Measuring System Performance

“Improving Irrigation Service Delivery in India” Stakeholder Consultation (National Hydrology Project) New Delhi, 15th February 2018

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Outline of this presentation

1. Introduction
2. Defining service delivery
3. The irrigation “system”
4. Performance indicators & data
5. Examples of performance assessment
4. Summary and conclusions
5. Questions for discussion
Introduction

Objective
Identify feasible options for improving efficiency of water management & systems operation in India

Purpose of presentation: To initiate discussion and seek advice on:

- Measures of system performance by scheme/ state.
- Identification of suitable performance indicators.
Performance assessment & benchmarking

“Low hanging fruit” - Low cost, high return quadrant

- Identified Action

Cost (financial, resources, effort, etc.)

Improvement in System Performance

Low

High

Low

High

a

z

m

s

b

c

p

j

Identified Action
Service delivery: Key measures
Assessing the performance of the service provider

Key measures of level of service (LoS) provision are:

- The **adequacy** of water supply.
- The **reliability** of water supply.
- The **equity** of water supply.
- The **flexibility** of water supply.
- The **cost** of the service provision.
- The **sustainability** of water supply.
Service delivery: Key elements

Payment

Service Agreement

Specifications

Conditions

Service Provider

Water User

Source: Huppert and Urban, 1998

Measurement

Management

Scheduling

Source: Huppert and Urban, 1998
Operational specifications & conditions

Core criteria

“Detailed description of the criteria for service”

- Rate, duration and frequency of supply
- Height (or command) of supply
- Pressure of supply
- Security of supply
- Delivery performance
- Measurement & monitoring arrangements

“Something required or limiting in an agreement”

- Payment for water supply
- Water ordering
- Location and nature of delivery point
- Supply restrictions
- Allocation priority
- Interruptions of supply

Source: Malano and van Hofwegen, 1999
The irrigation “system”

Setting the boundaries

Inputs/outputs to each system

1. Operation of irrigation facilities
2. Supply of water to crops
3. Agricultural production
4. Incomes in rural sector
5. Rural economic development
6. National development

Source: Small and Svendsen, 1992
“System” inputs and outputs
Core criteria

<table>
<thead>
<tr>
<th>I&amp;D System</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
</table>
|            | • Water abstracted  
 |            | • O&M of the physical system | Water delivered:  
 |            |                                   | • at the outlet (WRD)  
 |            |                                   | • to the farm plot (WUA)  
 |            |                                   | • to the crop root zone (farmer) |

<table>
<thead>
<tr>
<th>Irrigated ag system</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
</table>
|                     | • Water  
 |                     | • Labour, land, energy, seed, etc. | Agricultural produce |

<table>
<thead>
<tr>
<th>Ag – eco system</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
</table>
|                 | • Agricultural produce  
 |                 | • Markets | • Income to farmers and labour  
 |                 |                                   | • Ability to pay the ISF |
Where should we set the boundaries for measuring the main system service provider’s performance?

- To the head of the minor or distributary (for flow measurement)?
- To the final delivery point (the outlet to the chak)?
- To measuring the crop type and area in the chak (as a proxy for water delivery to the outlet)?
- To measuring the crop yield, crop production and crop value in the chak (and thus the scheme overall)?

How does this affect the performance indicators we use & the data we collect?
### Possible performance indicators

#### Main system service provider

#### Performance indicators

<table>
<thead>
<tr>
<th>Adequacy</th>
<th>Reliability</th>
<th>Equity</th>
<th>Flexibility</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ratio IPU/IPC</td>
<td>• User satisfaction survey</td>
<td>• Crop type and area</td>
<td>• User satisfaction survey</td>
<td>• Irrigation service fee</td>
</tr>
<tr>
<td>• Crop type and area</td>
<td></td>
<td>• Cropping intensity</td>
<td></td>
<td>• Total MOM expenditure</td>
</tr>
<tr>
<td>• Cropping intensity</td>
<td></td>
<td>• Fee recovery ratio</td>
<td></td>
<td>• ISF collected/MOM expenditure ratio</td>
</tr>
<tr>
<td>• Fee recovery ratio</td>
<td></td>
<td>• Delivery Performance Ratio (at disty/minor)</td>
<td></td>
<td>• Abstraction/river flow ratio</td>
</tr>
<tr>
<td>• Delivery Performance Ratio (at disty/minor)</td>
<td></td>
<td></td>
<td></td>
<td>• Groundwater levels</td>
</tr>
</tbody>
</table>

16-02-2018
## Data collection

<table>
<thead>
<tr>
<th>What to collect</th>
<th>Discharges, crop areas / types, fee, management, O&amp;M expenditure, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where to collect</td>
<td>For the whole system/ different locations within the system?</td>
</tr>
<tr>
<td>When to collect</td>
<td>During the season/ at the end of the season or year</td>
</tr>
<tr>
<td>Who collects</td>
<td>WRD/ other parties?</td>
</tr>
</tbody>
</table>

### Graph

- **jaunpur Branch Km. 56 Down As per roster**

```
0 500 1000 1500 2000 2500
```

```
```
Examples of Performance Assessment
### Base Data (10 data items)

- Distributary Committee name
- Localized Ayacut (acres)
- Paddy Irrigated Area (acres)
- ID Irrigated Area (acres)
- Total Area Irrigated (acres)
- Tax Demand (INR)
- Tax Collection (INR)
- Total O&M Expenditure (INR)
- Water Supplied (Mcf)
- Total Crop Value (INR)

### Analysis (8 Indicators)

- Distributary Committee name
- Localized Ayacut (acres)
- % Paddy
- % Irrigated Dry
- Total % CCA
- Av. tax rate/acre irrigated (Rs/acre)
- Tax Collection ratio (%)
- O&M expenditure per acre (Rs/acre)
- Tax rate to O&M exp. ratio (%)
- Av. Irrig. area per Mcft (Acres/Mcf)

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**Nagarjuna Sagar Right Canal, AP, 2008-09**
Nagarjuna Sagar Right Canal, AP, 2008-09

**Irrigated areas**

- Percentage of CCA (%)
- Distributary Committee
- % Paddy, % Irrig. Dry, Total % CCA

**Tax and O&M expenditure**

- Average tax rate/acre irrig. (Rs/acre), O&M exp. per acre (Rs/acre), Tax Collection ratio (%), Tax rate to O&M exp. ratio (%)
- Distributary Committee

16-02-2018
Madhya Pradesh, 2009-10 to 2015-16

Source: Julaniya et al, 2016
Maharashtra benchmarking
Doing performance assessment of schemes since 2001-2

2010-11: 1335 schemes benchmarked
- (86 major, 258 medium & 3108 minor)
- 12 indicators

Indicators in 5 categories:
- System performance (3 indicators)
- Agricultural productivity (2 indicators)
- Financial (5 indicators)
- Environmental (1 indicator)
- Social (1 indicator)
# Maharashtra benchmarking

**Performance indicators**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Indicator No.</th>
<th>Title of indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>System Performance</strong></td>
</tr>
<tr>
<td>1</td>
<td>I</td>
<td>Annual Irrigation Water Supply Per Unit Irrigated Area (m$^3$/ha)</td>
</tr>
<tr>
<td>2</td>
<td>Ia</td>
<td>Annual Area Irrigated per Unit of Water Supplied (ha/MCM)</td>
</tr>
<tr>
<td>3</td>
<td>II</td>
<td>Potential Created and Utilized (ratio)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Agricultural Productivity</strong></td>
</tr>
<tr>
<td>4</td>
<td>III</td>
<td>Output (Agricultural Production) Per Unit Irrigated Area (Rs/ha)</td>
</tr>
<tr>
<td>5</td>
<td>IV</td>
<td>Output (Agricultural Production) Per Unit Irrigation Water Supply (Rs/m$^3$)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Financial Aspects</strong></td>
</tr>
<tr>
<td>6</td>
<td>V</td>
<td>Cost Recovery Ratio (ratio)</td>
</tr>
<tr>
<td>7</td>
<td>VI</td>
<td>Total O&amp;M Cost Per Unit Area (Rs/ha)</td>
</tr>
<tr>
<td>8</td>
<td>VII</td>
<td>Total O&amp;M Cost Per Unit Volume Of Water Supplied (Rs/m$^3$)</td>
</tr>
<tr>
<td>9</td>
<td>VIII</td>
<td>Revenue Per Unit Volume Of Water Supplied (Rs/m$^3$)</td>
</tr>
<tr>
<td>10</td>
<td>XII(I)</td>
<td>Assessment Recovery Ratio Irrigation (ratio)</td>
</tr>
<tr>
<td></td>
<td>XII (NI)</td>
<td>Assessment Recovery Ratio Non-Irrigation (ratio)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Environmental Aspects</strong></td>
</tr>
<tr>
<td>11</td>
<td>X</td>
<td>Land Damage (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Social Aspects</strong></td>
</tr>
<tr>
<td>12</td>
<td>XI</td>
<td>Equity Performance (ratio)</td>
</tr>
</tbody>
</table>
Maharashtra indicators

Indicator I - Annual Irrigation Water Supply per Unit Irrigated Area (in m³/ha)

Indicator II – Potential Created & Utilized (ratio)
Summary and conclusions

- Performance assessment is a key management process for improving performance of schemes.

- The Level of Service (LoS) defines the performance indicators to be used and thus the data to be collected.

- It is important to define the “system” boundaries

- Three examples from India show a range of indicators used to measure performance.
Questions for discussion

Where should we set the boundaries for assessing performance (delivery only, agricultural production, value of produce)?

What indicators should we use for measuring the performance of major irrigation systems?

What data are required for these indicators and are these data readily available?
Thank you
References


Annexures
# Service Delivery
## Defining key measures

<table>
<thead>
<tr>
<th>Service quality</th>
<th>Irrigation</th>
<th>Drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequacy</td>
<td>Ability to meet water demand for optimum plant growth</td>
<td>Ability to dispose of excess water in minimal time to prevent crop damage</td>
</tr>
<tr>
<td>Reliability</td>
<td>Confidence in supply of water</td>
<td>Confidence in the ability to dispose of excess water</td>
</tr>
<tr>
<td>Equity</td>
<td>Fair share of available water and water shortage risks (e.g. Warabandi system)</td>
<td>Fair distribution of inundation risks</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Ability to choose the frequency, rate and duration of supply</td>
<td>Ability to choose the time, rate and duration of disposal</td>
</tr>
<tr>
<td>Cost</td>
<td>Cost of the irrigation service provision</td>
<td>Cost of the drainage service provision</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Ability to continue to provide water in the future</td>
<td>Ability to cope with extreme events</td>
</tr>
</tbody>
</table>

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Service delivery

Plan and reality

Design (Plan) vs Actual situation:

- Adequate & equitable supply
- Inadequate & inequitable supply
Descriptors of I&D systems

- Irrigable area
- Annual irrigated area
- Climate
- Water source
- Average annual rainfall
- Average annual ETo
- Method of abstraction (gravity, pumped)
- Water delivery infrastructure
- Type of water distribution
- Predominant on-farm irrigation method
- Major crops (type & percentage)
- Average farm size
- Type of management (Govt./farmer)
Some useful tools
GIS

Source: ADB, 2015
Web-based MIS

Source: www.mpwrdr.gov.in
Web-based MIS & performance management

### Target Achievement

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scheme Category</th>
<th>No. of Schemes</th>
<th>Culturable Command Area (CCA) (In ha)</th>
<th>Live Capacity at Full Reservoir Level (In M Cum)</th>
<th>Rabi Designed Irrigation (In ha)</th>
<th>Available Live Capacity as on 25/09/2014 (In M Cum)</th>
<th>Target Irrigation for year 2014-2015 (In ha)</th>
<th>Final Achievement till End of Rabi Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MAJOR</td>
<td>22</td>
<td>15,88,722</td>
<td>13,375</td>
<td>14,73,574</td>
<td>12,321</td>
<td>14,00,199</td>
<td>68</td>
</tr>
<tr>
<td>2</td>
<td>MEDIUM</td>
<td>90</td>
<td>3,60,012</td>
<td>2,031</td>
<td>2,19,015</td>
<td>1,421</td>
<td>2,57,815</td>
<td>199</td>
</tr>
<tr>
<td>3</td>
<td>MINOR</td>
<td>604</td>
<td>10,84,551</td>
<td>5,817</td>
<td>7,20,886</td>
<td>3,218</td>
<td>7,77,184</td>
<td>160</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>4,916</td>
<td>30,33,285</td>
<td>21,223</td>
<td>24,13,475</td>
<td>16,960</td>
<td>24,35,198</td>
<td>4,257</td>
</tr>
</tbody>
</table>

Note: Live Capacity means “Usable Quantity of Water”

Source: www.mpwra.gov.in