Agricultural land and water productivities; Tradeoffs and policies

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A region with multiple stresses

- Physical water scarcity
- Land degradation
- Groundwater depletion
- Frequent drought
- Salinity
- Poverty
Water scarcity intensifying

- Many countries with chronic water scarcity
- Water for agriculture in dry areas is declining
- Climate change adds to the problems
- Energy competes
- Consequences
New water ... limited !!!!

- Surface, mostly tapped
- Ground, over exploited
- Marginal-quality, small amounts, environment, health
- Desalination, costly, environment, transport
- Water transfer, cost and politics
The challenging equation

- Rapid population growth – shrinking resources

- Food security dimensions
  - Availability
  - Accessibility
  - Nutrition
  - Safety

  to people

HLPE report on water and food security

- More food needed with less resources (esp. water)
Conventional scarcity coping strategies: insufficient !!!

1. Increasing yield (land productivity)

Great !! but needs more water

Which is not available
2. Increasing irrigation efficiency
Recycling at scale: mostly paper saving

Storage

Precipitation

Runoff recoverable

Evaporation Losses

Transpiration

Irrigation

Seepage recoverable

Drainage

Partially recoverable

Quality losses

Deep percolation

To ground water recoverable
irrigation efficiency & modernizing systems

- Efficiency reflects the performance of irrigation system and not the return to water
- Ignores recoverable losses and wrongly used to judge the whole farm water management
- Huge investment in modernizing irrigation systems aims at water savings, not real!!!
- Modern systems increase productivity for other reasons but at cost
from efficiency to productivity
Water productivity: the concept

\[ WP = \text{Unit of water consumed} \]

**What return ??**
- Biomass, grain, meat, milk (kg)
- Income ($)
- Environmental benefits (C)
- Social benefits (employment)
- Energy (Cal)
- Nutrition (protein, carbohydrates, fat)

**What water ??**
- Quality (EC)
- Location (GW depth)
- Time available

**Consumed (depleted)**
- Evaporation
- Transpiration
- Quality deterioration
### Potential water productivity improvement

#### Biological WP kg/m³

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#### Economic WP $/m³

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#### Nutritional WP Protein gr/m³

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#### Nutritional WP Calories/m³

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#### Nutritional WP Potential Water Productivity Improvement

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Scales and drivers to increase WP

- **At the basin level:**
  - competition among uses (Env., Ag., Dom.)
  - conflicts between countries
  - Equity issues

- **At the national level:**
  - food security
  - hard currency
  - sociopolitics

- **At the farm level:**
  - maximizing economic return
  - Nutrition in subsistence farming

- **At the field level:**
  - maximizing biological output
Tradeoffs between Land & water productivities

\[ y = -0.4278x^2 + 4.7328x - 0.543 \]

\[ R^2 = 0.7611 \]
Supplemental irrigation for rainfed systems

- Substantial yield increases
- Highest water productivity
- Modification of crop calendar (CC)

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Water harvesting for rangelands

- Low cost WH technologies integrated
- Mechanization, laser guided contouring, direct seedling planting
- Water stored in soils and aquifer
- Grazing management
- Combating desertification
Intensification of Irrigated systems

- Increasing water productivity
- Improving surface irrigation
- Modifying cropping patterns
Policies to foster change

- Cropping patterns: change to be more water/land productive
- Land / water: optimize for the more limiting resource
- Indicators: efficiency but also productivity
- Scale: from local to regional & global
- Secure virtual water free trade
It is a prime time for change !!!!

Thank you