Approaches to Improving Irrigation Performance and Water Use

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OVERVIEW

• Context of irrigated agriculture
• Key messages
• Innovations
• Conclusions
Context of Irrigated Agriculture

Why performance of irrigation and agriculture is important.

- Growing population – changing diets
- Rural:Urban transition – increasing food and energy demands, rural labour shortages
- Falling contribution of agriculture to employment and GDP
- Changing role of agriculture in many HH livelihoods (ageing farmers, changing roles of women)
- Agriculture is largest user and consumer of H$_2$O; climate change
- Multiple and Competing uses of water
- Growing water constraints (quantity and quality)
SECTOR CONTRIBUTION TO GDP (%) & EMPLOYMENT

GDP contribution (%)

Agricultural employment (%)

ARUN JAITLEY - 2016 INDIAN BUDGET SPEECH

“We need to think beyond ‘food security’ and give back to our farmers a sense of ‘income security’. Government will, therefore, reorient its interventions in the farm and non-farm sectors to double the income of the farmers by 2022. Our total allocation (FY 2016/17) for Agriculture and Farmers’ welfare is INR 35,984 crore (USD 5.42 bln).”

Arun Jaitley Minister of Finance February 29, 2016
Different farmers have different needs

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>Farmer orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subsistence</td>
</tr>
<tr>
<td>Small</td>
<td>XXX</td>
</tr>
<tr>
<td>Medium</td>
<td>XXX</td>
</tr>
<tr>
<td>Large</td>
<td>XX</td>
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</table>

Improving I&D services will impact the rural community – not just farmers – support for transformation must include increasing off-farm employment.

Definitions
Definitions: Irrigation Efficiency:

- **Defined**: estimated water requirement (m$^3$) relative to water applied or withdrawn (m$^3$) from a source.
- **Application**: to assess “losses” in the distribution, conveyance, and application of irrigation water.
- **Appropriate for**:
  - Farm-scale irrigation investment and management decisions
  - Design of irrigation conveyance and application systems
  - “real-time” M&E of irrigation system operational performance
- **Limitations**:
  - Does not account for the capture and reuse of water within broader hydrologic systems (e.g., basins)
  - Can lead to incorrect water allocation and investment decisions, faulty public policy at the basin scale

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Definitions: Water productivity:

- **Defined:** Output (in kg, $, or kcal) in relation to water use (in terms of water withdrawn, applied or consumed).
- **Application:** To assess water allocation including accounting for:
  - Multiple sources of water
  - Multiple scales
  - Multiple, sequential (re)use within a basin.
- **Appropriate for:**
  - Water allocation decisions between uses (basin and farm scale)
  - Post-season performance assessment of irrigated agriculture
- **Limitations:**
  - Not applicable for operational management decisions
  - More complex to evaluate
OBJECTIVES OF IRRIGATION:

Simply:

i. provide essential moisture and transport of essential nutrients for plant growth, and

ii. leach and/or dilute salts in the soil

MODERNIZATION IS THE:

“Process of upgrading infrastructure, operations and management of irrigation and drainage systems to sustain the water delivery service requirements of farmers and optimize production and water productivity.”

Source: - Lance Gore, Arnaud Cauchois (ADB), Beau Freeman, Mike Chegwin (Lahmeyer), Ian Makin (IWMI), September 2015
MODERNIZATION

• **Understand** the real constraints – **before investing**
  
  – MASCOTTE – FAO guidelines on modernization of irrigation service:
    • What level of **water delivery service** does the system currently provide?
    • What **hardware** (infrastructure) and **software** (operational procedures, institutional setup, etc.) features affect this level of service?
    • What improvements in the various components could make a significant difference in service delivery to users?

• **Manage Irrigation Assets** for long-term performance
  
  – Current practice tends towards **deferred maintenance** (build-ignore-rehabilitate-ignore)

• **Expand use of ICT** to improve information and decision making

Innovations
Key message

Improving agricultural performance in irrigation requires:

• **Capacity** at farms and fields;
• **Technologies** to improve operation of canals and drains;
• **Enhanced management** of irrigation services
• **Leadership** and integrated actions

INNOVATIONS – FARM AND FIELD

• Surface irrigation often performs poorly, but:
  – **Improved** farmer knowledge and simple tools work;
  – **Laser grading** and levelling can transform performance and **reduce energy costs**;
  – Sprinkler, drip and trickle systems can reduce labour, fertilizer and water requirements.

• **On-farm storage** and/or **access to groundwater** enables farmers to get **better performance** from irrigation services
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BUT IMPACTS OF TECHNOLOGY ARE NOT HOMOGENEOUS

Different farms – different benefits

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>Cropping Intensity (%) Before</th>
<th>Cropping Intensity (%) After</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMALL</td>
<td>176%</td>
<td>198%</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>184%</td>
<td>200%</td>
</tr>
<tr>
<td>LARGE</td>
<td>190%</td>
<td>210%</td>
</tr>
<tr>
<td>ALL FARMS</td>
<td>184%</td>
<td>200%</td>
</tr>
</tbody>
</table>

Lesson: When examining water productivity’s contributions to broader development objectives, we must look not only at the overall benefits but also their distribution and trade-offs.

Different technologies – different benefits

<table>
<thead>
<tr>
<th>Technology</th>
<th>Water</th>
<th>Labor</th>
<th>Fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser levelling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero tillage</td>
<td></td>
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Ahmad et al., 2007
INNOVATIONS – SYSTEM OPERATIONS

Technology can:
• Provide real-time data
• Remote operations
• Improved access to information
• Offer new tools for manual system operations

But is unlikely to replace manual operations in the short-term
MODERNIZING IRRIGATION SERVICES

Simple flood irrigation:
- Construct channels
- Flood land

Supply orientated management:
- Fix cropping at design stage
- Enforce designed cropping pattern
- Control by level, maintain FSL in main canals

Modern management:
- Agree cropping pattern with water users at start of season based on available water supply
- Schedule to match demands
- Measure and monitor allocations
- Assess performance

Additional effort required to move from one level to the next


IMPROVING IRRIGATION PERFORMANCE

- Requires:
  - strengthening links between main system and farmers' fields.
  - problems identified by Chambers, Cernea in 1980s - Still is an issue

- Results
  - Expansion of groundwater use and local storage
  - Poor cost recovery, etc, etc
IMPROVING IRRIGATION PERFORMANCE

• But the solutions are not isolated in system O&M, but require:
  – Leadership to:
    • Set and support clear objectives for system managers and operators
    • Provide timely resources for operations, maintenance and repairs
    • Rewards for performance

Conclusions
Improving irrigation performance:

– **will not** automatically and/or substantially reduce (& may increase) agricultural water consumption!

– **should enable** reduced diversions from water bodies

– reducing impacts on flow-regimes

– **will reduce** return flows and agricultural pollution (lost agrichemicals)

– **must increase** farmers livelihoods and food security

Thank You

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