Modernisation of Irrigation System - An Overview

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Why Modernise?

Key issues:
• Societal behaviour is changing
• Farming systems are changing
• Better educated and more demanding water users
• New technologies available
• Performance has to improve – cannot afford to waste productive potential
• Cannot continue with build-neglect-rehabilitate-neglect scenario
• Current working practices are often outdated

Framework for analysis – Nested systems

Central concept - Improving service delivery
Focus shifted from WUE at project to overall water use efficiency - segregating beneficial and non-beneficial use, due to Scarcity of water - disparity in use - participatory efforts - social, environmental, equity and sustainability concerns - rising management issues

Modernisation is process of upgrading infrastructure, operations and management of irrigation systems to sustain the water delivery service requirements of users and optimize production and water productivity in harmony with the environment.

Modernisation process - a continuous and dynamic exercise

- **process means** - account for future changes in the irrigation system and service requirements of the farmers; ideally the process will align with existing government development and budgetary timelines and systems;
- **upgrading means** - improving beyond what is existing; not replacing or rehabilitating.
- **infrastructure means** - all physical assets related to the irrigation system;
- **sustain** - managing the water resources to account for reallocations to other users, prevent adverse depletion, and enhance resilience to climate variability and impacts anticipated from climate change.

Modernisation process - institutional reforms and strengthening

- **operations and management means** - all human resources and management processes;
- **irrigation system encapsulates** - all physical and non-physical components;
- **sustain** - the irrigation system to continue to operate at its optimal performance.

Source: ICID Working Group on M&R
Modernisation process – improved service delivery

➢ water delivery service requirements of the farmers means ensuring reliable, adequate and flexible supply of water as agreed with farmers allowing them to maximise water and agricultural productivity:
  - Farmers to be involved in planning, design and operation of the irrigation system, and in routine water management decisions;
➢ to optimise production and water productivity means - farmers must be supported through technology transfer and extension services;
  - to optimise the productivity of their land with the available water.

Challenges for Modernization Plans

• Few good examples of successful modernization
• Core modernization concepts cannot be taken for granted: service orientation, water rights, cost recovery
• Busy work schedules and people’s patience
• Low or very low performance baseline to start with
• How does one fix something they do not really understand?

Approach for solution

1. Carry out Rapid Performance Assessment
2. Identify key issues and priority schemes
3. Detailed assessment on priority schemes (incorporating asset management planning)
4. Targeted interventions to improve performance and water productivity/WUE

Analytical Approach – Comprehensive and Integrated

Physical Management Financial

Need to control and implement feasible demand management
Modernisation approach

- Basic business management approaches and tools
  ✓ strategic planning
  ✓ value chain analysis
  ✓ change management, etc.
- Asset management
- Remote sensing
- Stakeholder’s consultation

Asset management

Irrigation Modernization is a Process

- Identify the current situation
- Stakeholder consultation
- Define objectives
- Analysing problem and developing plan
- Progressively implement the plan

Modernisation steps

- Identify the current situation
- Stakeholder consultation
- Define objectives
- Analysing problem and developing plan
- Progressively implement the plan

Modernisation steps
Performance benchmarking:
- United Nations FAO RAP-MASSCOTE
- Water balances, groundwater, energy use etc.

Remote Sensing:
- NDVI for 5 Rabi seasons (medium resolution, 250 m MODIS)
- ET mapping (high resolution, 30 m Landsat) etc.

Identify current situation

Identify the current situation

Masscote

Remote Sensing for Evapotranspiration (ET) and Productivity of Water (POW)
Modernisation steps

- Identify the current situation
- Stakeholder consultation
- Define objectives
- Analysing problem and developing plan
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Stakeholder consultation

- Participatory Rural Appraisals (PRA)
- Focus Group Discussions (FGD)
- Interviews

What is the Rapid Appraisal Process (RPA)?

**RAPID**
- A few days to 2 weeks

**APPRAISAL**
- Combination of data from office and field technical, managerial, socio-economic and institutional (hardware and software)

**PROCESS**
- Holistic overview of irrigation performance
- Systematic procedures and standardized indicators

Modernisation steps

- Identify the current situation
- Stakeholder consultation
- Define objectives: Benchmarking
- Analysing problem and developing plan
- Progressively implement the plan
Benchmarking - A tool to improving performance

Defining objectives

Benchmarking - Performance Indicators

External indicators
- Examine inputs and outputs of the whole project
- Examine processes and hardware within the project
- Inside the black box

IPTRID and World Bank benchmark indicators
- Mostly external indicators from previous studies

Using benchmarking to identify improvement measures

Defining objectives

Common Challenges with Benchmarking

- Lack of good quality data and maps, especially
  - Rainfed vs. irrigated vs. groundwater areas
  - Groundwater pumping
  - Information scattered among different agencies
  - Lag times in processing
  - Sensitivity about some data (eg, budgets)

- People’s patience, the normal rush of consulting services
- Lack of institutional memory
Common Challenges with Benchmarking

- Hard to discern meaningful distinctions with low ratings

- Terminology, for instance:
  - Service area vs. "command area" (eg, low-lift pumps are "in" or "out")

- Some indicators are showing their age, for instance:
  - Communications (dependability of "radio")

- Capacity building, on-the-job training (not so fast...)

Benchmarking

Common Findings – Shared Lessons

- Lack of service equity
- Lack of service mentality – top-down vs. bottom-up (customer driven)
- Lack of innovation in design and engineering (same old designs, same old problems)
- Insufficient coordination between canal operations and farm irrigation needs

Common Findings – Shared Lessons

- Political interference and governance:
  - Expanding the service area (without providing water)
  - Low-lift pumps
  - Poor construction
  - Not enforcing rules and policies

- Wasted time and lack of focus, for instance:
  - Keeping hourly records of bad data?

- Lack of reasonable control and accurate measurement
- No re-regulation storage

Common Findings – Shared Lessons

- No real, comprehensive water balances
- Information management is outmoded

- Uncertainty over what the governments' real objectives are, for instance:
  - Cost recovery?
  - Water use efficiency?
  - Social, welfare and development?
  - Agricultural productivity?
  - Modernize for the sake of being modern?
Results of Performance Benchmarking: Pilot Projects 1-4

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Water Delivery Service provided by Main Canals</td>
<td>1.4</td>
<td>1.3 - 1.6</td>
</tr>
<tr>
<td>Actual Water Delivery Service provided by Paid Employee</td>
<td>1.0</td>
<td>0.8 - 1.2</td>
</tr>
<tr>
<td>Actual Water Delivery Service received at Individual Farms</td>
<td>1.2</td>
<td>1.0 - 1.4</td>
</tr>
<tr>
<td>Social Order in the Canal System</td>
<td>1.1</td>
<td>0.5 - 2.0</td>
</tr>
<tr>
<td>Cross Regulation Hardware</td>
<td>1.9</td>
<td>0.0 - 2.7</td>
</tr>
<tr>
<td>Communications</td>
<td>2.5</td>
<td>2.2 - 2.8</td>
</tr>
<tr>
<td>General Conditions</td>
<td>1.7</td>
<td>1.2 - 2.3</td>
</tr>
<tr>
<td>Operations</td>
<td>1.9</td>
<td>1.0 - 2.4</td>
</tr>
<tr>
<td>Water User Associations (overall)</td>
<td>1.0</td>
<td>0.0 - 2.6</td>
</tr>
<tr>
<td>Ability of the present Water Delivery Service to support modern irrigation</td>
<td>0.4</td>
<td>0.3 - 0.7</td>
</tr>
</tbody>
</table>

Water Delivery Service Indicators: Pilot Projects

Budgets, WUAs, Employees Indicators: Pilot Projects

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgets</td>
<td>0.2</td>
<td>0.0 - 0.4</td>
</tr>
<tr>
<td>Employees</td>
<td>1.4</td>
<td>0.9 - 1.6</td>
</tr>
<tr>
<td>Water User Associations</td>
<td>1.2</td>
<td>0.6 - 1.4</td>
</tr>
<tr>
<td>Mobility and size of operations staff</td>
<td>0.5</td>
<td>0.3 - 2.0</td>
</tr>
<tr>
<td>Computers for billing and record management</td>
<td>0.8</td>
<td>0.3 - 2.0</td>
</tr>
<tr>
<td>Computers for canal control</td>
<td>0.8</td>
<td>0.3 - 2.0</td>
</tr>
</tbody>
</table>

External Indicators – Pilot Projects

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual project irrigation efficiency (%)</td>
<td>56%</td>
<td>41 - 78%</td>
</tr>
<tr>
<td>Annual field irrigation efficiency (%)</td>
<td>46%</td>
<td>43 - 53%</td>
</tr>
<tr>
<td>Watering frequency</td>
<td>1.6</td>
<td>1.0 - 2.0</td>
</tr>
<tr>
<td>Financial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue collection performance (Collected/MOM Cost)</td>
<td>0.06</td>
<td>0.01 - 0.11</td>
</tr>
<tr>
<td>Productive Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total annual value of agricultural production (US$ million)</td>
<td>$241 M</td>
<td>$81 - 349 M</td>
</tr>
<tr>
<td>Relative cost of irrigation water (Collected water charges / Total production value $)</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>
To improve EXTERNAL indicators (crop yields, environmental impacts, economics, etc.), it is first necessary to understand and improve the INTERNAL processes.

- Communications
- Ability to measure and control flows
- Ability to re-regulate flows
- Ability to maintain water levels
- Ability to process key information and respond quickly

Defining objectives

- Identify the current situation
- Stakeholder consultation
- Define objectives
- Analysing problem and developing plan
- Progressively implement the plan

Modernisation steps

Improving WUE - Sectoral Dimensions

- Two ways to improve WUE:
  - Conserve water, reduce losses and reuse/recycle
  - Properly efficient use of water and increase allocation among competing uses while ensuring basic human needs and preserving and restoring ecosystems
- WSSD identified 4 distinct mechanism of improving efficiency
  - Improving technical/engineering efficiency
  - Improving productive efficiency
  - Improving product choice efficiency
  - Improving allocative efficiency
- Future Investments - GWP considers 3 pronged approach for future investments in improving WUE:
  - Conventional approaches of investing in physical improvements
  - Foster changes in user behaviour and
  - Developing integrated improvements in water management

Environmental Dimension

- Water use affects water quality and vice-versa to improve WUE, measures be taken to improve water quality
- Alternatives schemes under WUE improvement should be taken up after environmental impact assessment and impact assessment

Socio-Political Dimension

- Water sectoral development and management depend upon social values and political will
- Water rights, public awareness and involvement, legal and regulatory set up essential to deal scarcity
- Participation/interest of public at large is necessary while improving WUE
- Preference/interest of public at large is necessary while improving WUE
- Equity in distribution of water as well as divisible levels of beneficiaries essential to make citizens sharing responsibilities
- Social and environmental essential, before taking up WUE improvement projects
- Volumetric assessment and delivery is the only means to ensure social justice
Sectoral Dimensions to WUE (2 of 4)

➢ Economic Dimension
• Water is treated as a public property and a common good – thus prices on water delivery were low
• Low prices result into wastage and overuse and thus result into low WUE

➢ Principles of Water delivery economy
• Attention paid to WUE is directly proportional to the prices charged for water services
• Rising prices lead to increased attention and are to efficient water use
• While water prices should reflect full social costs of developing supplies, incentives to use water efficiently and rationally reflect its value in production of final commodities

Sectoral Dimensions to WUE (3 of 4)

➢ Regulatory Approach:
• Developing standards, limits use of water and use of guidelines to control quantity and quality of water into reduce water use that improve efficiency
• Imposing economic, environmental, rules regulations, standards require approach legislation
• Regulations exist legislative in developing standards and guidelines as well as act in quasi-judicial capacity to ensure compliance
• Regulatory commission may also be a custodian of Basin Plan
• Regulatory approach can only ensure improved WUE

Sectoral Dimensions to WUE (4 of 4)

➢ Sustainability of WUE in Basin Context:
• Water loss in one system sub-component may be a water gain for another sub-component
• Identification of gains and losses in time and space require water assessment, accounting and working with basin as a hydrologic unit
• Hydrological modeling, surface and ground helps in identifying such gains and losses in time and space with GIS help in the development and management
• Basin approach is also necessary to help allocation and involve different users and co-sharing states
• Basin approach is necessary if optimum levels of improved efficiencies are to be achieved

WUE under IWRM

➢ Environmental, social and economic dimensions, regulatory approach, WUE sustainability requirements in basin context all suggest IWRM to be the way out for gradually achieving optimal efficiencies
• Improving WUE under scarcity essentially requires a multi-dimensional approach, which is fairly possible under IWRM
• Judicious use of water within commands requires IWRM for achieving optimum WUE in basin context
• Implementation of IWRM may take time – present investment programmes, policies and institutional setup should ultimately merge into IWRM set up as and when it is implemented
Problem analysis – Identifying the issues

Main Problem
Unreliable, inadequate and untimely irrigation water supply

Problem
Inadequate main canal capacity

Problem
Inadequate discharge measurement

Problem
Damaged control structures

Problem
Insufficient funds for MOM

Problem
Poorly motivated O&M staff

Problem
Poor scheduling of available supplies

Problem
Poor control by O&M staff

Problem
Inadequate water supply at tail end

Problem
Unauthorised abstractions & shortages downstream

Problem
Insufficient social control at on-farm level

Problem analysis – Structuring the problem

Physical
Sediment in canal

Organisational
Damaged control structures (at intake)

Problem
Inadequate water supply at tail end of canal

Possible Root Cause
Inadequate supply of water at water source

Possible Cause
Sediment in canal

Possible Solution
Desilt canal

Problem analysis – Identifying root causes

Root cause
Improved irrigation service delivery and water management supporting increased agricultural production

Activity
Desilt main canal

Activity
Repair existing and install new measuring structures

Output
Canals able to pass design discharge

Output
Effective fee setting and collection mechanisms

Outcome
Reliable, adequate and timely service delivery to WUAs

Outcome
Fully functioning and operable canal network

Outcome
Irrigation supplies match water users' demands

Activity
Training in scheduling of available water supplies

Activity
Formation of WUA

Component 1: Irrigation system rehabilitation

Component 2: Improved system MOM

Component 3: Formation of effective, functioning WUAs

Problem analysis – Formulating a solution tree

Problem
Improved irrigation service delivery and water management supporting increased agricultural production
### Interventions:

**Physical**
- Upgrading and modernization of physical infrastructure
- Asset management planning and increased maintenance funding

**Non-physical (Main and distribution system MOM)**
- Re-engage with PIM and PPP
- Upgrade management and operation procedures
- Support for adoption of modern technology
- Capacity building and training

**Non-physical (Training)**
- Restructure and build capacity

### Core problem:

Low water use efficiency and productivity compromises water resources availability for agriculture and other users

### Causes:
- Inadequate I&D infrastructure
- Inadequate MOM of the main system
- Inadequate MOM of the distribution system
- Inadequate capacity building and training services

### Effects:
- Reduced water availability for agriculture
- Reduced water availability for domestic and industrial use
- Reduced water availability for the environment
- Low levels of farmer income
- Low levels of ISF collection and access to NIMF

### Modernisation - steps

- Identify the current situation
- Stakeholder consultation
- Define objectives
- Analysing problem and developing plan
- Progressively implement the plan
Improving Performance through PPP

➢ Requirements for PPP in service delivery

- Policy frameworks that supports PPP;
- Departments align and consider joint sharing of infrastructure for promoting micro irrigation on canal network;
- Development of pressure pipe network is allowed in place of conventional field channel and field drains;
- Integration of farmers committees and concessionnaires in producing and lifting quality goods, supply of inputs and lifting produce – agro processing and retailing;
- Governments ensure water supplies in per allocation/entitlements;
- Single window concept for all approvals;
- Agriculture insurance for monsoon failure; and
- Supporting legislation on contract farming for lifting produce from small and marginal farmers.

Improving Performance under Climate Change

➢ Additional Strategies

- Consistent watch on climatic parameters – record variability for each command;
- Study of changing demand patterns; and
- R&D for developing newer varieties to suit changed conditions.

Areas requiring reform interventions

- R&D: New budding, Breeding, Reproductive and Stabilization
- Water Productivity Enhancement proposals to save in selected areas
- BMP: Management of the distribution of water and use of water
- SAI: Storage, conveyance and irrigation efficiency
- CROP: Agriculture efforts
- INFRA: Project implementation
- AGENCIES: Management of the implementation of the projects

Implementing plan
Identifying cost-effective measures for improving performance

<table>
<thead>
<tr>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Cost (financial, resources, effort, etc.)</td>
</tr>
</tbody>
</table>

"Low hanging fruit" - Low cost, high return quadrant

Identified Action:

Management reform

Thank you