CHAPTER 4

Irrigation

Introduction

The irrigation sector in Maharashtra is one of the largest in the country, both in terms of the number of large dams and the live storage capacity. Nevertheless, the irrigation sector of Maharashtra has been facing multifarious problems. While the water availability for the future use of irrigation has been reducing at a fast rate, the demand for water for irrigation purposes has been alarmingly increasing due to agricultural expansion and intensification.

According to the estimate of the Maharashtra Water and Irrigation Commission (GoM, 1999), water available from both surface and groundwater can irrigate at most about 60 per cent of the cultivated land. The actual utilisation of irrigation potential created through major and medium irrigation (MMI) sector was only 1.73 million hectares (60.05 per cent) as against the created potential of 2.88 million hectares up to the end of ninth plan period (GoI, 2003). This is very low when compared to the average utilisation percentage of the country (CWC, 2000). Besides this, the financial recovery rate of state's irrigation sector is also very low. Despite revision of water rates at a regular interval, the revenue of irrigation sector is not even enough to maintain the Operation and Maintenance (O&M) cost of the sector.

Though the state has the second largest live storage capacity, the percentage of irrigated area to gross cropped area is one of the lowest among the major states, mainly due to the improper distribution of water among different crops. New water-saving technologies such as drip irrigation have been introduced in the state aiming to improve the water use efficiency through subsidy programmes. Though presently the state ranks first in the area under drip irrigation, not many studies have attempted to find out its potential and prospects, including its economic viability. Keeping in view the above-mentioned problems, we try to examine the important issues that are faced by the irrigation sector of the state over the last forty years. This study uses secondary level information for all its analyses.

This chapter is organised into nine sections. The first section deals with irrigation potential available, harnessed and utilised, since the first plan. Changes that have taken place in the available water potential, trends in water potential harnessed and utilised, the gap between potential created and utilised among different sources of water are also examined in this section. The second section focuses on investment made on the irrigation sector since the first plan across different sources. The pattern of public and private investment on different sources of irrigation, the relationship between the potential created and the investment made on different sources of irrigation, investment required to create one hectare of irrigation (cost efficiency), etc., are also studied.

The growth of irrigation projects and its associated issues are discussed in section three. Section four brings out the trends and development of irrigated area by crops besides looking at the consumption of water by crops and their importance in the economy of the state. Financial performance of the irrigation sector which includes prevailing water rates for different crops, changes introduced in water rates over the years, relationship between O&M costs and water rates, profits and losses, reasons for poor recovery rate etc., are studied in section five. Importance of micro (drip) irrigation, water saving and productivity gains, economic viability of drip irrigation, its prospects and potentials etc., are studied in section six.

Section seven focuses on the role of users' participation in conserving water and its current status, the impact of watershed development programme on water availability, total investment made on watershed programmes including its area coverage, etc. The eighth section on demand and supply scenario of irrigation water highlights the sector-wise demand and supply position of water in Maharashtra including the present and future scenarios.

The ninth section on irrigation and productivity nexus discusses the productivity differences of irrigated and non-irrigated crops as well as the relationship between growth of irrigation and production of crops. Policy suggestions that emerge from the analysis are presented in section ten.

Irrigation Potential Harnessed and Utilised

As per the data of Central Water Commission (CWC), the total irrigation potential of the country is estimated to be 139.86 million hectares (mha) from all sources namely Major and Medium Irrigation (MMI), Minor Irrigation Surface (MIS) and Minor Irrigation Groundwater (MIG). Maharashtra's total irrigation potential is estimated to be 8.96 mha comprising of 4.10 mha from MMI, 1.20 mha from MIS and 3.65 mha from MIG. This accounts for only 6.40 per cent of the country's total potential of irrigation. Though substantial water potential available along west coast (Konkan) of the state, it may not be easily possible to utilise the same because of want of suitable sites for construction of dams and also due to prohibitive cost of lifting the water to the east of Sahyadri for its use in the drought-prone area. This has resulted in lesser irrigation potential despite higher total water availability in the state.

Irrigation potential of the state is on the lower side in relation to its size of rural population and gross cropped area. For instance, the state ranks second in gross cropped area (GCA) in India by occupying about 11.45 per cent of GCA in 2001-02. Similarly, the share of rural population of the state is about 7.53 per cent in India in 2000-01. Given the limited availability of water and increasing demand for irrigation and from different sectors, there is going to be a tremendous pressure in the near future for water available in the state.

As regards trends in potential created and utilised, the status of the state upto the end of ninth plan was not very encouraging especially in MMI when compared to other states and national level average. The state has created a total potential of 2.88 mha through MMI source up to ninth plan period, of which only about 60 per cent is actually utilised. This is very low when compared to the average national level percentage of utilisation, which is about 89 per cent (GoI, 2003). What is interesting is that the utilisation per cent of MMI has been consistently declining from 83.6 per cent in third plan (1961-66) to 60 per cent in 2001-02, a decline of 23.60 per cent points. The rate of decline of utilisation percentage is found to be faster in the state as compared to the national level average, where it declined only by about 5 per cent points (from 90.29 per cent to 85.02 per cent) during the same period (Table 4.1). The administrators who worked with the state irrigation department argue that the less utilisation of irrigation water in MMI sector is mainly because of two reasons. First, intensive irrigation to water consuming crops like sugarcane has drastically reduced the total area actually irrigated (when compared with projected irrigated area) and reduced the utilisation percentage. Second, the appreciable increase in allocation of water for domestic and industrial purposes from the reservoirs when compared with the allocation as per project planning has also reduced the utilisation percentage. However, this argument is somewhat different from the results of earlier studies, which show that inadequate availability of funds for developing hardware aspects of irrigation such as construction of main canals and distribution systems which take water to the farmers' field are the main reasons for the less utilisation of irrigation potential created (World Bank, 2002; GoI, 1992; Vaidyanathan, 1999). Although the reasons for low utilisation per cent of MMI are different, one would hope that the establishment of five Irrigation Development Corporations (IDCs) during 1996-98 would take measures to increase both the creation of irrigation potential and percentage of utilisation relatively faster in the state in the future.

Utilisation percentage of MIS has also declined sharply in the state, from 82.1 per cent in sixth plan (1980-85) to 65 per cent in 1999-2000, which is comparable to the national level average, where it declined from 92.9 to 63.5 per cent during the same period. MIS caters to the needs of marginal and small farmers and therefore, any further reduction in it will have serious implications on these farmer groups. In contrast to surface irrigation sources, utilisation percentage of MIG (groundwater), which is predominantly owned and managed by farmers themselves, is relatively higher in the state. In fact, though the level of utilisation is only about 75 per cent at the end of 1999-2000, the utilisation

percentage of groundwater has been in the range of 96 to 97 per cent since 1980-81 in the state. Relatively higher number of electric pumpsets used for lifting water from wells, flat-rate electricity tariff policy (on horse power basis) followed for agriculture and less availability of surface sources of water must have prompted the farmers to exploit groundwater and fully utilise the created potential of groundwater. Though the percentage of utilisation of irrigation is higher in the state as per the data of Planning Commission (GoI, 2003), the actual utilisation of irrigation potential created in the state sector, as per the Economic Survey of Maharashtra: 2000-01, was only 34.7 per cent (1.654 mha) as against the created potential of 4.769 million hectares at the end of June 2000 (GoM, 2002).

Table 4.1: Development of Irrigation Potential and its Utilisation

(Cumulative area in mha)

Source	Fourth Plan (1969-74)		Ninth Plan (1997-2002)	
	India	M.S.	India	M.S.
MMI				
Potential	20.70	0.84	34.99	2.88
Utilisation	18.69	0.49	29.75	1.73
	(90.29)	(58.33)	(85.02)	(60.05)
MIS				
Potential	6.96[a]	0.40 [a]	13.02[b]	1.59[b]
Utilisation	6.96	0.40	8.27[b]	1.04[b]
	(100)	(100)	(65.32)	(65.41)
MIG				
Potential	16.44	0.93	53.07 [b]	3.41[b]
Utilisation	16.44	0.93	41.08 [b]	2.37[b]
	(100)	(100)	(77.41)	(69.50)
Total				
Potential	43.83	2.17	95.40	5.71
Utilisation	42.09	1.82	85.40	4.30
	(96.03)	(83.87)	(89.52)	(75.31)

Notes: Figures in brackets are percentage of utilisation.
a - Utilisation figures are not available separately. b - provisional figures upto 1999-2000 and therefore, total may not tally.
Source: CWC (2002); GoI (2002)

Investment in Irrigation Sector

Considering the vast area under rainfed cultivation and the importance of irrigation in agricultural development of the state, planners have given adequate thrust for irrigation development since the third plan period – planning in Maharashtra started with the third five-year plan. In the total plan expenditure of the state, the share of irrigation and flood control expenditure increased from 14.87 per cent (Rs. 0.65 billion) in third plan to 33.36 per cent (Rs. 153.93 billion) in ninth plan period (GoM, 2002). The total investment made on irrigation in Maharashtra is the largest as compared to any other state in India. Up to the ninth plan period (2001-02) for which we have comparable data, altogether Rs. 236.22 billion (in current prices) has been spent only on irrigation development (Table 4.2). This accounts for over 17.30 per cent of the country's total investment on irrigation, which is about Rs. 1360.65 billion, excluding investment on Command Area Development Programme and flood control. The state not only accounts for higher share in the total investment made on MMI but also in MI state as well as in MI institutional investment. While MMI investment of the state accounts for 17.78 per cent in India's total investment, MI state and MI institutional investments account for 16.91 per cent and 15.44 per cent respectively up to ninth plan period (CWC, 2002 and GoI, 2003).

Table 4.2: Sector-wise Total Investment in Irrigation up to Ninth Plan

(Rs. in billion)

States	MMI	MI		Total
		State	Insti.	
Andhra Pradesh	111.05 (11.55)	16.32 (6.57)	22.60 (15.01)	149.97 (11.02)
Bihar	53.91 (5.61)	17.19 (6.92)	4.46 (2.96)	75.56 (5.55)
Gujarat	135.80 (14.12)	18.42 (7.42)	6.71 (4.46)	160.93 (11.83)
Haryana	29.84 (3.10)	5.03 (2.03)	7.04 (4.67)	41.91 (3.08)
Karnataka	103.33 (10.75)	13.12 (5.28)	10.51 (6.98)	126.97 (9.33)
Madhya Pradesh	64.20 (6.68)	24.87 (10.01)	11.33 (7.52)	100.39 (7.38)
Maharashtra	**170.96 (17.78)**	**42.02 (16.91)**	**23.25 (15.44)**	**236.22 (17.36)**
Punjab	12.20 (1.27)	5.18 (2.08)	7.37 (4.89)	24.74 (1.82)
Tamil Nadu	19.42 (2.02)	8.97 (3.61)	7.73 (5.14)	36.13 (2.66)
Uttar Pradesh	79.38 (8.25)	23.59 (9.50)	27.94 (18.55)	130.91 (9.62)
West Bengal	18.29 (1.90)	9.35 (3.77)	2.63 (1.75)	30.27 (2.22)
India	**961.63**	**248.44**	**150.59**	**1360.6**

Notes: Figures in brackets are percentage to total investment.
Insti – Institutional.
Source: CWC (2002); GoI (2003)

Table 4.3: Details of Irrigation Development Corporations Established in Maharashtra

(Rs. Billion)

Name of IDC	Number of irrigation Projects incorporated	Total funds required	Govt.'s share capital		Funds to be raised	Funds raised upto 2001-02	Funds to be raised during 2002-03	Targeted irrigation potential (mha)
			Total	Paid upto 2001-02				
MKVDC (January, 1996)	23[a]/50[b]/324[c]/12[d]	95.64	35.00	14.25	81.60	54.63	4.14	1.085
VIDC (March, 1997)	14[a]/27[b]/55[c]	76.07	22.45	2.65	59.01	14.72	8.12	1.100
TIDC (March, 1997)	8[a]/37[b]/115[c]/10[d]	51.97	14.00	1.02	32.75	10.54	1.53	0.523
KIDC (December, 1997)	1[a]/4[b]/33[c]	9.37	2.73	0.49	6.17	3.98	1.54	0.109
GMIDC (August, 1988)	13[a]/24[b]/237[c]	32.66	13.00	2.41	26.00	13.90	5.81	0.561

Notes: a - Major; b - Medium; c - Minor; d - Lift Irrigation Scheme; Year of establishment of IDC is given in bracket; MKVDC-Maharashtra Krishna Valley Development Corporation; VIDC-Vidarbha Irrigation Development Corporation; TIDC-Tapi Irrigation Development Corporation; KIDC-Konkan Irrigation Development Corporation; GMIDC-Godavari-Marathwada Irrigation Development Corporation.
Source: GoM, 2003

In contrast to the traditional practice, one important change has taken place in irrigation investment in the state during the nineties. So far, almost the whole investment on irrigation especially on surface irrigation (MMI and MI) was directly made by the public sector. But, due to severe financial constraints, public sector was no longer in a position to allocate required investment for irrigation development. In order to avoid such constraints, a few states including Maharashtra established Irrigation Development Corporations (IDCs). Between 1996 and 1998, state government has established five IDCs, which mobilised Rs. 97.77 billion from public by selling state-guaranteed bonds upto 2001-02 (Table 4.3). Besides harnessing and utilising the water resources in different river basins, IDCs are responsible for surveying, planning, designing, executing, constructing and managing all projects in their respective river basins (World Bank, 2002). Though responsibilities of IDCs are many, these IDCs have been facing lot of difficulties in raising resources from the market by issue of bonds and debentures. For instance, it was planned to raise Rs. 32 billion from the market during 2003-04, but the actual realisation was only Rs. 2 billion till October 2003. Given the financial constraints, these IDCs will have to face severe challenges in accomplishing their objectives in the coming years.

While the investment on irrigation has been increasing in successive plan periods, there is hardly any relationship between the investment on irrigation and area created from each plan period. For instance, during sixth plan period, the state has spent Rs. 11.87 billion on MMI and created about 0.458 million hectares of irrigated area, by spending only about Rs. 25921/ha. But, this has totally changed during seventh and eighth plan periods (Table 4.4). With an investment of Rs. 37.07 billion during eighth plan period, the states could create only about 0.351 million hectares from MMI source. That is, the average investment required to create one hectare of irrigation increased to Rs. 105613 during eighth plan period. Investment required to create one hectare of irrigation has also been increasing at a faster rate in Maharashtra when compared to many states. Since Maharashtra state falls in the hard rock area, the per hectare investment required for MI is relatively higher as compared to all-India average. As regards MMI, though uneven terrain condition and rolling topography of the state is partly responsible for huge increase of per hectare investment, incompletion of projects in time especially after fifth five year plan mainly due to paucity of funds is often cited as the main reason for poor cost efficiency of irrigation (see, Gulati, et al., 1994; Abbie, et al., 1982). Whatever may be the reasons, the existing poor cost-efficiency cannot be allowed to continue further. Therefore, unless all the on-going projects are completed, new projects should not be taken up, as it will take away the limited

funds available for irrigation development in the state.

Table 4.4: Plan-wise Per Hectare Cost of Creation of Irrigation Potential: Maharashtra and India

(Rs. in current prices)

Plan	Maharashtra		India	
	MMI	MI	MMI	MI
Third	4894	NA	2582	1953
Annual	4874	5249	2809	2777
Fourth	6252	15640	4763	2679
Fifth	12643	8761	6269	3614
Annual	26143	18660	10969	3637
Sixth	25921	10545	21667	4543
Seventh	59163	23476	49920	6801
Eighth	105613	10717	95219	15559
Ninth*	166712	47108	237729	15857

Notes: MMI – Major and medium irrigation; MIS – Minor irrigation surface; MIG – Minor irrigation groundwater;
* - anticipated; NA- data not available separately.
Sources: Computed using CWC (2000 and 2002); GoI (2003)

Growth of Irrigation Projects

Altogether, a total of 3596 large dams were completed in the country as per the latest information available from CWC (2002). Besides this, 695 projects are also under construction in the country, of which 300 (43 per cent) projects are in Maharashtra. Of the total projects completed in the country so far, 1229 dams are in Maharashtra state alone, which is about 34 per cent of the total number of large dams in the country (Table 4.5). Thus, Maharashtra has the distinction of having the largest number of irrigation projects in the country. On an average, about 25 projects per year have been completed during the period 1951 to 1994. Number of projects that are constructed for irrigation purposes was very high during the seventies in the state and the same is true at the national level as well. While the projects completed between 1951 and 1970 were only 171 (about 8 projects per year), the same increased to 923 between 1971 and 1994 (about 40 projects completed per year). However, there are discrepancies in the number of projects given in CWC (2002) and the same reported in GoM (2000). For instance, as per GoM (2000), 33 major, 177 medium and 2032 minor projects have been completed in Maharashtra at the end of June 1999. Currently, 55 major, 126 medium and 908 minor irrigation projects are under construction in the state.

Table 4.5: Distribution of Large Dams in India and Maharashtra

Period	India	Maharashtra
Upto 1950	293	51
1951-1960	234	25
1961-1970	461	146
1971-1980	1190	589
1981-1989	1066	324
1990 & above	116	10
Year not known	236	84
Under construction	695	300
Total	**4291**	**1529**

Source: CWC, 1998

As a result of a large number of projects, the state has a live storage capacity of 35.01 BCM from the completed projects, which is the second highest capacity created among the states in the country (CWC, 2002). Thus, Maharashtra does not seem to have fallen short in creating water storage or at least the state is comfortably placed at the top rank as far as creation of the storage capacity is concerned. But in terms of achievements the proportion of cultivated area under irrigation is only around 17 per cent of GCA as of today, which is one of the lowest among the states in the country. Thus, despite having the largest number of projects and high storage capacity, the state claims only the bottom rank in terms of percentage of irrigated area in relation to GCA.

A section of researchers feel that this imbroglio can be sorted out by allowing privatisation of construction and management of irrigation projects. But the real question is: can privatising construction and management of irrigation sector solve this problem? This needs careful consideration, as given the present situation, neither do we have sufficient experience of privatised activities in irrigation management nor can we rely on the private sector knowing the existing inequity in land distribution. It is essential to underscore here that the problem is not about the quality of construction but about the delay in completing the projects, which can be sorted out only by judicious planning of irrigation sector. The important issues to be understood here are: Why the projects sanctioned could not be completed in time? What are the time over-runs and cost over-runs of each project under construction? Is the non-availability of required fund the main reason for this or is there any other reason? It was

not possible to study these issues in detail due to non-availability of required data on the extent of the time over runs and cost over runs. However, we have presented the details of time and cost over runs of selected irrigation projects in Table 4.6.

Trends and Development of Irrigated Area

Though it is not fair to compare the growth of irrigated area of the state with the national level average because of its different terrain condition and topography, area under irrigation has been increasing in Maharashtra since 1960-61, at an equal pace with the national level growth. While the net irrigated area (NIA) of the state increased from 1.09 mha in TE 1962-63 to 2.97 mha in TE 2000-01, the gross irrigated area (GIA) increased from 1.24 mha to 3.66 mha during the same period. The pace of growth of both NIA and GIA of the state is found to be almost similar to the growth achieved at the national level, where NIA increased 2.22 times (from 25.07 to 55.73 mha) and GIA increased 2.51 times (from 28.63 to 73.93) between TE 1962-63 and TE 2000-01 (see, Table 4.7). The trend growth rate computed for different time points shows that the growth of surface irrigated area is much higher during the first part of green revolution (1965 to 1981) as compared to the second part of green revolution (1981 to 2001) (Table 4.8). The important point observed from the growth analysis is that growth rate of irrigated area was very low during the period 1990-91 to 2000-01, despite spending substantial amount of money on surface irrigation development during this period. It is essential to examine as to why the growth of irrigated area has significantly slowed down during the nineties.

Though there are differences in the growth rate of different sources of irrigated area between Maharashtra and the national level average, the trends in the share of major sources of irrigated area is almost similar to the national level trend. The share of surface irrigation in the total net irrigated area has been coming down and the share of groundwater irrigation has been increasing both at the state and country level, though the decline rate of share of surface irrigation is relatively higher at the national level (Narayanamoorthy, 2002).

Table 4.6: Time and Cost Over-runs of Selected Irrigation Projects in Maharashtra

(Rs. in million)

Project name	Started in plan	Estimated cost		Likely exp. upto end of IX Plan	Spill over cost	Likely achievement of potento upto end of IX Plan ('000 ha)	Likely year of completion
		Original	Latest				
Bhasta	V	1641.10	3224.90	2464.20	760.70	8.93	2007
Bhima	III	425.80	9190.00	8586.00	604.00	214.53	2007
Chaskaman	V	224.80	3471.40	2892.50	578.90	21.21	2005
Jayakwadi St. I & II	V	1273.60	7968.70	7793.20	175.50	236.93	2004
Khadakwasla	II	116.20	3450.40	3222.10	228.30	62.15	2005
Koyna Krishna L.I.S.	VI	2591.00	10830.00	9214.90	1615.10	4.52	2009
Krishna	III	276.60	3700.00	3889.70	-189.70	89.95	2007
Kuadi	66-69	179.00	9190.00	10524.50	-1334.50	94.88	2007
Surya	78-80	193.20	1751.40	2282.00	-530.60	22.55	2007
Tillari (IS)	78-80	2172.20	4240.60	4841.60	-601.00	1.33	2008
Upper Godavari	66-69	142.00	1332.30	1169.40	162.90	66.17	2007
Upper Penganga	V	844.80	8619.90	5484.40	3135.50	73.97	2007
Upper Pravara	V	158.70	2871.40	1200.30	1671.10	4.83	2007
Upper Wardha	V	398.80	6618.60	6180.30	438.30	73.33	2007
Vishnupuri	78-80	789.30	1932.20	1841.00	91.20	18.54	2007
Warna	IV	310.80	8920.00	4295.50	4624.50	18.81	2010

Source: GoI (2003), Tenth Five Year Plan: 2002-07, Volume II, Planning Commission, New Delhi

Table 4.7: Trends in Irrigated Area - Maharashtra and India

(Area in mha)

Period	SIA		WIA		NIA		GIA	
	Maharashtra	India	Maharashtra	India	Maharashtra	India	Maharashtra	India
TE 1962-63	0.48	17.64	0.61	7.43	1.09	25.07	1.24	28.63
	(44.04)	(69.29)	(55.96)	(29.64)	(100)	(100)		
TE 1972-73	0.58	19.12	0.75	12.38	1.33	31.49	1.55	38.56
	(43.61)	(60.70)	(56.39)	(39.28)	(100)	(100)		
TE 1982-83	0.79	21.38	1.12	18.59	1.91	39.97	2.44	51.01
	(41.36)	(53.49)	(58.64)	(46.51)	(100)	(100)		
TE 1992-93	0.97	23.18	1.71	25.88	2.69	49.39	3.28	65.22
	(36.06)	(46.93)	(63.94)	(53.08)	(100)	(100)		
TE 2000-01	1.05	23.89*	1.92	31.84*	2.97	55.73*	3.66	73.93*
	(35.35)	(42.87)	(64.65)	(57.13)	(100)	(100)		

Notes: * - relates to TE 1998-99; SIA – surface irrigated area; WIA – well irrigated area.:
Figures in brackets are percentages to net irrigated area (NIA). GIA – Gross Irrigated Area.
Sources: GoI (various issues); GoM (various issues); FAI (2002)

Table 4.8: Growth Rate of Irrigated Area by Source in Maharashtra and India

(Per cent per annum)

Period	Maharashtra				India			
	Surface	Well	Net	Gross	Surface+	Well	Net	Gross
1960-61 to 1970-71	2.49[a]	3.12[a]	2.85[a]	2.97[a]	1.93[a]	5.09[a]	2.19	3.13[a]
1970-71 to 1980-81	4.20[a]	4.76[a]	4.52[a]	5.59[a]	1.87[a]	4.16[c]	2.46	2.97
1980-81 to 1990-91	2.52[a]	4.04[a]	3.44[a]	3.18[a]	0.91[c]	3.13[a]	1.90[a]	2.30[a]
1990-91 to 2000-01	0.84[a]	1.92[b]	1.53[a]	1.55[a]	-0.08	3.51[a]	2.16[a]	2.38[a]
1965-66 to 1980-81	3.47[a]	3.61[a]	3.55[a]	4.36[a]	2.17[a]	4.81[a]	2.65	3.09[a]
1980-81 to 2000-01	1.77[a]	3.67[a]	2.93[a]	2.71[a]	0.63	3.47	2.19[a]	2.49[a]
1965-66 to 2000-01*	2.12[a]	3.25[a]	2.81[a]	2.99[a]	1.49[a]	3.89[a]	2.30[a]	2.66[a]
1960-61 to 2000-01*	2.20[a]	3.22[a]	2.82[a]	3.05[a]	1.72[a]	3.83[a]	2.19[a]	2.65[a]

Notes: a, b, c are significant at 1, 5 and 10 per cent level respectively; ns - not significant;
+ - Refers to only canal irrigation; * - India's growth rate is upto 1996-97.
Sources: GoI (various issues); GoM (various issues); FAI (2002)

One of the important points that have been under discussion at different fora is whether the development of irrigation is equally distributed across regions or not. Available data shows that area under irrigation is not equally distributed across the divisions and districts in Maharashtra (Table 4.9). Four divisions namely Pune, Kolhapur, Aurangabad, and Nagpur together accounted for about 74.23 per cent (0.780 million hectares) of total surface irrigated area (1.050 million hectares) of the state during TE 2001-02. Though the same trend has been continuing since 1970s, the share of Nagpur division in the total surface irrigated area has sharply declined from 48.26 per cent in TE 1962-63 to 22.39 per cent in TE 2001-02. Since Nagpur division has relatively more area under tank irrigation, could this be due to reduction in area under tank irrigation in this region? If so, the worst affected farmers due to this must be poor resource-owning farmers namely marginal and small categories, for whom alternative source of irrigation is not affordable (Vaidyanathan, 1999; 2001).

The distribution of area under well-irrigation across divisions is relatively better than the surface source of irrigation. Except Konkan, Amravati and Latur division, the share of well-irrigated area in the

Table 4.9: Division-wise Trends in Area under Irrigation in Maharashtra

(in '000 ha)

Division	Surface Irrigation		Well Irrigation		Net Irrigation		Gross Irrigation	
	TE 1962-63	TE 2001-02	TE 1962-63	TE 2001-02	TE 1962-63	TE 2001-02	TE 1962-63	TE 2001-02
Konkan	10.97	25.43	9.77	27.40	20.77	52.83	21.37	63.73
	(2.28)	(2.42)	(1.59)	(1.43)	(1.90)	(1.78)	(1.72)	(1.74)
Nashik	29.30	108.13	84.33	302.43	113.77	410.57	147.33	511.20
	(6.10)	(10.30)	(13.77)	(15.76)	(10.41)	(13.83)	(11.84)	(13.97)
Pune	121.47	246.23	233.30	479.60	354.90	725.83	413.27	886.00
	(25.28)	(23.45)	(38.09)	(25.00)	(32.47)	(24.45)	(33.22)	(24.22)
Kolhapur	75.80	158.33	87.17	249.50	162.97	407.83	194.37	495.90
	(15.78)	(15.08)	(14.23)	(13.00)	(14.91)	(13.74)	(15.63)	(13.55)
Ahmedabad	5.93	139.77	85.67	310.17	91.63	449.93	107.47	554.03
	(1.23)	(13.31)	(13.98)	(16.17)	(8.38)	(15.16)	(8.64)	(15.14)
Latur	12.53	89.30	63.13	184.47	67.47	273.77	75.57	348.33
	(2.61)	(8.50)	(10.31)	(9.62)	(6.17)	(9.22)	(6.08)	(9.52)
Amaravati	0.53	47.73	25.97	129.00	26.57	176.73	26.63	225.03
	(0.11)	(4.55)	(4.24)	(6.72)	(2.43)	(5.95)	(2.14)	(6.15)
Nagpur	231.87	235.17	23.27	235.93	255.23	471.10	257.50	574.60
	(48.26)	(22.39)	(3.80)	(12.30)	(23.35)	(15.87)	(20.70)	(15.70)
State	480.50	1050.10	612.57	1918.50	1093.10	2968.60	1243.87	3658.83
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note: Divisions are as per the prevailing divisions in the state during the year 1994-95
Sources: GoI (various issues), GoM (various issues); Figures in bracket are percentage share

net (total) irrigated area varies from about 12 per cent to 25 per cent in other divisions. Nashik and Pune divisions together accounted for over 40 per cent of well-irrigated area during TE 2001-02. What is interesting is that those divisions, which have higher share of surface irrigated area also have higher share of well-irrigated area, except Nashik and Nagpur divisions. The same trend is observed in both NIA and GIA. As irrigation is one of the important factors which determine the income generating capacity of the rural population and it also involves a large amount of public investment, the allocation of resources for irrigation development needs to be linked with the percentage of utilisation of irrigation potential across regions/administrative zones in the future.

Unlike the other states, crop-wise irrigated area too is not distributed in a desirable manner among different crops in the state. Out of the total irrigated area of 3.55 million hectares available during TE 2000-01, important foodgrains crops such as paddy, wheat, jowar and bajra together accounted for only 45.89 per cent (1.50 million hectares), while sugarcane alone accounted for over 18 per cent.

Pulses and oilseeds are the important crops in Maharashtra accounting for about 28.33 per cent of GCA in TE 2001, but these two crop groups together accounted for only about 14.50 per cent of irrigated area during the same period (Table 4.10). Though net returns per unit of water generated by sugarcane is estimated to be very low when compared to most of the foodgrain crops (Rath and Mitra, 1989), available estimates show that major portion of irrigation water available in the state is still used only for sugarcane, which accounts for less than 3 per cent of gross cropped area in the state (World Bank, 2002). Irrigated sugarcane area accounted for over 18 per cent of GIA in the state, which is very high when compared to the national average figure of 5.36 per cent during TE 1992-93. Inspite of severe water scarcity in the State, area under sugarcane has increased at a rate of 3.77 per cent per annum between TE 1972-73 and TE 2001-02. Considering the increasing demand for irrigation water and drastic decline in available water for future use, strict rules should be enacted wherein a farmer should not be allowed to cultivate sugarcane for more than a fixed area under surface method of irrigation.

Table 4.10: Crop-wise Share in GCA and GIA in Maharashtra

(Data are Triennium Ending averages)

Crops	Gross Cropped Area					Gross Irrigated Area				
	1962-63	1972-73	1982-83	1992-93	2000-01	1962-63	1972-73	1982-83	1992-93	2000-01
Paddy	6.96	7.47	7.49	7.50	6.82	22.12	21.00	16.35	12.50	9.73
Wheat	4.74	4.64	5.16	3.47	4.26	11.29	17.65	21.25	15.96	19.58
Jowar	32.64	31.98	33.16	27.99	22.73	2.65	16.51	18.41	14.37	11.67
Bajara	8.80	8.88	8.08	9.13	7.99	0.14	2.88	2.14	2.20	3.32
Total Cereals	55.60	55.21	56.14	50.20	44.48	59.58	59.27	59.32	46.24	45.89*
Total Pulses	12.53	12.95	13.58	15.39	16.11	3.44	3.41	4.19	6.95	7.38*
Cotton	13.80	14.53	13.16	12.75	14.39	3.86	4.46	4.35	2.78	2.06
Sugarcane	0.78	1.12	1.83	2.63	2.59	11.91	12.94	14.62	16.91	18.12
Total Oilseeds	10.11	9.60	8.50	12.18	12.22	1.61	2.07	3.64	9.57	7.18*
Others	7.18	6.59	6.79	6.85	10.22	19.60	17.85	13.88	17.55	19.90*
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Note: * relates to TE 1997-98
Sources: GoI (various issues); GoM (various issues)

Financial Performance of Irrigation Sector

Fully knowing the fact that gross receipts from irrigation water is only one of the direct benefits of irrigation, the performance of irrigation sector is often judged on the basis of the extent of recovery of working expenses through gross receipts. The policy towards water rates has been the major points of discussion right from the time of the First Irrigation Commission of Maharashtra (GoM, 1962). Among the suggestions on water rates given by the Second Irrigation Commission (GoI, 1972), the important ones are: (i) water rate should relate to the benefits rather than the cost, (ii) it should relate to the crop and the season, (iii) it should consider the cropping needs of the states, (iv) it should be fixed between 6 and 12 per cent of the gross income, and (v) it should be revised after every five years. Though the productivity of most of the crops is relatively lower in Maharashtra, the recommendations of the Second Irrigation Commission are broadly followed and the water rates are revised with the required frequency. In fact, in order to cover full Operation and Maintenance (O&M) cost of irrigation, water rates have been increased since September 2001. These charges will increase by 15 per cent every year and have been announced and also published for a five-year period, 2001-05 (World Bank, 2002). It is worth mentioning here that no other state in India has taken this kind of bold decision in recent times. At present, the state has the highest range of water rates prevailing in the country (Table 4.11).

Table 4.11: Water Rates for Selected Crops and States as of September 2001

(Rs./ha)

Crop	A. P.	Kar.	Raj.	U.P	Maharashtra
S.cane	875	1000	574	474	3180-4673
Paddy	370-494	250	198	287	180-360
Wheat	250	150	148	287	360
Cotton	250	150	178	114	548-1088
Maize	250	88	67	---	270
Pulses	---	88	79	212	---
Veg.	---	---	109	287	548-2040

Notes: S.cane - sugarcane; Veg - vegetables.
Source: World Bank, 2002

Though the water rates are very high in the state, the percentage of cost-recovery is not appreciably higher when compared to other comparable states. As per the data of CWC (2002), the percentage of recovery of irrigation and multipurpose river valley projects has declined from 166.02 in 1974-75 to 2.26 per cent in 1998-99 in Maharashtra, while the same has declined from 64.2 per cent to 6.30 per cent at the national level during the same period (Figure 4.1). However, as per the data of irrigation department, Government of Maharashtra, the cost recovery has increased recently from 19 per cent in 1997-98 to 56 per cent in 2001-02 (see, World Bank, 2002). One of the important reasons for the poor recovery rate is that the per hectare working expenses in Maharashtra are about five times of the average per hectare working expenses at the country level (CWC, 2002; Deshpande and Narayanamoorthy, 2001). Besides this, a relatively less amount of actual collection of water rates in relation to demand raised is also one

of the reasons for poor recovery (Table 4.12). While efforts are needed to increase the collection of charges by increasing the quality of service, working expenses being spent for managing per hectare of irrigation need to be drastically reduced in order to increase the recovery rate. Therefore, instead of working only on the revenue side (water rates) vigorously, it is obligatory to consider with equal vigour the expenditure side also so as to understand the increasing trends in expenditure and ways and means to cut down unwarranted expenditure. One of the options available for reducing working expenses and improving recovery rate is transferring the water distribution below the main canal systems to the Water Users Associations (WUAs) (Rath, 1997). In order to increase the participation of farmers in water management, Government of Maharashtra has taken a policy decision in July 2001 to hand over the irrigation management to WUAs within a span of three years in all irrigation projects. Though it seems to be a feasible solution, the working details of this have to be analysed keeping in view the ground realities about the irrigation department.

Figure 4.1: Percentage of Cost Recovery in Irrigation Projects

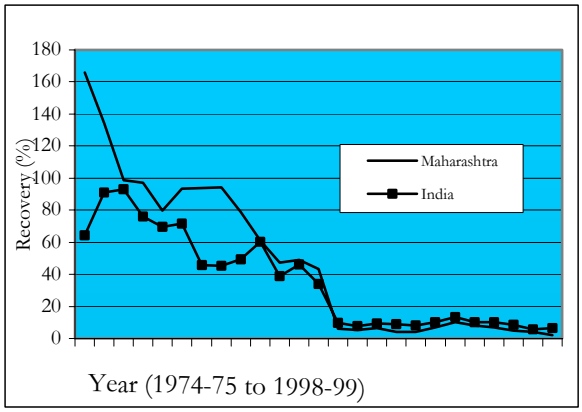


Table 4.12: Present Status of Irrigation Assessment, O&M Cost and Recovery in Maharashtra

(Rs. in billion)

Year	Assessment	O&M Cost	Recovery	Per cent of recovery
1998-99	1.951	3.790	1.135	30
1999-00	2.762	4.326	1.729	40
2000-01	4.375	4.900	1.953	40
2001-02	4.535	4.500	2.516	56

Note: OM cost includes establishment plus maintenance and repairs.
Source: GoM, Dept. of Irrigation.

Micro-Irrigation

One of the new methods introduced recently in India for increasing water use efficiency and yield of crop is drip method of irrigation (DMI). Unlike flood method of irrigation, which is followed predominantly in Indian agriculture, water is supplied directly to the root zone of the crops under drip method. Water use efficiency under DMI is very high as it saves substantial amount of water losses occurring through evaporation and distribution under flood method of irrigation. The growth of area under drip method of irrigation (DMI) is exceptionally high in Maharashtra when compared to any other state in India. Area under DMI increased from a mere 236 ha in 1986-87 to about 2,17,447 hectares in 2001-02, an increase of about 57 per cent per annum (Figure 4.2). Maharashtra State alone accounts for over 50 per cent of India's total drip irrigated area during 2000-01, for which we have state-wise comparable data (Table 4.13). There are many reasons for the rapid development of DMI in the state. First, state government is very keen in promoting drip irrigation on a large scale by providing subsidy, technical and extension services. Maharashtra is the only state that has been operating a separate state scheme since 1986-87 for promoting drip method of irrigation by providing subsidy. All other states have been operating only central scheme, which started functioning from 1990-91. Second, irrigation availability from both surface and groundwater is quite low and hence, farmers have willingly adopted DMI in order to avoid water scarcity largely in divisions like Nashik, Pune, etc. Third, farmers were not able to cultivate more lucrative crops like grapes, banana, pomegranate, orange, mango, etc. by surface method of irrigation due to depletion of groundwater, which also forced the farmers to adopt DMI extensively in certain regions in the state. It is also adopted for growing high value crops such as floriculture, vegetables, horticulture, etc., under green houses.

Though area under DMI increased significantly in the state since 1986-87, its development is not the same across the divisions and districts. While Pune, Nashik and Kolhapur divisions together accounted for nearly 67 per cent of the total area at the end of 1999-2000, districts like Nashik (14.53 per cent), Jalgaon (18.14 per cent), Solapur (9.82 per cent),

Ahemednagar (6.67 per cent), Pune (5.53 per cent) and Sangli (5.37 per cent) together accounted for over 60 per cent of state's total area. Besides favourable cropping pattern, water scarcity prevailing in these districts forced the farmers to adopt DMI. As of March 2000, more than 26 crops are being cultivated using DMI in the state. However, the area is concentrated with only a few crops. Crops such as banana, grapes, sugarcane, citrus group of crops and pomegranate together accounted for 75 per cent of Maharashtra's total drip irrigated area (1,60,281 ha) at the end of March 2000.

Figure 4.2: Area under Drip Irrigation in Maharashtra

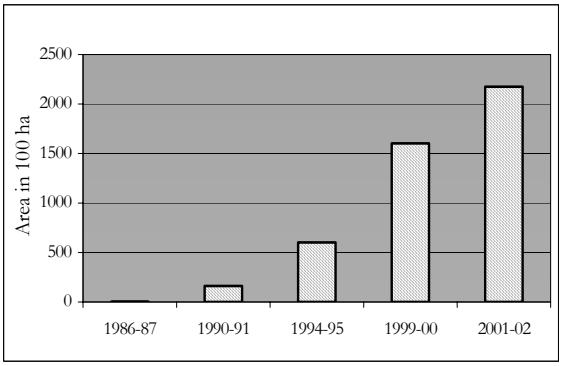


Table 4.13: State-wise Area under Drip Method of Irrigation

State	Area ('000 ha)		Per cent to Total Area		ACGR (Area)
	1991-92	2000-01	1991-92	2000-01	
Maha.	**32.92**	**160.28**	**44.64**	**53.16**	**19.23**
Kar.	11.41	66.30	16.17	18.03	19.55
T.N.	53.57	55.90	7.59	15.20	29.76
A.P.	11.59	36.30	16.41	9.88	13.52
Guj.	35.60	7.60	5.05	2.07	8.79
Kerl.	30.35	5.50	4.30	1.50	6.81
Orissa	0.04	1.90	0.06	0.52	53.56
Har.	0.12	2.02	0.17	0.55	76.74
Raj.	0.30	6.00	0.43	1.63	39.49
U. P.	0.011	2.50	0.16	0.68	82.74
Punjab	0.02	1.80	0.03	0.49	64.87
Others	2.12	5.40	0.00	1.47	10.11
Total	**70.59**	**367.70**	**100**	**100**	**20.13**

Notes: a- includes state subsidy scheme area of 58498 ha; b- includes area under central and state schemes for development of oil palm and sugarcane; ACGR - Annual compound growth rate per cent per annum between 1991-92 and 2000-01.
Source: AFC, 1998; GOI (2004)

Drip method of irrigation has many advantages over flood method of irrigation (FMI), which is followed predominantly in Indian agriculture. Besides saving substantial amount of water, it increases productivity of crops and reduces the cost of cultivation as well as consumption of electricity required for lifting water from wells. Studies carried out using experimental data show that while water saving under DMI ranges from 40 to 80 per cent in different crops when compared to FMI, productivity gains can be achieved up to 98 per cent as compared to FMI (INCID, 1994). Field level studies carried out in Maharashtra too established that DMI reduces water consumption and cost of cultivation besides increasing yield of crops to the extent of 19 to 29 per cent in crops like banana, grapes and sugarcane (see Table 4.14).

DMI is considered to be a capital-intensive technology requiring an investment of Rs. 20,000 – 50,000 per hectare depending upon the crop (INCID, 1994). While the investment required for DMI is generally higher for narrow spaced crops as compared to wide spaced crops, it varies with type of drip materials to be used, distance between water source (well) and the field to be irrigated. One of the important questions often asked with regard to DMI is whether the investment on DMI is economically viable or not? Studies carried out using field level data collected from Maharashtra on three crops clearly show that the investment on drip irrigation is economically viable even without government subsidy, under 15 per cent discount rate. The benefit-cost (BC) ratio varies from 1.77 to 2.23 among the three crops under without subsidy condition. Even though subsidy is not needed to enhance the economic viability of the drip system, it is still needed to enhance the incentive for the widespread adoption of DMI particularly among the resource poor farmers. From the policy point of view, this result suggests that subsidy can be phased out eventually once the new irrigation technology covered an adequate enough to expand subsequently through the demonstration effect.

Despite having many advantages, the area under DMI accounts for only 4.97 per cent in the net irrigated area of the state in 1999-2000. The total potential area suitable for DMI roughly comes to about 1.95 million hectares, which accounts for nearly 52.69 per cent in GIA in 1997-98. Studies showed that slow growth of DMI is not mainly due to economic reasons but due to less awareness among the farmers about the real economic and revenue-related benefits of drip technology (see,

Table 4.14: Advantages from Drip Method of Irrigation over Flood Method of Irrigation: Results of Field Study

Particulars	Banana[a] (Jalgaon)	Grapes[a] (Nashik)	Sugarcane[b]	
			Pune	Ahmednagar
Cost Saving (Rs/ha)	1300 (2.47)	13400 (9.07)	5843 (11.78)	7250 (15.26)
Water Saving (HP hours/ha)	3246 (29.15)	1968 (37.28)	1194 (40.69)	1632 (47.63)
Electricity Saving (Kwh/ha)	2430 (29.15)	1470 (37.28)	896 (40.69)	1224 (47.64)
Productivity Gains (Quintal/ha)	153.19 (29.00)	38.96 (19.00)	24.52 (20.99)	27.32 (25.27)
Net Present Worth (NPW) (Rs/ha)* With Subsidy Without subsidy	 257635 247753	 551220 540241	 206692 190025	 166619 149766
B-C Ratio* With subsidy Without subsidy	 2.36 2.23	 1.80 1.77	 2.16 1.98	 2.02 1.83

Notes: a – data relate to the year 1993-94; b – data relate to the year 1998-99. Figures in brackets are saving in per cent over FMI.
* - BC ratio and NPW are computed using discounted (at 15 per cent) cash flow technique.
Sources: Narayanamoorthy, (1996, 1997 and 2001b)

Narayanamoorthy, 1997). This means that apart from the provision of capital subsidy, there is also an urgent need for an awareness campaign through an effective extension network including aggressive field demonstration. Moreover, since sugarcane consumes major quantum of surface water, it would be worthwhile to introduce drip on canal irrigation where sugarcane has been cultivated extensively in the state.

Water Conservation Measures

The fast decline of irrigation water availability and the increasing demand for water from different sectors has forced the policy makers to introduce strategies to conserve water. Among various water conservation measures, Water Users' Association (WUAs) and Watershed Development Programmes (WDPs) have proved to be important in conserving water resources. While WUAs help to improve the overall performance of the irrigation sector besides increasing the water use efficiency, WDPs improve the water and moisture availability in the rain fed areas, where poverty is widespread because of the slow growth of agriculture (Narayanamoorthy, 2001a).

Water Users' Association

In India, more emphasis was given to users' participation in water management only after the announcement of the National Water Policy (1987), wherein gradual involvement of farmers in system management was advocated. The policy states that "efforts should be made to involve farmers progressively in various aspects of management of irrigation system, particularly in water distribution and collection of water rates" (GoI, 1987, p. 11). This has also been reemphasised in the new National Water Policy of 2002 (GoI, 2002).

Though WUAs are expected to improve the recovery rate and reduce part of the responsibility of the irrigation department, it is considered to be beneficial in many ways to users (farmers) as well. It has been clearly established that users-managed systems outperformed the systems that are managed by the irrigation agencies all over the world including India (Easter, 2000, Vermillion, 1997, GoI, 1992). The most commonly realised positive impact of users-managed systems are reduction in the cost of irrigation to farmers and government; enhanced financial self reliance of irrigation schemes; expansion of irrigation; flexibility in cropping pattern; reduction in the amount of water delivered per hectare and significant increase in cropping intensity and yield of crops.

While the irrigated area managed by the WUAs is very limited as of today in India, a significant improvement has been made, at the policy level, in bringing more irrigation systems under WUAs in the recent years. Though Vaidyanathan Committee on

Pricing of Irrigation Water observes that "the area covered by these initiatives is very small, less than 1 per cent of area irrigated at present" (GoI, 1992), the 10th five year plan document cites that currently about 15.25 per cent of the net irrigated area is partially covered under the participatory irrigation management scheme in India (GoI, 2003).

In Maharashtra, significant progress has taken place since 1992 as the irrigation department has been encouraging the farmers to form WUAs by explaining its advantages (Naik, et al, 2002). As a result of the continuous effort by the irrigation department and non-governmental organisations, about 2472 WUAs have been functioning at different levels, which cover an area of 7,97,587 ha as of December 2003 (Table 4.15). Besides this, the NGOs promoted *Pani Panchayats* have been working reasonably well in many drought-prone and water scarce areas in Pune district (Deshpande and Reddy, 1990; Thakur and Patnaik, 2002). Though the area brought under WUAs is only about 27 per cent of the net irrigated area so far, it has increased to as much as 372 per cent between 1996 (0.169 million hectares) and 2003 (0.798 million hectares). While the increasing role of WUAs is essential to increase the performance of irrigation system, there is no clear information about the performance of WUAs at the field level. Vaidyanathan Committee on Pricing of Irrigation Water observes that "the general consensus among the knowledgeable people is that they have been fitful and have not made much of impact. For the most part the outlet and canal committees are there only in name; they are not consulted on substantive issues; nor are department officers required to follow their advice. There is also considerable reluctance, if not opposition, from the operational staff of irrigation departments to involving users in management; and even users themselves tend to be apathetic to the idea" (GoI, 1992, pp.126-127).

A number of strategies need to be introduced in order to increase the participation of farmers in water management activities. For this purpose, one needs to understand the factors responsible for the tardy progress of WUAs. The 9th five year plan (1997-2002) listed, among others, seven important reasons, which can be reconsidered while making strategies to improve the users' participation in irrigation management (see, Box 4.1). Similarly, while emphasising the importance of WUAs in irrigation management activities, the Maharashtra Water and Irrigation Commission (GoM, 1999) also suggested various strategies to improve the users' participation in irrigation management (Box 4.2).

Table 4.15: Status of Water Users' Association in Maharashtra

Particulars	As of September 1996		As of December 2003	
	No.	Area (ha)	No.	Area (ha)
WUAs Functioning	100	43684	533	158923
Agreement Executed	34	9894	129	46367
WUAs Registered	180	60372	963	347399
WUAs Proposed	143	55211	847	244898
Total	**457**	**169105**	**2472**	**797587**

Sources: Naik, et al., (2002); GoM (2002), DIRD (2004)

Water users associations are functioning mostly at the tertiary level, which cannot accomplish their duties in improving supply, and management of irrigation as the supply of water is controlled by the irrigation agency. Users' organisations that exist in small irrigation systems namely tank were able to perform their duty relatively better than the WUAs that exist in the large irrigation network namely canal. There are two reasons for this. First, the control of government agency is minimal under small irrigation systems like tanks. Second, users group can clearly understand the demand and supply position of water and make decisions accordingly. Therefore, priority should be given to create users group in all minor irrigation systems so as to improve the water use efficiency.

As regards WUAs in larger irrigation systems, the results are not encouraging so far. The turnover of irrigation systems has been slow in most of the large irrigation projects. There are reports that the staffs who are managing irrigation systems see WUAs as a potential threat to their jobs (Easter, 2000). Therefore, the wholehearted involvement in establishing and supporting WUAs by the agency staff may not be very high. Moreover, unlike other South Asian countries where WUAs have been working reasonably well, irrigation systems are very large in India and therefore, practically impossible to manage efficiently by WUAs without adequate support from the irrigation agency. In order to

encourage the farmers' attachment with the WUAs, it is essential to demonstrate the benefits of WUAs in delivering water supply in the required quantity and time. Importantly, the WUAs should be able to reduce the cost of water over time in order to show the advantages of WUAs to the farmers (users).

Box 4.1: Reasons for Tardy Progress of WUAs

- The prolonged prevalence of government-managed systems has snapped the initiative of the farmers and made them dependent on the government.
- Non-availability of funds for PIM.
- Farmers are reluctant to adopt participatory approach unless deliveries of water can be made flexible and responsive to the need.
- Farmers fear that under new system, they might have to incur expenditure on O&M besides increased water rates.
- Farmers are reluctant to come together, because of differences of castes and classes, to form an association.
- Properly oriented, trained and motivated officials to implement this programme are lacking and there is no dedicated wing for this purpose.
- Lack of enabling law for the establishment of WUAs.

Source: GoI, 1997

Box 4.2: Some of the Recommendations of Maharashtra Water and Irrigation Commission

- In order to have proper utilisation of created irrigation potential, WUAs will have to be formed in large numbers.
- In order to legally enforce the participatory irrigation management, the existing irrigation act of 1976 should be amended forthwith.
- To speed up the setting up of water users' societies, there be an exclusive division in each CADA under the control of officers from cooperative department.
- Water from public canal system should be given to water users' societies on volumetric basis and water rates be charged accordingly.
- Tanks having irrigation potential upto 100 ha be entrusted to Gram Panchayat for their management while those having irrigation potential upto 1000 ha be entrusted to Taluka Panchayat samitie. The repair works on the tanks should be undertaken only after formation of water users' societies.
- Training needs to be given to the members of the office bearers of the WUAs in respect of working modalities of societies and their rights and responsibilities.

Source: GoM, 1999

WUAs have to be legally established in order to increase their responsibility and decisions related to water management. It is always difficult for WUAs to provide better water supply and other services to their members without legal standing (Easter, 2000). With the improved service, WUAs can convince the farmers to pay the charges for water that they use. As rightly observed by the Committee on Pricing of Irrigation Water (GoI, 1992), "an essential pre condition is to convince users that they will benefit from such group activity by getting more water, more assured supplies according to a pre-specified schedule (or according to the needs of the crops), greater flexibility in the use of water, or some combinations of these. Improvement in any of these dimension will almost certainly increase productivity and therefore induce farmers to take the idea of users' groups more seriously." Continued support from the government agencies is essential even after transforming the systems management to users group in order to sustain the participation of farmers. Importantly farmers at any level should not be allowed to think that the transfer of irrigation management is introduced in order to reduce the financial burden of the government. Before transferring the system to WUAs, it is also essential to restore the infrastructure created (main and sub canals, etc.) to efficiently deliver water to each farmer's field, as farmers may not be in a position to do the same due to resource constraints.

Watershed Development Programme

One of the massive programmes introduced to improve the rain fed agriculture during the seventh plan in India is Watershed Development Programmes (WDPs). As water is important for improving the performance of agriculture and thereby the socio-economic conditions of the people living in rainfed areas, major thrust is given to improve the availability of water by constructing rainwater harvesting structures like *nalla bunds*, contour trenches, contour bunds, farm ponds, dug-out ponds, masonry *bandharas* and other run-off management structures under WDPs. Though WDPs were introduced in a large scale in India during the Seventh Plan period (1985-86), it was introduced by the Government of Maharashtra under Employment Guarantee Scheme (EGS) in 1982 itself. The programme was entitled as

"Comprehensive Watershed Development Programme" (COWDEP). The centrally sponsored National Watershed Development Project for Rainfed Areas (NWDPRA) was implemented for the first time in 1986 in Maharashtra.

Considering the vast majority of cultivated area under rainfed cultivation (nearly 83 per cent as of today), the Government of Maharashtra has been giving high priority to the WDPs since early 1980s. Over the last 20 years, significant progress has been made in treating areas under the WDPs. Currently, WDPs are being operated under 16 different budget heads supported by Central and State schemes (Table 4.16). While 10 budget heads are operated under state schemes, the remaining 6 heads are operated with the support of Central schemes. Between 1992-93 and 2002-03, a total amount of Rs. 26005.48 million has been spent on WDPs.

Table 4.16: Budget Head-wise Expenditure Incurred for WDPs in Maharashtra

(Rs. Million)

Budget Head	1992-93	2002-03	Total*
1. EGS	1045.05	1839.81	9122.78
2. 100 days Prog.	0.00	0.00	151.12
3. D.P.D.C (Plan)	137.74	52.02	1533.97
4. Backlog (Plan)	77.62	318.79	1832.15
5.C.D. B.	0.00	98.58	185.47
6. D. P.D.C (TSP)	24.95	18.34	1138.49
7. Backlog (TSP)	15.91	10.89	59.65
8. Jalsandharan	195.08	3.11	1728.96
9. World Bank	20.41	0.00	33.39
10. Other	21.38	366.19	1321.78
Total State schemes	**1538.13**	**2707.75**	**17107.76**
1. J.R.Y	35.41	0.04	1511.63
2. E.A.S	0.00	214.66	1834.93
3. NWDPRA	209.92	68.70	2543.47
4. Western Ghat	41.65	100.47	788.21
5. R.V.P	2.54	160.69	831.02
6.D.P.A.P	56.24	176.29	1388.46
Total Central schemes	345.76	720.85	8897.71
Total State & Central	**1883.89**	**3428.59**	**26005.48**

Note: * - from 1992-93 to 2002-03.
Source: DSC & WD, 2003

As of March 2002, about 8322 micro watershed projects have been completed and 18391 projects are under different stages of completion (Table 4.17). Though the number of completed projects seems to be on the higher side, the total area treated through WDPs is very limited in relation to the total potential area available for watershed development programmes. As per the estimate of Directorate of Soil Conservation and Watershed Management (DSC&WM), the total area available for WDPs is about 20.36 million hectares, of which, only about 3.15 mha have been treated upto March 2002. That is, only about 15.47 per cent of potential areas have been treated through WDPs so far. The achievement of the state seems to be reasonably good while comparing it to the total coverage of treated area at the national level, which is expected to reach about 27.5 mha at the end of 9th plan (GoI, 2001). Of this, Maharashtra State's share comes to about 11.45 per cent.

Though considerable amount of cultivated area has been brought under WDPs, the share of area treated through WDPs across divisions and districts is not equally distributed in relation to their drought prone and rainfed area. One might expect that division/districts, which have higher share of rainfed and drought prone area, would have a higher share of treated area as well.

Table 4.17: Division-wise Coverage of Micro-Watersheds in Maharashtra

Division	PWA (mha)	Number of Watersheds			TWA (mha)
		Started	COM	OGG	
Konkan	1.69	2041	421	1620	0.214
Nashik	2.63	3590	1611	1979	0.510
Pune	3.42	6865	770	6095	0.231
Kolhapur	1.73	1900	487	1413	0.237
Aurangabad	2.36	2563	1186	1377	0.344
Latur	2.85	3473	1954	1519	0.853
Amravati	3.36	3917	1236	2681	0.377
Nagpur	2.32	2364	657	1707	0.387
Maharashtra	**20.36**	**26713**	**8322**	**18391**	**3.154**

Notes: PWA- Potential Watershed Area, COM -completed; OGG-ongoing TWA- Treated watershed area.
Source: DSC & WD, 2003

But this has not happened in the state as of today (Table 4.18). For instance, about 94 per cent of area in Amravati division is rainfed, but only 12 per cent of the area has been treated upto 2001-02. On the other hand, both Nashik and Latur division have relatively less rainfed area but their share in the total treated watershed area (TWA) is relatively higher when compared to Amravati division. While the exact reason for this imbalance is not known, high priority needs to be given to those areas/regions which have more drought-prone as well as degraded area, as suggested by the 10th plan Working Group on Watershed Development, Rainfed Farming and Natural Resource Management (GoI, 2001).

Table 4.18: Division-wise Inequality Index of Watershed Development: 2001-02

Division	PWA (%)	RFA (%)	TARFA (%)	NRF (mm)
Konkan	8.30	93.66	27.91	2923
Nashik	12.94	83.11	24.94	838
Pune	16.78	77.09	9.53	785
Kolhapur	8.49	74.76	19.87	1101
Aurangabad	11.58	78.02	21.52	747
Latur	13.98	88.90	37.58	909
Amaravati	16.52	94.11	12.91	882
Nagpur	11.41	75.29	27.23	1301
Maharashtra	**100.00**	**83.11**	**21.54**	**1290**

Notes: PWA – potential watershed area; RFA - per cent of rainfed area to total net sown area; TARFA - treated watershed area to rainfed area;, NRF- Normal rainfall.
Sources: GoM (various years); DSC&WM, 2003

Various evaluation studies carried out in different parts of the state clearly show that WDPs have increased the water and moisture availability (Deshpande and Reddy, 1991; Deshpande and Rajasekaran, 1995; Deshpande and Narayanamoorthy, 1999; Narayanamoorthy and Kshirsagar, 2000). A recent study carried out by Directorate of Soil Conservation and Watershed Management covering 2361 watersheds across different regions in the state clearly shows that there is a significant increase in water availability (irrigated area) including drinking water. Changes in irrigated area observed in some of the watershed projects are presented in Table 4.19.

While there are no two opinions about the fact that WDPs increase irrigated area, many scholars question the sustainability of WDPs. The report of the Working Group on Watershed Development, Rain fed Farming and Natural Resources Management for the 10th five year plan mention by citing a survey of 70 villages in Maharashtra and Andhra Pradesh covering several watersheds, that the increase in agricultural production and water availability did not last for more than two years, mainly because of lack of maintenance and poor mechanism for looking after common lands. The report adds further, that "for watershed projects to be sustainable community managed system are needed and they can succeed only with farmers contribution and their commitment of time and resources. This has been amply demonstrated in watershed programmes implemented by some voluntary organisations, in 25 villages of Pune" (GoI, 2001, p.17). Similarly, another study carried out in 86 villages of Maharashtra and AP found that participatory projects performed better than their technocratic, top-down counterparts. However, participation combined with sound technical input performed much better than all other projects (Kerr, et al., 2002). The message that emerges out from various studies is that users' participation is necessary for the sustained growth of watershed development programme. Therefore, instead of focusing only on technocratic and top-down approach (mostly followed in government managed projects), bottom-up approach that is mostly followed by NGOs is required to realise the full benefits of WDPs. Similarly, it is also essential to give greater focus on non-engineering and vegetative prescriptions and intervention for improving the productivity of land and also to obviate run off.

Table 4.19: Impact of WDPs on Irrigation: Selected Watersheds

(in ha)

Village	Geogra-phical Area	Irrigated Area		
		Before WDP	After WDP	Increase (%)
Adgaon	1049	83	500	40
Ralegoan.Siddhi	971	26	340	32
Naigaon	1528	60	400	22
C. Sastabad	1325	76	284	16
Kan. Mesai	2281	68	315	11
Dhumalwadi	1221	32	235	17
H. Bazar	977	190	375	19
Kachpal	4241	281	979	16
Khawasapur	1375	162	817	48
Pachegaon	2356	221	364	6
Tipehalli	1457	220	430	14
Alegaon	2411	167	416	10
Gheradi	5383	289	372	2
Narale	1760	224	464	14
Ajnale	3872	625	705	2
Shivane	2892	576	810	8
Medshingi	2966	101	136	1
Bhandgaon	604	22	197	29
Wadner (H)	1157	110	536	37
Umrad	2316	1533	1988	20
Total	**42142**	**5066**	**10663**	**13**

Source: GoM, 1999

Demand and Supply Scenario of Water

While demand for water from different sectors has been increasing due to intensification of agriculture and growth in industry as well as population across different states in India, the available water for future use has been declining. This is expected to create wide supply-demand gap in water use in the future (Saleth, 1996). In Maharashtra, as in the case of many other states, the present condition of

Table 4.20: Basin-wise Water Supply and Demand in Maharashtra: 1996 and 2030

(in Million m^3)

Basin	Available water for planned use	Demand for									
		Domestic		Agriculture (irrigation+livestock)		Industry		Others(hydro+ thermal power)		Total use	
		1996	2030	1996	2030	1996	2030	1996	2030	1996	2030
Godavari	38882	874	2066	16653	40384	192	678	250	318	17969	43446
Tapi	9324	350	731	4126	10562	35	766	20.20	175	4531	12234
Narmada	343	3.50	6.46	29.40	245.20	0.00	0.00	0.00	0.00	32.90	251
Krishana	18356	603	1428	9471	27438	138	415	3112	3112	13324	32393
WFRK	72322	938	1952	1811	12030	877	1395	0.90	2.90	3626	15380
Maharashtra	**139227**	**2768**	**6184**	**32091**	**90660**	**1241**	**3254**	**3394**	**3617**	**39484**	**103705**

Notes: Figures rounded off to the nearest integer; WFRK - West Flowing Rivers in Konkan
Source: GoM, 1999

supply and demand scenario of water is not very comfortable (see, MOWR, 1999; Iyer, 2003). As per the estimate provided by the Maharashtra Water and Irrigation Commission (GoM, 1999), the annual average availability of water is 1,48,208 mm^3, of which, an amount of 1,39,227 mm^3 of water is available for planned use. Presently (in 1996) about 39,484 mm^3 of water is used for different purposes, which accounts for just about 26 per cent of the total water available for planned use (detailed estimate on demand-supply of water for different sectors across basins is available only for two time points namely 1996 and 2030. For the purpose of comparison, the year 1996 is referred as current period). In the total current use of water, agriculture, which includes irrigation and livestock, accounts for about 81 per cent and industry and domestic use accounts for about 3 and 7 per cent respectively at the state level (Table 4.20). However, the proportion of water used by different sectors is not the same across different basins and sub-basins because of the varying nature of growth of agriculture and other sectors (GoM, 1999).

The demand scenario for water is expected to change drastically in the future because of the increasing demand for water from different sectors. The projections indicate that the total demand for water is likely to grow by about 162 per cent between 1996 and 2030 at the state level (GoM, 2003). That is, the total demand for water is expected to increase from 39,484 mm^3 in 1996 to 1,03,705 mm^3 in 2030. This means that about 70 per cent of the total available water for planned use will be utilised by different sectors in the year 2030. Water requirement for agriculture is expected to grow by about 182 per cent, from 32,091 mm^3 in 1996 to 90,660 mm^3 in 2030. This is very high when compared to the growth of water requirement for domestic and industry use, where the water requirement is expected to increase by about 123 and 162 per cent respectively. Water requirement for different sectors is also expected to increase substantially between 1996 and 2030 across all basins with varying rate of increase. Though the projection indicates that there will not be any supply-demand gap for water upto the year 2030 at least at the state level, there is going to be a severe water shortage particularly in three major basins namely Godavari, Tapi and Krishna. This is because of the fact that the demand for water from all the three major sectors is expected to increase substantially between 1996 and 2030 in all these basins. The availability of water by sub-basins indicates that most of the sub-basins coming under Tapi and Krishna basin are going to have severe water deficit in the future. It is clear that there is going to be a gap in the demand-supply of water by 2030 particularly in two main basins namely Tapi and Krishna, both supply about 26 per cent of water to Maharashtra. Besides these, some sub-basins falling under Godavari basin are also facing water scarcity. It may be possible to a very limited extent to meet these demands, making good the shortfall by transfer of water from water surplus river basin. Transfer of surplus water from WFRK to Godavari and Krishna would not be an economically viable

proposal because of the very high lift involved. In view of this, there is going to be extreme shortage of water in Krishna and Godavari basin. Therefore, there is an urgent need to prepare a master plan focusing on each basin with specific strategies that can be implemented to avoid supply-demand gap in water use. The plan to be prepared should include both demand and supply management strategies. Under supply side management strategies, volumetric pricing, periodic revision of water rates, etc are expected to save/conserve water. Establishing a large number of WUAs, shifting the cropping pattern from low-value-high water consuming crops to high-value-low water consuming crops and a large scale adoption of micro-irrigation (drip, sprinkler) etc; are some of the important options that need to be followed under demand side management strategies.

Irrigation and Productivity Nexus

By increasing the adoption of yield increasing inputs in crop cultivation, irrigation significantly helps to increase the productivity of crops. Productivity of crops is also found to be significantly higher in those lands that are cultivated using groundwater irrigation because of its better quality (in terms of reliability and controllability) as compared to other sources of irrigation. Since groundwater irrigation accounts for nearly 65 per cent of net irrigated area in Maharashtra, one might expect that the productivity of crops in the state would be higher than the national level average. However, against expectation, not only the total productivity of major crops is lower in Maharashtra but the irrigated productivity is also found to be relatively lower in the state as compared to the national level average (Table 4.21). Though the coverage of irrigation is relatively higher in crops like gram and groundnut in Maharashtra as compared to the national average, the irrigated productivity of these two crops is also lower when compared to many states (GoI, 2002). Does this imply that the marginal productivity of water is lower in Maharashtra? Or is water not used efficiently in Maharashtra? Only a disaggregated level analysis can throw some light on this.

Irrigation growth is expected to boost the growth of production and productivity of crops. Therefore, to find out whether or not such relationship exists in Maharashtra, we have compared the growth of irrigated area with production and productivity of some selected crops for different time periods. Unfortunately, there seems to be no direct relationship between growth of irrigated area and growth of productivity of major crops in all time periods selected for the analysis (Table 4.22). For instance, area under irrigated sugarcane increased at a rate of 3.79 per cent per annum during 1980-81 to 2000-01, but its productivity growth was negative (-0.58 per cent) during this period. This indirectly reinforces the issue raised earlier about the possibility of declining marginal productivity of water among various crops in the state.

Table 4.21: Irrigated (IR) and Un-Irrigated (UI) Yield of Principal Crops

(Kg/ha)

Crops	Maharashtra				India			
	1980-81		1994-95		1980-81		1994-95	
	IR	UI	IR	UI	IR	UI	IR	UI
Rice	1684	1518	1634	1587	1695	1050	2053	1345
Jowar	1010	675	859	443	1096	613	1250	606
Wheat	1249	419	1696	717	1803	1057	2683	1100
Gram	505	312	794	543	791	604	990	761
G.nut	1400	619	967*	741*	1028	678	1305	795
S.cane$	92.33	--	85.50	--	63.59	32.62	81.01	50.50
Cotton	197	68	759	402	308	97	923	455

Note: * relates to year 1988-89; $ - sugarcane yield is in tonnes.
Source: GoI (various years).

Table 4.22: Crop-wise Growth of Irrigated Area, Production and Productivity

Crops	1960-61 to 1980-81			1980-81 to 2000-01		
	I.A	Prod.	Yield	I.A	Prod.	Yield
Rice	2.29[a]	2.88[a]	2.16[b]	-0.12	0.66	0.56
Wheat	8.31[a]	5.92[a]	4.31[a]	2.00[a]	1.97[b]	2.86[a]
Jowar	2.80[a]	1.51	1.29	0.44	0.62	2.23[a]
Gram	4.23[a]	1.09	0.30	6.64[a]	8.29[a]	3.97[a]
G.nut	6.59[a]	-2.21[b]	-0.01	3.89[b]	0.59	2.05[a]
Cotton	3.54[a]	-0.49	0.25	-0.08	6.25[a]	5.03[a]
S.cane	4.57[a]	4.90[a]	1.95[a]	3.79[a]	3.72[a]	-0.58[a]

Notes: a & b are significant at 1 and 5 per cent level respectively; Growth rates are computed using log-linear function; IA – irrigated area.
Sources: GoM (various years); GoI (various years).

It is well known that the productivity of crops cultivated under irrigated condition is relatively higher than that of unirrigated crops. However, to what extent irrigation helps to increase the total

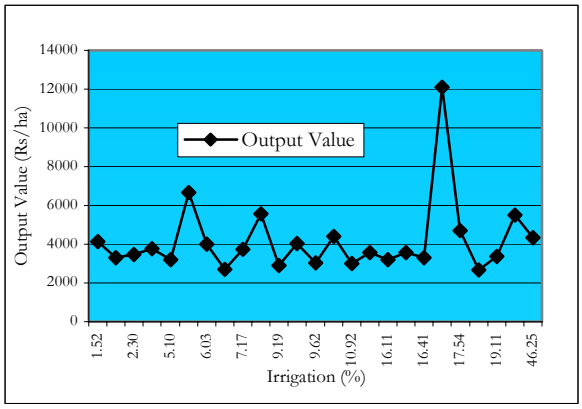
value of crop output has not been studied using data from Maharashtra. To understand this, we have compared the value of crop output per hectare with the level of irrigation across 25 districts of Maharashtra for three time points: 1970-73, 1980-83 and 1990-93. The value of crop output (in 1990-93 prices) per hectare has been calculated by taking the production of 35 important crops, which cover over 87 per cent of the gross cropped area in the state (Bhalla and Singh, 2001). The results presented in Table 4.23 clearly show that there is no significant difference in the value of output between the less-irrigated (< 10 per cent) and high-irrigated (>10 per cent) districts in Maharashtra (Figure 4.3). Could this be due to predominant cultivation of low value crops in most parts of Maharashtra? In-depth analysis using more disaggregated level data is needed to make any firm conclusion on this aspect.

Table 4.23: District-wise Irrigation and Value of Crop Output Nexus in Maharashtra

Year	GIA/ GCA	No. of districts	VOP (Rs/ha)	NPK (kg/ha)	CI (%)
1970-73	<10 %	14	2176	11.94	104
	>10%	11	2476	15.33	109
	All	25	2308	13.43	106
1980-83	<10 %	10	3588	20.23	109
	>10%	15	3614	32.35	113
	All	25	3603	27.50	111
1990-93	<10 %	13	3888	51.06	117
	>10%	12	4478	137.39	116
	All	25	4261	67.15	115

Source: Computed from Bhalla and Singh, 2001

Figure 4.3: District-wise Irrigation and Value of Output in Maharashtra: 1990-93



Source: Computed from Bhalla and Singh, 2001

Further to find out the contribution of irrigation to the value of output, regression (OLS method) analysis is performed by treating the value of output/ha as a dependent variable and percentage of irrigated area (GIA/GCA) as an independent variable for the above mentioned three time points covering 25 districts. As shown earlier through descriptive analysis, the regression results also suggest that there is hardly any relationship between the level of irrigation and per hectare value of crop output across districts (Table 4.24). All this seems to suggest that irrigation is not used efficiently in the state.

Table 4.24: Relationship between Irrigation and Value of Output: Regression Results

Year	Constant	Slope	R^2
1970-73	2617.58 (5.74)[a]	-17.73 (-0.39)[ns]	.006
1980-83	3459.83 (6.24)[a]	11.23 (0.30)[ns]	.004
1990-93	3835.60 (5.99)[a]	28.15 (0.66) [ns]	.018

Notes: a – significant at 1 per cent level; ns – not significant.
Figures in brackets are 't' values.
Source: Computed using data from Bhalla and Singh, 2001

Policy Suggestions

Among the important policy recommendations which emerge from this analysis the following may be underlined: (i) Irrigation policy should be focused on completion of on-going projects, even if it means foregoing new projects; (ii) Watershed Development Programmes (WDPs) must become central, and not marginal, to agricultural growth in Maharashtra. Despite the rhetoric, only 15 per cent of the total area, which potentially lends itself to this programme has been so far covered. There is, therefore, an imperative need to launch a massive WDP designed to cover the bulk of the area within a short period of time. In fact, the year 2004-05 may be declared as a year of WDPs; (iii) Since users' participation is necessary for sustained development of WDPs, Government of Maharashtra should seek to involve Panchayat Raj institutions in both implementation and maintenance of projects under WDP; (iv) Government of Maharashtra should also seek foodgrains grant from Government of India for supporting massive WDPs envisaged under (ii) above; and (v) Since drip irrigation is an efficient water saving and yield enhancing technology, all potential area should be brought under this method. These recommendations are spelt out in the following paragraphs:

- Many of the projects started in different plan periods have not been completed in time, which have resulted in cost overruns besides delaying water supply to farmers. The investment required to create one hectare of irrigation under MMI sector has increased by about 17 times between third and eighth five-year plan in Maharashtra. This has happened partly due to inadequate allotment of money required for completing the projects. Therefore, priority needs to be given to those projects, which are in near completion stage (over 75 per cent construction completed) by allocating the required money. If needed, no new project should be taken up for the next five years or till the completion of all the on going projects.
- It is essential to classify different irrigation schemes/projects in the state according to their level of sickness. Ideally, sickness of the projects should be judged by the performance in achieving its objectives. However, here sickness is defined in terms of time overrun, cost overrun, planning bottlenecks, financial performance and the level of completion of different development parameters for the purpose of making strategies. The projects can be grouped into three audit categories namely A, B and C, where audit grades refer to the performance of the scheme/project. Identification of problems and remedial measures can be planned after such categorisation.
- The entire irrigation sector of Maharashtra is currently managed by five IDCs established by the state government. However, the IDCs have been facing a lot of difficulties in making resources from the market by issue of bonds and debentures due to certain reasons. This is going to severely affect the progress of irrigation development in the state. Therefore, the state government should appoint a high level committee to find out ways and means to get out of this serious problem.
- The percentage of utilisation of irrigation to the total potential created especially in MMI sector is abysmally low in Maharashtra as compared to the national average. Inadequate allocation of funds required for constructing main and sub-canals are the important reasons for this. Therefore, efforts need to be taken to increase the utilisation per cent of irrigation potential by increasing investment on the hardware aspects of irrigation development.
- Surface irrigation, which is created and owned by the government, is not equally distributed across different regions in the state. Though the unequal distribution of surface irrigation cannot be avoided because of variation in the available irrigation potential across the regions, this can be reduced to some extent by transferring water from the abundant basin to the scarcity areas. It is also possible to reduce the inequality in irrigation by investing more on minor irrigation and watershed development programmes in those regions/districts, which have less area under surface irrigation.
- Despite periodically revising as well as charging highest water rates in India, the financial performance (recovery rate) of irrigation sector is not much different from other states. One of the main reasons that emerge out from the analysis is the very high working expense is required for managing the sector. Therefore, cost cutting measures need to be strictly followed by rationalising the staff strength for each one-lakh hectares of command area. There is also a wide gap between demand raised and actual collection of irrigation charges mainly because of differences in extent of service (water supply). In order to increase the collection of water revenue, a two-part tariff can be introduced, wherein all lands included in the command area should pay a flat annual fee on a per hectare basis for 'membership' of the system which entitles them to claim water and a variable fee linked to the actual extent of service (volume or area) used by each member, as suggested by Vaidyanathan Committee Report on Pricing of Irrigation Water (GoI, 1992).
- Area under micro-irrigation (drip) has increased phenomenally (about 57 per cent/annum) since 1986 in Maharashtra, which is a leading state in India. Despite this, drip irrigated area accounted for just 4.97 per cent in the net irrigated area as of 1999-2000. Since drip irrigation has proved to be an efficient water saving and yield enhancing technology, all the potential area needs to be brought under drip method of irrigation through

properly designed developmental programmes. Presently, the rate of subsidy is fixed uniformally for both water-intensive as well as less water-intensive crops. This needs to be restructured and the rate of subsidy should be fixed based on the crop's water consumption. Sugarcane, which consumes major share of water in the state, is highly suitable for drip method of irrigation (see, Narayanamoorthy, 2001). Drip irrigation can also be promoted in all those areas/regions where there is over exploitation of groundwater.

- Since sugarcane consumes major quantum of stored water, it would be worthwhile to introduce drip on canal irrigation necessarily where sugarcane is grown. By constructing farm ponds or making use of existing wells in the command area, canal water can be stored and the same can be used for drip system. Availability of water from storage dams is going to reduce progressively due to siltation of reservoirs as well as increase in upstream watershed development works, etc. Introducing drip system in canal command areas would be handy in restoring the projected irrigation despite the reduction in water availability. Pilot projects should be introduced on major projects (where water availability is poor) under Water User's Associations so that with the experience of its functioning, it could be replicated on a large scale on all major projects for sugarcane and other crops. Adoption of drip method in canal command area would also reduce damage of land due to water logging.
- WUAs, which are expected to reduce the responsibility of the government besides increasing the water use efficiency, have made slow progress in the state so far: only about 27 per cent of net irrigated area has been brought under the control of WUAs as of December 2003. While there is no evidence to suggest that WUAs are working well at the large scale irrigation systems, a large number of studies have shown that WUAs can perform well at small scale irrigation systems. Therefore, all those irrigation systems that have less than 1000 ha of command areas should be brought under the control of WUAs. Experience from different countries indicate that it is difficult for WUAs to provide better water supply and perform all necessary duties without proper legal standing. Therefore, in order to promote the users' participation in irrigation management in an effective manner, there is a need to bring an Act, which empowers WUAs. One can only hope that "Maharashtra Farmers Management of Irrigation System Act-2003", approved by the cabinet and to be placed before the state legislature, will stimulate the users' participation by giving required legal standing.
- Though the state has made tremendous progress in WDPs since 1982, it has treated only about 15 per cent of its potential area as of March 2002. Between 1994-95 and 2001-02, about 197 thousand hectares of area, on an average per year, has been treated through various intervention programmes under the WDPs. With the current rate of growth, it may take more than 100 years to treat the entire potential watershed area, which is estimated to be 20.36 mha. Therefore, since WDPs have proved to be effective intervention programme in increasing the water availability, thereby reducing rural poverty in the rainfed areas, new strategies need to be framed to cover at least one million hectares of area through WDPs every year. While selecting areas for WDPs, priority need to be given to those regions which have (a) more drought-prone area, (b) lower irrigation development and (c) lower utilisation of irrigation potential. Greater emphasis should also be given for non-engineering and vegetative prescriptions and interventions for improving the productivity of the land and to obviate runoff.
- Currently, WDPs have been operated by different departments/agencies in the state without any coordination by any single agency. As a result, the overall working conditions of WDPs including utilisation of allocated funds are not clearly known. Therefore, by developing a convergent approach between various departments not only the funds can be utilised meaningfully but the areas for WDPs can also be selected appropriately for treatments.
- Demand-supply scenario of water is not very comfortable in many main and sub-basins, although the state level position is expected to be satisfactory upto 2030. Projections indicate that

demand for irrigation water is expected to increase by 182 per cent between 1996 and 2030 at the state level. While no single strategy is going to solve the water scarcity problem, there is an urgent need to formulate appropriate strategies to reduce the demand for water. While watershed development programmes and reuse of municipal waste water may enhance the supply of water, volumetric pricing, turn-over system of irrigation management, appropriate cropping pattern, large scale adoption of micro-irrigation, etc., can reduce the demand for water. Measures such as demand management and supply reassessment are necessary in water scarce Krishna basin. Policies on water resource development and management should be different for water surplus and water scarce basins. The state also should study the feasibility of transfer of water from water surplus basin to water scarce basin keeping in view the future demand for water.

- There is no doubt that bold reforms are needed in order to sustain the huge irrigation sector. But, at the same time, the performance of irrigation sector should not be judged only on the basis of financial recovery rate (direct revenue) as the gross benefits of irrigation are substantial through they cannot be easily quantified (Gadgil, 1948). As suggested by a recent World Bank (2002) study on Maharashtra, "meaningful and sustainable reform in the water sector require a well thought through strategy for change, and a commitment to participation of and communication with all interested parties. Since most of the changes involved are difficult to implement, strong political leadership and commitment are required to make things happen" (World Bank, 2002, p.56).

- Finally, since irrigation sector of Maharashtra is the largest in India, it is essential to establish Water Regulatory Authority (WRA), similar to State Electricity Regulatory Commission (SERC), to manage and suggest strategies for improving the performance of irrigation sector as well as to solve all water related disputes take place within the state. Water rates for different purposes and working expenses needed to maintain the sector should be approved by WRA.