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Irrigation performance benchmarking in Maharashtra

by

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Acknowledgement

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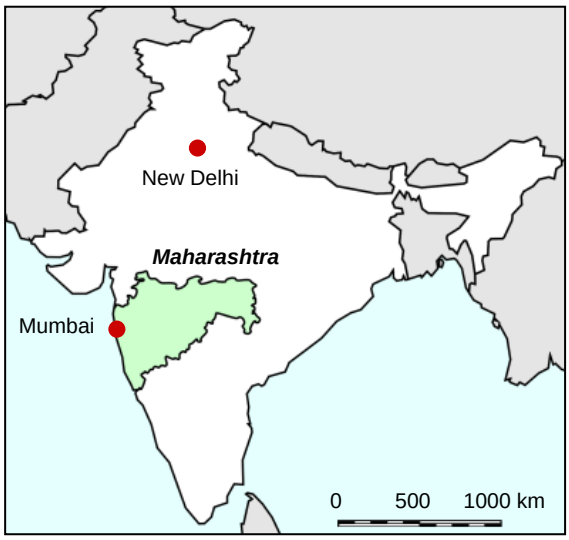

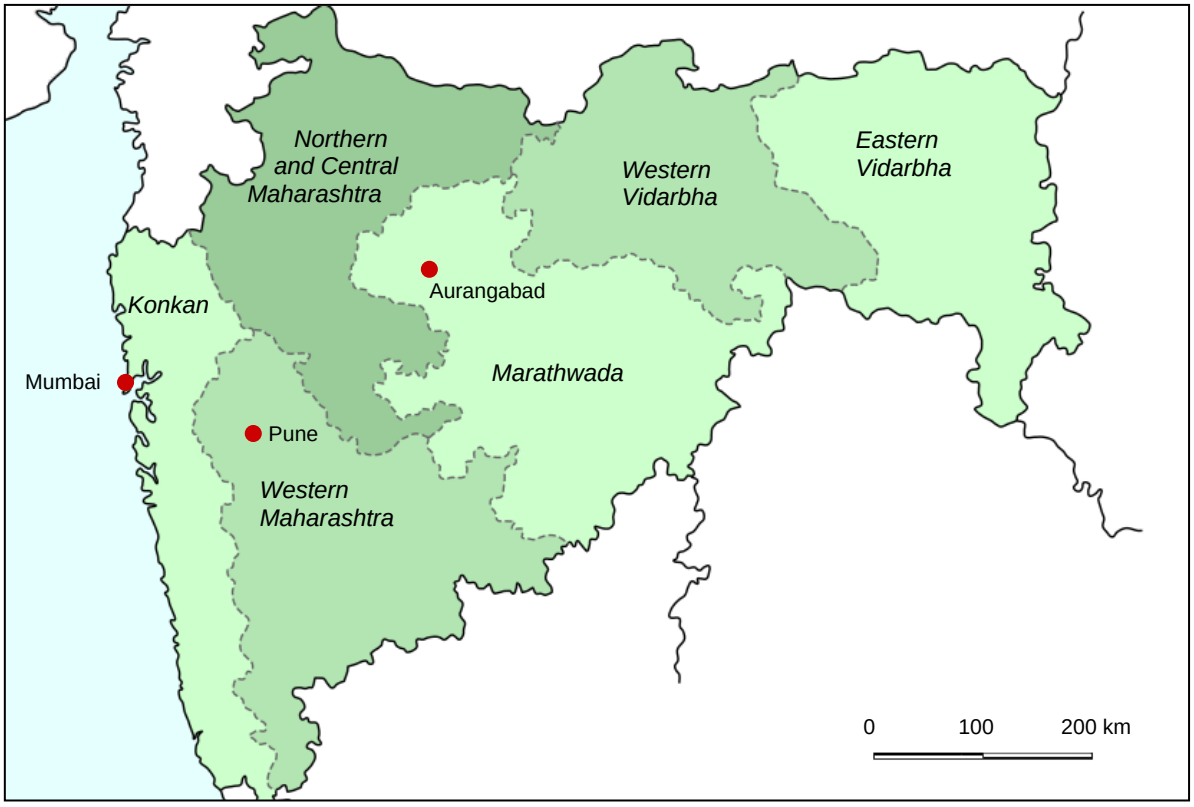

Acronyms and abbreviations

GOI:	The (central) Government of India
GOM:	The (state) Government of Maharashtra
ISP:	Irrigation system performance (ha per Mm3)
O&M:	Operation and maintenance
Mha:	Million hectares; 1 Mha = 10,000 km2
Mm3:	Million cubic metres
MWRD:	Maharashtra Water Resources Department
MWRDC:	Maharashtra Water Resources Development Centre
PIP:	Preliminary Irrigation Programme
Rs:	Indian rupees
USD:	US dollars
WUA:	Water user association

Glossary

Crore: 10,000,000 (100 lakhs)

Dry season (in Maharashtra): November/December to March/April

Hot weather season (or pre-monsoon season) (in Maharashtra): March-April to May; the cropping season lasts to June/July

Irrigation potential: The area covered by irrigation infrastructure (whether used or not)

Irrigation potential utilization: The area where the irrigation infrastructure is actually used

Kharif (rainy) cropping season (in Maharashtra): June to November/December

Monsoon (in Maharashtra): The southwest monsoon occurs in June-September, and the northeast monsoon in October-December

Non-irrigation water uses can be domestic and/or industrial

PIP (Preliminary Irrigation Programme): The annual plan for water availability and allocation for a specific irrigation scheme

Rabi (spring crop) (in Maharashtra): October/November to January/March

Wet season (in Maharashtra): June/July to September/November

Summary

Monitoring of irrigation systems can highly contribute to returns on the substantial investments in their construction, operation and maintenance.

Maharashtra has an area of 307,780 km2, of which 225,000 km2 is cultivable. 20 percent of the cultivable area is served by irrigation infrastructure.

The State applies water auditing (since 2003-04) and performance benchmarking of irrigation systems (since 2001-02). Recently, benchmarking of WUAs has been initiated on a pilot basis, in support of their operation and welfare of their members and society at large.

Today, performance benchmarking is conducted for 262 schemes. The benchmarking is based on a set of 12 indicators, covering system performance; agricultural productivity; financial aspects; environmental aspects; and social aspects. Findings are compared with past performance of each scheme; with the parallel performance of similar schemes; and with applicable state norms and targets. The process identifies opportunities for improvements and provides indications on appropriate measures to activate the full potential performance.

Methodologies, findings and related observations are comprehensively reported and published on the Internet.

The present paper introduces the work and makes some observations on approach and benefits. Related water auditing modalities are described in a separate paper.

1 Introduction

In Indian culture it is said that water is life. With the development of industries, and increasing domestic consumption, the water available for agriculture is decreasing every year. It has become necessary to use water in a very stringent manner.

Irrigation is the major off-stream water user in many Asian river basins - the present allocation in Maharashtra is between 70 and 75 percent, which is less than the demand. Making good use of the available water is a critically important management task, and even more so when the resource is finite. Also, irrigation infrastructure is expensive, and the returns on the investments must be monitored and optimized.

In support of these good purposes, the Government of Maharashtra has conducted annual performance benchmarkings of irrigation systems since 2001/02, initially covering 84 schemes and presently covering 262 schemes, including 73 percent of the major ones and 62 percent of the medium ones.

Over the period, the actually irrigated area has increased from 1.7 to 2.7 million ha, and the revenue recovery has increased from 60 to 150 million USD (Rs 252 to 673 crores)[1].

The present paper describes the procedures and exemplifies the findings.

Performance benchmarking of water user associations, recently introduced on a pilot basis, is summarized in Appendix 1.

Maharashtra's equally successful water auditing of irrigation systems is described in a separate paper (Chivate, May 2010).

2 Maharashtra at a glance

Geography

Maharashtra has an area of 307,780 km2, which is 9 percent of the area of India. The State has a 720 km coastline along the Arabian Sea. The western hill ranges (or ghats) are almost parallel to this coastline. The State is divided into two physiographic regions, separated by the ghats: Konkan to the west and the Deccan Plateau to the east, with altitudes around 300-600 m. Maharashtra is bordered by Gujarat to the northwest, Madhya Pradesh to the north, Chhattisgadh to the east, and Andhra Pradesh, Karnataka and Goa to the south.

Irrigation development

Maharashtra State as of today came into existence in 1960. The increasing population was facing shortage of food grains. This has led to the need of increasing agricultural production. By giving priority to agricultural development, attempt has been made to achieve irrigation development in a planned manner. Adequate, timely and reliable

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[1] At an roughly indicative exchange rate of 45 Rs per USD

water supply is of paramount importance in agriculture, and irrigation development plays a key role in alleviating rural poverty.

Some 0.3 Mha of irrigation potential had been created in the State during the pre-plan period (before 1950). Today, the irrigated infrastructure covers 4.5 million ha, as compared with a potentially irrigable area of 12.6 million ha (that includes groundwater irrigation potential).

The state has 806 registered water user associations (WUAs).

3 Irrigation benchmarking - what, why and how?

What is benchmarking?

Benchmarking can be defined as a systematic process for securing continual improvement through comparison, using indicators, with relevant and achievable internal and/or external norms and standards. It can compare past and present performance; and/or compare the performance of (otherwise similar) entities; and/or compare the performance against a relevant set of *'best practices'.*

Benchmarking is a powerful and widely accepted management tool for analyzing and improving the performance of water resources projects.

A utilization gap

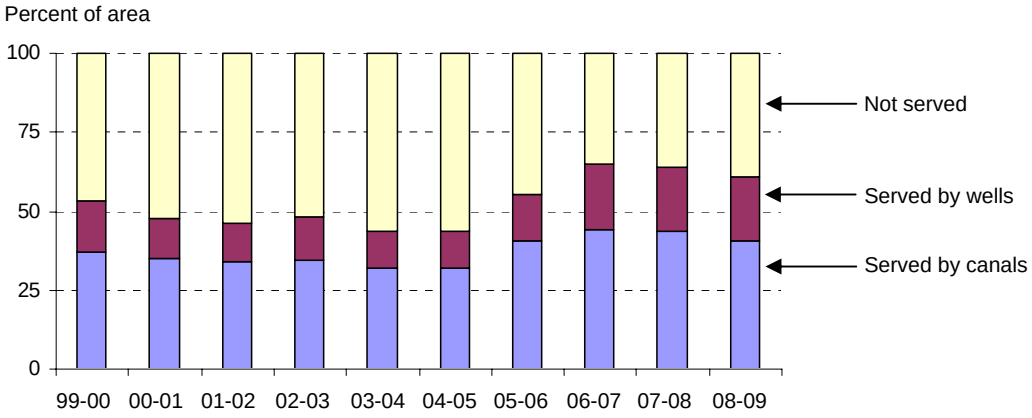
The potential benefits of a performance benchmarking are illustrated by a visible and persistent gap between the area covered by irrigation infrastructure and the area actually cultivated, as indicated below. The gap is decreasing, but mostly due to a larger area served by wells.

Table 1: Potential and actual irrigated area

Year	Irrigation potential	Actually served by canals	Actually served by wells	Actually served, total	Actually served, total
	Mha	*Mha*	*Mha*	*Mha*	*Percent of potential*
1999-00	3.50	1.29	0.58	1.87	53
2000-01	3.71	1.30	0.47	1.76	47
2001-02	3.70	1.25	0.46	1.71	46
2002-03	3.81	1.32	0.52	1.84	48
2003-04	3.86	1.24	0.44	1.68	44
2004-05	3.91	1.26	0.44	1.70	43
2005-06	4.00	1.62	0.60	2.21	55
2006-07	4.13	1.83	0.85	2.68	65
2007-08	4.33	1.90	0.87	2.76	64
2008-09	4.49	1.83	0.91	2.73	61

Source: MWRD (Mar 10b)

Figure 1: Utilization of irrigation potential (the area that can be irrigated)



Source: MWRD (Mar 10b)

The reasons for the incomplete utilization are as follows:

i) Raw water shortage

ii) Diversion of irrigation water to non-irrigation uses

iii) A tendency of farmers to grow cash crops which are highly water intensive like sugarcane, banana

iv) Low utilization during the kharif (rainy) season

v) Reduced storage capacity due to siltation

vi) Poor maintenance of the infrastructure due to financial constraints

vii) Lack of participation of beneficiaries in the irrigation management

A more detailed analysis shows that the areas irrigated in the kharif and rabi seasons have increased markedly over the period, while the area under perennial irrigation has gone down.

Benchmarking in Maharashtra

As the first state in India, The Government of Maharashtra has undertaken benchmarking of selected irrigation projects since 2000-01. Since then, benchmarking has been introduced in other states, building on the experience gained, and with encouragement from the Central Water Commission.

Initially, the exercise was conducted for 84 projects, using 10 performance indicators. The number of projects was increased to 254 in 2002-03 with 11 indicators. Today, the benchmarking covers 262 projects, using a set of 12 indicators.

Instead of presenting the data of all these projects individually, an irrigation circle was considered as a unit for evaluation of performance. It was observed that some of the characteristics of projects under a circle are not identical, and from 2003-04, to improve the validity of the comparison, projects under a circle in a sub basin are grouped together and the comparison is made with other projects in the same group.

4 Approach

4.1 Coverage

Benchmarking is a comparative exercise. It identifies opportunities for performance upgrading by comparing past and present performance for each scheme, and/or by comparing the present performance for a group of schemes. Each and every scheme has its particular individual features, but it is a basic assumption that schemes that are compared are indeed suited for comparison. Therefore, the benchmarking has been conducted for selected schemes with the following characteristics:

- Manual control of water allocation (as compared with fixed control and automatic control)
- Supply-oriented water allocation (as compared with demand-oriented allocation)
- Surface water as the raw water source (as compared with groundwater or a combination).

Further, the schemes are grouped according to their size and the water availability, in order to ensure the validity of the comparisons, as shown below.

Table 2: Schemes included in the 2008-09 benchmarking

Plan group	Major	Medium	Minor	Total
Highly deficit	1	27	7	35
Deficit	14	54	31	99
Normal	20	30	15	65
Surplus	3	22	4	29
Abundant	10	12	12	34
Total	48	145	69	262

4.2 Methodology

Benchmarking guidelines were prepared by the Indian National Committee on Irrigation & Drainage (INCID) in 2002. Today, Maharashtra applies its own benchmarking guidelines.

The following steps are taken:

- Irrigation projects are selected, representing the main geographical regions and different scheme categories, as described in Section 4.1.
- For the sake of consistency, a continuity of the projects is aimed at from year to year.
- Data are collected from the field officers in a spreadsheet with 30 columns, supported by notes and explanations.
- The data about water use and irrigated area are correlated with the related water accounts.
- Each indicator is presented as the latest 5-years average, as well as for the previous and present year, in order to compare past and present performance.
- Also, the indicators are compared to state targets, some of which relate to all schemes, while others depend on the size or the water availability.
- Comparisons are made within the categories of project size and water availability.

- Reasons for deviations are requested from each circle.
- Target values are revised with experience gained in the process.
- For financial indicators (of output per ha and per m3), fixed prices (of 1998-99) are applied, to allow for comparisons over time.

There are 2,940 completed minor irrigation projects in the State. Therefore, it has been decided to carry out benchmarking and monitoring of minor projects at circle level. Hereby, each circle can define its own targets, reflecting specific conditions of project areas, crop type, conditions of canal system etc.

4.3 Indicators

The indicators listed below have been applied since 2004-05.

Table 3: Applied indicators and targets

No	***Indicator***	***Unit***	***Target (a)***
	System performance		
1	Irrigation water supply per ha	m3/ha/year	6,667-7,692
2	Actual and potential irrigated area	(ratio)	1.00
	Agricultural productivity		
3	Agricultural production per irrigated area	Rs/ha/year	16-36,000
4	Output (agricultural production) per m3 of water supplied for irrigation	Rs/m3	2.40-5.40
	Financial aspects		
5	Cost recovery	(ratio)	1.00
6	Total O&M costs per ha	Rs/ha/year	1,150-1,250
7	Total O&M costs per m3 of water supplied	Rs/m3	0.16-0.17
8	Water fee per m3 of water supplied	Rs/m3	0.18-0.19
12(I)	Water fee recovery, irrigation	(ratio)	1.00
12(NI)	Water fee recovery, non-irrigation	(ratio)	1.00
	Environmental aspects		
10	Land damage index (b)	(ratio)	0 (c)
	Social aspects		
11	Equity performance (d)	(ratio)	1.00

(a): Targets may depend on the size of the scheme and its water availability

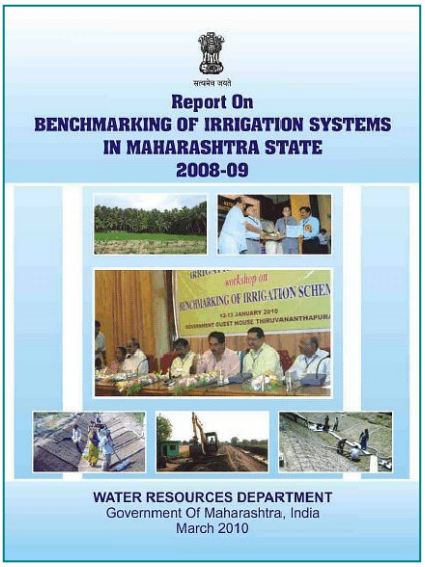
(b): Ratio between (1) land damaged (for example by waterlogging or salinisation) and (2) irrigable command area

(c): No target, should be as low as possible

(d): Describing the spatial supply coverage within the command area

4.4 Results

Results, together with the applied methodologies and related analyses and observations, are reported in detail in MWRD (Mar 10b).[2] The results are disseminated directly to the users, as well as on the Internet.



In brief, it has been observed that

- the actually irrigated area has increased;
- the irrigation water supply (m3/ha/year) has improved;
- the output per ha has improved;
- a scope remains for improving the output per m3 of irrigation water;
- the cost recovery ratio is well below the state norm; and
- the operation and maintenance costs per ha were well above the state norm.

5 Observations

Apart from the actual weather, the performance of an irrigation scheme is related to its location (and hereby the topography, the normal weather and the soil), its design, its state of maintenance, its hydraulic operation, and the cultivation. Given the purpose of a benchmarking - to improve the performance by good irrigation system management - it is important that the indicators are suited for this purpose.

Most indicators, however, reflect a combination of interacting performance determinants - which can be more or less manageable. For example, the location of the scheme is *'not manageable'* - and many old schemes were built at the best locations, while more recent (and future) schemes are located at moderately suited locations.

On the other hand, more recent schemes can (sometimes) be better designed and be more maintenance-friendly.

The economic aspects are related to the type of crop and can fluctuate over time for a given crop. Erratic weather is not manageable in itself, but can interact strongly with aspects that can be managed. Clearly, such considerations must be made when comparing benchmarking results over time or among schemes.

Indispensable information is available with operators and water users and can contribute to the recommendations, for example by conducting a dialogue about the initial findings.

The value of the benchmarking depends on the dissemination of results. First and foremost, this involves the managers/operators and the water users, with their direct interest in specific observations and recommendations related to each scheme. Also planners and policy makers have a high interest in the findings, but with different

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[2] For a summary of results for 2007-08, please refer to B A Chivate (Dec 09)

expectations to the produced knowledge and its presentation - expecting a higher degree of synthesis - with few, general and clear recommendations.

The scientific community, on the other hand, may be less interested in the conclusions and more in search of basic data with a high transparency. Other users are engineers involved in design and maintenance, and agricultural extension services.

The basic comparative analysis of the benchmarking can be supplemented with small stand-alone case studies, of well managed schemes (with high benchmark ratings), or of other specific observations, for example an innovation or a particular response to some requirement.

6 Conclusion

Benchmarking is a highly useful exercise, and particularly so when repeated over time. It can highly contribute to social and economic returns on the substantial investments in construction, operation and maintenance of the irrigation infrastructure.

Over the last seven years, the Water Resources Department has applied benchmarking as an effective tool to evaluate the performances of irrigation projects. Information is available to field officers, for ready comparison of the scheme performance with the past, with similar schemes, and with state norms.

This provides a solid basis for action plans and specific measures in support of a steady performance upgrading.

If you want to know more ...

Irrigation benchmarking in general is well covered on the Internet. Check for example the following websites:

IWMI: International Water Management Institute, Sri Lanka, www.iwmi.cgiar.org

MWRD: Maharashtra Water Resources Department, www.mahawrd.org

MWRDC: Maharashtra Water Resources Development Centre, www.mwrdc.org

PIRSA: Primary Industries and Resources SA, Government of South Australia, www.pir.sa.gov.au/

References

(All references are available on the Internet)

Chivate, B A (May 10): Water auditing in Maharashtra. CRBOM Small Publications Series no. 22. Center for River Basin Organizations and Management, Solo, Central Java, Indonesia

Chivate, B A (Dec 09): Benchmarking of irrigation projects in Maharashtra, India - a case study. IE(I) Journal, Agricultural Series, Volume 90, published by the Institution of Engineers (India)

MWRD (Mar 10a): Report on water auditing of irrigation projects in Maharashtra State 2008-09. Published annually by Water Resources Department, Government of Maharashtra, Mantralaya, Mumbai

MWRD (Mar 10b): Report on benchmarking of irrigation projects in Maharashtra State 2008-09. Published annually by Water Resources Department, Government of Maharashtra, Mantralaya, Mumbai

Appendix 1: WUA benchmarking

Benchmarking of water user associations (WUAs) has recently been initiated on a pilot basis. The purpose is to support the operation and management of the WUAs, to the benefit of their members and society at large.

11 WUAs were included in the first batch. A set of 9 indicators were applied, as listed in the table below.

Table A1.1: Applied indicators and targets for WUAs

No	***Indicator***	***Unit***	***Target***
1	WUA membership (actual versus potential)	(ratio)	1.00
2	Actual water supply as compared with quota allocation	(ratio)	1.00
3	Actual irrigated area after and before WUA was formed	(ratio)	> 1.00
4	Actual use of irrigation water	m3/ha/year	< 5,382
5	Management costs	Rs/ha/year	400
6	Revenue-cost ratio (a)	(ratio)	> 1.00
7	Remittance of government revenue (b)	(ratio)	> 1.00
8	Output per ha irrigated area	Rs/ha/year	(c)
9	Water distribution within command area (d)	(ratio)	1.00

(a): Recovered water fees as compared with expenditure
(b): Actual as compared with statutory remittance of revenue to the government
(c): As per target for irrigation system benchmarking (see Table 3)
(d): An equitable distribution is aimed at within the head, middle and tail reaches of the command areas

Appendix 2: Performance indicators

Below are given a long-list of possible indicators for consideration in a context different from Maharashtra's, as relevant from case to case. Please refer to literature and to the Internet for other (and more detailed) suggestions.

Water resources

Normal and reliable water availability, annual and available to cultivation

Live storage (capacity and actual)

Well capacity

Depth to groundwater table (year-on-year variation)

Hydraulic performance

Command area, area actually irrigated, and area actually cultivated

Water delivered to the field relative to water withdrawn from the source

Losses: Evaporation, seepage and infiltration from reservoirs, tanks and canals

Drainage capacity

Return flow

Operation

Predictability and reliability of water allocation

Water distribution over time and within command area

Contingency planning for floods, drought and pests

Social

WUA membership and WUA performance

'Consumer satisfaction' of water users; whether users feel they receive value for their fee

Water-sharing modalities, related conflicts and conflict resolution

Access to minor non-irrigation withdrawals (such as livestock)

Fish yield in reservoirs and command area

Economics

Value generated per ha and per m3 delivered

Operation and maintenance costs per irrigated ha and per m3 delivered

Staffing per irrigated ha and per m3 delivered

Cost recovery

Environment

Salinity of soils and groundwater

Waterlogging, acid soils

Use of pesticides (per ha and per value generated)

Nutrients in return flow (nitrogen, phosphorous)

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