An initiative towards saving of water and sustainable Irrigation Management in Maharashtra State, India.

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Abstract
Maharashtra State is the third largest state in India. The state has created irrigation potential to the tune of 3.812 Mha. But the state lags in utilisation of created potential. As irrigation consumes 75% to 80% of water resources, organisation of water for irrigation would benefit other sector. Water saving measures are also more important in the context of growing population and water scarcity.

To improve upon performance of irrigation sector, which is wholly governed by government, a total approach has been adopted. An approach involving policy reforms, technological and managerial interventions have been undertaken. All-round measures which includes capacity building of personnel as well as institutions, also public awareness campaign to promote participation of users, have been undertaken.

The reforms in irrigation sector have received general acceptance. Its successful implementation has resulted in remarkable water saving. The reforms have also improved financial performance of irrigation project, with O&M expenses being recovered through water charges.

With all-round reforms in water resources management and its successful implementation, Maharashtra State has emerged as one of the best performing state in India.

1.0 Introduction

Maharashtra State, is situated in the southwest of India. The geographical area of state is 30.8 Mha, with cultivable area of about 22.5 Mha. It is the third largest state in India. As per 2001 census, the population has touched to a figure of 100 million.

Agriculture has been the prominent occupation to provide food and fiber to the growing population of the state. The state economy is dependent upon agriculture production. Irrigation facility is regarded as the key element of irrigated agriculture. The modern agriculture and irrigation practices play a key role in alleviating rural poverty.

1.1 Climate and Rainfall

The state has a tropical climate. The annual rainfall varies from 400 mm to 6000 mm. The average rainfall of state is around 1300 mm of which 88% fall during June to September and remaining between October to December. It has therefore a greater impact on state's water resources planning.

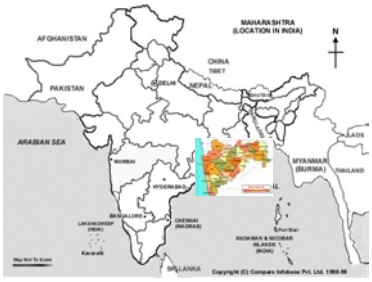

Fig.1 Map of India showing location of Maharashtra

1.2 Surface water resources

The geographical area of the state is divided into basins of Krishna, Godavari, Tapi, Narmada and narrow basins of west flowing rivers of Konkan. The average annual availability in above basin is anticipated as 163.82 BCM, out of which permissible use as per inter-state tribunal award is 125.94 BCM.

1.3 Irrigation potential created

Hardly 0.274 Mha irrigation potential was created in the state during pre plan period i.e. prior to 1950. As agriculture is prominent occupation, the state has concentrated upon construction of irrigation projects. There was manifold increase in irrigation potential creation, The state has created 3.815 Mha irrigation potential using surface water resources by 2002. The state has constructed almost 2700 major, medium and minor irrigation projects, around one half of the country's total population of dams. The ultimate irrigation potential, through both surface water and ground water resources, has been estimated as 12.6 Mha.

1.4 Scenario of irrigation management in Maharashtra (Upto 2000)

The irrigation management is done wholly by irrigation department. Collection of water demand, distribution of water and collection of water charges is responsibility of irrigation department. Over the years, the funds available for maintenance of irrigation work have also been less than requirement. There was less participation of farmers in irrigation management. This has led to poor maintenance and consequent deterioration of irrigation system.

In spite of manifold increase in potential creation, the utilization of irrigation potential remains low. Table-1 shows year-wise creation of irrigation potential and its utilization.

Table-1 Status of potential creation and utilisation.

Sr. No.	Year	Potential created Mha.	Potential utilized Mha.*
1.	1997-1998	3.228	1.202
2.	1998-1999	3.416	1.225
3.	1999-2000	3.500	1.286

* This does not include irrigated area on wells in command of projects which is about 0.48 Mha.

Reasons for low utilization can be attributed to less yield in reservoir, more non-irrigation use than that planned, more conveyance losses and less water use efficiency. Thus, to reduce gap between potential created and utilisation, there is need to improve upon water use efficiency in irrigation sector. The water conserved can be used for bringing more land under irrigation or catering need for other sector as water (upto 2000) for irrigation constituted 75% to 80% of total water use. Thus conservation of irrigation water is indispensable.

1.5 Status of irrigation assessment and recovery.(upto 2000)

It is always advisable that for efficient management of system, the O&M expenditure and part of capital investment should be met out through water charges recovery. Non irrigation water charges are charged on volumetric basis depending on it's use for industrial, domestic and other use. Irrigation charges are based on crops sown and area under crops. Irrigation charges have no relation with actual use of water. There is no incentive for saving of water. Table 2 shows yearwise status of irrigation assessment, O&M cost and recovery.

Table -2 Status of irrigation assessment, O&M cost and recovery. (upto 2000)

Rs. In Billion

Sr.No.	Year	Total assessment (Irrigation & non-irrigation)	O&M cost (Establishment + Maintenance & Repairs)	Total Recovery	% of Recovery with O&M cost (5/4*100)
1	2	3	4	5	6
1.	1995-96	1.220	4.340	0.8	18.25%
2.	1996-97	1.320	4.390	0.9	20.50%
3.	1997-98	1.173	4.308	0.8	18.95%
4.	1998-99	1.951	3.790	1.135	30.00%
5.	1999-00	2.762	4.326	1.729	40.00%

It can be seen from the above table that O&M cost itself, is not met out fully through recovery of water charges. To make irrigation management sustainable one, it is imperative to improve upon financial performance of irrigation project.

2.0 Measures initiated to improve performance of irrigation project

In above context, to overcome the poor scenario and improve the performance of irrigation project, all-round measures, policy reforms, technological and management interventions are planned and implemented

systematically. Earlier, as Joint Secretary (Water Resources) and now as Secretary (CAD), the author has played pivotal role in conceiving and implementing reforms. The measures initiated are broadly categorised as follows
a) Policy reforms
b) Administrative reforms
c) Application of State of Art Technology
d) Capacity building and public awareness campaign

2.1 Policy reforms

2.1.1 Maharashtra Management of Irrigation Systems by Farmers Bill (MMISF)

Maharashtra has an age old tradition of participation of farmers in irrigation development, for example Ex-malgujari tank in eastern Vidharbha and phad system in Northern Maharashtra. But during British rule, the control shifted from farmers to Government.

In recent times also, the Maharashtra state is pioneer in Participatory Irrigation Management (PIM). There are successful examples of Water User Associations(WUA) in various parts of the state. With this background, Maharashtra Government has made it mandatory to the irrigation beneficiaries to form WUA

To empower the users and provide justice to tail-enders and weaker section of society, MFMIS bill is brought in.

Salient features of MFMIS are as follows.

1) Water will be supplied only to WUAs'.
2) Water supply to WUA will be only on volumetric basis
3) WUAs' will have freedom for cropping pattern
4) WUA has to contribute 15% in rehabilitation work of minor
5) Tail-enders are assured about supply of water.
6) Women's representation is made obligatory in WUA.

With the formation of WUA and transfer of irrigation management to users, the job of irrigation department would remain as facilitator. This is a major break-through in water resources management where users are adequately empowered and are center of reforms.

2.1.2 State Water Policy

The national water policy has been revised in 2002. Federal Government directed states to formulate water policy of state. The state has prepared state policy encompassing state water scenario, challenges, strategies, approaches etc. The Maharashtra State is among first few state to have its own water policy. The policy has been framed considering diverse needs of different parts of the state, as state rainfall varies from 400 mm to 6000 mm as mentioned earlier. The policy emphasises on Integrated Water Resources Management (IWRM). The need for watershed management, ground water management, aquifer management is also stressed. The policy advocates river basin management. It also duly addresses drought management and measures to mitigate it. The use of new technology is encouraged in water resources management. The policy has innovative features such as water auditing, benchmarking of water resources projects, water entitlements etc. The state water policy is good example of visionary and down to earth approach.

2.1.3 State Water Resources Regulatory Authority

With growing population and water scarcity, there is growing competition among various sectors of water users. This leads to conflict among them. To overcome it, a quasi-judicial body will be established at state level. The regulatory authority will consist of a panel of experts from water resources management, economist, and river basin representative and will be headed by retired Chief Secretary. MWRRA is first such attempt in the country. It is also one of the most progressive model of regulatory authority.

It will regulate

i) Sectoral allocation
ii) Water rates
iii) Changes in water use/diversion of water use
iv) Compensation for such changes in water use

All these policy issues are first discussed in group with experts in water resources management, agriculture, economy, social science, NGO, WUA and farmers. The draft policy then discussed at regional and state level conferences involving stake-holders, municipal corporation, industrial users, WUAs', people representative, environmentalist, and farmers. Media has given wide coverage, enabling the various section of society, to share their opinion by mail or other means of communication. Necessary amendments made in draft policy considering views, suggestions during conference and after.

All these reforms are progressive and will set a benchmark in management of water resources. State cabinet has approved all these reforms. It is quite likely that in ensuing session, legislative assembly will accord necessary sanctions to the reforms.

2.2 Administrative reforms

2.2.1 Water auditing

Comprehensive water accounting method is devised, with water accounting at project level as well as at last manageable unit i.e. section office level. The water account covers each minute details, giving complete account of water. After each season, the season-wise water use is compiled, then at the end; annual water account is prepared. The water use efficiency arrived, is compared with the targeted one. In order to have effective implementation, an independent organisation is being set up for water auditing. The organisation can carry out water auditing annually as well as mid term, if needed. If the audit reveals any irregularity, then officers responsible are subjected to disciplinary action.

2.2.2 Water pricing

It is necessary for the system to be self-sustainable; the water rates for both irrigation and non-irrigation should be such that annual water charges accrued should meet the yearly O & M expenditure fully. To achieve this objective, the water rates are enhanced in 1999 by about 2 to 2.5 times of earlier water rates. The increase in water rates is largely discussed among water users and their association. ***Accordingly, enhancement in water rates is successfully implemented from September 1999 onward with built-in provision of 15% increase in water rates every year***. It is really creditable to convince the users and to effect the hike in water rates

2.2.3 Manual for operation and maintenance of irrigation system

A manual on operation and maintenance of irrigation system is prepared to provide systematic approach to O&M. It is a comprehensive document, providing detailed guideline for better O&M of irrigation system.

2.2.4 On-farm development (OFD) manual

To provide State of Art knowledge on OFD works, a manual of OFD works is prepared. It is a comprehensive document on the topic. For better on farm efficiency, the OFD works plays an important role, thus proper construction and maintenance of OFD works leads to better water conservation.

2.2.5 Project monitoring Cell

Monitoring cell will facilitate and guide field personnel in real time operation, to improve upon performance of irrigation projects.

2.3 Application of State of Art Technology

2.3.1 Irrigation status report

Irrigation Status Report is a complete document providing up-to-date information about creation of irrigation potential, water availability, season-wise irrigation, irrigation / non-irrigation water use, water use efficiency, cropped area and crop yields, assessment, recovery, status of formation of WUAs etc. for all projects in state. The purpose is to have an at-a-glance summary of the status of irrigation and to initiate action to minimize the gap between irrigation potential created and utilization. Over the last three years, the status report was made widely available to the sections of society. This Report provides increased transparency amongst stakeholders, accountability amongst department personnel leading to improvement in overall water use efficiency.

2.3.2 Benchmarking report

As stated earlier, the state has been publishing status report of irrigation project annually. In search of State of Art Technology, for performance improvement of irrigation project, the state has been actively working on benchmarking of irrigation project. Last year, a report on benchmarking of irrigation project for 2001-2002 has been published. The report comprises study of 84 irrigation projects hailing from different regions of the state. The regions have variation in climate, soil, cropping pattern and social condition. To have a comparison on a better footing, first comparison is made with project within the region and then externally, with the project outside the region, within the state. Benchmarking report for 2002-03 covers benchmarking of almost all Major and Medium Projects in the state

Benchmarking exercise has provided insight into project performance, which has enabled to strive for best performing practice to improve the performance of the project. It has highlighted important area of improvement and has resulted into healthy competition among project authorities.

2.3.3 Promotion of water conservation technology

With advances in technology, use of sprinkler and drip irrigation methods would conserve water to the tune of 30 to 50% respectively. Use of sprinkler and drip irrigation in command area of project is encouraged. A special assistance is provided for use of sprinkler and drip irrigation systems in command area through project funds since 1999-2000. It has resulted in increased adoption of technology. Today, Maharashtra has largest area under modern irrigation systems.

2.3.4 Use of remote sensing for assessment

The weak link in irrigation assessment is measurement of crop-wise area in each season. This is more time-consuming and moreover, there have been instances of omissions in assessment. To have correct assessment of area, use of satellite imageries for assessment of area under crop like sugarcane has been practiced since last few years.

2.3.5 Use of information technology

Today is the age of information. Thus to provide up-to-date information on water storage of dams, irrigation rotation schedule, irrigation assessment & recovery, water users association (WUA) and relevant information, a web-site www.mahagovid.org was hosted. The web-site is in English as well as in local language.

An international information center is also under process of establishment, to keep abreast with the development in irrigation management, on international scenario.

2.3.6 Research and Development

For sustainable growth of any sector, it should be backed by active R&D. The State has its own R&D set-up, to deal with challenges in water sector.

In recent years, a major thrust has been given on R&D, to provide solutions to problems faced by field personnel and farmers, especially improving water use efficiency, water saving practices, conjunctive use of water, drainage etc. Numbers of technical publications have been brought out to disseminate the knowledge. 'Sinchan', a quarterly journal is published, to provide information about R&D, case studies from field and development in the water resources management. To excel the performance and keeping pace with international standards, the concerned organisations are under-going ISO 9001:2000 certification.

2.4 Capacity building and people awareness campaign

2.4.1 Capacity building of Irrigation personnel

To bring about any positive change in organisation, it is utmost important that the personnel who are involved in implementation must be well versed with objectives and mission. There should be clarity in aims and means. This can be achieved through proper training.

A massive thrust has been given on training activity. It has been also decided that irrigation personnel should undergo training for minimum period of 3% of his/her total service period.

2.4.1.1 Study groups (Quality circles)

Various study groups involving top officials, field officers, agriculture experts, socio-economic experts, are evolved within the department to study and provide in-depth report on crucial topics of irrigation management.

2.4.1.2 Workshops/Conferences

State level as well as National level conferences are also promoted in the state to share the experience and knowledge from various parts of the country.

2.4.2 Capacity building of farmers

The trust and mutual understanding between farmers and irrigation personnel are of utmost importance. Thus capacity building of farmers is very important. It can be achieved through various training and formation of WUA . Various innovative means and methods used to reach the goal. Some of the measures are listed below.

i) Farmer's training
ii) On-farm farmer's training
iii) Farmer's camps
iv) Exhibitions
v) Study tours
vi)WUA Awareness week

2.4.3 WUA formation

As stated earlier, Maharashtra State is pioneer in PIM implementation. The pilot studies conducted so far show that the WUA functioning resulted into sustainable development. The success of PIM has resulted in general acceptance of WUA, so far 564 nos. of WUA on 0.165 Mha. are functioning satisfactorily, and over 1390 Nos. of WUA on 0.46 Mha. are under various stages of formation. Thus with WUA coming in action, role of irrigation department will remain as a facilitator.

2.4.4 Involving non government organisations

The involvement of NGO would facilitate participation of farmers in irrigation management. Participation of NGOs is encouraged to raise awareness of common people in water management. A conducive atmosphere is created at state level as well as at field level to work together with NGO in order to make reforms fruitful.

2.4.5 Educational empowerment

Water is basic for human survival, but the resource is a limited one. In order to inculcate good habits in new generation, a timely education to the youth is very necessary. An initiative is taken to design curriculum for water and its important aspects for primary to higher school.

2.4.6 Industry-institute partnership

To build positive relationship between academic institution and field, active interaction between field and institution is encouraged. Field problems are referred to nearby engineering institute, to take up as study project. Engineering colleges, agricultural universities are also involved in carrying out socio-economic study of irrigation projects. All these efforts would result into building better partnership with educational institute in community development.

2.5 Canal cleaning movement

A massive campaign of canal cleaning movement is launched. The systematic planning and deployment of 75 machinery units, timely monitoring has made the campaign a complete success. The campaign has enabled best use of machinery for productive work. It has resulted in reducing complaint about quality of work, providing satisfaction to users and reduction in M&R expenditure. Sugar factories in command area are also participated in the canal cleaning movement.

The massive campaign involving users, NGOs, people's representative resulted into "Shramdaan" (Voluntary physical work) on 30 major, 27 medium & 193 minor irrigation projects in various parts of Maharashtra State. The important aspect of "Shramdaan" was that the users were now feeling belonging to the system.

3.0 Impact of measures initiated

The all-round measures initiated, as discussed above has resulted in improvements in performance of irrigation projects and water saving. This can be manifested from facts and figures given below.

3.1 Water saving

Water use efficiency is a very important parameter in performance evaluation of irrigation projects. As the irrigation sector consumes 75%-80% of water resources, an increase in water use efficiency will make water available for other sectors. Table-3 below, show details about irrigated area, water use and water use efficiency

Table-3 Status of water availability, actual irrigation and water use

Sr. No	Year	Designed water storage Mm^3	Water availability on 15 Oct. Mm^3	% available storage with designed	Water used for irrigation Mm^3	Irrigated area * on canal MHa	Water use efficiency Ha/Mm^3	Remarks
1	99-00	26716	25271	95	16037	1.286	80	
2	00-01	26748	18947	71	13575	1.298	96	Less water yield in reservoir
3	01-02	28062	17817	63	12346	1.250	101	
4	02-03	28715	18936	66	12955	1.315	101.5	

* This does not include irrigated area on wells in command of irrigation projects, which is about 0.52 Mha.

a) Water requirement for 1.315 Mha irrigation with previous Duty $1.315 \times 10^6 / 80$ = 16437 Mm^3

b) Water requirement for 1.315Mha irrigation with improved Duty $1.315 \times 10^6 / 101.5$ = 12955 Mm^3

So saving of water (a-b) = 3482 Mm^3

It can be seen from the above table that yields available for year 2000-01 to 2002-03 is lower as compared to year 1999-2000. However, there is increase in irrigated area. In other words, with water use efficiency of 1999-2000, the water required for irrigating 1.315Mha area could be 16437 Mm^3, but due to improved water use efficiency, the water requirement reduced to 12955 Mm^3, which ultimately resulted in saving of water to the tune of 3482 Mm^3. There is 21% saving of water as compared to earlier performance. It is indeed a remarkable achievement in conserving irrigation water.

3.2 Improvement in financial performance

As discussed earlier, O&M expenses are reduced through various efforts of downsizing establishment and participation of mechanical organisation, sugar factory and users in maintenance of canal system. With the increase in water rates, simultaneous efforts were made for effective assessment and recovery of water charges. Table-4 below shows status of O&M assessment and recovery of water charges.

Table-4 Present status of irrigation assessment, O&M cost and recovery

Rs. in Billion

Sr. No	Year	Total irrigation assessment	O&M cost (Establishment +M&R)	Total Recovery	% Of recovery with. O &M cost
1.	1999-00	2.762	4.326	1.729	40%
2.	2000-01	4.375	4.900	1.953	40%
3.	2001-02	4.535	4.500	2.516	56%
4.	2002-03	4.750	3.700	3.780	102%
5.	2003-04	5.050	3.500	3.800	109%

It is very well seen from the table that during last two years, O&M cost including establishment cost is fully recovered through recovery of water charges, which is a step in the direction of sustainable development. It is first such example in the country to meet O&M cost through water charges recovery.

A constant monitoring and effective application of new techniques and innovative ideas have been tried to improve financial performance of irrigation projects. There is positive outcome of the measures under-taken by the Irrigation Department. The recovery percentage reached to 109% of O&M cost. The initiatives taken so far have clearly shown the improvement of financial performance of irrigation projects, which will be continued in future, making the water resources management, a sustainable one.

4.0 Conclusion

Irrigation is a key element for agricultural sector. The state has achieved a landmark in irrigation potential creation, but performance in potential utilisation remains comparatively low. It was high time to work upon minimising gap between the two, and conserve irrigation water to make best use of available water resources.

To improve water use and overall performance, all-round measures have been initiated, which includes policy reforms, technological and managerial intervention at appropriate time. A strategic planning and effective implementation coupled with timely monitoring and evaluation has resulted in improvement of performance. No doubt, the conducive environment building to bring desired change has played important role. Development of human resources, improvement of institutional capabilities, are key to successful implementation.

With consistent efforts during last two consecutive year, O&M expenses are fully recovered through recovery of water charges. A beginning in performance improvement will go a long way in making irrigation sector of the state, self sufficient and sustainable one, in years to come.

A total approach to improve the water use efficiency of irrigation has resulted into remarkable improvement in efficiency, with water saving of 3482 Mm^3 . In other words irrigating same area with 21% less water as compared to previous years. Each drop of water saved is water generated and in water scarcity situation its importance is even more valuable. With timely and appropriate reforms and application of state-of-art-technology, Maharashtra state has set a new paradigm in water resources management.