Global Water Management: More Crop per Drop

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Outline

I. More Crop Per Drop
- a. Current situation
- b. Potential situation

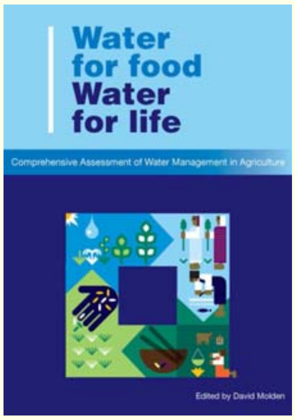
II. Field-level Water Management
- a. Rainfed Agriculture
- b. Supplemental Irrigation
- c. Soil and Water Conservation Practices

III. Watershed Management
- a. Water Trade-offs (agriculture vs. other uses)

IV. Policy Implications and Needs

Water for Food, Water for Life…

"Is there enough <u>land, water</u>, and <u>human capacity</u> to produce food for a growing population over the next 50 years—or will we "run out" of <u>water</u>?"



Comprehensive assessment

Global Outlook

Food need potentially greater than supply

- 50% more people to feed by 2050
- Increasing demand for meat, which requires more grain & water
- Competition with biofuel feedstocks
- Climate change and variability
- Market limitations
- Water scarcity: How do we meet food needs?

We must produce

More Crop Per Drop!

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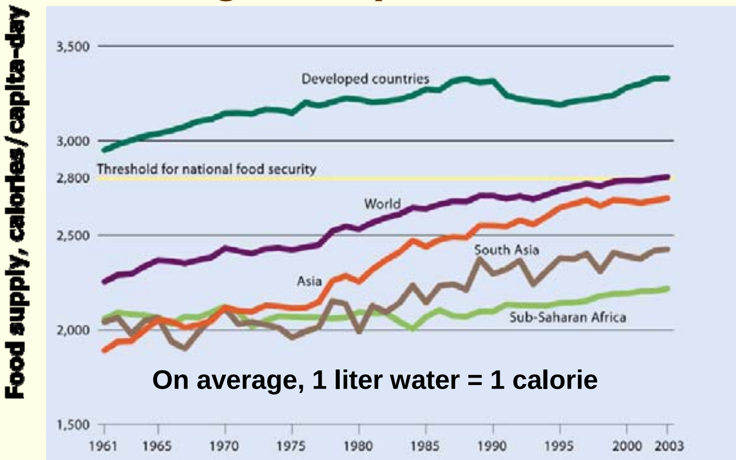
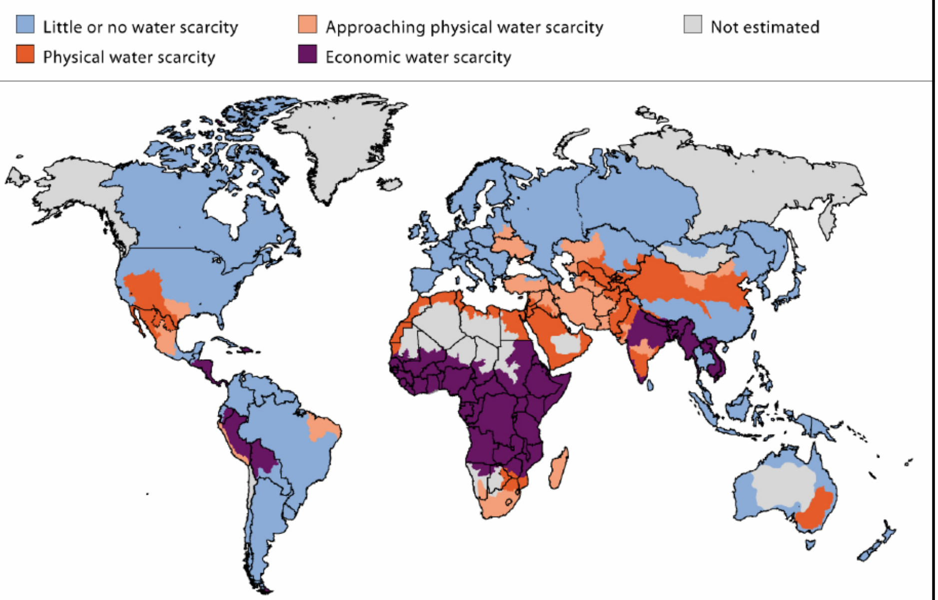
Lack of water is a key factor limiting food production



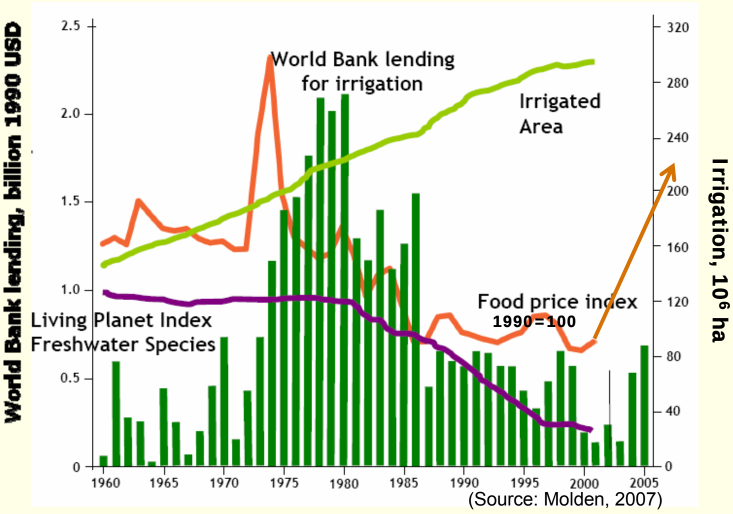
(Source :FAO, 2006 as cited in Molden, 2007)

Water Scarcity 2000



1/3 of the world's population live in basins that have to deal with water scarcity

Is irrigation the solution?

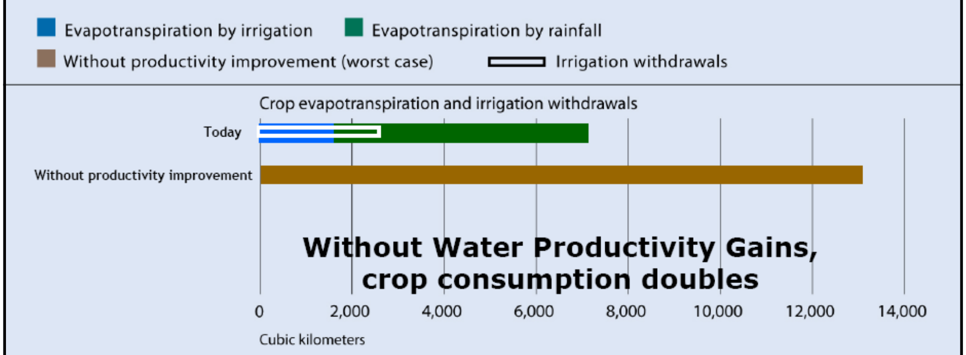


(Source: Molden, 2007)

Irrigation

- 70% of water human withdrawals
- 20% of cultivated land provides 40% of food (45% by 2030)
- Era of large public irrigation projects is over
- Some potential in sub-Saharan Africa and Latin America
- Improved irrigation efficiencies possible elsewhere
- Huge potential for supplemental irrigation to increase yields in **rainfed systems where 60% of food is produced**

Crop water consumption to 2050

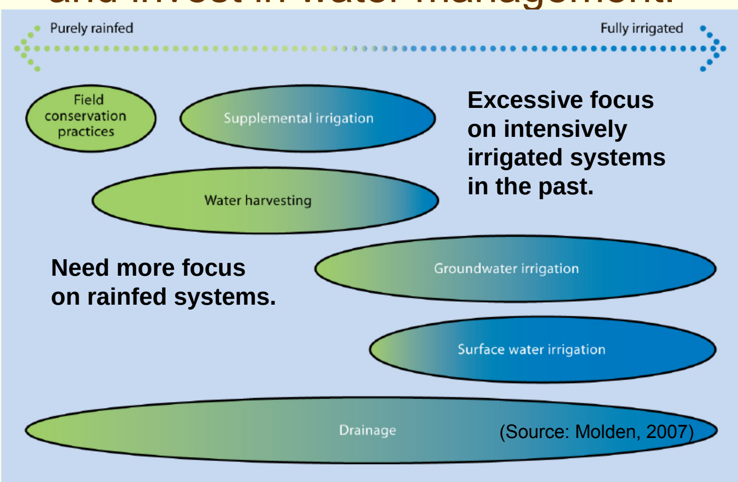


Based on IWMI WaterSim analysis for the CA

The world does not have sufficient water where needed to achieve this growth. We **must** improve water use efficiency.

(Source: Molden, 2007)

Must change the way we think about and invest in water management!



Must also consider competing water uses: municipal, industrial, and ecosystem services

Water Investment Options

Goal: More Crop per Drop

Appropriate technologies for **field scale** implementation…

- **Conventional irrigation**
- **Rainfed systems with or without supplemental irrigation**
- **Conservation tillage**
- **Water harvesting**
- **Other soil and water conservation practices**
- Alternative crops and cropping systems
- Improved nutrient management (fertilization)
- Improved seeds and pest management

Watershed/basin scale implementation…

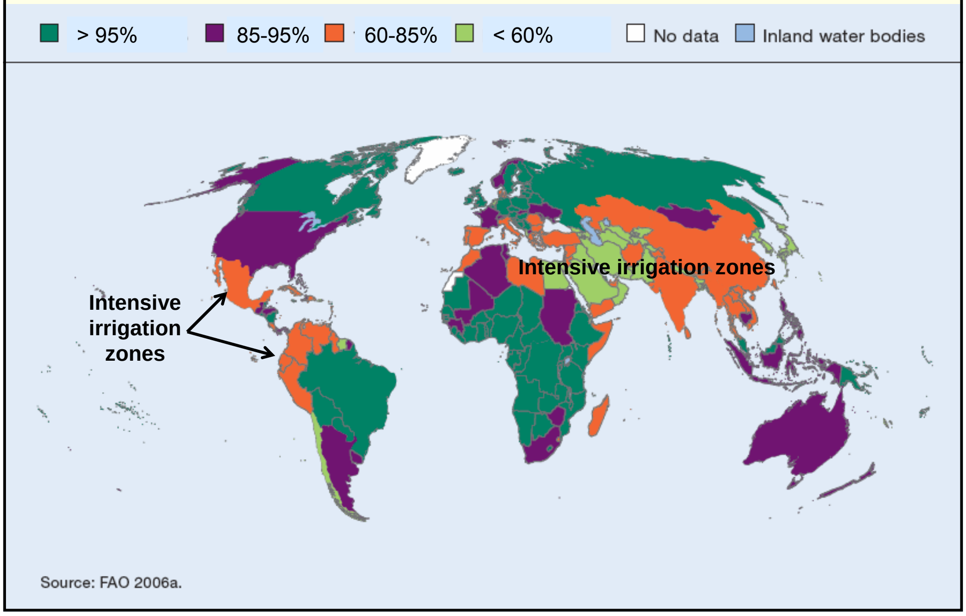
- Multi-use systems (agriculture, forestry, forage, aquaculture/fisheries, etc.
- Industrial and municipal uses
- Ecosystem services

More Crop and Value Per Drop!

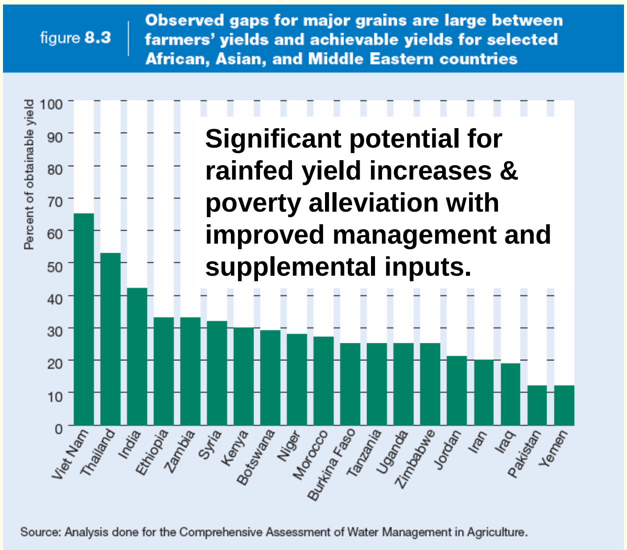
Rainfed Agriculture

- 80% of world's cropland
- 60% of world crop production
- Practiced by poorest farmers
- Key to rural poverty alleviation

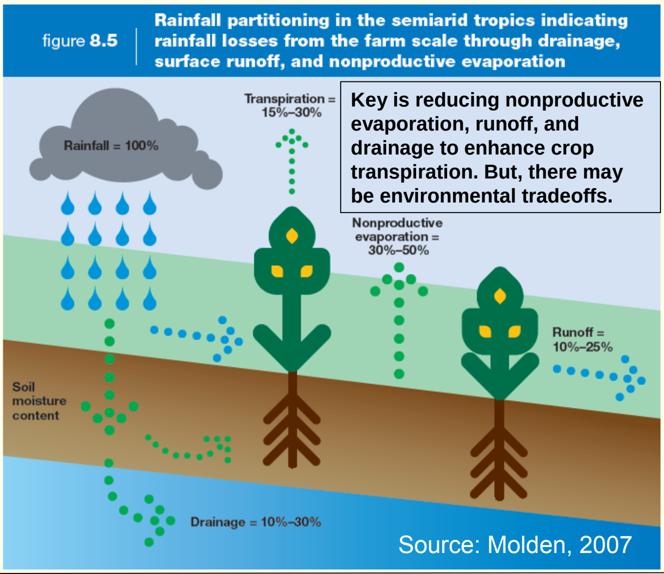
Rainfed Agriculture



Potential yield improvements with improved water management, fertilization and soil management



Rainfed Agriculture



Key is reducing nonproductive evaporation, runoff, and drainage to enhance crop transpiration. But, there may be environmental tradeoffs.

Source: Molden, 2007

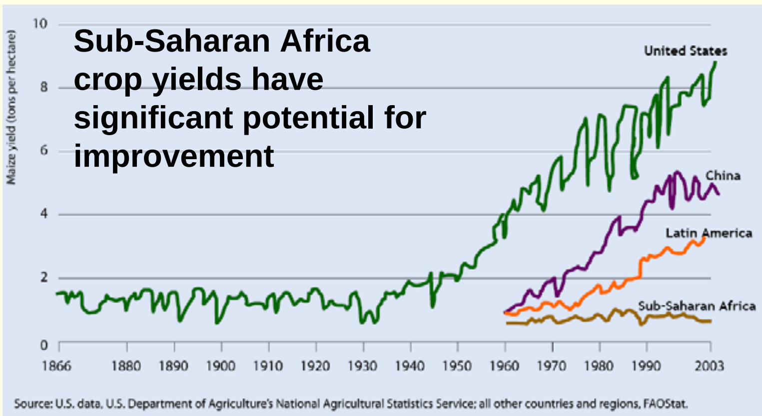
Rainfed Agriculture

- Better management of rainwater and soil moisture and supplemental irrigation are key to helping the greatest number of poor:
  - Improve yields
  - Cut yield losses from dry spells
  - Give farmers security to invest in fertilizer & seed
  - Allow farmers to grow higher value crops
- However, improved yields also require:
  - Farmer access to markets
  - Credit
  - Inputs (fertilizers, seed)
- Potential cereal yield increases of 100 to 400%.

Challenges to improving water use efficiency

- Lack of technical support for farmers using rainfed agriculture (extension services)
- Modest biotechnology improvements expected in the next 15-20 years
- High productivity regions are already efficient water users
- Inefficient management and equitable distribution of water in irrigated areas

Improving Water Use Efficiency



(Source: Molden, 2007)

Improving Economic Water Productivity

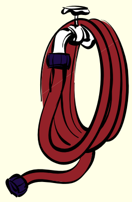
Focus on production of **higher value** agricultural or other **products** that can be exchanged for staple foods more efficiently grown elsewhere.

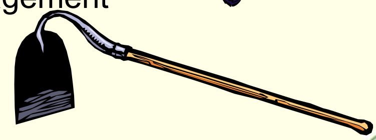
- Fruits
- Vegetables
- Trees
- Flowers
- Cereals (at current prices)
- Aquaculture

Improving Water Use Efficiency

Tools for improving agricultural productivity in **low-yielding rainfed areas**:

- **Conservation tillage**
- **Soil and water conservation practices**
- **Water harvesting**
- **Supplemental irrigation**
- **Drip irrigation**
- Nutrient management (fertilization)
- Better seeds
- Improved forage management
- Knowledge
- Adaptive management





Conservation Tillage

Replaces conventional inversion tillage with **ripping**, **sub-soiling**, and **reduced and no-till systems** using direct planting techniques and mulch management. Builds soil organic matter, soil structure, and fertility. Essential to improve water productivity.

Benefits (East and Southern Africa):
•Reduced labor needs
•Improved yields (20 to 120%)
•Improved rainwater productivity (20 to 40%)
•Improved soil quality/fertility

Requires more knowledge & management.

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Conservation Tillage

(Source: CTIC)

No-till Soybeans

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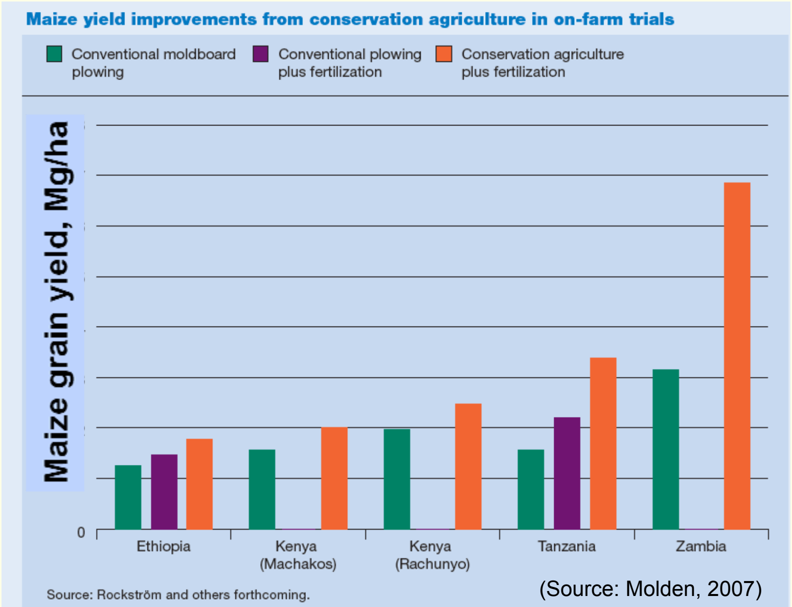
Conservation Tillage



Soil & Water Conservation Practices

Soil & Water Conservation Practices

Terraces/
Courbes de niveau

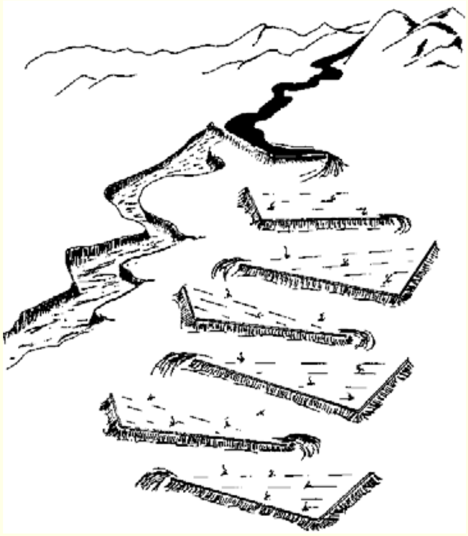
Women from the town of Koena, Burkina Faso, terrace the soil to control erosion. UN Photo #167616C

Soil & Water Conservation Practices

Contour stone bund

People from Boulzema, Koumbri and Ninuingi, Burkina Faso use small stone walls to hold the rain water on there fields. This keep the underground water level higher. Source www.flickr.com

Water Harvesting



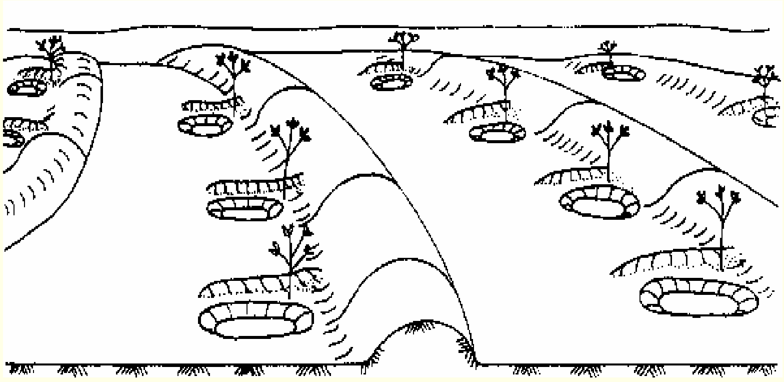
Dispersal of flood & other waters to crop production areas.

Flood water/stream harvesting (FAO)

Water Harvesting

Negarim micro-catchments (FAO)

Water Harvesting



Zai or planting pits with contour bunds or ridges

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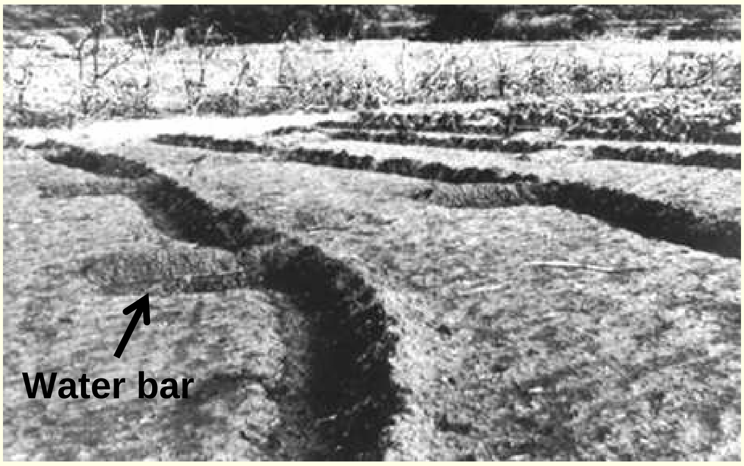
Water Harvesting



Contour Ridges

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Supplemental Irrigation

Provides additional soil moisture during **critical** crop growth periods to protect yields. Not intended to eliminate all crop water deficits. Requires reliable water source and/or storage.

Supplemental Irrigation

- Collection/storage in reservoirs/tanks
- Water from runoff, wells, and streams

Supplemental Irrigation

Treadle pump for shallow groundwater

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Drip Irrigation

- Water from streams, catchments, wells
- Can double or triple water use efficiency
- Use during critical crop growth stages and to enhance quality of crops
- Production of high value crops

Drip Irrigation

Crop	Yield Increase, %	Decline in Water Application, %	Water Productivity Improvement, %
Bananas	52	45	173
Okra	72	40	157
Potatoes	46	0	46
Tomatoes	5-50	37-39	44-145
Cotton	10-35	15-60	27-212

But, improved water management only improves productivity and livelihoods with increased access to:

- Fertilizers
- Markets
- Improved seeds
- Knowledge

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Watershed Management

- Agriculture is responsible for ≈ 70% of human water use.
- In terms of economic value, the value of non-agricultural water uses dwarfs the value of agriculture water use.
- Must manage water at the watershed/ basin scale to insure that other beneficial uses are provided for.

Watershed Management

Management at the watershed scale helps insure that all stakeholders receive their fair share of water and associated benefits and/or that they are compensated for lose of water rights.

Stakeholders/Beneficiaries:

- Agriculture
- Fisheries
- Industrial/municipal water users
- Navigation
- Ecosystem services

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Watershed Management

Tools

Models

- Biophysical and economic that can be used to quantify benefits and tradeoffs

Monitoring

- Collect information required for decision making
- Assess progress

Participatory decision making involving stakeholders to insure:

- Stakeholder buy in when tradeoffs must be agreed to
- Equity
- Increased knowledge flow
- Increased probability of success

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Watershed Management Tradeoffs

- **Win-win situations are rare.** Someone will usually lose. Need compensation from winners.
- Payments for ecosystem services
- Increased upland water productivity may mean less water downstream.
- Consultative and inclusive decision-making can reduce inequitable effects.
- Need better tools for assessing tradeoffs.
- Trade-offs:
  - Water for agriculture versus ecosystem services
  - Reallocation and over allocation issues
  - Upstream – downstream conflicts
  - Equity – productivity conflicts
  - Current versus future users needs

(Source: Molden, 2007)

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Policy Implications & Needs

- Expanded water management capacity and **knowledge** (science, government, advisory services, farmers)
- Extension and other **advisory services** with water management expertise
- **Adaptive management approach** to start improving water management, soil quality, and agricultural productivity **now**.
- Major investments in **rainfed agriculture**.
- **Integrated participatory planning** at the watershed/basin scale, which considers rainfed agriculture and ecosystem services.

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Policy Implications & Needs

- **Target women** in water management activities as they are disproportionately responsible for food production in many developing countries.
- **Target the poor** in water management.
- **Land tenure and legal water rights**
- Improved water management practices will not work unless combined with **complimentary inputs**:
  - fertilizer,
  - market access,
  - improved seeds
  - knowledge

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Policy Implications & Needs

- Manage agriculture to **enhance ecosystem services**
  - Awareness of multifunctional systems
- **Fight poverty** by improving agriculture and water use
  - Target smallholder farmers - particularly in low productivity rainfed areas
  - Compensate poor for tradeoffs
- **Change the ways we think about water and agriculture**.
  - Abandon the divide between irrigated and rainfed agriculture.
  - Urban waste water is not waste, but a resource.

Policy Implications & Needs

- **Reform the reform process - Target state institutions as they are the institutions most in need of reform.**
- The state must ensure greater equity in access and foster investments to reduce poverty.
- Water bureaucracies must address social and political issues as well as technical issues.
- Empower women and other marginalized groups.
- Integrated approaches to water management.

(Source: Molden, 2007)

Rethinking Agricultural Water Resource Investments

- How do we most effectively disperse knowledge to stakeholders?
- How do we select and implement the best water management and integrated agricultural production systems?
- How do we best engage stakeholders in negotiation, coalition building, and decision making?
- Payments for ecosystem services. Do they work? Who pays?
- **How can we get more crop/value per drop?**

Water Management Toolbox

Recommended Reading

Molden, David. 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management. Earthscan, London.

Available at:
http://www.iwmi.cgiar.org/Assessment/

Questions?

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