13 45**
Assam	16 13	15 40	15.47
Bihar	34.40	36 57	39 63
Goa	N A	11 40*	9 27
Gujarat	24 07	23 60	26.97
Haryana	63.20	66 13	75.33
Himachal Pradesh	16 87	17 30	17 73
Jammu & Kashmir	40 60	40 33	40.77
Karnataka	16 33	18 37	20 70
Korala	13 53	14.47	13 50
Madhya Pradesh	12 20	14 30	16.17
Maharashtra	12 40	12 13	11 53
Manipur	37.63	40 03	40 07
Meghalaya	21 40	20 73	20.07
Mizoram	N A	N A	11.63
Nagaland	40 53	28 83	29 17
Orissa	22 67	23 07	24.53
Punjab	88 30	90 93	92 57
Rajasthan	21 17	22.73	26 03
Sikkim	10 87	12.20	11 43
Tamil Nadu	47 23	46 90	44 30
Tripura	9 20	10 03	9 83
Uttar Pradesh	48 17	51 63	56 53
West Bengal	24 97	24 13	22 90
All India	29 70	30 97	33 40

Source : Indian Agriculture Statistics-Vol 1, 1985 86 1989 90 Ministry of Agriculture, Government of India, New Delhi 1990

Note : 1 Average of 1981 82, 1982 83 and 1983-84; 2 Average of 1984 85, 1985-86 and 1986 87, 3 Average of 1987 88, 1988 89 and 1989 90,
* Average Based on One Year ** Average Based on Two Years

As regards foodgrains, Punjab is the only state which shows almost the entire foodgrains area under irrigated condition during late eighties as a result of gradual increase in the already high percentage of irrigated foodgrains in early eighties. In Haryana too bulk of the foodgrains area is seen to be irrigated which is seen to have increased from around 63 per cent in early eighties to around 74 per cent in late eighties (Table 6). In the states of Andhra Pradesh, Tamil Nadu and Uttar Pradesh nearly half to little more than half of the foodgrains area is seen to be irrigated in late eighties, having shown in increasing trend from early eighties. These five states together account for the bulk of the foodgrains (specially paddy and wheat) produced for the market, known as grain bowl of the country. The other major states where irrigated foodgrains account for between 30 and 40 per cent of the total foodgrains area are Bihar, Assam, Jammu and Kashmir and Kerala. West Bengal and Orissa, two major paddy growing states, show only 25 per cent of the foodgrains area to be irrigated.

Table 6 : Percentage of Irrigated Area to Total Area Under Foodgrains, Statewise

(Per unit)

States	1 Ealry Eighties	2 Mid Eighties	3 Late Eighties
Andhra Pradesh	43.03	44.20	49.53
Arunachal Pradesh	N.A	N.A	17.60**
Assam	32.60	32.60	32.60
Bihar	35.73	38.20	41.17
Goa	N.A	24.70*	17.07
Gujarat	19.37	17.83	22.10
Haryana	62.67	65.43	74.07
Himachal Pradesh	16.40	16.70	16.97
Jammu & Kashmir	38.73	38.27	38.27
Karnataka	15.60	16.67	18.33
Kerala	34.63	41.17	40.33
Madhya Pradesh	12.57	15.10	17.33
Maharashtra	11.07	13.93	9.60
Manipur	43.97	43.70	44.07
Meghalaya	36.80	35.77	35.20
Mizoram	N.A	N.A	13.40
Nagaland	45.07	33.33	33.07
Orissa	21.73	21.13	24.50
Punjab	89.27	91.87	93.60
Rajasthan	19.97	19.73	20.33
Sikkim	17.30	19.80	19.80
Tamil Nadu	52.43	51.80	49.90
Tripura	9.97	11.27	11.70
Uttar Pradesh	46.40	49.87	54.50
West Bengal	25.43	25.17	54.50
All India	30.43	31.97	34.37

Source : Indian Agriculture Statistics-Vol 1, 1985-86 1989-90 Ministry of Agriculture, Government of India, New Delhi 1990

Note 1 Average of 1981-82, 1982-83 and 1983-84, 2 Average of 1984-85, 1985-86 and 1986-87, 3 Average of 1987-88, 1988-89 and 1989-90

* Average Based on One Year ** Average Based on Two Years

1.4 Trend Growth Rates in Irrigated Area

To get better insights into the nature and extent of development of irrigation during the last four decades we have estimated the trend growth rates in net irrigated areas as well as in its breakup into sourcewise irrigation.

Table 7 : Trend Growth Rates in Net Irrigated Area (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1990-91	2.2087*	0.9920*	68.6745
1950-51 to 1967-68	1.7323*	0.9957*	59.5808
1967-68 to 1990-91	2.2309*	0.9778*	31.1521
1950-51 to 1960-61	1.6812*	0.9940*	36.4162
1960-61 to 1970-71	2.2108*	0.9449*	12.4284
1970-71 to 1980-81	2.6551*	0.9900*	29.9926
1980-81 to 1990-91	1.4306*	0.9045*	9.2362

Table 8 : Trend Growth Rates in Canal Irrigated Area (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R Square	T Value
1950-51 to 1990-91	1.8945*	0.9871*	54.0730
1950-51 to 1967-68	1.8829*	0.9856*	32.0730
1967-68 to 1990-91	1.6940*	0.9521*	20.9178
1950-51 to 1960-61	1.9552*	0.9898*	27.9646
1960-61 to 1970-71	1.9557*	0.9135*	9.7553
1970-71 to 1980-81	1.9282*	0.9738*	18.3138
1980-81 to 1990-91	0.7859*	0.7888*	5.7985

Table 9 : Trend Growth Rates in Tank Irrigated Area (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1990-91	-1.1410*	0.6260*	7.9763
1950-51 to 1967-68	-1.1611*	0.4166*	3.2731
1967-68 to 1990-91	1.8414*	0.8415*	10.8103
1950-51 to 1960-61	3.3384*	0.8604*	7.0244
1960-61 to 1970-71	-1.6986*	0.8714*	7.8109
1970-71 to 1980-81	-0.9028	0.3659	2.2792
1980-81 to 1990-91	-1.3498	0.3413	2.1598

* Statistically significant at 1 per cent level of significance.

Table 10 : Trend Growth Rates in Area Irrigated by Wells (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1990-91	3.9490*	0.9790*	42.1280
1950-51 to 1967-68	2.3374*	0.8832*	10.6547
1967-68 to 1990-91	3.8298*	0.9831*	35.8769
1950-51 to 1960-61	1.1042*	0.8315*	6.2853
1960-61 to 1970-71	5.1852*	0.9682*	16.5548
1970-71 to 1980-81	4.3115*	0.9982*	71.2917
1980-81 to 1990-91	2.8157*	0.9897*	29.4756

Table 11 : Trend Growth Rates in Area Irrigated by Other Sources (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1990-91	0.3977*	0.4319*	5.3759
1950-51 to 1967-68	0.1715	0.0301	0.6834
1967-68 to 1990-91	0.8413*	0.6382*	6.2298
1950-51 to 1960-61	-0.5525	0.1109	0.9991
1960-61 to 1970-71	0.4646	0.2537	1.7493
1970-71 to 1980-81	0.7854*	0.8420*	6.9276
1980-81 to 1990-91	2.3835*	0.8018*	6.0358

Table 12 : Trend Growth Rates in Gross Irrigated Area (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	2.6162*	0.9905*	64.0717
1950-51 to 1967-68	2.2328*	0.9950*	54.7363
1967-68 to 1992-93	2.4234*	0.9713*	27.9123
1950-51 to 1960-61	2.1730*	0.9978*	60.5474
1960-61 to 1970-71	3.1298*	0.9770*	19.5543
1970-71 to 1980-81	3.0304*	0.9927*	35.0946
1980-81 to 1992-93	1.5297*	0.8999*	9.4835

* . Statistically significant at 1 per cent level of significance.

Table 7 presents the estimates of trend growth rates in net irrigated area. Overall, from 1950-51 to 1990-91 the net irrigated area is seen to have grown at the rate of 2.2 per cent per annum. The period 1967-68 to 1990-91, which is considered as post-green revo-

lution period, shows a much higher rate of growth in net irrigated area compared to the period 1950-51 to 1967-68, considered as pre-green revolution period. The decade seventies is seen to have registered an accelerated increase in the growth rate in net irrigated area. However, the momentum of the rate of increase is seen to have been lost in the decade eighties and hence we find a sharp decline in the rate of increase in the net irrigated area in the period 1980-81 to 1990-91. This ought to be a matter of serious concern for planners and policy makers.

Major contribution in the net irrigated areas has come from the growth in canal irrigated area (Table 8) and that in well irrigated area (Table 10) specially the latter. Together they accounted for more than 85 per cent of the net irrigated area (1990-91), as reported earlier. While the overall rate of growth in canal irrigated area has been around 1.89 per cent, that in well irrigated area has been nearly 4 per cent. Further, while a spurt in the growth of well irrigated area (4/5 per cent) is noticed in the decade sixties and seventies, canal irrigated area shows a steady growth of around 1.95 per cent per annum in the decade fifties, sixties and seventies. Annual growth rates in the case of both well and canal irrigated area are seen to have decelerated in the decade eighties, the deceleration in the same in the case of canal irrigated area appears to be drastic, which indeed ought to be a matter of concern considering the fact that an additional 25 million hectares of major and medium sources of irrigation potential still remain unexploited, as earlier noted. Declaration in the rate of growth of well irrigated area in the decade eighties is not unexpected owing to the fact that well irrigated area in early nineties reached very near its full ultimate potential, as noted earlier.

As regards tank irrigation a gradual decline is depicted through negative growth rate in the same in the decades sixties, seventies and eighties. Tank irrigation appears to have lost its importance in the post-green revolution period and hence a positive growth rate in the same in the decade fifties turned into negative one in the decade sixties, seventies and eighties (Table 9). Many studies show that tank irrigation, which was once an important source of irrigation in fifties and early sixties, specially in the southern part of the country, lost its importance in the latter period.

Trend growth rates in gross irrigated area depict a similar picture

as is observed in the case of net irrigated area (Table 12). After registering an accelerated rate of growth in sixties and seventies the rate of growth in gross irrigated area decelerated drastically in the decade eighties, which as mentioned earlier, ought to be a matter of concern.

1.5 Trend Growth Rates in Cropwise Irrigated Area

Cropwise analysis is carried out with a view to have further insights into the trends in gross irrigated area as revealed by the trends in the irrigated area under major crops. The trend growth rates in irrigated area under cereals is mainly influenced by the trend growth rates in the same under rice and wheat (Tables 13, 14). The overall rate of growth of irrigated area under cereals is estimated to be around 2.6 per cent which is nearly the rate at which gross irrigated area is estimated to have grown in the corresponding period (Table 15) indicating a strong influence of irrigated area under cereals on gross irrigated area. Even though irrigated area under wheat has grown at the rate of 5.24 per cent compared to only 1.58 per cent under rice during the period 1950-51 to 1992-93, because of higher weight of irrigated rice area in the irrigated area under cereals, the latter has grown only at the rate of 2.6 per cent in the corresponding period.

Irrigated area under rice increased at a much higher rate (2.99 per cent) than that of wheat (1.78 per cent) in the decade fifties, however, the trend changed in sixties and seventies (the post-green revolution period), while the trend growth rate of irrigated area under rice decelerated in sixties and increased marginally in seventies, the trend growth rate in irrigated area under wheat accelerated phonomenally in sixties and considerable in seventies. In the decade eighties and early years of nineties, a drastic deceleration in the irrigated area under wheat and a moderate deceleration in the irrigated area under rice are noticed. In the later section we shall see to what extent has the total area under wheat been brought under irrigation by the end of eighties in different states.

Foodgrains comprise cereals and pulses, but pulses account for much smaller area under foodgrains, the pattern in the trend growth rate in irrigated area under foodgrains is similar to that of cereals (Table 16, 17). As noticed in the case of cereals there is deceleration in the rate of growth of irrigated area under foodgrains in the

period 1980-81 to 1992-93. Pulses, on the other hand show a significant rate of growth under irrigated area (2.35 per cent) in the corresponding period after near stagnancy in the same in the earlier three decades. This large increase in the rate of growth of irrigated area under pulses may be attributed to computation being carried out with a very low base (irrigated area) to begin with.

Table 13 : Trend Growth Rates in Irrigated Area Under Rice (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R Square	T Value
1950-51 to 1992 93	1.5810*	0 9752*	39 1714
1950-51 to 1967 68	2.2004*	0 9369*	14 9238
1967-68 to 1992 93	1.5087*	0 9762*	30.7422
1950-51 to 1960 61	2.9883*	0 9906*	29.0684
1960 61 to 1970-71	1.0790*	0 9185*	10.0716
1970-71 to 1980-81	1.9354*	0.9367*	11.5431
1980-81 to 1992 93	1.4884*	0 9367*	12 1656

Table 14 : Trend Growth Rates in Irrigated Area Under Wheat (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R Square	T Value
1950 51 to 1992 93	5.2470*	0 9568*	29.3970
1950 51 to 1967-68	3 2995*	0 8542*	9 3766
1967 68 to 1992 93	4.0848*	0 9192*	16 1789
1950 51 to 1960 61	1 7776*	0 8310*	6.2723
1960 61 to 1970 71	8 7949*	0 9535*	13.5988
1970 71 to 1980 81	5.1028*	0 9826*	22 5651
1980 81 to 1992 93	1 9863*	0 9381*	12.3204

Table 13 : Trend Growth Rates in Irrigated Area Under Total Cereals (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R Square	T Value
1950 51 to 1992 93	2 5743*	0 9861*	52 7735
1950 51 to 1967 68	2 1041*	0 9817*	28.4399
1967-68 to 1992 93	2 2746*	0 9668*	25.8822
1950-51 to 1960 61	2 0067*	0 9808*	20 2513
1960-61 to 1970 71	3 2127*	0 9637*	15 4581
1970-71 to 1980 81	2 9792*	0 9918*	33.0593

* : Statistically significant at 1 per cent level of significance

As regards major non-foodgrains crops sugarcane shows a moderately decelerating rate of growth in seventies and eighties and early years of nineties compared to fifties. In the decade sixties, however, there was significantly large deceleration in the rate of growth of irrigated area under sugarcane presumably due to sudden and large increase in the rate of growth of irrigated area under foodgrains (mainly wheat) in the corresponding period which happened to be the period aftermath of green revolution (Table 18).

Table 16 : Trend Growth Rates in Irrigated Area Under Total Pulses (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	0.0926	0.0206	0.9059
1950-51 to 1967-68	0.7684*	0.6421*	5.1879
1967-68 to 1992-93	0.5408	0.1894	2.3187
1950-51 to 1960-61	0.1377	0.0275	0.4757
1960-61 to 1970-71	0.2846	0.0635	0.7816
1970-71 to 1980-81	-0.0845	0.0039	0.1887
1980-81 to 1992-93	2.3466*	0.6968*	4.7939

Table 17 : Trend Growth Rates in Irrigated Area Under Total Food Grains (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	2.3933*	0.9885*	57.8994
1950-51 to 1967-68	1.9771*	0.9809*	27.7587
1967-68 to 1992-93	2.1390*	0.9767*	31.0609
1950-51 to 1960-61	1.8214*	0.9786*	19.1441
1960-61 to 1970-71	3.1009*	0.9658*	15.9663
1970-71 to 1980-81	2.7456*	0.9867*	25.8887
1980-81 to 1992-93	1.5855*	0.9860*	26.5519

Table 18 : Trend Growth Rates in Irrigated Area Under Sugarcane (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	2.6392*	0.9697*	35.3506
1950-51 to 1967-68	3.1816*	0.8845*	10.7221
1967-68 to 1992-93	2.5182*	0.9330*	17.9005
1950-51 to 1960-61	3.6086*	0.7624*	5.0667
1960-61 to 1970-71	1.9824*	0.7380*	5.0352
1970-71 to 1980-81	3.3249*	0.8194*	6.3905
1980-81 to 1992-93	2.3426*	0.8047*	6.4204

* Statistically significant at 1 per cent level of significance

Table 19 : Trend Growth Rates in Irrigated Area Under Cotton (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	3.6440*	0.9388*	24.4735
1950-51 to 1967-68	5.5007*	0.8966*	11.4105
1967-68 to 1992-93	2.8280*	0.8842*	13.2574
1950-51 to 1960-61	7.9223*	0.8864*	7.9041
1960-61 to 1970-71	3.0198*	0.8048*	6.0921
1970-71 to 1980-81	4.0692*	0.9406*	11.9454
1980-81 to 1992-93	1.7334*	0.7140*	4.9976

Table 20 : Trend Growth Rates in Irrigated Area Under Total Oilseeds (Based on Tricnnium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	8.0506*	0.8765*	16.6378
1950-51 to 1967-68	3.9224	0.1329	1.5163
1967-68 to 1992-93	9.2428*	0.9856*	39.7167
1950-51 to 1960-61	-1.1101	0.0028*	0.1501
1960-61 to 1970-71	8.6292*	0.9414*	12.0250
1970-71 to 1980-81	6.9275*	0.8638*	7.5569
1980-81 to 1992-93	9.1328*	0.9902*	31.8963

Table 21 : Trend Growth Rates in Irrigated Area Under Non-Foodgrains (Based on Triennium Averages)

(Per cent)

Periods	Growth Rate	R-Square	T Value
1950-51 to 1992-93	3.3778*	0.9788*	42.4873
1950-51 to 1967-68	3.2616*	0.9885*	35.9680
1967-68 to 1992-93	3.3621*	0.9145*	15.6863
1950-51 to 1960-61	3.6340*	0.9729*	16.9783
1960-61 to 1970-71	3.1698*	0.9926*	34.8616
1970-71 to 1980-81	4.0233*	0.9880*	27.2490
1980-81 to 1992-93	1.4876	0.2925	2.0337

* Statistically significant at 1 per cent level of significance.

The rate of growth of irrigated area under cotton is seen to have fluctuated a great deal during different decades (Table 19), with clear signs of declining trend from decade to decade. As a matter of fact in the period 1980-81 to 1992-93 the same is seen to have

increased only at 1.73 per cent compared as high as almost 8 per cent in the decade fifties. Such a drastic deceleration in the rate of growth in irrigated area under cotton in the latest period should indeed be a matter of concern.

Remarkable progress is noticed in the growth of irrigated area under oilseeds over the decades (Table 20). The overall rate of growth over the period 1950-51 to 1992-93 is seen to be around 8 per cent per annum; in fact in the period 1967-68 to 1992-93 the annual growth rate of irrigated area under oilseeds turn out to be little over 9 per cent. Except in the decade fifties, there has been a high and sustained rate of growth in the irrigated area in all the subsequent three decades. This indeed has been a very encouraging development which is reflected in the quantum jump in the production of oilseeds, specially in the decade eighties.

Compared to the growth in the irrigated area under foodgrains the non-foodgrains depict a higher rate of growth in irrigated area in decades fifties, sixties and seventies (Table 21). It is only in the period eighties to early nineties that the same is seen to be marginally smaller in the case of non-foodgrains compared to the foodgrains. A drastic decline (though statistically non-significant) in the annual rate of growth of irrigated area under non-foodgrains in the period eighties and early nineties is again ought to be a matter of concern. Since the non-foodgrains occupy only on an average 20 per cent of the irrigated area under crops (Table 21), the rate of growth of irrigated foodgrains largely influences the rate of growth in gross irrigated area, as noticed in Tables 12 and 17.

Overall it is observed that there has been a significant deceleration in the rate of growth from major and medium sources of irrigation. Considering that an additional 25 million hectares are still to be brought under irrigation to achieve the target of full potential of irrigation from this source by the year 2010, a deceleration in the rate of growth of irrigation under medium and major projects in recent years is indeed a matter of concern. A deceleration in the rate of growth in well irrigation (the major source of minor irrigation) as observed for the recent period is as expected because near full potential of irrigation under minor sources have already been achieved by the end of decade eighties. The states of Punjab, Haryana, Uttar Pradesh and Madhya Pradesh in North, Andhra Pradesh and Tamil Nadu in South, Rajasthan in West and Bihar in the East are the major states mainly contributing to the irrigated area in India. Foodgrains continue to account for the bulk of the irrigated area

under crops. However, a significant deceleration in the rate of growth in irrigated area under foodgrains in the recent period is indeed a matter of concern in view of the target of around 240 million tons of foodgrains production to be achieved by the year 2010.

1.6 Overall Investment

Availability of adequate, timely and assured irrigation is a critical determinant of agricultural productivity and to meet this requirement massive investment is called for. Accordingly large investment in irrigation development has been made over the last four decades.

Beginning with Rs. 380 crores investment on major and medium in the First Plan period, the same reached a level of Rs. 22,414 crores on major and medium irrigation. There has been a quantum jump in such investment during Sixth, Seventh and Eighth Plan periods. Investment on minor irrigation is seen to have increased from a meagre 66 crores in the First Plan Period to Rs. 6,427 crores in the seventh Plan Period. Proposed investment for the Eighth Plan period is Rs. 5,977 crores (Table 22)[4]. Again for minor irrigation too there has been quantum jump in investment during the Sixth and Seventh Plan periods. In the Eighth Plan period, however, the proposed investment on minor irrigation shows a slowing down in its rate presumably because near full potential in well irrigation development has already been achieved by the beginning of nineties, as mentioned earlier.

Table 22 : Planwise Investment on Irrigation Investment

	(Rs Crores)			Cost per hectare (Rs.)	
Period	Major and Medium	Minor	Total	Major and Medium	Minor
First Plan (1951-56)	380	66	446	1,200	691
Second Plan (1956-61)	380	161	541	1,810	2,012
Third Plan (1961-66)	581	443	1,024	2,526	2,014
Annual Plan (1966-69)	434	561	995	2,893	2,805
Fourth Plan (1969-74)	1,273	1,174	2,408	4,758	2,609
Fifth Plan (1974-79)	2,442	1,411	3,853	6,075	3,713
Annual Plan (1979-80)	2,056	987	3,043	10,936	3,655
Sixth Plan (1980-85)	7,516	3,240	10,756	21,510	4,544
Seventh Plan (1985-90)	11,107	6,427	17,534	35,081	7,331
Eighth Plan (1990-97)	22,414	5,977	28,391	N.A.	

Source : Five Year Plan Documents for various years, Planning Commission, Government of India, New Delhi.

4. In addition to the investment on major/medium and minor irrigation, there is investment on Command Area Development and Flood Control which we have not considered in our discussion.

1.7 Cost of Irrigation Development

Irrigation development cost as cost per hectare of potential created in nominal terms is seen to have increased phonomenally in the case of major and medium irrigation and considerably in the case of minor irrigation over the four decades 1950-51 to 1990-91 (Table 22, last two months)[5]. In the case of major and medium sources of irrigation initially the cost per hectare increased only gradually over the period First Plan to the Fifth Plan from 1,200 to Rs. 6,075, but thereafter, specially in Sixth and Seventh Plan periods there has been sudden jump in the rate of increase and the cost per hectare of potential created from major and medium sources of irrigation amounted to massive Rs. 35,000. One of the reasons for such a massive increase in the same is deceleration in the rate of growth in the canal irrigated area in the corresponding period, as noted earlier (Table 8). The cost per hectare of potential created under minor irrigation is also seen to have increased 10 times over the four decades (Table 22). However, the apparent difference in cost per hectare of irrigation potential created between major and medium and minor irrigation projects is seen to be estimated at around 5 times. Such a comparison of cost per hectare over time and between the sources, however, is not always meaningful, firstly, because these costs are reported at current prices prevailing during various plan periods, unadjusted for inflation, secondly, because a gestation lag exists between the time investment is undertaken and the time irrigation potential is created (mainly in the case of major and medium irrigation projects) and thirdly, because operation and maintenance cost is not considered (which may be comparatively higher in the case of well irrigation) in such a comparison[6]. We shall however not enter into discussion of these issues as the purpose of our study is not to bring about a comparative analysis of cost of irrigation over time and across sources, but only to bring into focus the dimension of investment in irrigation so as to appreciate the need and urgency for proper maintenance and management of the network of the storage and distribution systems created through such massive investment as also appropriate pricing of water for irrigation.

5. The Planning Commission uses the approach of dividing the expenditure incurred on major/medium irrigation schemes and minor irrigation schemes during a plan period by the respective potential created during the same period to report irrigation development cost on per hectare basis.

6. In the recent study an attempt has been made to capture capital cost per hectare in real terms in the case of major, medium irrigation schemes in India (Gulati, Svendsen, Roy Choudhury, 1995).

SECTION II

Irrigation Management Practices in India

2.1 Importance of Irrigation Management

It is a common knowledge that irrigation helps in increasing agricultural production brought about not only by raising land productivity, but also by increasing the land use intensity. However, the process through which such a positive change is effected after the introduction of irrigation is not very well recognised. Making available water for irrigation in the storage is not enough, its proper and efficient distribution is more crucial in bringing about desired changes through the introduction of irrigation. Efficient control of irrigation water distribution is supposed to contribute to increased agricultural production by making possible planting at optimal time, extending the effective cropping season and permitting in the process a switch to high productivity, high value crops. Given agro-climatic conditions and seed varieties the ability of the irrigation system to regulate the water supply to individual pieces of land in its command and maintain an appropriate level of soil moisture at all stages of the growth make a significant difference to outcome. Within the limits set by the physical characteristics of the water sources and the engineering design of the system, the way the distribution is organised and managed can make a considerable difference to the effectiveness with which changes are sought to be introduced with the introduction of irrigation,

2.2 Water Control Systems and Water Allocation[7]

India being a country of continental dimension there is marked difference between the regions in the manner in which distribution of harnessed water is organised. Large scale irrigation projects, both storage type and river diversion type, have been the characteristics of irrigation development in India. Even though in recent years, in relative terms, the importance of these projects have declined as a result of rapid expansion of ground water development, the absolute scale of activity has risen steeply. The nature of distribution system depends upon the agro-climatic condition of a region, while what is technically feasible has also to match the conditions set by socio-

7. Discussion in this section is based on the study on Joint Management Irrigation System in India carried out by the author earlier (Mitra, 1992).

economic factors. It should, however, be kept in mind that throughout India involvement of state in the operation and management of the surface irrigation systems extends from the source, through the main branch canals upto outlets commanding around 40 hectares or thereabout. The overall responsibility for management of each system is vested with senior official drawn always from a permanent cadre of engineers. The entire project command is divided into smaller administrative units, the management of which rests with the lower, intermediate and higher level of officials of the state cadre. Besides management, the state has a direct responsibility for maintenance of all canal systems.

In general in India the canal system is generally geared to specified crop pattern (e.g. distribution of irrigable area under seasonal, two seasonal, perennial as well as heavy water using crops like paddy, sugarcane, banana etc.) The crop mix is decided and incorporated in the system on the basis of careful evaluation of seasonal rainfall, likely water supply in the reservoir, the water requirement of different crops under different soil conditions as also the extent to which water intensive crops like paddy, sugarcane can be sown. In general the systems are designed for continuous operation of the main canals except during the closure period which varies depending upon the needs of maintenance and on the crop pattern. The operation of branch canals and distributories are continuous in some sytems, rotated in others. There are, however, important differences in the way canal supplies are regulated in any particular year or seasons in different regions of India. A fairly detailed account of all these aspects are available in a paper on water control institution and agriculture (Vaidyanathan, 1985). Some of the most commonly used managed systems in India include, rotational, intermittent and continuous flow systems.

In northern India where rotational system is followed the water delivered to farmers is rationed according to a pattern of rotation at water-course level worked out in advance on the basis of forecast of available water evey season. The entitlement of water is in proportion to the area and the cropping pattern. There is no control on cropping pattern, but it is sought to be effectively limited by the rigid schedules and the amount of water. The northern system is more flexible because it attempts to match the available supply with farmers' demand. Rotation of supply between minor branches and distributories is common during the winter season; there is reportedly

no rotation between outlets. It appears that the system provides a potential means for enforcing some sort of equitable rationing of water in period of shortage.

In western India the intermittent flow system is followed. Water delivery is according to area served and the types of crops grown. The annual operation of the systems is decided on the basis of the supply positions in the reservoir, but deliveries in different branches and distributories/minors are regulated on the basis of the area under different crops in different parts of command.

The system in western India is supply-based in as much as control is exercised on the choice of the crops by the canal management authorities of the state by stipulating the cropping pattern. For instance, in Maharashtra, the irrigation department invites applications from the farmers to indicate the area and the crops that they wish to grow within the stipulated cropping pattern. If the demand is more than the available water reduction in allocation is made in proportion to the land area. The supply schedules are presented in advance for each rotation though the rotation schedule is changed many a times in the course of operation. The area irrigated per unit discharge in a rotation is the index of system efficiency.

In south India and in humid and sub-humid parts of India where rice based cropping system is prevalent, depending on the supply in the reservoir, water is released to the command area from a fixed date at the beginning of the crop season till the maturity of the main crop. In such areas water flows continuously for the duration of the crop and the schedules designed are on the concept of duty, i.e., the area that can be irrigated by a unit discharge flowing continuously. In this system no effort is made to ascertain the demand for water on a weekly or fortnightly basis which may vary according to rainfall and period of sowing the crop.

All these systems of distribution and regulation of canal water have their shortcomings and disadvantages from the point of view of efficient utilisation of available water for irrigation. The system followed in Western India exercises some control on the choice of crops, which is resented by the users, besides the system gives rise to maldistribution of water not only between different reaches of canal command, but also between different crops. Evidences from the studies carried out on irrigation water management in Maharashtra

bring out this fact clearly (Mitra 1988; Rath, Mitra 1989). These studies show that not only do the farmers not adhered to the stipulated cropping pattern, but also that a large part of the command area either does not get any water or gets very little. Heavy water using crops like sugarcane are preferred which leads to underutilisation of irrigation potential created and also make the tail enders suffer on account of lack of availability of water (Mitra, 1986). In addition considerably large transmission and distribution losses are also reported. Many tracts of land in the upper reaches of the command area are reported to have been affected by serious water logging due to heavy use of surface water without any adequate drainage facilities. The present manner of distribution of water makes it possible for a user to take water to his field to his full satisfaction, but which may not have any relation with crop water requirement at different stages. All these reflect the low efficiency with which such systems operate.

In south Indian system, as mentioned earlier, the rotation system is not in vogue, hence in the period of water shortage there are no well defined procedure to assure predictability of supplies and equitable distribution of water to each outlet. Under such a situation inevitably the areas close to head reaches of the distribution system are in a relatively better position with degree of certainty falling as one moves towards the tail end.

Even in the north Indian system, which appears to have built in method of handling shortage situation, scheduling is less flexible than what would the system suggest. It is reported in some studies that while the farmers can be reasonably certain about the rotation schedule as between distributories and channels in terms of supply of water, no assurance as to the amount of water they would get could be given. The uncertainty of timing and volume of supplies at the individual farmer's level, which is determined by a futher rotation system below the channel outlets, is considerbaly greater. If at all in north India the 'Warabandi' system of distribution of water is relatively and partially successful, it is largely because canal water is supplemented by groundwater, through well irrigation, as and when required, specially during the period of shortage.

It would not be far from truth to suggest that more generally most sufrace irrigation systems in India fail to conform to the distribution and allocation of water visualised in the original design. A great deal of assumptions are involved in ex-ante working out of the

distribution and allocation procedure, such as (i) availability of water in the system during different seasons and its variability, (ii) cropping pattern in different reaches of the canal command, (iii) crop water requirement and (iv) losses in conveyance and field applications. It is not surprising that many of these turn out to be either erroneous or mutually inconsistent because they are based mostly on inadequate and superficial data and observations which may at times turn out also to be inaccurate. Project reports for planned irrigation development and utilisation are often sought to be made ready in a short period that does not allow detailed technical and socio-economic investigation and scrutiny, often because of political exigencies. In addition to these problems in most surface irrigation systems in India available water for irrigation is less than demand. Under such circumstances suitable control on water distribution, both technical organisational assumes added significance. It is argued that the physical control devices are inadequate and crude, hence the canal authorities have to take recourse to manual control through supervision and policing the proper rationing of water supply (Vidyanathan, *op. cit.*, 1985). As mentioned earlier in shortage situation, which occurs more often than not in most systems, this gives rise to conflict over water allocation among different reaches of the canal command.

While fairly reasonable knowledge about the distribution system and allocation for the main distribution system above the outlet exists, the same can not be said with any degree of confidence about the allocation below the outlet. In northern India Warabandi system of rotational water supply managed by the user historically and backed by administrative support may be working with fair degree of success, but in other parts of the country distribution and allocation of water below outlet level is in pretty bad shape. Evaluation studies show that the field channels are non-existent or are incomplete and disfunctional under most surface irrigation schemes. Field losses are estimated to be very high, therefore what is common in all these systems is enormous transmission and distribution losses and widespread conflicts over water allocation among different segments of the canal command giving rise to inequitious distribution of water and rampant corruption.

In recent years efforts have been made to draw serious attention towards introduction of rotational water supply system in surface irrigation in different parts of the country, specially in the western part where water resources are scarce, scarer in fact than land. The

state governments are reported to be taking interest in the matter along with some commodity efforts in this direction (Hashim Ali, 1980; Kulkarni Lele, 1980, Jayaraman, 1981; Singh, 1983). As a result of these efforts significant changes have been taking place both in organisational and techniques of water management. One important development that took place in the mid seventies was the establishment of Command Area Development Authorities (CADA). The CADA was established as a separate government agency from the deaprtments responsible for construction and maintenance of main facilities. The objective of CADA is to improve field distribution system both in its physical organisational aspects through land leveling, construction of field channels and drainages, land consolidation in canal command and also organising farmers for some kind of group management. The original CADA programme was very ambitious and all encompassing, e.g. land development, construction of field channels/drains, arranging input supply and output marketing etc. However, from the very beginning the programme has been facing administrative, technical and financial difficulties and therefore soon got bogged down at the implementation stage and even after more than a decade's existence the CADA has not been able to meet even its basic objectives of land development and improvement in distribution network in the command area, specially below the outlet serving a given 'chalk'. The problem facing CADA are identified as (i) lack of resources, (ii) lack of coordination and (iii) lack of people's participation in the programme.

Efforts so far made in effecting improvement in the operation and management of the distribution system for the surface irrigation in India have only been half hearted and that too have not been properly directed either due to ill defined objectives or due to lack of political will. Water control activities necessitate both technical and organisational aspects of water management. Devoid of organisational structure requiring people's participation, technical changes can not be brought into use with positive results to meet the desired objectives.

SECTION III

Problems Relating to Irrigation Management

Despite remarkable expansion of irrigation in India during the last several decades and the large production and employment gains that it has made possible, most of India's irrigation systems are known for their under performance. Continuing under performance, needless to say, results into a significant loss to the country, both in terms of production and employment. In addition it also leads to widening inequality in access to irrigation water between the users as well as across the regions. It was noted in a study that an increase of as much as 20 per cent in total production can be achieved merely by improving the performance of irrigation system through management reforms (Bottral, 1981).

3.1 Problems Relating to Major and Medium Irrigation Systems[8]

For the purpose of discussion it is better to distinguish the set of problems that arise in the construction phase from the set of problems that arise in the operation and maintenance phase and concentrate on the latter. The problems that arise in the construction phase are (i) cost and time overruns (may be due to inadequate project finance), (ii) faulty design, (iii) rehabilitation of the project affected people and (iv) environmental degradation. The problem that arise in the operation and maintenance phase and which accounts for most of the ills of Indian irrigation are (i) underutilisation of irrigation capacity (potential), (ii) inequity in irrigation, (iii) lack of dependendability of irrigation, (iv) indifferent quality of irrigation, (v) wastage of irrigation water, (vi) water logging, soil salinity and alkalinity, (vii) sustainability of irrigated farming and (viii) financial losses and pricing of water. These are all interlinked problems and a number of problems that occur in operation and maintenance phase are a fall out of the problems faced in the construction phase, for example, the crucial problem of underutilisation/misutilisation of irrigation potential. It is well known that an irrigation scheme is declared to have been completed for commissioning even when the net-work of field channels and land leveling work to receive water in the entire canal command, specially at the tail reaches, have not been completed. This inevitably leads to concentration of use of storage water

8. Discussion in this Section is based on the study on Irrigation Sector Reforms carried out by the author (Mitra, 1996).

when released at the head reaches of the distribution system which leads to adoption of crops like paddy, sugarcane, banana etc., which require large quantity of water. Even when most of the canal command is ready to receive the water after completing the works of land leveling and construction of field channels, the users in the head reaches are not ready to give up their claims on intensive use of irrigation water for their crops. This leads to underutilisation/misutilisation of irrigation potential and inequitable distribution of water in the operation - maintenance phase (Dhawan, 1989).

One of the most widely discussed features of major and medium irrigation works is the lag between the creation of potential and its utilisation, specially in drought prone and water scarce regions. Various estimates of underutilisation of irrigation potential in respect of irrigation schemes from different regions are available. The estimates vary from as low as 15 percent to as high as above 50 per cent. Table 23 gives the average picture of irrigation potential created and utilisation in different periods. However, the data presented in Table 23 do not give a correct picture of utilisation of irrigation potential because different states adopt different criteria for reporting. Besides the concepts and the estimates of irrigation potential and its utilisation are themselves open to question. Since the utilisation rate is area related a change in crop mix from seasonal to perennial and/or from low water using crops to heavy water using crops would change the extent of utilisation considerably. Further, even if the area under the crop gets irrigated only once during a season compared to its requirement for more, it gets reported as area irrigated regardless of whether it got adequate irrigation water or not. Thus, on account of this the reported data on utilisation are overestimates. To get a clearer and truer picture of underutilisation, it would be necessary to take into account the amount of water used during the year from the quantity available from storage for irrigation in addition to the area actually irrigated.[9] In view of the complex nature of the problem it is difficult to arrive at a precise estimate of the extent of underutilisation. Notwithstanding above argument studies by research scholars of different irrigation schemes suggest that the extent of underutilisation and misutilisation of irrigation potential created is quite considerable and needs to be curtailed through improved technical efficiency in operation and maintenance of the system and improved distribution of available water across the canal command. The follow-

9. For a detailed discussion on the issue of conceptualisation of irrigation potential and utilisation, see the author's study on this aspect (Mitra, 1986).

ing table gives the extent of irrigation potential created and utilised in India as estimated by the Central Water Commission.

The second problem in the operation and maintenance phase is that of inequity in irrigation. This problem is closely related to the problem of underutilisation. Underutilisation of irrigation potential leads to unequal distribution of water across canal command in its different reaches.

The third and fourth problems, the lack of dependability of irrigation and the indifferent quality of irrigation are also interlinked with the first two problems of irrigation management. The matnitude of these problems also depends on the manner in which the canal supplies are regulated.

Table 23 : Planwise Irrigation Potential Created and Utilised in India (Cumulative)

(Thousand hectares)

Period	Potential Created	Utilised	Per cent Unutilised
Pre-plan (upto 1951)	8641	8656	Nil
First plan (1951-56)	11127	9936	89.30
Second plan (1956-61)	13270	12003	90 45
Third plan (1961-66)	15501	14126	91.12
Annual plans (1966-69)	17031	15702	92 20
Fourth plan (1969-74)	19639	17639	89.82
Fifth plan (1974-79)	23653	20114	85.04
Annual plans (1978-80)	25548	21596	84.53
Sixth plan (1980-85)	27695	23574	85.12
Seventh plan (1985-90)	29920	25467	85.12
Annual plan (1990-91)	30360	25967	85.53
Annual plan (1991-92)	30984	26583	85 90
Annual plan (1992-93)	31638	27158	85.83
Eighth plan (1992-97)	36071	30835	85 48

Source : Central Water Commission, Ministry of Water Resources, Government of India, New Delhi.

It is observed that there are important differences in the way canal supplies are regulated in any particular year or seasons in different regions of India (Vaidyanathan, op. cit., 1985). In northern India where rotational system (Warabandi) is followed water delivered to farm is rationed according to a pattern of rotation at water-course level worked out in advance on the basis of forecast of available

water supply every season. The entitlement of water is in proportion to the area and the cropping pattern. There is no control on the cropping pattern. Control is exercised through rigid schedules and amount of water supplied. The northern system of Warabandi is supply based and the system appears to provide some potential means for enforcing some sort of equitable rationing of water in the period of shortage. In Western India the systems are mainly demand based and the flows are intermittent. Water delivery is according to area served and the types of crops grown and the control is exercised on the overall cropping pattern. The area irrigated per unit discharge in a rotation is the index of system efficiency. In south India and in humid and sub-humid parts of India where rice based cropping system is prevalent, depending upon the supply in the reservoir, water is released to the command area from a fixed date at the beginning of the crop season till the maturity of the main crop. In such area water flows continuously for the duration of the crop. In this system no effort is made to ascertain the demand for water on a weekly basis and the schedule designed are on the concept of duty.

All these systems of distribution and regulation of canal water have their shortcomings and disadvantages from the point of view of efficient utilisation of available water for irrigation. Besides, the losses in conveyance and field applications under each type of systems are much high actually than what are assumed. It is argued that the physical control devices are inadequate and crude, hence the canal authorities have to take recourse to manual control through supervision and policing for proper rationing of water supply (Vidyanathan, op. cit., 1985). All these shortcomings get reflected in the underutilisation of irrigation potential, inequality in irrigation and lack of dependability on irrigation and in indifferent quality of irrigation from the major and medium surface systems.

The fifth problem is of wastage of water. The wastage of water occurs, firstly, through conveyance losses at different stages of the distribution system, secondly, through losses at users' field level application of water and thirdly through over irrigation (Dhawan, op. cit., 1989). Some loss of water in conveyance from main storage to the tertiary level through evaporation and seepage is inevitable and should be accepted as normal loss in conveyance in operating such systems.

However, as mentioned earlier, actual conveyance losses are

found to be much higher than anticipated and need to be avoided by plugging the loop-holes and by proper maintenance of the physical structure of the system. Second type of undue wastage occurring in the field also need to be checked through land leveling and construction of field channels which receive the least priority in the scheme of construction and maintenance activities of the irrigation sector. It is only after the introduction of command area development authority in mid-1970s that in later years we have been observing some gradual improvement in mitigating field losses. The most crucial of all the wastage is wastage through over irrigation, i.e., application of water to a greater depth than what the root zone warrants. This occurs, firstly, becuase the farmers are not knowledgeable about the water requirement of the crops and their exact periodicity; secondly, because of the uncertainty about getting the supply of water when needed; thirdly, owing to the manner of distribution of water which is not volumetric and fourthly, because of low price of water (water rates). There is an urgent need to evaluate all these factors with a view to amend the wrong signal which farmers are getting with regard to the use of scarce capital input.

The sixth problem is that of water logging, soil salinity and alkalinity. This problem is directly related to the problem of over irrigation and indirectly to the concentrated use of water for heavy water using crops in the immediate reaches of the canal command. The latest estimates show that the land rendered unfit for cultivation through water logging, soil salinity etc., is of the order of 13 million hectares; 6 million hectares by water logging and 7 million hectares by salinity and alkalinity. Moreover, the extent is growing. This also indicates that the extent of utilisation of the potential created (an average picture of which is presented in Table 23) will have to be agricultural production. This will make consequently the extent of underutilisation much higher than what is reported. This is a serious problem and needs to be tackled urgently through proper management of soil and water in the canal command. In this regard better adaptation of crops grown to the varied soil conditions in the command area and more careful management to avoid over watering assume significant importance.

The issue of conjunctive use of groundwater and surface water can be best examined in this context. Firstly, it needs to be emphasised that conjuctive use does not only mean supplementing canal water by well water and vice-verse in the canal command.

Indeed it means taking a comprehensive account of all the available water resources, both surface and underground, in the canal seepage and recharge of ground water. It also means developing cropsequences and water delivery systems most suitable for the use of such water for irrigation. In a way such an approach visualises reducing the diseconomies (externalities) of canal irrigation and maximising the positive externalities of canal irrigation. The concept of conjuctive use views canal command as a watershed and aims at optimal use of canal and groundwater resources in the entire canal command and its near vicinity. Recent studies that take into consideration this concept of conjuctive use, and developing operational and policy implications of such a concept are developments in the desired direction.

The seventh problem is that of sustainability of irrigated farming. The question arises whether the major and medium storage systems and their distribution network can function with more or less efficiency over reasonably long period considered as life period of the system. It is argued that lack of treatment to upper catchment area in maintaining and regenerating vegetative coverage gives rise to great deal of soil erosion from such area which deteriorates the environmental and ecological conditions not only in the upper catchment area but also adversely affects the storage systems through large scale siltation. As a consequence the live storage capacity of the system is considerably reduced within a short period of time giving rise to the question of sustainability of irrigated farming. In addition the problem of water logging and soil salinity further aggravates the question of sustainability. A comprehensive approach to land and water management is what is urgently needed for a sustainable irrigated farming.

The last but not the least is the problem of financing irrigation management and hence inevitably the question of pricing of water. Indeed, the issues of financing irrigation management and pricing of water are so crucial and are of such overriding consideration that all other problems are subservient to these. It would not be an exaggeration to state that all other problems stated earlier are largely the fall out of the problem of financing irrigation management of the major and medium irrigation schemes. It is stated and accepted by all concerned that the revenue realised from sale of water does not even meet the operation and maintenance expenditure of the major, medium irrigation schemes let alone meeting depreciation charges

and a part of capital expenditure. Estimates show that direct financial recovery from these irrigation schemes is less than Rs. 300 crore as against an investment of Rs. 60,000 crore from 1951 to 1990, both at 1988-89 prices, incurred in irrigation sector. This indicates that not only is the capital investment a sunk cost, but also that the resources obtained through direct recovery are only half of the one per cent level often assumed in project planning documents for proper operation and maintenance of the systems (Gulati et. al. 1994). Under these circumstances, how does one except proper operation and maintenance of the systems in the post construction stage. In fact, over the years, growing scarcity of funds for proper operation and maintenance of the irrigation system has succeeded in downgrading the performance of these systems thereby undermining the effectiveness of the massive investment that has gone into building them. Problems of underutilisation, inequity in irrigation, lack of dependability and indifferent quality of irrigation, wastage of irrigation water, waterlogging, soil salinity and sustainability of irrigated farming arise directly and/or indirectly owing to critical financial situation in the sphere of operation and maintenance of the systems. It is against this background that the Planning Commission set up a Committee on pricing of water (Vidyanathan Committee) in 1991 to study the various aspects of pricing of irrigation water (GOI, 1992).

3.2 Issues in Minor Irrigation Management, Operation and Maintenance

As mentioned earlier, the minor irrigation systems are of various types; the minor surface irrigation schemes as well as tank and pond irrigation and ground irrigation, viz., dug wells and deep tube wells. Unlike major and medium irrigation schemes, the minor irrigation schemes, specially the groundwater types, are mainly privately owned and operated. The enevitable outcome of such ownership and operation is higher degree of utilisation compared to the major and medium irrigation.

Table 23 gives the minor irrigation potential created and utilised upto 1987. It is observed that at all India level around 42 per cent of the ultimate potential of around 98 million hectares had already been created by 1986-87 from both the sources of minor irrigation, ground water and surface water. It is also noted that groundwater sources constitute around 82 per cent of the total ultimate irrigation potential from the minor irrigation. Around 40 per cent of the ultimate

Table 24 : Minor Irrigation Potential Created/Utilised upto 1986-87

(Hectares)

State/UT	Ground Water			Surface Water			Totals		
	Ultimate Potential (Th.)	P	U	Ultimate Potential (Th.)	P	U	Ultimate Potential (Th.)	P	U
3	2	3	4	5	6	7	8	9	10
Andhra Pradesh	5190	1831333	1593109	2300	1553828	1088510	7490	3385161	2681619
Arunachal Pradesh	20	0	0	150	60770	43282	170	60770	43282
Assam	1560	49717	30836	1000	161071	116149	2560	210788	146985
Bihar	7180	2394143	2125878	1900	747596	753174	9080	3141739	2879052
Goa	76	3511	1962	25	14232	9959	101	17743	11921
Gujarat	4810	3685003	1448687	347	206688	19484	5157	3891691	1468171
Haryana	1880	1931524	1733570	50	6184	9073	1930	1937708	1742643
Himachal Pradesh	74	19467	14951	235	176481	151379	309	195948	166330
Jammu & Kashmir	783	5809	6174	400	321745	347022	1183	327554	353196
Karnataka	3120	735457	601491	900	1004994	501304	4020	1740451	1102795
Kerala	990	55047	55047	800	341362	257854	1790	396409	213901
Madhya Pradesh	12700	1661947	1462860	2200	726225	598354	14900	2388172	2061214
Maharashtra	5840	2284837	2221313	1200	904785	712110	7040	3189622	2933423
Manipur	16	0	0	100	21491	14211	116	21491	14211
Meghalaya	56	10942	4621	85	38824	30400	141	49766	35021
Mizoram	5	0	0	70	6242	5887	75	6242	5887
Nagaland	5	88	88	75	52236	50693	80	52324	50781
Orissa	5400	233776	112098	1000	593355	362576	6400	827131	474674
Punjab	3820	4065046	3885787	50	7344	4692	3870	4072390	3890479
Rajasthan	3440	N.A.	N.A.	600	N.A.	N.A.	4040	N.A.	N A
Sikkim	2	0	0	50	15649	15648	52	15649	15648
Tamil Nadu	3350	1823533	1277560	1200	1164283	838907	4550	2987805	2116467
Tripura	80	9275	6190	100	50510	23022	180	59785	29212
Uttar Pradesh	18000	9749538	8322895	1200	235983	284970	19200	9985521	8607865
West Bengal	1880	1236178	992244	1300	1122909	769190	3180	2359098	1761434
State Total	60277	31786150	25897361	17337	9534787	7007850	97614	41320947	32905211
Andaman & Nicobar	0.5	0	0	15	1181	1181	15.5	1181	1181
Chandigarh	0.5	3379	2657	0.5	978	982	1	4357	3639
Dadra & Nagar Haveli	8	707	577	5	386	333	13	1093	910
Daman & Diu	1	742	515	5	0	0	6	742	515
Delhi	111	56448	56379	10	4367	4099	121	69815	60478
Lakshadweep	0	0	0	0.5	0	0	0.5	0	0
Pondicherry	0	16117	15725	5	16425	14453	5	32542	30178
UT Total	121	77393	75853	41	23337	21048	162	100730	96901
All India Total	60398	31863553	25973124	17378	9558124	7028898	97776	41421677	33002112

Source : Report on All India Census of Minor Irrigation Works, 1986-87, Ministry of Water Resources (Minor Irrigation Wing). Remarks : State and All India totals in respect of Potential Created and Utilised do not include corresponding figures for Rajasthan. P : Potential Created, U : Potential Utilised, N.A.: Not available, Th.: Thousand.

groundwater potential is seen to have been created by the year 1986-87. As regards surface water source of minor irrigation, 55 per cent of the ultimate irrigation potential is seen to have been created by the year 1986-87. The extent of utilisation is seen to be around 80 per cent of the minor irrigation potential created on the all India basis. The same for the groundwater is seen to be around 82 per cent in the year 1986-87. Since groundwater constitutes the main source of minor irrigation we shall confine our further discussion on minor irrigation to groundwater alone.

At the state level Punjab and Haryana are the two states where the groundwater exploitation in terms of potential created is found to be 106 and 103 per cent respectively of the ultimate potential. This shows that in these two states by 1986-87 the groundwater had possibly reached the stage of over-exploitation. In the other states where groundwater exploitation has reached relatively high proportion by 1986-87 were Gujarat (77%), West Bengal (65%) and Tamil Nadu (54%). Minor irrigation statistics presented in Table 24 are based on the All India Census of Minor Irrigation 1986-87 and hence are in divergence from the earlier estimates of the Central Water Commission (CWC), Ministry of Water Resources[10]. As per the earlier estimates of the CWC the extent of groundwater potential created (exploited) of the ultimate potential from this source was 93 per cent upto the end of 1990-91 on All India basis. As for different states, the earlier estimates of the CWC shows that among the western states in Gujarat the exploitation of groundwater potential is more than 100 and in Maharashtra nearly 77 per cent, among the northern states the same is near 100 or over 100 in Punjab, Haryana and Rajasthan, among southern states the same is as high as 82 per cent in Tamil Nadu and around 70 per cent in Andhra Pradesh and among eastern states the created (exploited) potential is as high as 81 per cent in Bihar. Thus, it appears that as per the earlier estimates of the CWC nearly full exploitation of groundwater resources has already been achieved at the all India level and that Punjab, Haryana, Rajasthan and Gujarat, at the state level, have reached the stage of over-exploitation of groundwater.

10. There is considerable disagreement on the estimates of ultimate irrigation potential from groundwater sources in the country as a whole, as well as, for different states. While the Planning Commission reckons irrigation potential from groundwater sources at 40 million hectare of crop area, the Central Groundwater Board's estimate is 80 million hectare, twice the magnitude. Scholars have also questioned the reliability of groundwater estimates (Dhawan, 1991).

A recent study on groundwater exploitation has examined the available empirical evidence with regard to over-exploitation of groundwater resources of the country (Dhawan, 1995). Based on the volumetric statistics provided by the Central Groundwater Board rather than on irrigated area statistics of the Planning Commission, the study argues that barring a dozen districts of West-Gangetic plains, no state as a whole appears to have reached the danger mark of groundwater over-exploitations.

The main issues relating to groundwater based irrigation are (i) assumed near full utilisation (ii) assumed high productivity and (iii) assumed depletion of groundwater in several tracts of northern, southern and western India. As regards the first issue of utilisation, statistics presented in Table 24 shows that the extent of utilisation at the all India level of 82 per cent is roughly of the same order as in the case of major and medium surface irrigation sources and in that sense the claim of higher utilisation percentage under groundwater sources compared to major-medium surface irrigation sources are not borne out. However, the official utilisation estimates under major and medium surface irrigation systems are suspects and unreliable on account of several technical and institutional factors. Many field level studies have indicated that the extent of utilisation under such systems are much lower than the official estimates. Whereas under groundwater based irrigation, owing to the absence of such technical and institutional constraints and owing to the fact that bulk of the groundwater sources are privately owned, the estimated utilisation figures are much more reliable. Hence, the argument that utilisation under groundwater based irrigation is higher seems to be correct. It should, however, be noted that the extent of underutilisation is to the tune of 18 per cent, on an average, under groundwater based irrigation which ought to be reduced further.

As regards productivity there is no concrete and uniform evidence to suggest that the crop productivity will be necessarily higher under groundwater based irrigation. To the extent that the control of groundwater is entirely in the hands of the user it is possible that making available water in time and in required quantity help in improving the crop productivity.

Depletion of groundwater through over-exploitation is a major issue. As noted earlier, different measures give different results of over-exploitation. Nonetheless, over-exploitation in the northern states

of Punjab, Haryana and in some tracts in Gujarat and in some tracts in southern states are found commonly in all the measures used. This indeed is a problem in the context of sustaining groundwater based farming. A study carried out to examine select groundwater issues (Moench, 1992) argues that the use of groundwater has grown exploitatively since 1950. Nationwide the diesel and electric pumpsets jumped from 87,000 in 1950 to more than 15 million in mid nineties. Falling water tables and depletion of economically accessible groundwater resources could have major social and economic consequences. The small and marginal farmers faced with depleting water tables in the wells may be forced to abandon the use of the well because of economic reasons and, similarly, falling water tables and consequent increase in the depth of the well make the cost of lifting and using water for irrigation very high, beside increasing the energy needs for pumping water to provide the same services. It is argued that with agriculture (irrigation in particular) consuming anywhere around 30 per cent of total electricity consumption and with shortage of energy affecting every sector, the energy related economic costs of falling water table could be huge. To avoid such adverse consequences, it is desirable to check and regulate the exploitation of groundwater to a sustainable level. During the last decade several legislations designed to regulate groundwater extraction have been attempted without much success mainly owing to liberalised and well developed credit policy and provision of subsidised electricity by the states. Although, as mentioned earlier, there is lack of availability of reliable estimates of reserves of groundwater resources, there is lack of availability of reliable estimates of reserves of groundwater resources, there is growing concern about the current pattern of development and its sustainability in the long run and hence the need for efficient management of groundwater. We shall now turn our attention to cost aspects of the operation and maintenance of the irrigation systems in India in the next section.

SECTION IV

Operation and Maintenance Costs and Gross Receipts from Irrigation

In this section we deal with the operation and maintenance costs of the irrigation systems in India. In the first part of the section we discuss the operation and maintenance costs of the major and medium canal irrigation systems and in the other half of the section we take up the discussion on operation and maintenance costs of the minor irrigation systems, mainly the groundwater based irrigation. Effective operation and maintenance of the existing system is generally presumed to be one of the important determinants of the degree of utilisation of the created potential. As noted in the earlier section the gap between the created potential and its utilisation has been increasing steadily, specially in respect of major and medium canal irrigation systems and this has been a matter of concern during the eighties and nineties. It is against this background that a detailed analysis of operation and maintenance costs of the existing systems will throw light on the problem areas with a view to seeking possible remedial measures and solutions.

4.1 Operation and Maintenance Costs of Major and Medium Canal Irrigation Systems

The operation and maintenance (O&M) of the public surface irrigation systems (major and medium) are largely carried out by the government. The responsibility of the State Irrigation/Public Works Department lies in maintaining facilities and regulating water supply up to outlets which commands anywhere between 5 and 40 hectares. There are instances where the Irrigation Departments are found help maintaining the structure below the outlet level also, say field channels, etc. There are, however, instances of the users' (irrigators') involvement in maintenance of the tertiary systems and below. The need for attending to and maintaining the physical structure which comprises irrigation system arises from the normal wear and tear which these structures and facilties are subjected to. Since these physical facilties are expected to give service over the entire life of the project, maintaining the efficiency of the system through periodic repair and maintenance is a pre-requisite.

There are four components of the expenditure on O&M and

these are under the heads of (i) Direction and Administration (ii) Machinery and Equipment (iii) Extension and Improvement and (iv) Maintenance and Repair. Since irrigation is a state subject and irrigation systems in different states are managed and operated by the irrigation departments of the State Governments there is no uniformity in the practices in this regard not only between the states but also between different irrigation projects in the same state and hence norms, if any, for allocating the working expenses are not followed strictly. A recent study has shown that overhead expenses such as wages and salaries included in the component Direction and Administration, eat away a significant part of the total amount available for O&M leaving very little for actual maintenance work. According to this study, the share of wages and salaries have gone up from 'little under 30 per cent in early sixties to near 50 per cent in late eighties (Svendsen, Gulati, 1995).

Various committees and commission reports have suggested from time to time that the O&M of the existing irrigation project is not given its due share resulting into underutilisation of irrigation potential and the reduced efficiency with which the systems are operated. Various Finance Commissions have also examined this issue and have often allocated O&M funds for canal irrigation schemes on the basis of the area irrigated by each scheme. The Working Group on Major and Medium Irrigation for the Eighth Plan found that most of the allocated money for O&M was being spent on staff payments (GOI, 1989). The central problems, as brought about by various studies including the Working Group are the inadequacy of funds available to carry out the O&M was being spent on staff payments (GOI, 1989). The central problems, as brought about by various studies including the Working Group are the inadequacy of funds available to carry out the O&M activities and to find out ways and means to ensure a higher level of resources for O&M so that the systems could operate more efficiency. Keeping with this observation the Eighth Finance Commission (1984) recommended the provision of a consolidated amount of Rs. 100 per hectare of gross irrigated area for purposes of maintenance in all the states and an additional 30 per cent for the hill states. A later committee set up by the Ministry of Water Resources upgraded this nrom to Rs. 180 per hectare per annum of gross irrigated area for O&M grant taking the base year as 1988. The Working Group on Major and Medium Irrigation, however, felt that a minimum of Rs. 200/- to Rs. 250/- per hectare was required to keep the system in good order. The Tenth (1994)

Finance Commission has adopted a norm of Rs. 300 per hectare for the utilised potential and Rs. 100 per hectare for the unutilised potential. The norm adopted for the hill states are higher by 30 per cent. A recent study on O&M expenses found that in the period 1960-61 to 1986-87, the total working expenses at 1988-89 prices had ranged between Rs. 109 and Rs. 192 per hectare (Gulati, Svendsen and Roy Choudhury, op.cit., 1994).

Table 25 : Gross Receipts from Irrigation and Multipurpose River Projects in Relation (Independently) to Working Expenses and Interest on Capital

(All India)

Year	Gross Receipts (Rs. Lakhs)	Working Expenses (Rs Lakhs)	Percent (2) to (3)	Interest on Capital (Rs Lakhs)	Percent (2(to (5)
(1)	(2)	(3)	(4)	(5)	(6)
1974-75	6070 61	9461 21	64 16	13792 90	44 01
1975 76	8688 29	9538.52	91 09	15769 35	55 10
1976-77	10474 78	11280 29	92 86	17486.26	59.90
1977 78	9693 75	12716 71	76 23	21550 22	44 98
1978 79	10805 81	15517 01	69 64	25553 85	42 29
1979-80	10070 90	14051 48	71 67	29234 51	34.45
1980 81	10336 23	22574 46	45 79	30153 73	34 28
1981 82	12017 87	26530.82	45 30	41558 68	28.92
1982-83	11709 08	23774 01	49 25	87268 06	13 42
1983 84	16505 91	27388 66	60 27	56282 07	29 33
1984-85	12967 89	33395 93	38 83	63570 71	20 40
1985-86	22382 11	48690 09	45 97	68172 69	32 83
1986-87	16673 35	48962 57	34 05	86729 03	19 92
1987 88	13868 15	140028 25*	9 90	N A	—

Source Combined Finance and Revenue Accounts of the Union and State Government of India
Note N A Not Available
* Inclusive of Interest on Capital Outlay at the end of year which is not separately available

Let us now examine some details of the O&M expenses. Table 25 furnishes the O&M expenses (working expenses) in respect of irrigation and multipurpose river projects in India. It is nted that gross receipts has been falling short of total of working expenses and interest on capital by ever increasing margin (Figure 1). From 1974-75 to 1987-88 the loss increased from approximately Rs. 17, 183 lakhs to Rs. 1,26, 160 lakhs. Table 25 also shows the gross receipts as percentage working expenses and we find that the gross receipts from irrigation and multipurpose projects covered only upto 35 to 60 per cent of the working expenses for the same in different years

during the period 1980-81 to 1986-87.[11] In other words, varying between 65 per cent and 40 per cent of the working expenses, annually, during different years remained uncovered creating a mounting burden of loss to the government. It is also noted that till late seventies the gross receipts fell short of working expenses only by a very small margin. It is only after early eighties that the situation started deteriorating. It we consider only the interest part the working expenses are seen to cover ranging between 19 per cent and 34 per cent of the same in different years during 1980s and the same is seen to have declined considerably from the decade 1970 (Figure 2). Thus, the oft repeated requirement of covering any where between 1 and 5 per cent of the capital cost over and above the working expenses appears to be a far cry.

Considering the irrigation projects alone we find that the gross receipts which constituted around 80 per cent and above of the working expenses during the period mid seventies to late seventies, decreased to around 50 per cent in early eighties and then again to around 40 per cent in late eighties. This has occurred mainly on account of rising O&M cost in the face of near stagnant water rates (Table 26 and Figure 3).

Estimates of rates of growth presented in Table 27 shows that during the period 1974-75 to 1987-88 while gross receipts from irrigation and multipurpose projects increased at an annual rate of 6.7 per cent, the working expenses and interest on capital increased at the rate of 18.6 per cent and 17.4 per cent respectively. Similarly, Table 28 shows that during the period 1974-75 to 1987-88 while the gross receipts from irrigation projects increased at an annual rate of 8.9 per cent, the corresponding working expenses increased at 15.6 per cent. This is another way of revealing that these projects are unable to meet the rapidly increasing working expenses from the gross receipts.

Statewise estimates of gross receipts and working expenses for the years 1980-81 and 1985-86, 1986-87, 1987-88 and 1988-89 in respect of 15 states presented in Table 29 also reveal the same picture. Except for the year 1980-81 when gross receipts covered bulk of the working expenses in most states, from the year 1985-86

11. Estimates of working expenses are separately not available from the year 1987-88. Interest on capital outlay at the end of the year is also included in the working expenses from the year 1987-88, hence we have confined our analysis upto the year 1986-87. The situation in respect of gross receipts in relation to working expenses, however, does not improve even in nineties

onwards there appeared ever increasing deficiency in the gross receipts towards covering working expenses. This is amply borne out by the statewise estimates of recovery in percentage term presented in Table 30. Except in Andhra Pradesh, Jammu and Kashmir and to an extent in Tamilnadu and West Bengal, the recovery of working expenses through gross receipt was in the range of 60 per cent and above upto late seventies. It is in the decade eighties that the sharp deterioration in this regard is seen to have set in. As a matter of fact the state of Maharashtra showed comparatively a higher percentage of recovery of working expenses through gross receipt until upto late eighties.

Figure 1 : Gross Receipts, Working Expenses and Interest on Capital from Irrigation and Multipurpose River Projects (All India)

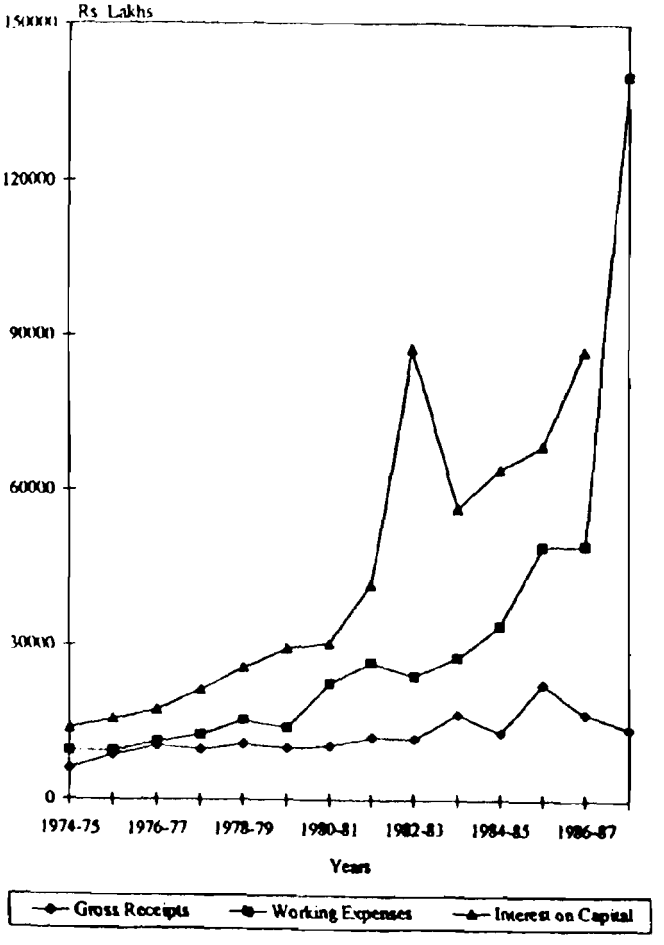


Figure 2 : Gross Receipts in Relation to Working Expenses (WE) and Interest on Capital (IOC) from Irrigation and Multipurpose River Projects (1) and Gross Receipts in Relation to Working Expenses (WE) from Irrigation Projects (2) (All India)

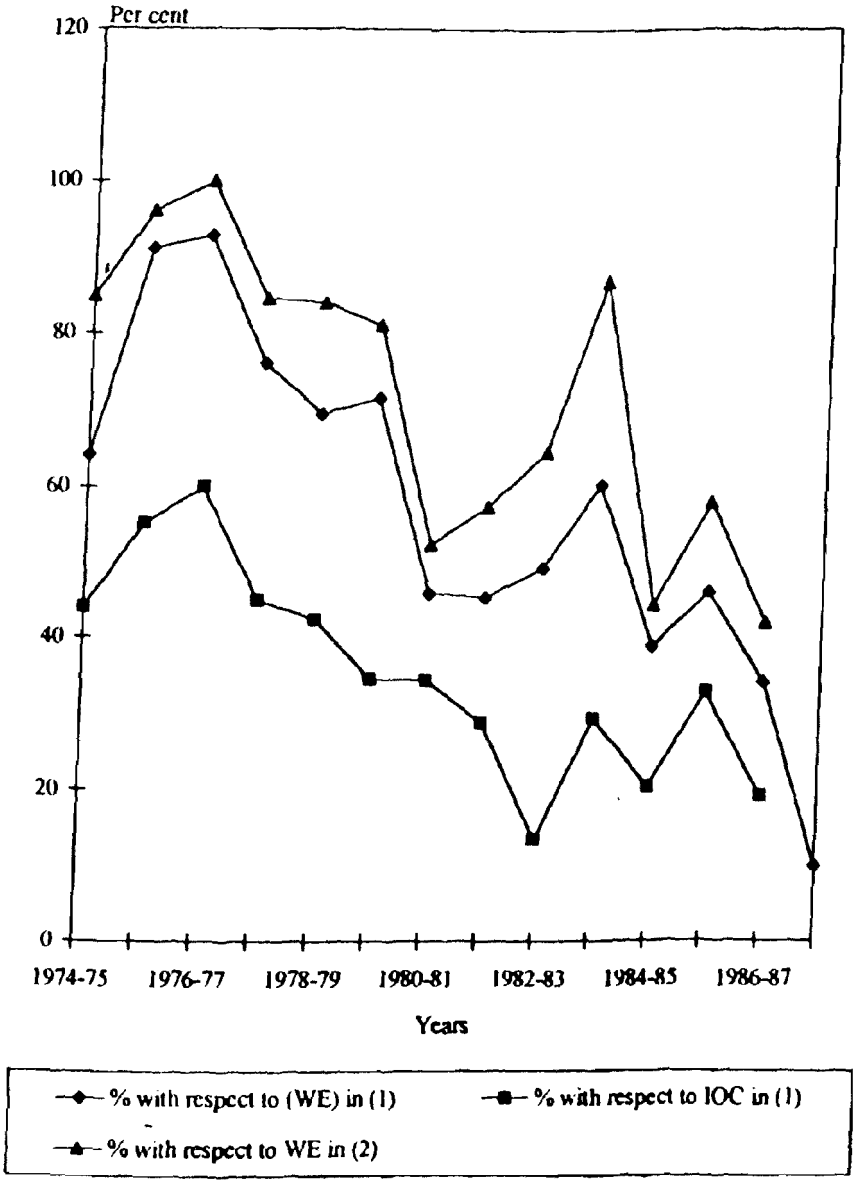


Figure 3 : Gross Receipts and Working Expenses from Irrigation Projects (All India)

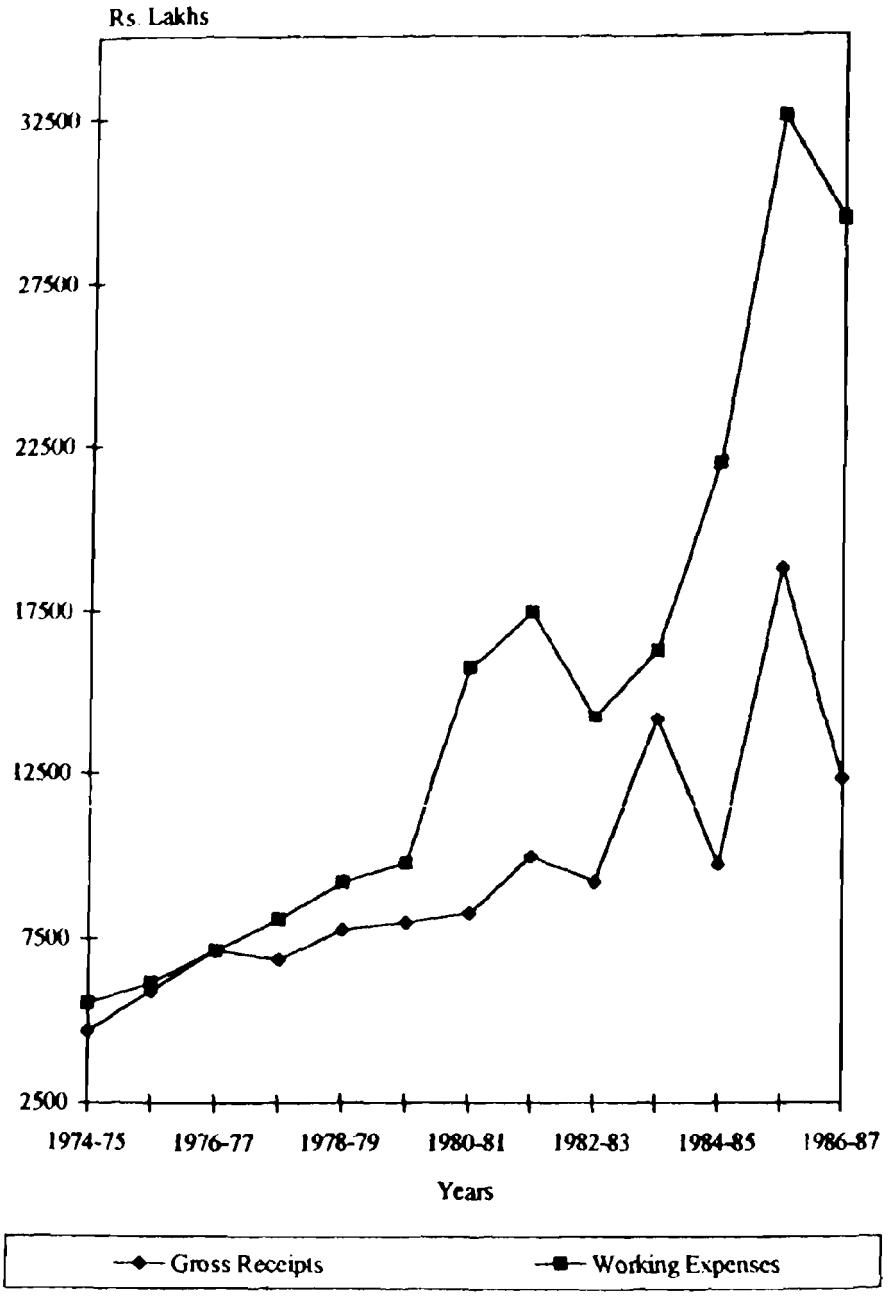


Table 26 : Gross Receipts from Irrigation Projects in Relation to Corresponding Working Expenses

(All India)

Year	Gross Receipts (Rs. Lakhs)	Working Expenses (Rs Lakhs)	Percent (2) to (3)
(1)	(2)	(2)	(4)
1974-75	4710.30	5542 25	84.99
1975-76	5893.49	6131 84	96.11
1976-77	7123.50	7120 74	100.04
1977-78	6844.39	8072 91	84.78
1978-79	7734.38	9185.87	84.20
1979-80	7957.00	9792.69	81 25
1980-81	8244.50	15738 19	52 39
1981-82	10015.01	17471.99	57 32
1982-83	9209.70	14243.50	64 66
1983-84	14144.09	16271 50	86.93
1984-85	9739.40	21988 62	44 29
1985-86	18823.99	32548 28$	57 83
1986-87	12321.21	29382 80	41 93

Source : Combined Finance and Revenue Accounts of the Union and State Governments in India.
Note : $ - After deducting Rs. 872.08 lakhs

Table 27 : Rate of Growth of Gross Receipt, Working Expenses and Interest on Capital from Irrigation and Multipurpose River Projects

(All India)

Period	Gross Receipts			Working Expenses			Interest on Capital		
	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value
1974-75 to 1987-88	6.6987	0.7268*	5 6512*	18.5757	0 8915*	9 9328*	17.4045	0 9215*	11.3693*

* Significant at 1% level of significance.

Table 28 : Rate of Growth of Gross Receipt and Working Expenses

(All India)

Period	Gross Receipts			Working Expenses		
	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value
1974-75 to 1986-87	8.9397	0.8158*	6 9813*	15 6251	0.9488*	14.2818*

* Significant at 1% level of significance.

Table 29 : Gross Receipts from Irrigation and Multipurpose River Projects in relation (Independently) to Working Expenses and Interest on Capital, Statewise

(Rs Lakhs)

State	Year	Gross Receipts	Working Expenses	Interest on Capital	Per cent 3 to 4	Per cent 3 to 5
1	2	3	4	5	6	7
Andhra Pradesh	1980-81	128.93	1843.92	6831.13	6.99	1.89
	1985-86	1435.30	3886.52	11030.18	36.93	13.01
	1986-87	341.74	3424.45	11221.87	9.98	3.05
	1987-88	1042.30	13463.58	N.A	7.74	—
	1988-89	544.07	49098.47	—	1.11	—
Bihar	1980-81	1047.09	1655.71	—	63.24	—
	1985-86	955.99	3263.59	—	29.29	—
	1986-87	566.84	3763.18	—	15.06	—
	1987-88	767.13	3908.18	N.A	19.63	—
	1988-89	N.A.	N.A	—	—	—
Gujarat	1980-81	622.37	1810.32	1927.92	34.38	32.28
	1985-86	721.45	2795.96	9158.11	25.80	7.88
	1986-87	1462.10	3280.44	11957.04	44.57	12.23
	1987-88	1368.60	21199.50	N.A	6.46	—
	1988-89	N.A	N.A	—	—	—
Haryana	1980-81	1009.48	1568.79	2767.00	64.35	36.48
	1985-86	1209.01	2585.74	4821.70	46.76	25.07
	1986-87	1365.10	2396.44	5463.65	56.96	24.99
	1987-88	784.34	8665.73	N.A	9.05	—
	1988-89	1554.80	9390.09	—	16.56	—
Jammu & Kashmir	1980-81	3.16	175.96	39.27	1.80	8.05
	1985-86	20.88	259.88	135.29	8.03	15.43
	1986-87	40.66	296.83	157.05	13.70	25.89
	1987-88	28.84	588.52	N.A	4.90	—
	1988-89	N.A	N.A	—	—	—
Karnataka	1980-81	393.23	5174.89	N.A	7.60	—
	1985-86	644.92	9837.87	N.A	6.76	—
	1986-87	846.93	2186.99	8968.15	38.73	9.44
	1987-88	1335.05		N.A	—	—
	1988-89	1430.90	13843.26		10.34	—
Kerala	1980-81	132.22	267.08	310.98	49.51	42.52
	1985-86	112.66	452.20	660.33	24.91	17.06
	1986-87	141.35	854.83	767.84	16.54	18.41
	1987-88	123.96	1964.90	N.A	6.31	—
	1988-89	263.14	2228.55	—	11.81	—
Madhya Pradesh	1980-81	461.69	1015.61	—	45.46	—
	1985-86	1439.63	3447.40	—	41.76	—
	1986-87	1241.65	3732.09	—	33.27	—
	1987-88	1470.97	4620.04	N.A.	31.84	—
	1988-89	N.A	N.A	—	—	—

Contd.

Table 29 : Gross Receipts from Irrigation and Multipurpose River Projects in relation (Independently) to Working Expenses and Interest on Capital, Statewise

(Rs. Lakhs)

State	Year	Gross Receipts	Working Expenses	Interest on Capital outlay at the end of the year	Per cent 3 to 4	Per cent 3 to 5
1	2	3	4	5	6	7
Maharashtra	1980-81	1020 72	1087.95	6666.19	93.82	15.31
	1985-86	1522.72	3116.22	17750.82	48.86	8.58
	1986-87	1486.60	3436.39	20818.53	43 26	7.14
	1987 88	1874.00	31765.25	N.A	5.90	—
	1988-89	1873.16	35982.15	—	5 21	—
Orissa	1980-81	317.10	678.01	—	46.77	—
	1985-86	863.19	640.04	—	134.87	—
	1986-87	1820.31	872.64	—	208.60	—
	1987-88	660.18	1441.18	N.A.	45.81	—
	1988-89	N.A	N.A.	—	—	—
Punjab	1980-81	956.54	1296.75	884.86	73.76	108.10
	1985-86	1135.10	2348.52	1792 27	48 33	63.33
	1986-87	1220 14	2369.10	2076.83	51.50	58.75
	1987-88	1206.44	5752.99	N A.	20 97	—
	1988-89	1664.99	6539.89	—	25 46	—
Rajasthan	1980-81	968.99	1734.75	3435.46	55.86	28.21
	1985-86	1244.98	6435.96	6159.12	19.34	20.21
	1986-87	1434.98	8924.87	6698.51	16 08	21 42
	1987-88	1290 20	10761 31	N.A.	11.99	—
	1988-89	1125 86	11587.92	—	9.72	—
Tamilnadu	1980-81	175.40	1126.13	1435.60	15.58	12.22
	1985-86	118 75	1735 83	2903 08	6 84	4.09
	1986 87	119 53	2772.14	3407 16	4 31	3 51
	1987-88	134.23	6937.51	N A.	1 93	—
	1988 89	125.81	6395.67	—	1.97	—
Uttar Pradesh	1980-81	2999 70	2232 25	5258 96	134 38	57.04
	1985 86	10829 08	6377.63	12358 41	169 80	87.63
	1986 87	4488 47	9192 22	13688 26	48 84	32.79
	1987-88	1716 08	25338 21	—	6 77	—
	1988-89	3039.50	30431 82	—	9 99	—
West Bengal	1980-81	99.39	906 35	595 66	10 97	16 69
	1985-86	109.68	1506.72	1403.38	7.28	7.82
	1986-87	93 70	2040 75	1504 16	4 59	6 23
	1987-88	136 83	3621 84	N A	3 78	—
	1988-89	147 11	4126 58	—	3 56	—

Source : Combined Finance and Revenue Accounts of the Union and State Governments in India.
Remarks : N A : Not Available.

Table 30 : Statewise and Yearwise Percentage Recovery of Working Expenses Through Gross Receipts in Irrigation and Multipurpose River Projects

States 1	1974-75 2	1975-76 3	1976-77 4	1977-78 5	1978-79 6	1979-80 7	1980-81 8	1981-82 9	1982-83 10	1983-84 11	1984-85 12	1985-86 13	1986-87 14	1987-88 15	1988-89 16
Andhra Pradesh	15.50	16.94	7.50	7.66	8.71	7.60	6.99	6.62	6.77	120.20	21.81	36.93	9.98	7.74	1.11
Bihar	72.52	94.43	61.15	74.00	39.46	47.38	63.24	39.84	49.28	58.42	29.82	29 29	15.06	19.63	N.A.
Gujarat	71.14	94.34	84.09	90 55	71 29	70.57	34.38	16.01	30 84	35.67	35.37	25.80	44.57	6.46	N.A.
Haryana	55.34	77.90	86.58	68 36	66 16	55.21	64.35	57 52	43 54	42.86	37.74	46.76	56.96	9 05	16.56
Jammu & Kashmir	5.96	2.04	3.23	4 13	3.12	2.21	1.80	1.48	1 87	0.55	5.79	8.03	13.70	4.90	N.A.
Karnataka	97.64	129.24	83.40	76 36	95 46	85.86	7.60	77.33	33.17	50 91	29.67	6.76	38.73	—	10 34
Kerala	51.15	69.63	50.79	135 91	58 74	139 22	49 51	24 40	31 98	82 91	37.75	24.91	. 16.54	6.31	11.81
Madhya Pradesh	129.27	539.87	*	*	1401 80	*	45 46	30.74	39 84	44 81	30.16	41.76	33.27	.31.84	N.A.
Maharashtra	166.02	134.28	98.76	97 21	79 80	93.49	93.82	94.14	78 72	61.05	47.30	48.86	43.26	5.90	5.21
Orissa	30.72	86.39	71.88	75 66	60 94	46.28	46.77	69.79	79.30	94.95	64.25	134.87	208.97	45.80	N.A.
Punjab	63.20	113.40	106 71	106 49	92 26	81.75	73 76	69 28	26 57	49 96	81 48	48.33	51.50	20.97	25.46
Rajasthan	49.55	104.88	105.70	57.04	65.53	66.02	55.86	46.54	51 23	43.72	43.63	19.34	16.08	11.33	9.72
Tamil Nadu	22.46	9.87	8.62	6.87	5.28	6.43	15.58	2.51	10 98	6.43	7.68	6.84	4.31	1.94	1.97
Uttar Pradesh	123.33	184.89	286.37	201.68	218.23	187.66	134.38	152 74	111 72	186.92	48.35	169.80	48.83	6.77	9.99
West Bengal	38.22	46.77	34.99	31.50	11.21	20.78	10.97	8.09	16.49	13.05	8.76	7.28	4.59	3.78	3.56
All India	64.16	91.09	92.86	76 23	69.64	71.67	45.79	45.3	49 25	60.27	38.83	45.97	34.05	9.9	

Source : Combined Finance and Revenue Accounts of Union and State Governments in India.

Remarks : 1. * : Due to more credits in Irrigation Projects (Non-Commercial) which resulted in negative working expenses, as such figures not given.
2. N.A. : Not Available.

To get a better idea of recovery through gross receipts we may confine our attention to irrigation projects only. Table 31 presents the estimates of gross receipts from irrigation projects under various heads. Sale of water for irrigation purposes constituted between two-third and three-fourth of the total receipts from irrigation projects during seventies and eighties at all India level. The same is seen to have remained at the level of around 80 per cent in the early years of seventies and then had been very gradually declining and reaching a level of 60 per cent in 1986-87 (Figure 4) Table 32 presents the details of working expenses on irrigation projects. The working expenses is seen to have increased sixfold between 1974-1987 on all India basis, from Rs. 5,542 lakhs to Rs. 29,383 lakhs whereas the gross receipts are seen to have increased only by two and half time during the same period. Therefore, as percentage of working expenses, the gross receipt is seen to have declined over the period 1974-75 to 1986-87 (Table 26).

As regards the Working Expenses, the expenses on direction and administration account for major portion of the total working expenses, as discussed earlier. The same is seen to be ranging from around 30 per cent to around 43 per cent over the years at all India level (Table 32). The repair and maintenance component which accounted for more than 50 per cent of the total working expense in mid and late seventies showed a decline in its share since then and in 1986-87 the same stood at a little over one-third of the working expenses, whereas the share of direction and administration (wages, salaries, etc.) is seen to have increased gradually from 30 per cent in mid-seventies to little over 40 per cent in late eighties (Figure 5). The reduction in the proportionate share of repair and maintenance in the face of increasing share of direction and administration may be coming in the way of operating the systems effectively.

Another way of looking into the irrigation receipts in relation to working expenses is to compare the per hectare receipts from irrigation potential utilised with per hectare working expenses of the same. Tables 33, 34 and Figure 6 present the estimates for such a comparison in respect of 15 states and for 3 points in time, viz., 1977-78, 1979-80 and 1984-85. At the all India level the working expenses per hectare of irrigation potential utilised increased from mere Rs. 46.60 in 1977-78 to Rs. 114.48 in 1984-85 (Table 34). The same is seen to be the highest in Maharashtra in all the three

periods. On the other side Gujarat, Jammu and Kashmir, Maharashtra, Karnataka and Rajasthan show a high level of working expenses per hectare. It is difficult to assess the reasons for such divergences in per hectare working expenses across the region and over time. It could be because of several factors, eg., age of the project, condition of the physical structure, nature of terrian, potential actually utilised, scarcity of funds, etc. However, one thing is clear from the above estimates that except in the sate of Maharashtra in the case of all the other 14 states the working expenses per hectare are found to be much lower than that recommended by the Working Group (GOI, op.cit., 1989).

Receipts per hectare of irrigation potential utilised at the all India level remained stagnant over 3 points of time at the level of around Rs. 20 (Table 33) which is dismally low. Receipts were highest in the state of Maharashtra followed by Gujarat. Maharashtra, however, shows a stagnant level of receipts per hectare between two points in time, 1979-80 and 1984-85. The states showing receipts per hectare on the upper side are Haryana, Karnataka, Madhya Pradesh, Punjab, Rajasthan and Uttar Pradesh and the states showing the same on the lower side are Andhra Pradesh, Bihar, Jammu and Kashmir, Kerala, Orissa, Tamil Nadu and West Bengal. Tamil Nadu shows the lowest per hectare receipts (around Rs. 7) followed by Andhra Pradesh and West Bengal. Again, it is difficult to assess the reasons behind such variations in the receipts across the regions and over the periods. There could be several factors accounting for this; the foremost among them are low water rates and poor recovery.

Receipts per hectare in relation to the working expenses per hectare reveal that at all India level the receipt per hectare in 1984-85 constituted only 19.5 per cent of the per hectare working expenses (Table 35). The situation was worst in Jammu and Kashmir, Tamil Nadu and Andhra Pradesh where gross receipt per hectare constituted less than 5 per cent, 8 per cent and 10 per cent respectively of the working expenses in the periods 1977-78. This improved to around 26 per cent in 1984-85 in the case of Andhra Pradesh while in the case of Jammu and Kashmir and Tamil Nadu, the same did not increase even during mid-eighties as the receipts per hectare remained stagnant at a very low level of around Rs. 5 and Rs. 7 respectively all through. On the other hand, states of Punjab, Gujarat and to a large extent states of Bihar, Maharashtra,

Table 31 : Details of Gross Receipts from Irrigation Projects (Commercial) (All India)

(Rs. Lakhs)

Year	Direct Receipts						
	Sale of Water for Irrigation purposes	Sale of Water for Domestic purposes	Sale of Water for Other purposes	Sale proceeds from canal plantation	Total	Indirect Receipts (Total)	Grand Total
1	2	3	4	5	6	7	8
1974-75	3337.00	129.44	162.84	63.80	4508.38	202.22	4710.50
	(70.84)	(2.75)	(3.46)	(1.35)			
1975-76	4647.55	162.66	129.80	80.86	5780.02	113.42	5893.49
	(78.86)	(2.76)	(2.20)	(1.37)			
1976-77	6071.06	146.85	156.95	37.33	7052.85	70.65	7123.50
	(85.23)	(2.06)	(2.20)	(0.52)			
1977-78	5895.78	117.89	141.10	29.64	6754.01	90.38	6844.39
	(85.89)	(1.72)	(2.06)	(0.43)			
1978-79	6655.59	129.56	146.04	24.08	7617.87	116.51	7734.38
	(86.05)	(1.68)	(1.89)	(0.31)			
1979-80	6161.35	237.33	127.09	44.60	7799.20	157.80	7957.00
	(77.43)	(2.98)	(1.60)	(0.56)			
1980-81	6145.49	141.33	201.92	28.56	8132.37	112.13	8244.50
	(74.54)	(1.71)	(2.44)	(0.35)			
1981-82	7636.35	219.02	125.29	20.55	9914.86	100.15	10015.01
	(76.25)	(2.19)	(1.25)	(0.20)			
1982-83	6957.84	205.19	143.03	21.17	9011.87	197.83	9209.70
	(75.56)	(2.23)	(1.55)	(0.23)			
1983-84	8399.67	300.62	146.79	23.58	10771.88	3372.21	14144.09
	(57.39)	(2.13)	(1.04)	(0.17)			
1984-85	6707.79	307.68	203.16	18.14	9496.33	243.07	9739.40
	(68.87)	(3.16)	(2.09)	(0.19)			
1985-86	13967.63	1786.25	235.96	33.57	18555.51	268.48	18823.99
	(74.20)	(9.49)	(1.25)	(0.18)			
1986-87	7463.86	684.34	304.02	216.18	12115.59	205.62	12321.21
	(60.58)	(55.55)	(2.47)	(1.75)			

Source : Combined Finance and Revenue Accounts of the Union and State Government in India
Note : Figures within brackets represent percentage of Grand Total (Gross Receipts)
Definition of Indirect Receipts : Indirect Receipts cover portion of Land Revenue due to Irrigation Works, Betterment Levy, Irrigation Cess and Other Receipts.

Haryana, Orissa, Rajasthan, Kerala and Uttar Pradesh show a high ratio of receipts to working expenses. In many of these states in the period 1977-78 the receipts from irrigation covered more than the working expenses which are seen to have gradually reduced covering less and less of working expenses. A clear declining trend in the ratio (percentage) of receipts from irrigation to working expenses per hectare is noticed in the case of almost all the 15 states as well as for India.

Figure 4 : Share of Individual Components of Direct Receipts to Gross Receipts from Irrigation Projects (All India)

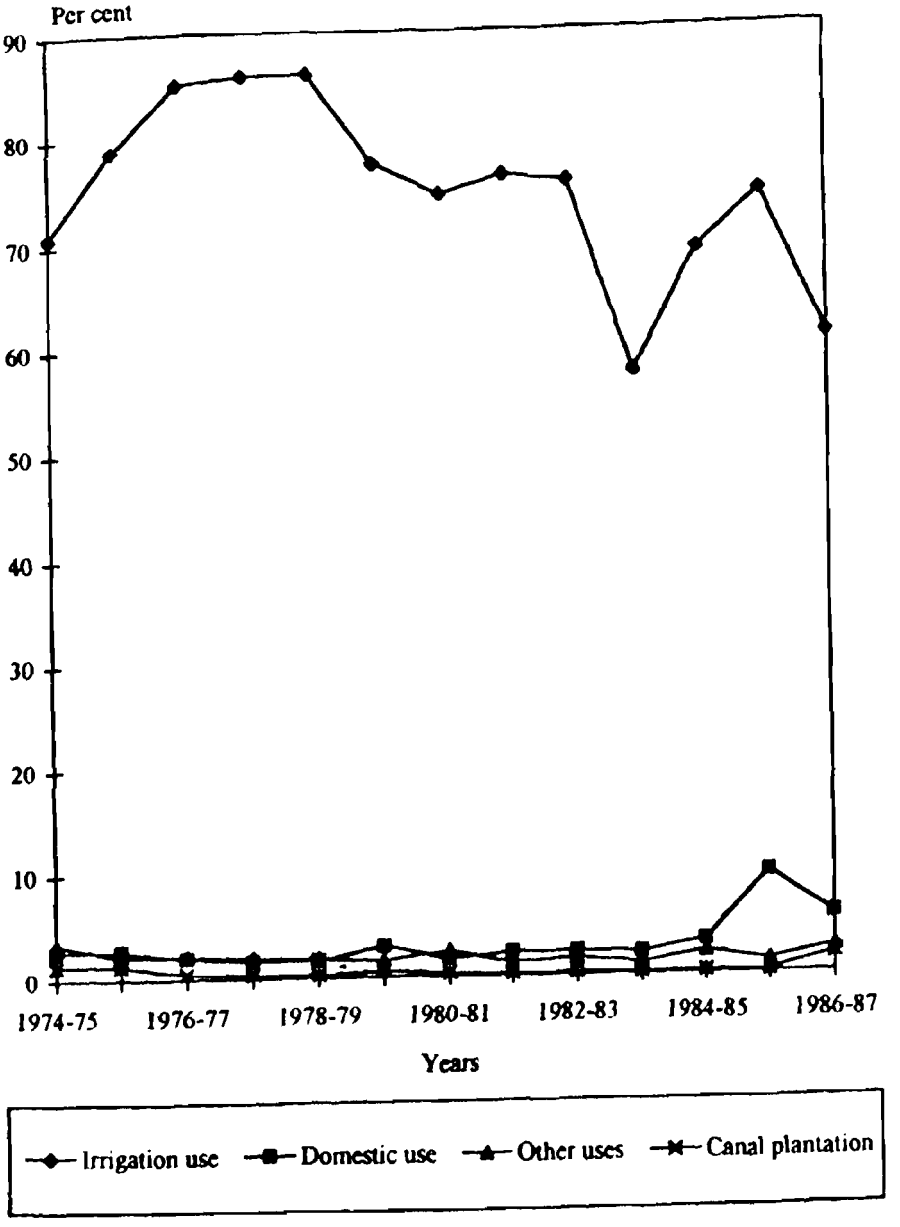


Table 32 : Details of Working Expenses on Irrigation Projects (Commercial) (All India)

(Rs. Lakhs)

Year	Direction and Administration	Machinery and Equipment	Suspense	Extension and Improvement	Maintenance and Repairs	Other Expenditure	Total
1	2	3	4	5	6	7	8
1974-75	1880.25	60.30	136.02	753.56	2550.93	161.19	5542.25
	(33.92)	(1.09)	(2.45)	(13.60)	(46.03)	(2.91)	
1975-76	1948.80	79.36	2.28	528.65	31.50.92	421.89	6131.84
	(31.78)	(1.29)	(0.04)	(8.62)	(51.39)	(6.88)	
1976-77	2150.49	110.21	-88.04	328.66	4457.89	131.52	7120.74
	(30.20)	(1.55)	(-1.24)	(4.62)	(63.02)	(1.85)	
1977-78	2390.39	95.90	69.61	513.83	4559.42	444.16	8072.91
	(29.61)	(1.18)	(0.86)	(6.36)	(56.48)	(5.51)	
1978-79	2716.26	112.87	92.59	276.68	4638.78	1348.70	9792.69
	(29.57)	(1.23)	(1.01)	(3.01)	(50.50)	(14.68)	
1979-80	3027.43	117.89	140.92	284.41	5638.98	583.02	9792.69
	(30.92)	(1.20)	(1.44)	(2.90)	(57.58)	(5.96)	
1980-81	4079.23	254.50	-53.66	480.66	6745.41	4232.02	15738.19
	(25.92)	(1.62)	(-0.34)	(3.05)	(42.86)	(26.89)	
1981-82	4882.65	176.74	235.21	596.93	7207.89	4372.55	17471.90
	(27.94)	(1.01)	(1.35)	(3.42)	(41.25)	(25.03)	
1982-83	5786.53	172.87	468.02	505.99	7327.86	-17.84	14243.50
	(40.63)	(1.21)	(3.29)	(3.55)	(51.45)	(-0.13)	
1983-84	5986.08	356.83	465.32	398.16	7492.35	1572.76	16271.50
	(36.78)	(2.19)	(2.86)	(2.45)	(46.05)	(9.67)	
1984-85	6974.75	206.90	358.94	570.61	10047.85	3829.57	21988.62
	(31.71)	(0.94)	(1.63)	(2.60)	(45.70)	(17.42)	
1985-86	11963.78	191.21	272.55	9634.67	8059.60	3298.55	32548.28$
	(36.76)	(0.59)	(0.84)	(29.69)	(24.76)	(10.13)	
1986-87	12588.52	229.16	529.75	3337.90	10682.16	2015.30	29383.80
	(42.84)	(0.78)	(1.80)	(11.36)	(36.36)	(6.86)	

Source : Combined Finance and Revenue Accounts of the Union and State Government in India.
Remarks : Figures within brackets represent percentage to the total (Working Expenses).

Figure 5 : Share of Different Components in Total Working Expenses on Irrigation Projects (All India)

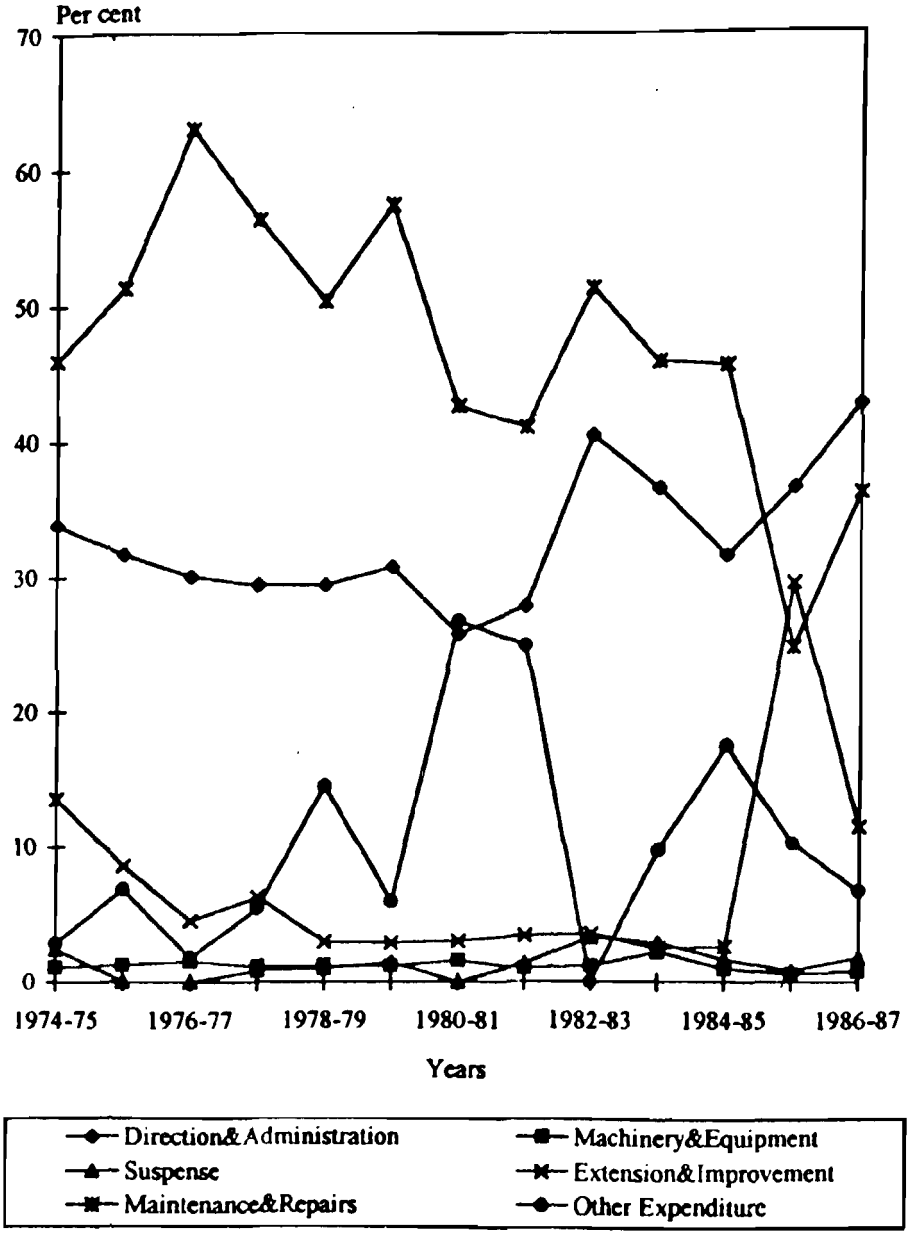


Table 33 : Receipts per Hectare of Irrigation Potential Utilized Major and Medium Irrigation Projects

(Rs.)

States	1977-78	1979-80	1984-85
1	2	3	4
Andhra Pradesh	4.99	5.18	25.00
Bihar	50.30	36.70	34.82
Gujarat	97.05	92.67	140.74
Haryana	58.46	48.70	64.15
Jammu & Kashmir	3.34	2.82	11.53
Karnataka	48.29	68.37	56.22
Kerala	35.02	61.56	35.70
Madhya Pradesh	44.28	42.48	94.19
Maharashtra	95.98	148.70	147.50
Orissa	108.04	24.68	28.20
Punjab	40 16	40 00	70.66
Rajasthan	69.86	80 88	92.51
Tamil Nadu	6.94	5.37	6.92
Uttar Pradesh	63.39	67 90	57.27
West Bengal	22.22	14.23	9.74
All India	20.47	19.56	22.11

Source : Central Water Commission (Statistics Directorate)

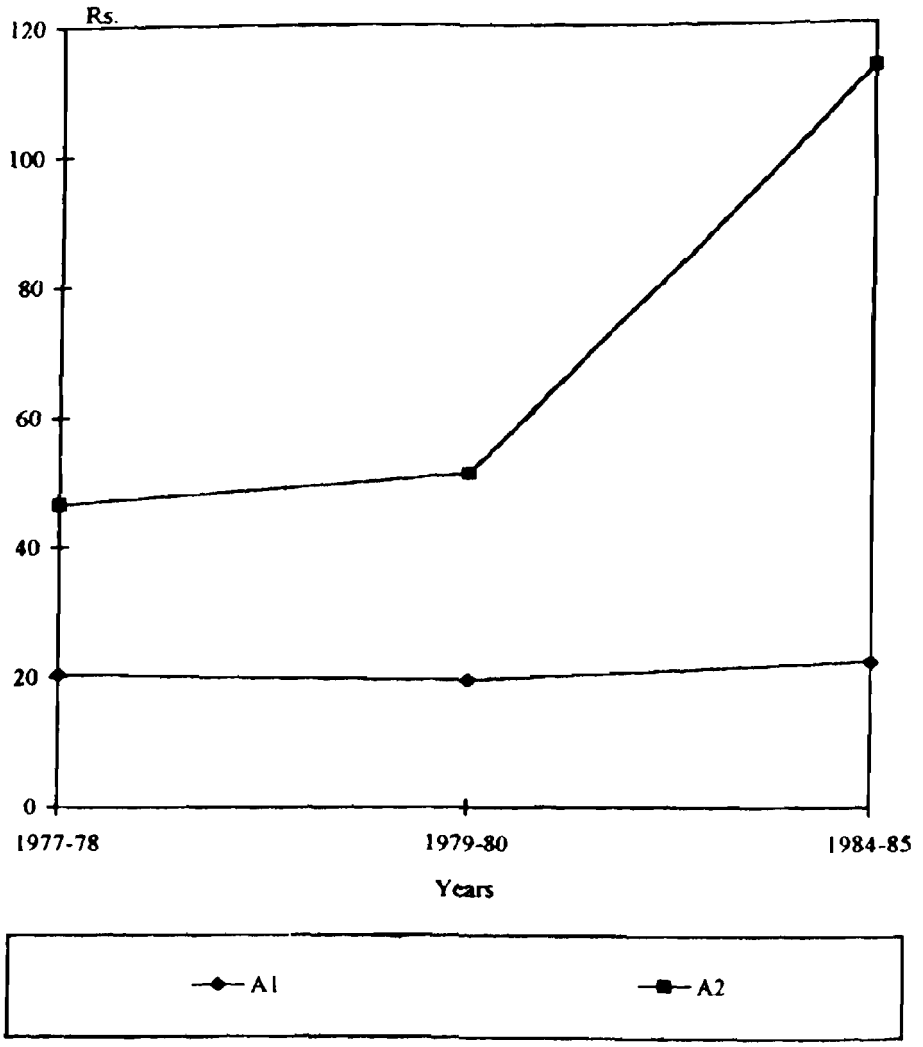
Table 34 : Working Expenses per Hectare of Irrigation Potential Utilized Major and Medium Irrigation Projects

(Rs.)

States	1977-78	1979-80	1984-85
1	2	3	4
Andhra Pradesh	56.80	57.34	94.88
Bihar	42.25	42.40	64 69
Gujarat	93.43	106 97	191.74
Haryana	50.35	56 71	120.02
Jammu & Kashmir	80 92	127.37	199 24
Karnataka	63.24	79.64	189 45
Kerala	25.77	65 14	—
Madhya Pradesh	—	—	291 69
Maharashtra	98.73	159 05	311.84
Orissa	17.84	45.49	23.24
Punjab	25.00	30 79	53.75
Rajasthan	97.30	90 99	144.04
Tamil Nadu	101.19	83.60	89.99
Uttar Pradesh	31.14	36 02	115 74
West Bengal	15.68	27.85	63.54
All India	46 60	51.43	113.48

Source : Central Water Commission (Statistics Directorate)

Figure 6 : Receipts (A1) and Working Expenses (A2) per Hectare of Irrigation Potential Utilised Major and Medium Irrigation Projects (All India)



A recent study show that at 1988-89 prices the recovery ratio, i.e, gross receipts divided by the expenses (O&M) expressed in percentage term remained above 100 at the All India level upto the middle of the 1960s indicating a somewhat satisfactory financial performance. However, the study shows that this encouraging situation did not last beyond the end of the Third Plan period (1960-65). The ratio had fallen below 100 and gradually declining indicating that the receipts had fallen below expenses on maintenance of irrigation projects, during the entire period 1960 to 1988 except during early to mid 1970s when the irrigation receipts had climbed marginally above working expenses owing to hike in water rates by most states and a fall in the money spent on O&M of irrigation schemes (Svendsen, Gulati, op.cot., 1955). The study also found that the recovery ratio had been deteriorating over the past two decades for all the states studied.

From whichever angle we examine, it clealy emerges that grants (funds) allotted to irrigation projects are grossly inadequate to allow the system to be operated with reasonable efficiency. Further, it is argued on the basis of the gross receipts from irrigation that the low levels of water rates is the main problem of allocating adequate funds for proper upkeep of the systems. The Irrigation Commission of 1972, keeping in view the inappropriateness of keeping water rates low, had recommended that irrigation schemes should generate enough annual income to equal at least the annual cost of O&M and a part of the capital cost. To meet the rising costs of O&M the Commission suggested that water rates should be revised every five year and should lie within the range of 5 to 12 per cent of the gross revenue of the farmers in the canal command areas, depending upon whether the farmer is producing foodgrains or cash crops. The Public Committee of 1983 opined that irrigation authorities need to generate sufficient revenue to pay for the maintenance, operation and depreciation charges and also yield some interest on capital invested in the irrigation schemes. Various Finance Commissions also went into the question of return from investment in irrigation and related issues. The Fifth Finance Commission (1969) was of the opinion that the receipt from irrigation should yield the annual costs on O&M plus 2.5 per cent of the capital cost. However, the Sixth (1973) and Seventh (1978) Finance Commissions recommended that over and above O&M expenses the irrigation schemes should cover at least 1 per cent of the capital cost. Subsequently, Eighth (1984) and Seventh (1978) Finance Commissions recommended that irriga-

tion schemes should at least fully cover its O&M costs from irrigation receipts. The report of the Tenth (1994) Finance Commission after reviewing the recommendations of the earlier Finance Commissions, mention that the irrigation receipts should cover not only O&M costs but also give a return of at least 1 per cent per annum on capital. For hill states the Commission assumes a recovery of only 75 per cent of the O&M costs. Further, receipts have not been assumed from the unutilised potential for any state.

The widening gap between the receipts from irrigation and expenses on O&M results in the paucity of funds for O&M. To sustain the current and future expected level of agricultural development sufficient and timely water must be made available through the major and medium surface irrigation systems and to supply optimal levels of water, these systems need to be operated well and maintained regularly. Unfortunately paucity of funds owing mainly to low levels of water rates, comes in the way of satisfactory performance of the irrigation network created. The foregoing discussion takes us to the question of pricing of water for irrigation. However, before going to the question of pricing of water for irrigation we shall, in the remaining part of this Section, discuss the operation and maintenance costs relating to minor irrigation systems, specially the groundwater types.

Table 35 : Receipts Per hectare in Relation to Working Expenses (per cent)

States	1977-78	1979-80	1984-85
1	2	3	4
Andhra Pradesh	8.78	9.03	26.35
Bihar	119.05	86.56	53.83
Gujarat	103.87	86.63	73.40
Haryana	116.11	85.88	53.45
Jammu and Kashmir	4.13	2.21	5.79
Karnataka	76.35	85.85	29.68
Kerala	135.89	94.50	—
Madhya Pradesh	--	—	32.29
Maharashtra	97.21	93.49	47.30
Orissa	605.61	54.26	121.34
Punjab	160.64	129.91	131.46
Rajasthan	71.80	88.88	64.22
Tamil Nadu	6.86	6.42	7.69
Uttar Pradesh	203.56	188.50	49.48
West Bengal	141.70	51.10	15.33
All India	43.93	38.03	19.48

4.2 Operation and Maintenance Costs of Minor Irrigation Systems

As mentioned earlier the minor irrigation systems comprise minor surface irrigation schemes and groundwater based irrigation. Since bulk of the minor irrigation sources, specially the groundwater ones, are privately owned and operated, it becomes difficult to have an accurate and reliable estimates of the operations and maintenance costs of the minor irrigation systems. Besides, the same would vary from region to region and also depending upon the type of well. As regards the state/publicly owned minor irrigation schemes, both of surface types and groundwater based, the operation and maintenance expenditure and gross receipts can be obtained from the official statistics, but for the privately owned groundwater based irrigation reliable and uniformly applicable and comparable data are difficult to marshall. It is, however, not our concern to compare the operation and maintenance costs between major-medium and minor irrigation schemes. As mentioned earlier, our purpose is ultimately to compare these costs with the prices paid for the services received and also the type of services received so as to ascertain to what extent the gross receipts from providing the service cover the cost of providing the same.

Let us begin our discussion with the O&M costs under public minor irrigation systems. It is noted that while the gross receipts from combined minor irrigation schemes, soil and water conversation schemes and area development programmes increased from Rs. 2,242.63 lakhs to Rs. 4,842.13 lakhs between the period 1974-75 and 1987-88, the corresponding working expenses under the same increased from Rs. 17,754 lakhs to Rs. 143,780 lakhs (Table 36 and Figure 7). Thus, the gross receipts covered only between 12.63 per cent and 3.37 per cent of working expenses in the period 1974-75 to 1987-88. The situation regarding coverage of working expenses in the period 1974-75 to 1987-88. The situation regarding coverage of working expenses which was already very bad in early seventies itself deteriorated gradually further over the period. It is also clear from these results that so far coverage of working expenses from gross receipts from irrigation are concerned, minor irrigation schemes have fared much worse than the major and medium schemes.

Table 36 : Gross Receipts from Minor Irrigation Schemes, Soil and Water Conservation Schemes and Area Development Programme in Relation to Corresponding Working Expenses

(All India)

Year	Gross Receipts (Rs Lakhs)	Working Expenses (Rs Lakhs)	Percent (2) to (3)
1	2	3	4
1974 75	2242 63	17754 40	12 63
1975 76	2481 55	20345 70	12 20
1976 77	2577 45	22371 47	11 52
977 78	2437 91	27900 49	8 74
1978 79	3285 98	36581 79	8 98
1979 80	3125 98	44999 55	6 95
1980 81	2651 23	48092 35	5 51
1981 82	4053 89	49038 43	8 27
1982 83	3183 35	59678 82	5 33
1983 84	3832 85	73506 41	5 21
1984 85	3855 87	78303 67	4 92
1985 86	5614 10	88333 13	6 36
1986 87	4666 35	116041 50	4 02
1987 88	4842 13	143779 80	3 37

Source 1 Combined Finance and Revenue Accounts of the Union and State Government in India
2 State Finance Accounts

Table 37 : Gross Receipts from Minor Irrigation Schemes, Soil Conservation and Area Development Separately in relation to the Respective Working Expenses (per cent)

(All India)

Year	Minor Irrigation Schemes	Soil Conservation Schemes	Area Development Programme
1	2	3	4
1974 75	3 86	14 99	1 23
1975 76	10 82	3 65	2 67
1976 77	9 48	6 49	1 78
1977 78	8 98	4 53	0 97
1978 79	10 94	3 15	1 22
1979 80	7 27	2 38	0 83
1980 81	4 81	1 82	0 73
1981 82	10 58	2 55	0 95
1982 83	5 71	2 02	1 33
1983 84	4 70	2 96	0 70
1984 85	4 19	1 87	0 54
1985 86	4 44	1 78	2 23
1986 87	1 88	2 04	0 25
1987 88	2 25		0 09

Source 1 Combined Finance and Revenue Accounts of the Union and State Government in India
2 State Finance Accounts

Figure 7 : Gross Receipts and Working Expenses from Minor Irrigation Schemes, Soil and Water Conservation Schemes and Area Development Programme (Combined) (All India)

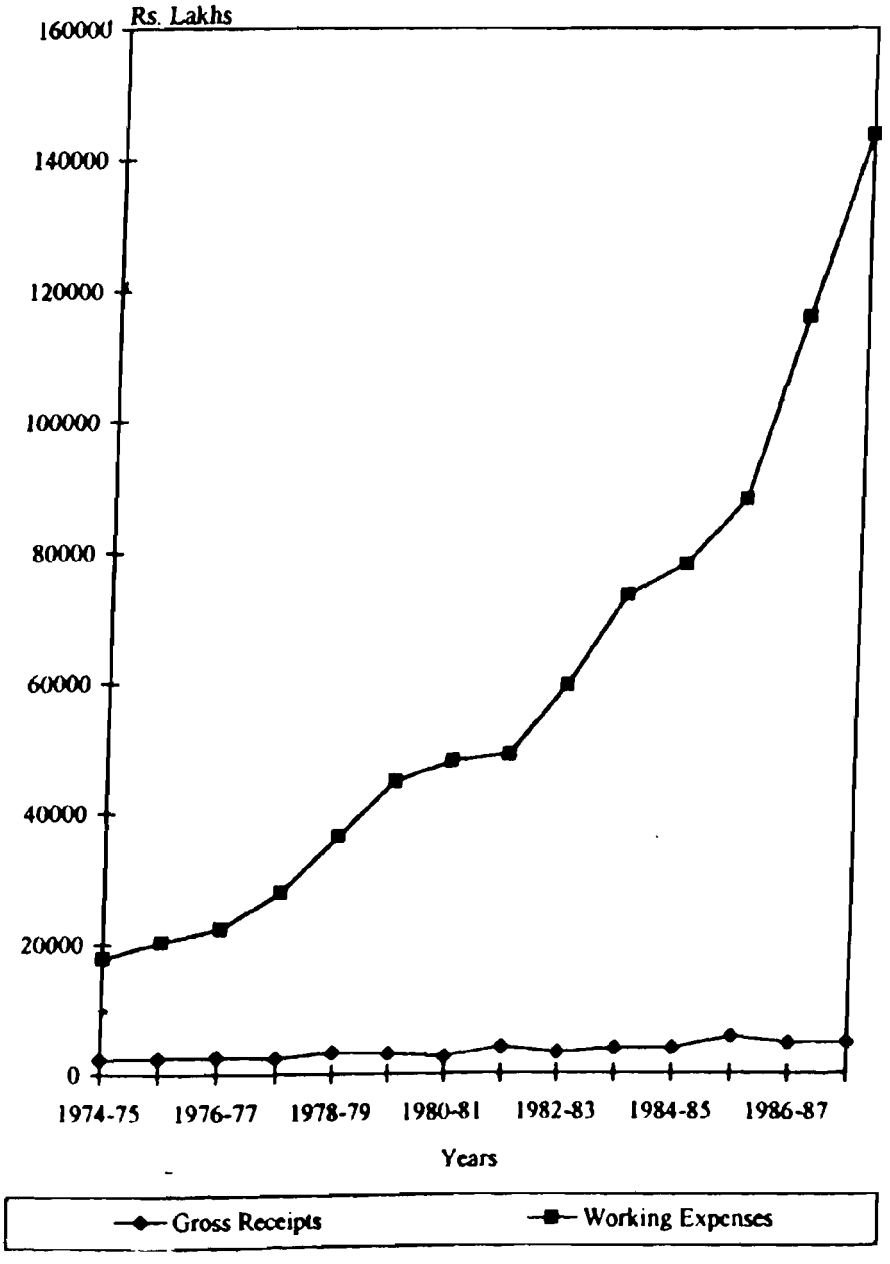
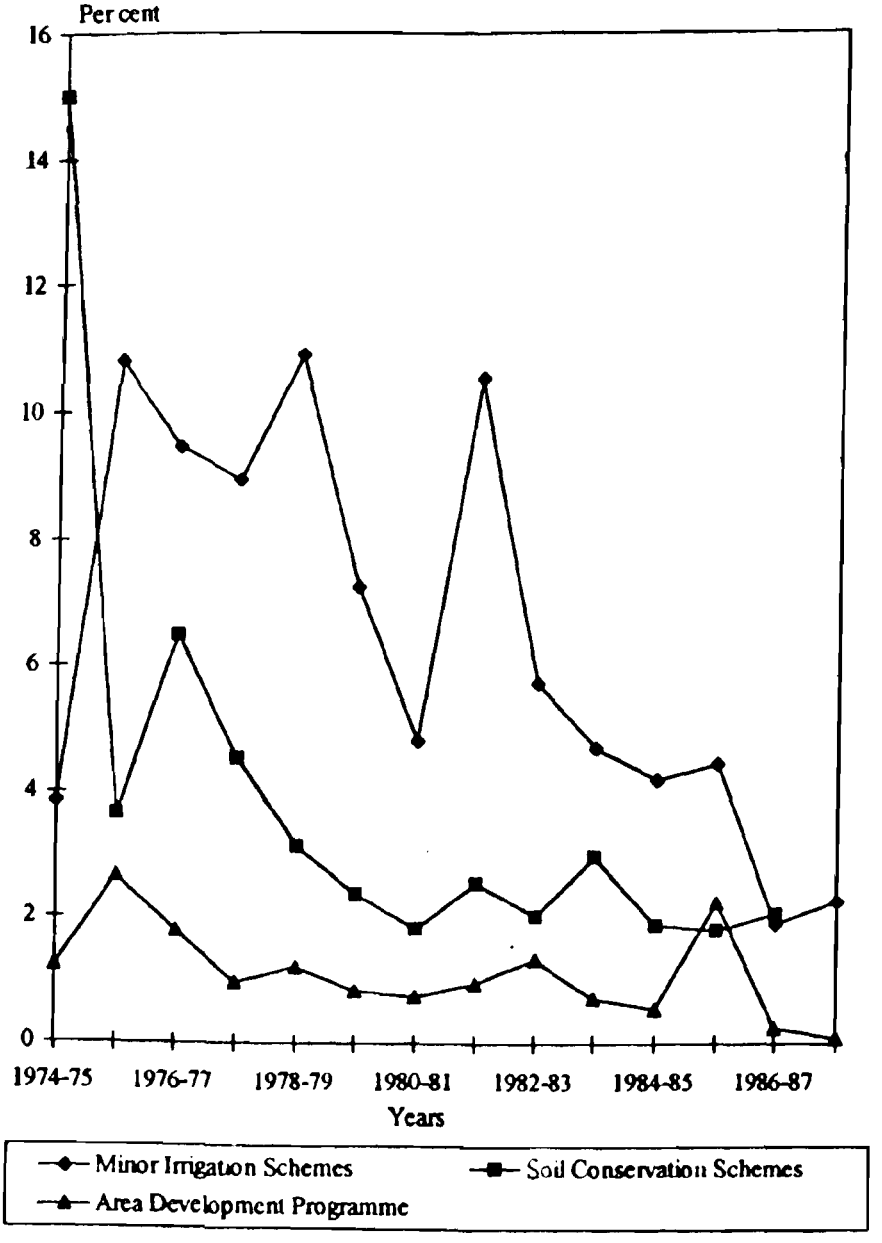


Figure 8 : Gross Receipts from Minor Irrigation Schemes, Soil Conservation and Area Development Separately in relation to the Respective Working Expenses (All India)



If we examine individually, the position of gross receipts from area development is seen to be worst in a much as less than 1 per cent of the working expenses are covered by the corresponding gross receipts. Gross receipts as percentage of working expenses under minor irrigation, which remained around 10 per cent from mid-seventies to early eighties gradually decreased over 1980s to around 2 per cent. The same under soil conservation schemes is seen to be around 2 per cent during 1980s (Table 37 and Figure 8).

Table 38 : Rate of Growth of Gross Receipts and Working Expenses in respect of Each of Minor Irrigation, Soil Conservation and Area Development Programme

(All India)

Period	Gross Receipts								
	Minor Irrigation			Soil Conservation			Area Development		
	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value
1974-75 to 1987-88	6.9512	0.3479	2.5306	2.1292	0.0481	0.7462	-0.3277	0.0003	0.0608

Period	Working Expenses								
	Minor Irrigation			Soil Conservation			Area Development		
	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value	Growth Rate	R Square	T Value
1974-75 to 1987-88	17.4516	0.9744*	21.4136*	16.0242	0.9629*	17.6697*	14.7545	0.8544*	0.3946*

* Significant at 1% level of significance.

Another way of looking at this phenomenon is to compare the rate of growth of gross receipts and working expenses. While the gross receipts under minor irrigation schemes increased at the rate of 6.95 per cent per annum, compounded, between 1974-75 and 1987-88, the corresponding working expenses increased at an annual rate of as high as 17.45 per cent (Table 38). Similarly, while the gross receipts under soil conservation increased by 16.02 per cent per annum in the period 1974-75 to 1987-88. In the case of area development programme, the situation is even more alarming; the gross receipts are seen to have declined annually at the rate of 0.33 per cent against an annual increase of 14.75 per cent in working expenses in the period 1974-75 to 1987-88 (Table 38).

Over all the receipts from minor irrigation schemes are seen to be very poor which barely covers 10 per cent of the working expenses. This does not auger well for overall development and management of minor irrigation works. This inevitably takes us to the charges (prices) paid by the beneficiaries for receiving services under such schemes and the nature and type of services they receive.

In the case of minor irrigation from groundwater sources, e.g., bore well, dug well, tube well, the main constituent of the working expenses consists of electricity in the case electricity operated wells and tube wells and diesel in the case of wells fitted with oil engines. We shall in this discussion confine our attention to electricity consumption only for obvious implication of this consumption, at subsidised rate or at no cost, on the society as a whole.

Table 39 gives the distribution of electricity pumpsets and power consumption in different states at three points of time. It is noted that at the All India level the number of electric pumpsets increased from around 10 lakhs in 1970-71 to 43 lakhs in 1980-81 and to 98 lakhs in 1992-93; i.e., the number increased by almost 10 times over a period of around 20 years. The power consumption is seen to have increased at the all India level from around 4,500 million kwh in 1970-71 to around 14,500 million kwh in 1980-81 and to around 63,330 million kwh in 1992-93 i.e., an increase of around 14 times over a period of around 20 years. Thus, power consumption is seen to have increased at a faster rate than the increase in the number of electric pumpsets thereby indicating that the consumption per pumpset has increased over the years.[12] Among the states Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu accounted for more than 50 per cent of the electric pumpsets in the country in 1992-93. Maharashtra alone accounted for nearly 20 per cent. While Madhya Pradesh's share is seen to have increased from 2 per cent to 10 per cent and Maharashtra's share from 11.5 per cent to 18 per cent between the same period.

As regards power consumption Andhra Pradesh, Gujarat, Maharashtra and Uttar Pradesh together consumed a little over 50 per cent of total for the country in 1992-93 (Table 30). While most states showed gradual increase in the consumption of electricity over

12. The assumption is that entire electricity consumption is confined to irrigation pumpsets alone. This assumption may not be far fetched as most studies indicate that 90 per cent or thereabout of total consumption of electricity in agriculture is accounted for irrigation pumpsets

Table 39 : Statewise Distribution of Pumpsets and Power Consumption

States	Electric Pumpsets ('000 numbers)						Power Consumption (ml. kwh.)					
	1970-71*	% share in Total	1980-81	% share in Total	1992-93	% share in Total	1970-71	% share in Total	1980-81	% share in Total	1992-93	% share in Total
Andhra Pradesh	123	11.29	472	10.89	1398	14.19	408	9.13	977	6.74	8095	12.78
Bihar	50	4.59	160	3.69	261	2.65	69	1.54	435	3	1549	2.45
Gujarat	42	3.86	231	5.33	415	5.21	405	9.06	1334	9.21	7804	12.32
Haryana	45	4.13	218	5.03	397	4.03	299	6.69	954	6.58	4063	6.42
Karnataka	92	8.45	311	7.18	869	8.82	180	4.03	393	2.71	5374	8.49
Kerala	14	1.29	90	2.08	265	2.69	41	0.92	80	0.55	235	0.37
Madhya Pradesh	25	2.3	315	7.27	1004	10.19	65	1.45	345	2.38	3750	5.92
Maharashtra	125	11.48	658	15.18	1761	17.87	357	7.99	1724	11.9	8068	12.74
Orissa	1	0.09	17	0.39	61	0.62	11	0.25	59	0.41	280	0.44
Punjab	59	5.42	291	6.71	639	6.49	464	10.38	1850	12.77	6144	9.7
Rajasthan	18	1.65	205	4.73	439	4.46	113	2.53	1009	6.96	3097	4.9
Tamil Nadu	410	37.65	912	21.04	1403	14.24	1275	28.52	2367	16.35	5226	8.25
Uttar Pradesh	76	6.98	399	9.21	695	7.05	721	16.13	2792	19.27	8536	13.48
West Bengal	1	0.09	29	0.66	95	0.96	21	0.47	72	0.5	738	1.17
All India	1089	—	4334	—	9852	—	4470	—	14489	—	63328	—

Source : Centre for Monitoring Indian Economy (CMIE), 1994 and India's Agricultural Sector, CMIE, 1996
Note :Figures are for the year 1968-69.

the period 1970-71 to 1992-93, the state of Tamil Nadu showed a sharp decline in the same period. It may also be noted that the share of agriculture in total power consumption has also increased from 16 per cent during 1989-90 to 29 per cent during 1992-93. Across states the share of agriculture in total power consumption is far higher for Haryana (50 per cent), Punjab (44 per cent), Andhra Pradesh and Karnataka (both 42 per cent) and Gujarat and Uttar Pradesh (both 39 per cent) as compared to other states. In order to examine the changing intensity with which electricity was consumed for irrigation we have estimated the per hectare consumption of electricity, statewise, for the periods 1970-71, 1980-81 and 1992-93. For this purpose we have considered the total electricity consumption in each period in each state and divided the same by the corresponding area under irrigation from groundwater sources (adjusted) to get consumption of electricity per hectare of irrigated area. The results of the estimates are presented in Table 40. The results indicative in nature and the trends in the consumption are more significant for our argument than estimated magnititude. Area irrigated from groundwater sources are not available separately for area irrigated by electric motors alone will over-estimate the irrigated area by this device and to that extent underestimate the electricity consumption per hectare. To overcome this difficulty we have firstly adjusted the groundwater irrigated area estimates (readily available statewise) with the statewise proportion of electric motors to total water lifting devices (electric motor + diesel engine). The statewise power consumption estimates in agriculture are then divided by the corresponding adjusted groundwater irrigated area to arrive at electricity consumption per hectare of irrigated area by electric motors.[13]

The estimates show that at the All India level electricity consumption per hectare is estimated to have increased from 628 kwh in 1970-71 to 1317 kwh in 1980-81 and to 3703 kwh in 1992-93; almost 6 times increase in consumption per hectare over a period of two decades (Table 40). At the state level Gujarat showed highest consumption per hectare in 1992-93, an increase from around 2500 to around 10,000 kwh/hectare between early seventies and early

13. The assumption underlying such a procedure is that the proportion of area Irrigated by electric motors to total area irrigated from groundwater sources is the same as proportion of electric motors in total water lifting device. The other point to note is that reported groundwater irrigated area estimates are net irrigated area and not gross irrigated area, hence, to that extent the electricity consumption per hectare may be overestimates.

nineties. Other state which registered relatively higher and over time increasing electricity consumption per hectare were Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu in that order. All these states showed six to ten fold increase in power consumption per hectare over the last two decades or thereabout.

Table 40 : Area Irrigated by Electric Pumps and Electricity Consumption, Statewise

States	Area Irrigated (Million Hectares)			Electricity Consumption (Million kwh)			Average Electricity Consumption per Hectare (kwh)		
	1970-71	1980-81	1992-93(a)	1970-71	1980-81	1992-93	1970-71	1980-81	1992-93
Andhra Pradesh	0.389	0.597	1.187	408	977	8095	1049	1637	6820
Bihar	0.353	0.553	1.461	69	435	1549	195	787	1060
Gujarat	0.157	0.462	0.742	405	1334	7804	2580	2887	10518
Haryana	0.539*	0.737	0.953	299	954	4063	555	1294	4263
Karnataka	0.194	0.316	0.730	180	393	5374	928	1244	7362
Kerala	N.A	N.A	0.057	41	80	235	—	—	4123
Madhya Pradesh	0.281	0.771	1.928	65	345	3750	231	447	1945
Maharashtra	0.406	0.829**	0.999	357	1724	8068	879	2079	8076
Orissa	0.008	0.135	0.174	11	59	280	1375	437	1609
Punjab	1.067	1.019	1.494	464	1850	6144	435	1816	4112
Rajasthan	0.542	1.472	2.038	113	1009	3097	208	685	1520
Tamil Nadu	0.665	0.949	1.014	1275	2367	5226	1917	2494	5154
Uttar Pradesh	1.904	1.882	2.166***	721	2792	8536	379	1484	3941
West Bengal	N.A	N.A.	0.237****	21	72	738	—	—	3114
All India	7.116	10.999	17.103	4470	14489	63328	628	1317	3703

Note : (a) : Estimates relates to the year 1991-92
* : Estimates relates to the year 1969-70
** : Estimates relates to the year 1978-79
*** : Estimates relates to the year 1990-91
**** : Estimates relates to the year 1985-86

The above account clearly shows that electricity consumption has increased phenomenally over the last two decades, specially in the last one decade. Not only total consumption has gone up due to increase in the number of electrically energised wells and tube wells, but also due to increase in the gradually increasing depth of wells

from where water is lifted for irrigation and partly due to increasing in-efficiency with which the electric pumps are maintained and operated by the users. Inefficiency in the maintenance and operation of electric pumps by the users which is largely responsible for increasing consumption of electricity per hectare of land irrigated seems to have close link with low or no tariff for electricity. There is no compelling reason for the user to improve the efficiency of the pumps by proper maintenance and operation because the low or marginal electricity tariff does not unduly inflate the electricity charges to the user. This naturally takes us to the highly controversial and much debated issue of pricing electricity.

It is argued that electricity tariffs charged by the State Electricity Boards (SEBs) to its agricultural consumers are abysmally low in the face of mounting generation and distribution charges leading to adverse effect on the health of the SEBs. The huge losses that are being incurred by the SEBs are unsustainable. The losses of SEBs have increased because of inflation, low levels of operational efficiency, high transmission and distribution losses and low levels of tariff being charged from different consumers. Among all these factors that have contributed to the financial mess of the SEBs, it is argued that the major one among these is the supply of electricity to the agricultural sector. This is mainly because of the two reasons; firstly the higher cost of rural electrification (owing to very high losses) and secondly low tariff charged to the users in the agricultural sector (Sharma, 1994). We present below the statewise electricity tariff in agriculture made effective from early nineties with a view to assess the strength in the above argument. It is noted from the table 41 that agricultural users are provided free electricity in Tamil Nadu and Karnataka effective from 1st March 1993 and 1st August 1993 respectively and that in Andhra Pradesh and Maharashtra electricity tariffs are as low as 10 paise and 15 paise respectively. As noted earlier, these are also the states where total consumption as well as hectare consumption of electricity are high.

Table 41 : Average Electricity Tariff Charged by the State Electricity Boards (SEBs) for agriculture

SEBs	Effective date	Paise/kwh
Andhra Pradesh	1 December 1992	10.45
Assam	1 January 1993	76.00
Bihar	1 July 1993	60.00
Goa	1 November 1991	84.00
Gujarat	21 May 1993	39.61
Haryana	5 June 1992	42.00
Himachal Pradesh	1 August 1992	33.00
Karnataka	1 August 1993	0.11
Kerala	1 June 1993	29.33
Madhya Pradesh	1 October 1992	29.08
Maharashtra	1 February 1993	15.00
Meghalaya	1 June 1992	50.00
Orissa	1 April 1992	34.00
Punjab	23 October 1993	24.42
Rajasthan	1 September 1992	36.55
Tamil Nadu	1 March 1993	0.00
Uttar Pradesh	18 January 1992	35.68
West Bengal	20 September 1993	20.55

Source : CMIE, Basic Statistics, States, September, 1994

Except in Assam, Bihar, Goa and Meghalaya, where incidentally electricity consumption are reported to be relatively lower, in no other state the electricity tariff is more than 40 paise per kwh. In most states the same is seen to vary between 20 paise and 35 paise per kwh. Such a low tariff structure is unable to cover even 50 per cent of the generation and distribution costs of electricity in the case of most of the states. In a study carried out to estimate the subsidy on electricity that flows to minor irrigation it was found that subsidy on electricity in the country increased from Rs. 754.59 million to Rs. 20.89 billion; more than 27 times between TE 1976-77 and TE 1989-90. The per annum growth in electricity subsidy to minor irrigation amounted to 28.81 per cent at current prices and at 12.78 per cent at constant prices. Amongst the different regions of the country, it was the western region comprising Gujarat, Maharashtra, Madhya Pradesh and Rajasthan which exhibited an alarmingly high rate of growth of 80.57 times between two triennia in electricity subsidy to minor irrigation (Sharma, op.cot., 1994). Another study carried out on subsidy goes on power tariff for irrigation in Maharashtra finds that bulk of the benefits of subsidy to large life irrigation co-operatives which constitutes only a small proportion of the life irrigators and area irrigated (Sant, Dixt, 1996).

It is clearly from the above account that there is substance in the argument that very low power tariff in agriculture is contributing to the worsening of the already deteriorated financial conditions of the SEBs. There is urgent need for enhancing the power tariff in agriculture so as to improve the financial health of the SEBs so that the Boards can take up the challenge of meeting the increasing demand of electricity from the agricultural sector. The poor health of the SEBs has been the main deterrent to private investment in power sector as private power companies are allowed to sell power only to SEBs.

After two recent conferences of Chief Ministers, the states have agreed to bring electricity tariff for agricultural sector to 50 paise per unit, according to the "common minimum national action plan for power" announced by the Union Government (Times of India, December 31, 1996). The action plan adopted says states will bring the tariff for the farm sector to 50 per cent of the average cost of generation, transmission and distribution in not more than three years. According to the action plan, the Union Government will set up a Central Electricity Regulatory Commission (CERC) and each State Union Territory will set up a State Electricity Regulatory Commission (SERC). In fixing retail tariff, however, pay less than 50 per cent of the average cost of supply. Recommendations of the SERC will be mandatory. It any deviations from tariffs recommended by the SERC are made by a State/Union government, it will have to provide for the financial implications of such deviations explicitly in the state budget. It may be noted that although at a conference in 1993, State Power Ministers had agreed on a minimum farm tariff of 50 paise per unit, most of the state governments failed to implement the policy. It is hoped that this time the states will strictly adhere to the recommendation of the SERC as agreed upon in the recent conference.

SECTION V

Financing of Operation and Maintenance and Pricing of Water

We have noted in the earlier section that paucity of funds owing mainly to low levels of water rates and poor recovery performance is the main cause of said neglect of operation and maintenance of the existing major and medium surface irrigation systems. This has led to deterioration in the physical conditions and technical capabilities of such systems and the consequent low efficiency with which the systems perform undermine the effectiveness of massive investments that have gone into creating such net work of irrigation systems over last several decades. The new investment has become more expensive in terms of increase in capital costs per hectare and such investments create further scarcity of funds being made available for proper operation and maintenance of the existing systems. Notwithstanding investments in new irrigation greater attention has to be paid to the rehabilitation and proper operation and maintenance of the existing systems such that further rehabilitation expenditure could be avoided. In this circumstances internal generation of financial resources for O&M of completed projects have become essential such that operational performance of such projects could be assured.

Similarly, in the case of state operated minor irrigation too the internal generation of financial resources to provide for the cost of services provided to the users is abysmally low which results in heavy financial burden on the exchequer. A uniform policy is to be evolved for yearly increase in O&M charges so as to ensure proper maintenance of irrigation works. Improper maintenance of minor irrigation works has resulted not only in loss of irrigation but also loss of work itself over a period of time. Minor irrigation schemes, theefore, should always be financially viable and users are expected to meet at leat O&M costs and a reasonable proportion of capital cost. It is against the above background that we discuss in this section the financing of O&M and pricing of water for irrigation, first with respect to major and medium sufrace irrigation systems and then with respect to minor irrigation works.

5.1 Financing of O&M Expenditure Under Major-Medium Irrigation Systems

Irrigation systems are constructed, operated and maintained by

the State Governments. Irrigation departments or civil works departments which are public agencies and are branches of State Government maintain and operate the systems keeping with the rules and guidelines provided for the same. It is argued that the ability of such public agencies to operate and maintain irrigation systems efficiently is presently constrained by a number of factors - poor physical condition of the systems, a general absence of staff and institutional incentives related to system performance, poor linkage with users, inadequate financial resources and appropriate allocation of resources among cost line and cost centres (Svendsen, Gulati, op. cit., 1995).

As noted in the earlier section, states have followed varied practices over the years to allocate funds for O&M purposes, but generally the practice has been to allocate funds for O&M purpose on the basis of the area irrigated (net, gross or culturable command area). It is also agreed on principal that the cost of irrigation services should fall principally on the direct beneficiaries who are easily identifiable. It is in keeping with this principle that various commissions and committees have recommended from time to time that irrigation charges (tariff) levied on the user should not only cover O&M expenditure, but also a part of the capital cost. However, it is argued that the present practice of allocating funds for O&M expenditure and levying water changes (tariff) has very tenuous link with the quality of irrigation services provided to the user in general and with the user participation in particular. All that is sought to be achieved through such a practice is to generate revenue to the state exchequer. Irrigation development budgets do not, in general, change with the changes in irrigation receipts.

Under the existing system in India, however, the financing mechanism is not tied to irrigation financing. The revenues from irrigation service fees become part of the general government revenues which cannot be used to provide funds to operate and maintain irrigation facilities. In the light of selected priorities money is then allocated for public purposes each year. There is a distinction between irrigation financing and cost recovery. Direct cost recovery, based on area irrigated and type of crops, as is in practice in India, flow into general government revenues regardless of whether or not these funds are used to pay for the cost of providing the irrigation services. Irrigation financing, on the other hand, is the generation of funds that are specially used to pay for the costs of providing irrigation services. It is important to clealry understand this distinction

between irrigation financing and irrigation cost recovery because the mechanisms which increase the government's cost recovery from irrigation but which are not used to finance the costs of irrigation do nothing to improve the ability of the irrigation agency to operate and maintain the irrigation facilities in satisfactory manner (Small, Carruthers, 1991). Hence, the implementation of the recommendations of various committees and commissions from time to time, for increase in the water rates and/or increase in the O&M outlay per hectare may not necessarily lead to improve in the quality of services to the users. This is mainly because of lack of linkages between the operating agencies (irrigation departments and their clients farmer-irrigators). Such a situation inevitably gives rise to lack of accountability on the part of operating agencies. If a high quality irrigation service is to be provided the operating agency has to be made accountable for expenditure incurred on O&M and the irrigation charges levied and realised and the commensurate services provided to the users. This would also help establish the required linkages between the operating agencies and the user and would generally encourage users' participation in operation and maintenance of the systems. The operating agencies (irrigation departments) are to provide the service of supplying irrigation water in quantity and quality desired by the user and therefore will have the obligation to maintain and operate the systems efficiently with the help of financial resources generated through irrigation fees (tariff) levied to the user. The user, on the other hand, will have the obligation to pay for the operation and maintenance of the systems if they wished to be provided with the quality service. A great deal of autonomy, both financial and functional, for the operating agencies (irrigation department) is required if this system has to succeed. Some researchers argue for complete financial automomy of the irrigation agencies, more in the nature of autonomous corporation, i.e., irrigation agencies operating budgets and the agency's staff levels, perquisites and bonuses mut be a direct function of receipts generated by the agency's operations (Svendsen, Gulati, op. cit., 1995).

While full autonomy of the irrigation agencies in the nature of autonomous corporations or regulated public utilities, as suggested, may not be possible in the near future on acount of the bureaucratic structure of the existing irrigation departments of the State Governments, a great deal of financial and functional autonomy can be accorded to the 'Irrigation Division' under the command of senior executives like Executive Engineers. Except for the salary, etc., of

the Executive Engineer, the entire operating budgets of such irrigation agencies incorporating staff levels, prequisites, incentive, bonuses could be made a direct function of receipts generated by the agency's operation as suggested by the study quoted earlier. It is argued that such financial automomy will create enough incentives for the irrigation agencies to cut down the cost of O&M and also to increase revenue through collection of water charges.

This method of financing irrigation is a direct method requiring specified beneficiaries to make payments linked to the use of irrigation services. Somethimes, however, the public irrigation service is considered to be free, when, as a matters of fact somebody somewhere is paying because the resources consumed in irrigation development and operation are scarce and have alternative uses. Making budget allocations to the irrigation agencies from the government funds (treasury) generated from a variety of types of taxes is an indirect method of financing irrigation. As noted earlier, in the case of states in India, although cost recovery is direct, irrigation financing is not direct, but of indirect nature, which as argued earlier, brings about lack of accountability and users participation. There are also several indirect methods of cost recovery from irrigation, e.g., benefit tax, betterment levies, etc. There can also be various combinations of direct and indirect methods of irrigation financing and cost recovery that can be followed by a country.

The method of financing and cost recovery a country will follow depend upon the objectives that have to be achieved. If the objective to be followed in the already existing irrigation projects is cost effectiveness of operation and maintenance and recovery of such costs, to begin with, then direct financing policies in conjunction with financial autonomy are best suited for the purpose. As mentioned earlier such a policy will improve O&M through incentive to the operating agencies to collect fees from the user as the budget available for O&M will be affected by the amount collected from the water user and also through increased accountability of the operating agencies to the users. Finally, financial autonomy may create incentive for increased involvement of the water users in O&M. Once these policies of direct finarncing and cost recoveries are followed with financial and functional accountability and partcipation in the subsequent stages, gradually the opeating agencies can undertake the responsibility for the recovery of some portion of the investment costs from the users. This takes us finally to the issue of pricing of water.

5.2 Pricing of Water

We have so far discussed about the financing of irrigation and cost recovery which though indirectly bring in the issue of water rates or tariffs, etc., do not explicitly deal with the theory and practices of pricing of irrigation water taking into consideration both the efficiency and equity aspects of irrigation. To appreciate the need for a proper policy for pricing of irrigation water it is necessary to take into account the government policy in this regard in the distant and recent past.

In the days of colonial rule, the irrigation systems were originally looked upon as commercial ventures. Only schemes that could pay for the annual expenses for operation and maintenance and meet interest charges on the investments for irrigation construction were undertaken. Area was used as the main criteria for water rate fixation. However, the area based rates were differentiated further by factors like crop and season-specified variations in water requirements. Assessment and collection of these rates were strictly followed. A number of schemes fulfilled these criteria and made net profit. Later, in 1880, a new category of unproductive irrigation projects was introduced as a famine relief measure and in subsequent years a number of such protective schemes were undertaken. Gradually after the independence the irrigation projects were begun to be viewed as instrument of development, specially for augmenting food production, employment and income. Since independence owing to abandonment of the commercial approach, the financial returns from the irrigation systems has been dwindling. These works, as has been mentioned earlier, have been showing increasing losses and imposing a growing burden on the general revenue of the state. However, in view of the assumed impact on overall agricultural development and food self-sufficiency and security in particular, the direct financial return criterion of project selection on irrigation investment gave way to social benefit costs (B.C) ratio in early sixties, as recommended by the Gadgil Committee. As per committee's recommendation as the minimum B-C ratio used for selection of irrigation projects were low, being 1 for the projects in drought prone areas and 1.5 for projects elsewhere, the applicable water rates were also kept at a lower level. The water rates continued to be based on area irrigated rather than on the volume of water use and there has not been any change or modification in that in the four decades of independence. The main criteria for determining the water rates have

been (i) farmers capacity to pay (determined by total output), (ii) volume of water used (determined by area irrigated), (iii) quality of irrigation services (determined by dependability) and (iv) recovery of at least O&M cost (Government of India, 1972). The position was, however, reviewed by the Second Irrigation Commission 1972. The Commission was conscious of deteriorating financial position of the irrigation works and opined that the financial return of the project should also be carefully examined at the time of considering a project for acceptance. The Commission observed that if the return did not cover working expenses and interest charge on capital, the need for revision of water rates in the states should be examined. The Commission further observed that since the benefits from irrigation projects were less evenly distributed and the main beneficiaries were only a section of the cultivators in the command area, the irrigation works as a whole should give an annual income at least equal to their annual cost of operation and that no part of the burden for providing irrigation should fall on the general tax payers (GOI, 1989).

The procedures for B-C ratio analysis of irrigation projects were reviewed in 1983 by a committee constituted by the Planning Commission. This Committee recommended replacing the B-C ratio by the Internal Rate of Return (IRR) and suggested that projects should normally earn a minimum IRR of 9 per cent; a lower minimum of 7 per cent was prescribed for the drought prone and hilly areas. The National Conference of Irrigation and Water Resources Ministries in 1986, argued that water rates should be such as to provide signals to the beneficiaries regarding the precious value of scarce water supplies and wanted the rates to be increased gradually taking into consideration the rising cost of irrigation projects, in regard to both capital outlays and operation and maintenance costs. The National Water Policy adopted in 1987 also echoed the same view and argued for water rates that would cover the annual O&M costs and a part of the fixed cost while ensuring timely water supplies.

In view of the deteriorating financial position of the irrigation works and heavy financial burden on the state the Fifth Finance Commission recommended a return of 2.5 per cent of capital invested over the above the O&M costs. The Sixth and Seventh Finance Commissions diluted that to 1 per cent. When even this whittled down standard was not met, the Eighth Finance Commission exhorted a minimum effort from the State Government to ensure that

the receipts cover at least the cost of maintenance. The Ninth Finance Commission, while observing the worsened financial positions of irrigation works, recommended the same diluted norm of the Eighth Finance Commission. The Tenth Finance Commission has, however, recommended that the receipts from irrigation should not only cover O&M costs, but also give a return of 1 per cent per annum on capital. The Commission's recommendation is based on the observation that even though there has been substantial gain in agricultural productivity over the years in the irrigated tracts the receipts from irrigation are not only meagre, but that they constitute a negligible proportion of the value of produce per hectare of irrigated area.

Table 42 : Canal Water Rates for Irrigation in Major States

States	Range (Rs /ha)		Few Crop Specific Rates			Year Rates Revised Last
	Minimum	Maximum	Paddy	Wheat	Sugarcane	
Andhra Pradesh	99	222	222	—	370	1986
Bihar	30	158	89	—	158	1983
Gujarat	40	830	110	110	830	1981
Haryana	17	99	74	61	99	1975
Karnataka	37	556	99	—	556	1985
Maharashtra	65	1000	—	—	750	1989
Madhya Pradesh	15	297	59	76	—	1990
Orissa	6	185	40	—	—	1981
Punjab	14	81	49	29	—	1974
Rajasthan	20	143	—	74	—	1982
Tamil Nadu	6	65	49	—	62	1962
Uttar Pradesh	7	327	143	143	237	1983
West Bengal	74	593	125	—	-	1977

Source : Saleth, 1996

We give below the water rates for canal irrigation in different states as reported in a recent study (Saleth, 1996). Since water is a state subject in India, each state fixes its water rate. As a result, water rates vary widely both across and within the states. All major states charge for canal water wither directly or indirectly. The study reports that in Andra Pradesh, Karnataka and Tamil Nadu there is no separate water charge but only a higher assessment of land revenue for wet lands. While water rates in West Bengal vary only by season, those in Kerala are charged just in terms of gross area irrigated irrespective of both crops and seasons. In all other states, the water rates though are area based, are highly differentiated not only by crop and season but also by category of projects, irrigation

types, users, etc. (Saleth, op. cit., 1996). As can be noted from the table there is great deal of variation in water rates from state to state which is presumably due to irrigation services in terms of its dependability and continuity. Water rates are also different for lift and flow irrigation. While in some states like Gujarat, Haryana, Punjab and Uttar Pradesh the rates for private lifts are only 33 to 50 per cent of area based flow rates, in Maharashtra, on the other hand, the rates for lift irrigation water are substantially higher than the flow rates (Sangal, 1991).

Although the rates are to be revised from time to time, it is seen from Table 42 that in Tamil Nadu since 1962 the water rates have not been revised. Similarly, in Punjab, Haryana and West Bengal, the rates were last revised in 1974, 1975 and 1977 respectively. In all the other states except Maharashtra the water rates were revised last in early to mid eighties. Only in the state Maharashtra the water rates were revised in 1989. Thus, not only the water rates are low (Tamil Nadu being lowest), but the same also remain unrevised for more than a decade in most states.

In view of the deteriorating financial position of the irrigation works and increasing financial burden on the State exchequer on the one hand and low and unrevised water rates prevailing in different states on the other, specially the ones which are the heartland of paddy and wheat revolution in India bringing about substantial productivity gains, the issue of appropriate pricing of water for irrigation becomes very pertinent. It is against this background that the Government of India, as mentioned earlier, appointed a Committee under the Chairmanship of A. Vaidyanathan to examine the issue of pricing of water and give its recommendation in this regard.

The need for guidelines for establishing water charges arises because of periodic disaggreements over what share of irrigation project costs should be recovered from beneficiaries and what forms of recovery are acceptable. Government of India's policy in this regard has been remarkably consistent over the last two decades that the water charges ought to recover (i) current O&M costs and (ii) at least a partial recovery of investments. There are three basic approaches to setting charges. Rates can be related to the cost of providing irrigation, to the benefits to be derived from irrigation or to some value judgement on the beneficiaries' ability to pay rates. If a cost approach is used, rates can be set to recover capital and re-

current costs or some proportion of them. If the benefit approach is used, it is advisable to rate a proportion of the incremental benefits from irrigation (using with and without approach). If the creterion is ability to pay, then income data will have to be analysed to indicate the income of the small farmers (Carruthers and Clark, 1983). Considering all these aspects the whole issue boils down to the question of what is the 'right price' for water.

5.3 Theoretical Arguments of Pricing of Water

Economists normally address the question of 'right price' for water mainly from the efficiency point of view and conclude that as long as excess capacity exists, the price of irrigation water should equal the marginal cost of providing it, but whenever a capacity constraint exists the price should be allowed to rise above marginal cost to the point where quantity demanded just equals available supply (Small and Carruthers, 1991). This is nothing but marginal cost pricing, i.e., setting the price of a product equal to incremental cost associated with incremental production. Economic theory clearly states that in a situation (irrigation project) where marginal cost is continuously falling with the size of the unitl it will remain below the average cost throughout and any price fixed on the basis of marginal cost under such condition will not cover the full average cost and will thus necessitate subsidisation. This may turn out to be the case with resepct to cost incurred in distribution network of irrigation projects. Financing these subsidies by the state will bring about inefficiency in the economy which, it is argued, may not be overcome by meeting the subsidies through income tax owing to likely distortion in allocation of time by the tax payers. Under the circumstances, average cost pricing with no subsidy appear to a better alternative to marginal cost pricing. It is, however, argued that a marginal cost pricing incorporating two part tariff, one based on marginal cost and the other a lumpsum charge levied would not only avoid distortions regarding the use of the product, but would also eliminate the need for subsidy. In any case marginal cost pricing may not increase the economic efficiency of allocation of irrigation water if other prices in the private/public sector of the economy are not set at the marginal cost of production (the problem of second best solution).

Marginal cost pricing has other practical problems too, apart from the theoretical considerations. Firstly, it will change with the nature of the irrigation decision with which the irrigation agencies are con-

cerned. Secondly, marginal cost of irrigation water generally varies over both space and time which will result into different prices being charged at different area and at different times. For instance, seasonal differences in the availability of water may create differences in marginal costs, the marginal cost to society to delivering one unit of water to the farmers at the tail end may be higher than the same to the farmer nearer the source of water supply. Price based on marginal cost, under these circumstances, would necessiate charging varying prices within a single irrigation system and also over time. This would violate the requirement of equating marginal benefits to all users, and since other things are not equal such spatial and temporal price differentials would lead to economic inefficiency (Small and Carruthers, op. cit., 1991). Thirdly, marginal cost pricing will require volumetric measure of water delivered to the farmers. Presently, we do not have any measuring device (meter, etc.) at the tertiary level of distribution and neither do we see any possibility of introducing such measures even in distant future. In view of the above it is argued that a system of uniform prices (postage stamp) may often turn out to be satisfactory.

Notwithstanding the arguments against functional difficulties of marginal cost pricing the fact remains that the existing water rates are abysmally low and need to be enhanced with immediate effect so as to improve the financial health of the State Irrigation Departments, and also to reduce and finally eliminate the burgeoning burden of irrigation subsidies on the government.

There is also a very strong case for enhancing the water rates in view of the large productivity gains in the irrigated tracks over the last two decades or thereabout. Table 43 gives the yield of major foodgrains crops under irrigated and unirrigated conditions.

Table 43 : Crop Yields Under Irrigated Areas of HYVs and Under Unirrigated Areas (Kg./hectares) 1990-91 : All India

Crop	Irrigated Area (Overall average)	HYV Area	Unirrigated Area
Rice	1972	2192	1046
Jowar	1316	1208	384
Bajra	1236	907	425
Wheat	2177	1967	1133
Maize	1980	2313	1565

Source : CMIE, India's Agricultural Sector, July 1996

Irrigated yields are seen to be almost double the unirrigated yields under the major cereal crops. Similarly, the yields of major cereal crops under HYV are also seen to be nearly double the unirrigated crops. Besides, the compounded annual rates of growth of foodgrains, non-foodgrains and all crops for all India during the triennium ended 1980-81 to 1994-95 are estimated to be 3.3 per cent, 2.7 per cent and 3.1 per cent respectively (CMIE, 1996). These estimates are for overall area; for irrigated area the same are likely to be much higher. All these go to suggest that there has been substantial productivity gains in the irrigated areas during the last decade and half and that there is no conceivable reason why the water charges which are abysmally low and remained unrevised over a long period, should not be enhanced to do away with the large subsidies involved in providing these services to the users. Presently, the receipt from irrigation projects are not only meagre, but they constitue a negligible proportion of the value of produce per hectare of irrigated area. The Vaidyanathan Committee has referred to an assessment that indicates that the gross receipts per hectare for major and medium irrigation projects are less than 3 per cent of the value of production. Obviously, the states have not succeeded in capturing the gains from higher productivity in terms of better irrigation receipts. In fact the Irrigation Commission of 1972 had suggested way back that in order to meet rising cost of O&M water rates should be revised every five years and should lie within the range of 5 to 12 per cent of the gross revenue of farmers in the canal command area, depending on whether the farmer is producing foodgrain or cash crop.

Similarly, the procurement prices for major agricultural crops have periodically been increased, often disproportionately to the rise in input cost. Table 44 gives the procurement prices of major crops.

Table 44 : Procurement/Support Prices of Major Agricultural Crops (Rs. per quintals)

Crops	1984 85	1990-91	1995-96	Carg (%) 1985-86
Wheat	157	225	380	8 4
Paddy (Common)	137	205	360	9 2
Coarse grains	130	180	300	7 9
Gram	260	450	700	10 4
Arhar	275	480	800	10 2
Rapeseed & Mustard	360	600	860	8 2
Groundnut (Pods)	340	580	900	9 3
Cotton (Kapas H4)-	535	750	1350	8 8
Sugarcane	14	23	42	10 6

Source : CMIE, India's Agricultural Sector, July 1996.

For all the major crops the procurement/support prices have increased at compounded annual rate varying between 8 and 11 per cent. The rising procurement/support prices coupled with productivity gains must have improved the agricultural income considerably in the irrigated regions during the last decade and a half. It is only justified that irrigators pay for the services of the input which helped them to realise productivity gains. Rough estimate indicates that raising the price of water to the extent needed just to cover the O&M expenses and about 1 per cent of the capital cost works out to only 6 per cent of the gross value of output per irrigated hectares (GOI, 1992).

5.4 The Basis of charging Water Rates

The physical, technical and institutional structures of the existing irrigation network of the major-medium sufrace irrigation systems rule out the possibility of introducing volumetric supply of water to the individual farmers. Due to several technical, administrative and financial reasons it is also not expected that volumetric supply of water to individual farmers will be introduced into the surface irrigation systems in India in near or distance future. It is, however, possible to introduce volumetric supply of water at the minor/watercourse head for groups of farmer in a continuous area. We shall discuss this proposition in detail in the next section. Until such a transition takes place, we shall have to continue with area based tariff largely. However, while fixing (enhanced) area based tariff, cropwise and seasonwise, productivity gains that has accrued in irrigated areas and the necessity of assured water supply will have to be taken into consideration. Area based tariff though is considered easy to operate, in reality it turns out to be rather complicated owing to differentiation in the rate structure arising out of many complex factors. Such a system also gives scope for arbitrariness in assessment and collection. Besides, such a rate structure based on area does not seem to have any relationship with either water productivity or supply cost or with scarcity value. It is further argued that incentive aspect of water rate structure based on area is as serious as its financial aspect. Existing rate structures give wrong signals to the users and promote no incentive for the users to economise on use of water so as to bring about water use efficiency and conservation of canal water (Saleth, op. cit., 1996). Instead of maximising value of output per unit of water, which is most scarce, the irrigators tend to maximise value of output per unit of irrigated land. Such a practice not only leads to underutilisation of irrigation potential through dis-

torted cropping pattern, but also to uneven distribution of irrigation water across canal command and beneficiaries, specially in the water scarce regions in the country. It has been argued in a study that the policy of using water for crops giving the highest net social return per unit of water not only generates greater social income from given volume of water, it ensures a more equitable distribution of this greater social income through more extensive irrigation involving larger body of farmers, and finally, by providing irrigation to larger cultivated areas, growing seasonal crops, it provides greater stability to agriculture of the region, specially water scarce, drought prone ones (Rath, Mitra, 1989). Such a change in attitude of the farmers will come only from realisation of the scarcity value of water. Volumetric basis for charging for irrigation water use instead of area based tariff is likely to bring about such a change. But, as mentioned earlier, since there are technical, organisational and adminstrative difficulties in introduing volumetric measures, ways and means of rationalising the area based tariff will have to be arrived at without any further delay. The effort, however, has to be in the direction of gradual shift to volumetric measure of water tariff for irrigation.

To begin with, in view of the severe resource constraints facing the government, cost recovery ought to be the main consideration governing rate determination to reduce the burden of subsidies of uncovered costs. But, as argued by the Vaidyanathan Committee, one must not assume that the entire subsidy accrues to users of irrigation. Part of it represents the cost of inefficiency in producing and distributing irrigation services on account of defective design, inordinate delays in completing projects, over extended distribution systems, wastes and other factors which inflate capital cost; and overmanning, relatively high administrative costs, avoidably high costs of repair works and other factors which raise operating costs, and/or affect the efficacy of assessment and collection of revenue. Since it is not possible to determine how much of the total implicit subsidy is attributable to inefficiency and how much really benefits farmers through under-pricing of water, attempts to reduce the magnitude of overall subsidies must therefore focus both on improving the efficiency of planning and management of irrigation (thereby cutting costs) and on increasing the collection of users charges by raising rates and the more effective enforcement of the scheduled rates (GOI, op.cit., 1992).

Falling short of introducing volumetric pricing in the immediate future, a two-part-tariff, as suggested by the Vaidyanathan Committee should be introduced. All land included in the command should pay a flat annual fee on a per hectare basis, more in the nature of 'membership' fee, which entitles them to claim water, regardless of water being actually used or not, and a variable fee linked to area irrigated by the farmers. Even though the costs naturally differ from project to project because of several factors, in order to avoid complexities uniform rates are to be charged in retion (state) differentiated only by season and crop.

It is argued by many researchers that beneficial impact of groundwater recharge in the canal command specifically owing to flow of water in the canal and distribution network ought to be taken into account by charging some fees to the well users. There are some regulations concerning the location and spacing of wells in canal command, but these are not strictly followed and the farmers take advantage of the seepage of surface water in canal command by sinking and energising wells for lifting water for irrigation. However, the Vaidynathan Committee has rightly argued that while on the one hand there is positive fall out of surface irrigation water which benefits the farmers in the command area, the command area as a whole also benefits from mitigation of water logging and soil salinity due to vertical drainage brought about by such pumping. On the whole therefore recycling seepage from surface sources should not be taxed (GOI, op. cit., 1992).

The other issue in fixing the basis for tariff for irrigation water is equity consideration. It is argued that hiking water charges will adversely affect the economic interest of the small and marginal farmers as such charges will be beyond their capacity to pay. While the point is well taken, it may also be argued that small and marginal farmers' interest are taken care of by separate agencies like Small Farmers Development Agency (SFDA) under which subsidised inputs and credit at concessional rates are provided to them and therefore there is no need for additionally providing each and every input to them at a subsidised rate, specially irrigation water which is the scarcest of all inputs.

5.5 Operationalisation of the Norms for Fixing Water Rates (Price of Water)

In keeping with the recommendations of the several past commissions and committees and those of the Vaidyanathan Committee and

the Tenth Finance Commission, the water charges must cover at least the entire O&M costs of irrigation and 1 per cent of the capital cost to begin with. This brings us to the question of translating the general principles regarding the pricing of water into specific rates. We have examined in the earlier section the O&M costs (working expenses) and the gross receipts from irrigation and have found that at all India level the gross receipts from irrigation covered on an average only around 50 per cent of the O&M cost. Therefore, to cover 100 per cent of the O&M costs water charges per hectare of irrigated area should be enhanced to double the existing rate. This is only by way of illustration of how to operationalise the norms. Following this principle for each state the uncovered O&M costs (working expenses) as a proportion of gross receipt from irrigation will have to be estimated and then water rates will have to be increased by that proportion over the existing rates. It should, however, be mentioned that the existing O&M costs are much lower than what has been recommended by various committees and commissions from time to time. The Vaidyanathan Committee has recommended O&M costs as Rs. 270 per hectare and the Tenth Finance Commission, after taking into consideration the price rise and other changes during the period 1990-95 has adopted a norm of Rs. 300 per hectare for the utilised potential and Rs. 100 per hectare of unutilised potential as O&M costs. For hill states the same norms are higher by 30 per cent. The actual O&M costs (working expenses) was estimated to be Rs. 113 per hectare on all India basis for the year 1984-85. The same varied between Rs. 20 per hectare (lowest) in Orissa to Rs. 300 per hectare (highest) in Maharashtra (Table 34). So while revising the water rates according to the principle mentioned earlier this norm has to be taken into consideration.

As per the Vaidyanathan Committee, 1 per cent interest on the capital outlay on major-medium projects at the end of 1986-87 worked out to around Rs. 70 per hectare. On this basis the total recoveries, to begin with works out to Rs. 370 per hectare (Rs. 300 per hectare of O&M outlay as suggested by the Tenth Finance Commission + Rs. 70 per hectare of capital outlay as estimated by the Vaidyanathan Committee). As against this, the estimated gross receipts from major-medium projects in 1989-90 was only Rs. 68 per hectare and considering only direct revenue out of the total, the actual irrigation revenue worked out to Rs. 50 per hectare. The non-irrigation users and other miscellaneous users were estimated to contribute Rs. 30 per hectare (GOI, op. cit., 1992). The recovery

from irrigation charges will then have to be around Rs. 340 (370-30) per hectare. As mentioned earlier, out of this Rs. 50 per hectare (a basic flat rate as requirement of the two-part-tariff) for all lands in the cultivable commands is to be levied, as suggested by the Vaidyanathan Committee. Even after this the recovery from irrigation charges appears to be much higher compared to irrigation revenue per hectare realised. However, the entire difference is not expected to be realised from enhanced variable water rates. As pointed out by the Vaidyanathan Committee major portion of the difference can be covered (i) improving assessment and collection, (ii) charging higher rates to high water using crops, like paddy, sugarcane, banana and other water intensive pernnial crops and also increased rates to two seasonals to hot weather crops. This practice is already in prevalance in some states like Maharashtra, Gujarat, Orissa. Indeed Maharashtra is the only the state which has revised water rates periodically (last revision being in the year 1989) besides charging differential rates to seasonal, two seasonals, perennials like sugarcane and banana and hot weather crops. However, even after taking these into consideration, upward revision of the water rates in most of the states will be necessary to meet the O&M cost and 1 per cent of the capital cost of irrigation. It has been estimated by the Vaidyanathan Committee that, on the average, the required revenue by way of irrigation charges will still be barely 6 per cent of the gross produce per hectare of the irrigated area, and that without taking any account of likely improvement in productivity. As against this, as mentioned, earlier Irrigation Commission of 1972 considered 5-12 per cent of gross produce as reasonable level of water charges to be recovered from farmers. It may, however, be pointed out that since the Tenth Finance Commission has provided for suitable increase in the norms of Rs. 300 per hectare for O&M (working expenses) each year of the forecast period (1995-96 to 1999-2000) to insulate these from inflation, it follows that the water rates need be revised upward gradually to keep pace with enhanced O&M costs (working expenses).

There is no reason to believe that the farmers will resist paying enhanced water charges for canal irrigation, which may work out to around 5 per cent of gross value of output of canal irrigated area; after all they are paying and are willing to pay much more for the use of ground-water for irrigation. The underlying reason is that there is much less conveyance and distribution loss in the case of ground-water and in addition it permits greater control of farmers over when

and how much water to supply which lead to higher produce per unit of water. Therefore improvement in the quality of services from major and medium irrigation systems is a pre-requisite for such a change. At present the management of canal systems are unable to commit about the quality of service provided and cost effectiveness of such services, sizeable segments of the command do not get any water at all or get much less water than needed by the crops; the supplies tend to be quite unviable in terms of quantum and time. In short, there is no accountability, neither on the part of operating agency (irrigation department) to be accountable for the service provided and charges levied on the users of irrigation water, not on the part of farmers on economising the use and conserving canal water. Mere enhancing the outlay under O&M costs as well as water rates will not automatically bring about improvement in the operation and maintenance of the surface irrigation systems, it will also require simultaneous changes in the organisational and institutional structures of the whole management and distribution systems. This takes us to the issue of reforms in the irrigation sectors which is the subject matter of the next section.

SECTION VI

Reforms in the Irrigation Sector

The earlier sections have dealt with issues relating to management and distribution of water in respect of major and medium surface irrigation systems in India and also the issues relating to cost of operation and maintenance of major, medium and minor irrigation systems and consequent pricing of irrigation water. The concern of this study is with that of poor performance of the existing irrigation systems, specially the major and medium surface irrigation ones. Improving the efficiency of the existing major and medium irrigation systems through effective and efficient operation and maintenance of the existing facilities would require among other things, to begin with, stepping up of outlays required for carrying out such activities. Paucity of resources owing mainly to absymally low water rates and poor recovery, has led to inadequate outlays to meet O&M costs of existing systems. It is, however, a moot point whether the irrigation services provided are adequate and dependable, and whether or not inefficiency and corruption in the irrigation sector enhance the cost of irrigation services to the users; and therefore should the users be asked to bear the burden of inefficiency of the irrigation bureaucracy. Notwithstanding the above observations the case for enhancing the water charges with a view to strengthen the financial positions of the irrigation sector thereby enabling it to run the systems effectively and efficiently is indeed strong.

It may, however, be noted that the improvement in financial position and consequent improvements in physical design and control structure do not necessarily ensure better management if the institutional arrangements and organisation structures governing the system are also not strengthened and made conducive to the requirements. This brings in the question of reforms in the irrigation sector which will bring about a change in the conventional operation and maintenance and financing of O&M costs of the systems. There are two aspects of such reforms. The first deals with the operating agency (Irrigation Department) and the other deals with the users (the irrigators). These two, however, not separate aspects of reforms but are very intimately intertwind in each other such that success under one is, as it were, a precondition of success under the other. These two aspects of reforms are (i) financial autonomy of the operating agency (Irrigation Department) and (ii) farmers participation in management.

6.1 Financial Autonomy

As argued in the earlier section financial autonomy of the operating agency (Irrigation Department) carries with it certain clear advantage for financing of the O&M. Not only it gives the operating agency greater access to resources, it also frees the agency from the uncertainties of funds being made available in adequate quantities and in time from the government's budgetary provisions. Such an autonomy provides the operating agency with full control and considerable influence over the nature and quality of irrigation services. Finally, financial autonomy tends to increase the participation and influence of the water users in the O&M proceeds (Small and Carruthers, 1991). This will automatically give rise to financial accountability.

This process can be initiated either projectwise or for a group of projects. In the initial stages, however, in the process of transition, there are bound to be problems both from the operating agencies side as well as from the users' side. For irrigation agency to maintain and operate the system efficiently and as per the demands of the situation and requirements of the users, the distribution system has to be technically sound in terms of design and physical structures. As mentioned in the earlier section, because of lack of funds for O&M operations, historically, most of the existing distribution systems under major and medium irrigation projects are not in condition to provide the services stipulated in the project reports. These are presently being run on much reduced efficiency leading to provision of poor quality of irrigation services, both in terms of quantity of water and its timelines. Under such a situation the irrigation agencies may not be able to charge the users adequately to raise funds for meeting the cost of efficient operation of management because the irrigators will find such water charges to be not commensurate with services provided and resist to pay. Besides, the irrigation agency may not be so successful in its efforts to assess and collect funds from the water users and it could find itself with fewer funds than might have been forthcoming from the government budget. The users may not be accustomed to paying for the irrigation services and as mentioned earlier, they may resist paying to the irrigation agencies if the quality of irrigation services has been poor.

In view of these, in the transition phase of initial years the irrigation agencies can not be expected to have complete financial au-

tonomy. It has to be kept in mind that during the transition phase of initial years the irrigation agency will require support from all directions in establishing financial autonomy, including financial support from the government.

Under the system of financial autonomy, the irrigation agency is accountable for its user of resources because of the direct link between the users fee (water charges) collected and irrigation services provided. These linkages will enable the users to have a say in determining how the agency's funds are to be utilised. The irrigation agency under such an autonomy will not only have incentive to increase revenue, but also to cut costs. The reward to the managers/ executors in the system will depend upon the performance and the agency will be free to decide upon the staffing pattern and its tenure.

6.2 Farmers' Participation[14]

The need for farmers participation in the irrigation management has been convincingly made in the earlier section to emphasise the necessity for major changes in the way irrigation systems are managed so as to make it more cost effective and rationalise irrigation pricing. The country must move over progressively from management wholly through the government bureaucracy to a management by user farmers (GOI, po. cit., 1992). Farmers' participation in system management is a prime pre-requisite for a smooth and successful transition to a more efficient system. Such a change in the system management will not only establish linkages between the users and the irrigation agencies, but will also bring about accountability on the part of the users.

This idea is not new. It has been raised earlier in several studies (Hashim Ali, 1980; Jayaraman, 1981; Uphoff 1986, APO 1991, Singh 1992 Mitra 1993, Lele and Patil 1994, Malony and Raju 1994 to cite a few). Farmers' participation in management was also one of the objectives set out in National Water policy of the government of India in 1987. Since such an institutional change is complex in nature and difficult to delineate and execute administratively, renewed discussion on the issues involved helps in conceptual clarity and in clarifying the measures to be taken for effecting such an institutional

14. The discussion in this section is largely based on an earlier study on Irrigation Sector Reforms carried out by the author (Mitra, 1996.)

change successfully. Experience of attempts to organise users' groups and/or users' participation in management in diverse situations and in different areas and a discussion on that enrich our knowledge for future endeavour in this direction.

The questions that now arise are what kind of organisational structures are to be planned and what methods are to be adopted to bring about such organisational changes. It is argued that since centralised agency (state management) finds it difficult to efficiently administer the distribution and uses of water at hundred of thousands of points across the entire canal command, a decentralised system by involving and ensuring the participation of the users in managing the distribution and use of water will go a long way in effecting necessary improvements in management of the distribution systems. The idea is to organise a large groups of farmers who will receive supply of water in bulk from the irrigation agencies (departments) to be distributed among the member farmers. This would firstly relieve the departmental functionaries of the responsibilities of managing the systems at different levels and the resulting time saved could be effectively utilised in managing the main system efficiently. Secondly, the collection of revenue from individual users would be the responsibility of the group, with the group paying for the bulk supply to the department.

The idea of such an institutional arrangement seems to be simple but it is likely to involve complex operational procedure in its establishment mainly because of involvement of human factor with diverse and heterogeneous interest groups among participants. Further, at what level the state managed operation and maintenance of the whole system ought to be handed over to the users, what should be the organisational structure of the users' group, what would be the nature of responsibility of each party and what should be the financial and non-financial arrangements for maintenance of the systems at users' level are some of the crucial questions that any reforms would be confronted with. In short, the main issue under such a contemplated institutional reform would be delineating hydraulic units which would not only be technically, socially and administratively manageable, but also economically viable.

The basic proposition is that, to begin with farmers' group, which may be called as Water Users Association (WUA) and which would be juridical entity, may be organised below the level of minor and/or

water course covering an area of around 500 to 1,000 hectares. Initiative to organise the farmers into WUAs will have to be taken by an outside agency because the chances of users themselves taking it up on a voluntary basis are remote at the present juncture. Such outside agencies could be NGOs, but the number of NGOs working in the rural areas, interacting with the farmers and having intimate knowledge of the socio-cultural milieu and the economic compulsions of the village community, is limited.

It may, therefore, be argued that since Command Area Development Authority (CADA) is already in the field for almost two decades and have established rapport with farmers associations (WUAs), as these are variously called (Mitra, 1992). In initiating the formation of such association advantage may be taken of the work experience of traditional as well as newly developed farmers' associations in different parts of the country. It is important the WUAs not only have representation and the right, legitimised in law, to voice opinions, suggestions and objections on all matters pertaining to their field operation before the state authorities from whom they receive water, but are also empowered for conflict resolution and allotment of field lot necessiated by land consolidation and land development in the field command. A two-tier or three-tier organisational structure may be visualised in which there would be sub-groups of users, say, below every outlet and which would not have the qualification of juridical person. These smaller organisations (sub-groups) would look after the operation and maintenance of the outlets and field channels, drains and other smaller facilities organised on the basis of what is known as 'Chak'. In other words, two kinds of organisations are visualised to be in existence, the WUA which is juridical person responsible for the operation and maintenance of the system from distributory/minor below, as the case may be, and the contracted co-operative which is not a juridical person and is, in fact, subordinate to the former, representing stratified organisational structure as in Japan.

Two main roles of the WUAs would be as follows : (i) to utilise to the utmost the quantities of water which state authorities make available to them, (ii) assume the responsibility for the distribution and utilisation of water in most eficient and equitable manner, (iii) to maintain properly the distribution net works under its control and prevent any possible waste and (iv) to collect water charges from members for payment to the irrigation department. Settlement of disputes

and conflict resolution will also fall in the lawful jurisdiction of the WUAs. Further, WUAs in consultation with CADA will work out the best possible schedule of water distribution under each outlet/watercourse. A close co-operation and co-ordination between WUAs and CADA on the one hand, and CADA and irrigation department on the other, will be a precondition for such an institutional change to be effective in bringing about improvement in the efficiency of the existing systems. This approach visualises joint management of the systems, irrigation department on the one hand, managing the storage and main canal network, and WUAs on the other, managing the tertiary systems which CADA working as catalyst and a liasion between the parties. The role of CADA in effecting such a reform is of curcial importance. The CADA is expected to initiate, help and cooperate and guide the WUAs in bringing about land development, consisting of land levelling, construction of field channels and drains, and also land consolidation through exchange of field lots which it has largely not been able to achieve so far as a part of its regular programme because of the 'top down' approach. The CADA in subsequent stages, is also expected to advise the WUAs about the suitable cropping pattern and other agronomic variables with a view to maximise the benefit out of the water supplied through the system (Mitra, 1992). In short, the approach is towards a comprehensive management of land and water resources in the canal command.

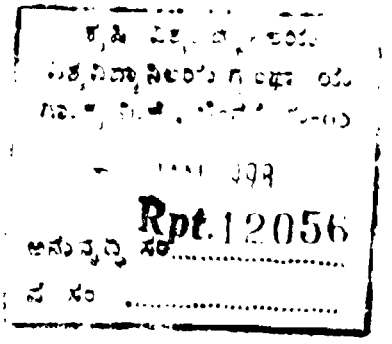
Such an institutional reform, as mentioned earlier, will not only attempt to mitigate the problems of underutilisation/misutilisation, inequity in irrigation, dependability and sustainability of the system and water logging, but will also seek to bring about improvement in financing O and M of the system. In fact, the overriding consideration for an institutional reform may be sought in pressing necessity for improved financing of operation and maintenance of the existing irrigation systems. After all, the systems can be better managed and efficiently operated only if these are not starved of funds. The reform sought in this respect is functional autonomy of sorts at various levels of operations, i.e., at the level of WUA and irrigation department respectively with a view to have greater control over the budget by these respective operative agencies. Necessary revenues will be forthcoming to the irrigation department from the collection of fees for bulk delivery of water to WUAs and the WUAs in turn will generate revenue through collection of fees from their members for the irrigation services provided. This facilitates creation of accountability

linkages between those who operate the irrigation facilities and the users. Because these linkages increase the likelihood of the needs and perspectives of the water users being taken into consideration by the irrigation department, the potential for improved irrigation performance is established (Small and Carruthers, op. cit., 1991). Besides, the irrigation department is assured of timely collection of water fees based on the volumetric supply to the WUAs and the WUAs in turn would timely collect fees from the users based on area irrigated, the sum of which would work out to be slightly higher than what is paid by the WUAs to the irrigation department. The difference is expected to meet a large chunk of O and M expenses of the tartiary system under the control of the WUAs. However, the WUAs need to be supported in the initial stages through subsidies or financial grants in order to meet administrative and establishment expenditure. In all probability such financial grants or subsidy will turn out to be less than saving effected by the government in handing over the O and M of tertiary systems to WUAs.

Many developing countries in the South East Asia and Far East have either introduced or are in the process of introducing institutional and financial reforms which makes the user pay a proper price for irrigation services and at the same time create potential for significant improvements in the quality of services provided. Community based system of irrigation management followed in Bali in Indonesia is one such system known as 'Subak' system. Subak is a micro level water board organisation of rice producers based on (a) the felt needs for continuous water supply and a just distribution of irrigation water, (b) strong group consciouness tackle specially water related problems and (c) religious belief. Management of the tertiary systems are financed by the users' fee and also from the contribution of labour by the members. In the Republic of Korea farmers' participatory management innovation have been successfully implemented in operating and maintaining new irrigation projects where fees are levied for services being rendered to the users. In Philippines, the National Irrigation Administration (NIA) is attempting to encourage farmers participation in management along with financial/functional autonomy that would result in higher effective rate of fee collection commensurate with services provided. In Japan the Land Improvement Districts (LIDs) through irrigation associations/water users' association at lower level manage, operate and maintain systems largely financed by the users' fees. The LIDs have their financial autonomy and the managers of the system work for the farmers. In Taiwan

the systems are essentially owned and managed by the users of water. The irrigation associations are financially autonomous and can hire and fire managers. The willingness of the farmers to pay depend upon how well the systems are operated.

These are some of the examples of either well established or on going cases of institutional and financial reforms in managing irrigation systems in the developed and developing countries of the east. Although no model is reliable and applicable in its entirety owing to diverse socio-cultural and economic factors operating in different countries and in different regions of the country of continental dimension like India, there may be certain key elements which are common to the dissimilar systems which may be made use of in evolving suitable organisational structure in different systems.



SECTION VII

Concluding Observations and Policy Issues

As irrigation development in India has progressed over the four decades, two problems have come up in the forefront. Firstly, the problem of paucity of resources which not only restricts taking up new projects, but also put severe restrictions specially on operation and maintenance of the existing surface irrigation systems and completing the on going unfinished projects. Secondly, the problem of overall poor performance, specially of the existing major and medium irrigation systems. It may be argued that the second problem is largely a fall out of the first, but that would be too simplisitic an explanation. Even though making available adequate investible resources and working expenses are essential requirements of the management of the systems created, increased resources devoted to operation and maintenance alone cannot bring about desired changes in the efficiency of the systems. Far-reaching fundamental reforms of the irrigation sector are required to achieve this end. This issues and approaches to such institutional reforms and consequent possibility of emergence of appropriate organisational structure would make it possible to establish linkages between finances and other institutional factors. Even though the issue is not posed as 'either-or' investment in new projects vis-a-vis existing ones, it is time that the policy makers give serious consideration to salvaging massive investment made in major and medium surface irrigation network through higher returns.

Minor irrigation still remains the major segment of our irrigated agriculture, accounting for around 60 per cent of the irrigation potential created so far. Within the minor irrigation sector, groundwater based irrigation dominates over the surface water based irrigation works with a share of three-fourths of the total irrigated area as per the available statistics. Minor surface irrigation works have not in general received much attention so far and it is in respect of such irrigation that watershed area planning has a major role to play. Such works can easily be dovetailed into the programmes of employment guarantee schemes and would involve reforestation of the catchment areas etc. Besides, construction of the small weirs, check bunds and other structures to control rain water would also form part of such minor surface works. Planned in consultation with user communities, such works can be both more economic and more effec-

tive. Gross receipts from minor irrigation schemes, soil conservation and area development schemes which are constitutent parts of surface works do not constitute even 10 per cent of the working expenses under these. Only through integrated planning for bringing together afforestration, soil conservation works and creation of water structures like percolation ponds, tanks that such expenditure can be made effective functionally and economically for the users to participate and pay for the services rendered.

The phenomenal growth of groundwater irrigation can be attributed to massive rural electrification programme, availability of institutional credit at concessional rate and the advent of green revolution. Although because of better control over water, the use of groundwater is found to be more efficient compared to surface water from major and medium works, there exists problems of over exploitation and inefficient and wasteful use of energy (electricity) for lifting water for irrigation. While the problems of overcrowding of wells and over exploitation resulting in rapid depletion in a number of aquifers dominate in hard-rock regions, underutilisation of groundwater is a serious problem in the eastern part of the indogangetic plain. Subsidies for irrigation water and power are both direct and indirect and are often disguised in budget allocations which inevitably give rise to losses running into hundreds of crores of rupees. Water rates for minor irrigation projects should be such that they are able to fully cover O & M charges along with some interest on capital outlay. Water rates could be reduced by reduced capital costs and by efficient execution and management (Sangal, 1991). Electricity pricing and availability for pumping are other areas of policy concern. Current flat rate/free pricing of electricity policies though politically popular, give rise to inefficiency in both water and electricity use. Unit pricing would provide incentives for efficient end use of these scarce inputs. Selling electricity in bulk to user-groups, co-operatives or private electricity retailers and having them collect fees from the end-users might increase the feasibility of changing unit rates (Moench, 1992). In any case the electricity price should cover the generation and distribution charges and to begin with, all the states should charge at least 50 paise per kwh of power consumption for irrigation.

In the case of major and medium surface irrigation systems, the dismal performance in operation and maintenance of most of the existing systems, owing mainly to the paucity of funds and low water rates, calls for a radical change in the age old and outdated prac-

tice of managing these systems. There is need not only for allocating more funds for the O&M costs and enhancing the water rates to restore the financial health of the public irrigation works which has deteriorated progressively at a rapid rate, but also for accountability through suitable changes in institutional set-up and organisational structure in the management and operation and maintenance of these systems.

Pricing of irrigation water is very ticklish and complex issue. There could be several arguments for rationalising on objective grounds the act of not enhancing the price of water in the face of rising costs. For instance, it could be argued that irrigation facilities are in the nature of infrastructure critical to achievement of target of foodgrains production, or that hike in price will act as deterrent to its judicious use or even that water charges are many of the taxes that the farmers pay and need have no relation to the cost incurred by the government in providing irrigation water, etc. (GOI, op. cit., 1992). Notwithstanding the merits in these arguments, the fact remains that irrigation water can not strictly be considered in the nature of 'public goods'. It is very mucy user-oriented and capital-intensive infrastructure for agriculture where users can be readily identified. The user must pay for the irrigation service which directly contributes to increase in production. Hence, the need for hike in water rates in the face of increasing cost to provide the services and productivity gains to the users.

However, simply increasing the outlay under O&M and hike in water rates will not bring about necessary change and improvement in the O&M of the systems. It is necessary to establish the accountability linkages between the operating agency and its farmer clients that are needed for sustained provision of high quality of irrigation service by a responsive co-operating agency.

The first aspect of the reforms in the irrigation sector has to be in terms of financial autonomy of the irrigation department operating and maintaining the systems. This is expected to improve the performance of the systems through incentives to both suppliers as well as the users. Incentives to the suppliers is the additional funds that could be generated, and to the users is in the nature of improved operation and maintenance of the systems that could be demanded in lieu of the fees paid for the services. Through the incentives a direct functional link between suppliers and users would develop

which would strengthen and improve the operation of the systems based on mutual dependence. The second aspect of the reforms is more comprehensive and is to be brought about through the user's participation in management so as to link irrigation financing with other institutional factors. It is argued that since the centralised agency, the state irrigation department finds it difficult to effectively administer the operation, maintenancne and distribution of water at hundreds of thousands of points across the entire canal command, a decentralised system involving and ensuring participation of users in management would go a long way in effecting necessary improvement in the management of the existing distribution systems. The accountability linkages between the users groups (WUAs) and the suppliers, the irrigation department, which ensures that the fees for irrigation services rendered are commensurate with the quality of services provided, is the essence of the reforms process. The WUAs being users' association, voluntarily accepting the responsibility of operating and maintaining the systems below, would also ensure farmers to be more efficient in their use of water. The Vaidyanathan Committee's recommendation on a two-part tariff and tariff based on volumetric use of water rather than area linked, can only be implemented if a gradual institutional reforms suggested above are also brought about creating an organisational structure in which WUAs would pay to the irrigation department for the bulk of supply of water on volumetric basis. It is not possible to measure the supply of water to each farmer as the process is complex and also the hardware and software for such procedure are neither available not are feasible to be introduced at the present juncture. So long as the shift from the area based tariff to volumetric price is not effected, the two-part tariff suggested by the Vaidyanathan Committee (GOI, op. cit., 1992) should be adopted with immediate effect.

One of the prerequisites of reforms in irrigation sector is systems modification. Unless suitable modifications in project design, and operational procedures along with improvement in the physical and technical structures of the existing distribution systems are undertaken, it is not possible immediately to bring about financial autonomy of the irrigation agency, initiate farmers participation in management and switch over to volumetric rates. The investment requirement for modifying the current canal distribution network to make it conducive for a volumetric assessment has been estimated to Rs. 5 billion (GOI, op. cit., 1992). The Vaidyanathan Committee has recommended that, at least, 10 per cent of the plan expenditure on major

and medium irrigation projects need to be devoted for the specific purpose of renovating and upgrading the existing systems to facilitate a smooth switch over to volumetric water allocation and rate fixation.

The irrigation sector reforms discussed here can not conveivably be brought about at one shot with immediate effect. It must be gradually introduced through stages without any further delay, for the time to act is overdue. To begin with, pending switch over to volumetric rates, the existing water rates should be enhanced and rationalised to reflect only area and season with a view to improve the financial health of the irrigation agencies. Simultaneously, renovating, upgrading and modernising the existing distribution systems should be taken with immediate effect. In the second stage steps to introduce financial autonomy of the irrigation agency (department) should be initiated. The irrigation agency should be made accountable to provide irrigation services to the users and collect appropriate and commensurate service charges (water rates) from the users with complete freedom to decide its course of action best suited to the situation. Simultaneously, the CADA's services should be utilised to initiate required steps towards organising WUAs which will take over the management and distribution of water below an outlet, a minor or a watercourse, as the case may be as a part of participatory management. A switch over to volumetric tariff for irrigation water would be the immediate next step, once the two way accountability is established.

Such a change in funding and financing of irrigation operation and maintenance and associated change in institutional set up and organisational structure will not be easy to introduce. It will require a great deal of co-ordination and a strong political will. Clearly, any shift away from the existing structure and practice involves a wide range of issues which would require a major policy debate. There is, however, no alternative to such a change if the huge investment made in creating the physical structure distribution network over the last four decades is to be salvaged by making the system that are created through such investment cost effective and efficient in rendering services. A beginning has to be made and sooner it is made better it would be for the State Irrigation Department, Electricity Board and the country as a whole. It is time that policy-makers at the Ministry of Water Resources, the Planning Commission and the Central Water Commission took a serious view of the deteriorating financial and functional (operational) conditions of the irrigation works

and shifted their priorities from expansion of irrigated area through new investment to improve the quality of irrigation of the existing systems. Since irrigation is a state subject the state governments may at time take populist stand, detrimental to sustainable development of irrigation, under political compulsions. Strong political will and determination backed by committed bureaucracy will certainly make a world of difference in attempting to bring about the required reforms in the irrigation sector.

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