Measurement and action: Water accounting, Water productivity, Water Governance

Some contributions from IWMI

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About IWMI

IWMI is one of 15 research centers supported by the Consultative Group on International Agricultural Research (CGIAR).

Mission: To improve the management of land and water resources for food, livelihoods and the environment.

Where we work:

Headquarters: Colombo, Sri Lanka
In Africa: Ghana, Southern Africa, Ethiopia
In Asia: India, Pakistan, Nepal, Laos, Vietnam, Central Asia, Syria
Topics

• Putting water use into context
• Measuring water use
• Reducing water use
Which Water?

Rainfed

Irrigation
  • Surface irrigation
  • Groundwater irrigation

Recycled water / return flows
Not all water is equal. Context matters!

- Water stressed/ Water abundant
- Rich or poor countries
- Values produced
- Negative impacts
TEA
30 liters of water/cup

Rainfall - 3 to 4 m/yr
Downstream impacts?
*Is it a water problem?*
Measuring water use

Water accounting
- Inflow, Depleted use, Outflow
- How much water used
- Who uses water
- Where is water used
- Use at different scales – farm, system, basin

Water productivity
- Net benefits derived per water use
- \( WP = \text{kg or value per unit of water} \) (applied or ET)
- Use at different scales – farm, irrigation system, basin
- Depends on water and agricultural practices
Water for a food-secure world
How much water does irrigation waste?

Accounting for Water Use at Chishtian, Pakistan

Overuse is more a problem than wastage.
Real Waste is from low water productivity.
Approaches to compute water productivity

- Measured Per field Quadrats (5)
- Secondary Prod/A (2°) Prod/A (RS)

Physical Water Productivity

\[ K_{\text{grain}} \]

\[ M^3 \]

ET\(_a^{\text{predicted}}\) hydrological models

ET\(_a^{\text{SEBAL measured}}\)

- ET\(_p^{\text{predicted}}\) Penman Monteith

Actual Water Use

Predicted Crop modelling

- Temperature data
- Soils and location data
- Inputs = water, NPK...

- Total Biomass
- NPP, LAI

Predicted Remote Sensing

- Harvest Index
- Direct regression on 2\(^\circ\) data

RF+GW+SW @ canal head

- Canal Flows
- Rainfall ± interpolation

RF+GW+SW @ 2\(^\circ\) or 3\(^\circ\) level

- Water Supply

Capillary contribution

SM carry over

Inputs = water, NPK...
Use of Remote Sensing for measuring ET

Two sources of radiation:
- Solar radiation
  - visible
  - near infrared
  - short-wave infrared
- Earth Surface
  - thermal infrared
  - microwave

- Estimate Water use (ET) and Biomass, Water availability
- Available daily / monthly, cheaper now, large areas
- Translate to Irrigation advice
Jordan River
Original Hydrology

From Venot, Courcier and Molle (CA RR 9)
From Venot, Courcier and Molle (CA RR 9)
Jordan River
1975

From Venot, Courcier and Molle (CA RR 9)
From Venot, Courcier and Molle (CA RR 9)
Water for a food-secure world

Jordan River 2025?

From Venot, Courcier and Molle (CA RR 9)
Major Pathways to Meet Future Food & Water Demands

• Invest in rainfed agriculture
• Invest in irrigation
  – Improve productivity of existing systems
  – Expand irrigation – in areas where water resource development is still possible
• Promote trade from highly productive to less productive regions
• Manage demand, consume and waste less
### Change the way we manage water

<table>
<thead>
<tr>
<th><strong>Transition From</strong></th>
<th><strong>To</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploiting water resources</td>
<td>Managing Demand</td>
</tr>
<tr>
<td>New allocations</td>
<td>Reallocating water</td>
</tr>
<tr>
<td>Who is included and excluded</td>
<td>Safeguarding right to water</td>
</tr>
<tr>
<td>Developing groundwater</td>
<td>Regulating groundwater</td>
</tr>
<tr>
<td>Institutions for single sectors</td>
<td>Institutional frameworks able to deal with cross sectoral issues</td>
</tr>
<tr>
<td>Manage as per design</td>
<td>Deal with uncertainty, adaptive manage for change, data, monitoring, feedback important</td>
</tr>
</tbody>
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*Water for a food-secure world*
REFORM WATER GOVERNANCE

• By demonstrating that evidence based policy and management works best
• By providing options for policies and institutional reform
• By improved determination of water rights
• By better valuation and pricing of water that protects the rights of the poor
• By improved management systems that are equitable and gender friendly
Water Storage – a safeguard against climate variability

Re-think water storage: not only large scale reservoirs but also small village ponds, groundwater, water harvesting (i.e. soil moisture storage), virtual storage (food)

<table>
<thead>
<tr>
<th>Country</th>
<th>Water Storage (cubic meters per capita)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>4</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>43</td>
</tr>
<tr>
<td>South</td>
<td>746</td>
</tr>
<tr>
<td>Africa</td>
<td>1,287</td>
</tr>
<tr>
<td>Thailand</td>
<td>1,406</td>
</tr>
<tr>
<td>Laos</td>
<td>2,486</td>
</tr>
<tr>
<td>China</td>
<td>3,255</td>
</tr>
<tr>
<td>Brazil</td>
<td>4,729</td>
</tr>
<tr>
<td>Australia</td>
<td>6,150</td>
</tr>
</tbody>
</table>

Source: World Bank data from ICOLD
Grow more food per unit of water
Increase water productivity

Growth in yields

Source: U.S. data, U.S. Department of Agriculture’s National Agricultural Statistics Service; all other countries and regions, FAOStat.

Water for a food-secure world
Opportunities in Rainfed Agriculture

- Largest opportunities to build resilience and improve water productivity are in rainfed landscapes – low water productivity, high poverty

- Technology
  - water harvesting, supplemental irrigation
  - Field water conservation to reduce nonproductive evaporation
  - Improved nutrients
  - Drought resistance varieties

- Expand Policies to include upgrading rainfed systems
Summary - Water and Food Agenda

Change perceptions
Manage water demand – eat less, waste less
Transform water governance
Trade has important water implications
Rethink water storage – (eg groundwater banking)
Grow more food per unit of water
  Revitalize irrigation, upgrade rainfed agriculture
Water access and productivity – high poverty reduction potential
Thank you