Improving Water Efficiency in Rainfed Agriculture

Erick Fernandes, Adviser, Agriculture & Rural Development
How can we meet food and fiber demands with our land and water resources?

The world’s available land and water resources can satisfy future food demands in several ways:

1) Investing to increase production in rainfed agriculture (rainfed scenario)
   - Increasing productivity in rainfed areas through enhanced management of soil moisture and supplemental irrigation where small water storage is feasible.
   - Improving soil fertility management, including the reversal of land degradation.
   - Expanding cropped areas.

2) Investing in irrigation (irrigation scenario).
   - Increasing annual irrigation water supplies by innovations in system management, developing new surface water storage facilities, and increasing groundwater withdrawals and the use of wastewater.
   - Increasing water productivity in irrigated areas and value per unit of water by integrating multiple uses—including livestock, fisheries, and domestic use—in irrigated systems.

3) Conducting agricultural trade within and between countries (trade scenario).

4) Reducing gross food demand by influencing diets, and reducing post-harvest losses, including industrial and household waste.

Source: IWMI 2007. A Comprehensive Assessment of Water Management in Agriculture
What policy actions are needed?

1. Reform thinking about Water and Agriculture
   • First manage rain – the ultimate source of water – then address water withdrawals from rivers and groundwater.
   • Agriculture in production landscapes – integrated ecosystem-agroecosystem linkages and multiple-use concept.

2. Improve access to agricultural water and its use.
   • Target poverty reduction with a special focus on smallholder farmers by securing water access through land and water rights and investments in water storage, soil improvement, provision of timely and reliable agrometeorological information, and delivery infrastructure where needed.
   • Support multiple-use land and water systems—operated for domestic use, crop production, aquaculture, agroforestry, and livestock to improve water productivity and reduce poverty.

3. Manage agriculture to enhance ecosystem services & optimize production-service tradeoffs
   • Good agricultural practice can yield food, fiber, fuel, and a range of ecosystem services (agrobiodiversity, carbon sequestration, water quality/quantity).
   • In most cases productivity-ecosystem service tradeoffs will need to be managed from field to watersheds and beyond.
What policy actions are needed?

4. Increase the productivity of water.
   • Gaining more yield and value from less water can reduce future demand for water, limiting environmental degradation and easing competition for water. A 35% increase in water productivity could reduce additional crop water consumption from 80% to 20%. Especially in Africa and parts of Asia, where productivity is relatively low, more food can be produced per unit of water in all types of farming systems, with livestock systems deserving attention.
   • Larger potential exists in getting more value per unit of water, especially through integrated systems and higher value production systems (agroforestry, silvopasture, aquaculture) and through reductions in social and environmental costs.
   • Distributed hydrological modeling approaches, recent and emerging remote sensing platforms, and rapidly improving downscaling techniques for regional to local climate models are already guiding land and water users and policy makers globally.

5. Re-engineer rainfed systems in close collaboration with farmers and local institutions.
   • Improve land and water conservation, enhance rooting depth via liming and judicious fertilizer amendments, use cereal-legume rotations to improve soil structure and, where feasible, provide supplemental irrigation. Rehabilitate all degraded lands!!
   • Mixed crop and livestock systems hold good potential, with the increased demand for livestock products and the scope for improving the productivity of these systems.

6. Transform existing irrigation technology and apply it to higher value agriculture and integrated food, fish, fiber production systems
   • Recent scientific breakthroughs that enable near real time field crop evapotranspiration and linking it to new high resolution remote sensing platforms will dramatically improve water use efficiency and facilitate the design of integrated cropping systems for higher yield/value per unit of water used in the next 5-10 years.
The Big Picture - production landscapes with environmental services ($$)

World Bank, 2006
Major Challenge -
Agriculture & Climate Change
• Many of the major “food-bowls” of the world are projected to become significantly drier
• Globally there will be more precipitation
• Higher temperatures will tend to reduce run off
• A few important areas drier (Mediterranean, southern South America, northern Brazil, west and south Africa)
Increase in frequency of extreme events likely

Improving Land and Water Management: Create a Dynamic Hydrology Analysis Framework
Create a Dynamic Hydrology Analysis Framework

WATER FLOWS: FIELDS TO BASINS

VIC * (Variable Infiltration Capacity)

*extensive literature in international peer-review

DHSVM (Distributed Hydrology Soil Vegetation Model) (150m)
75% of the world’s poor are rural and most are involved in farming.

In the 21st century, agriculture remains fundamental for poverty reduction, economic growth and environmental sustainability (WDR 2008).
Protect Existing Forests

• REDD (Reducing Emissions from Deforestation and Forest Degradation)
  – REDD was first proposed by the governments of Papua New Guinea and Costa Rica at an international climate meeting in 2005.
  – Stern (2006) identified avoided deforestation as the cheapest means of stemming carbon dioxide emissions. A two-thirds cut in emissions from deforestation could be done for around US$5–10 billion a year—roughly half the price of preventing a similar loss of emissions from western power generation.
  – With almost one-fifth of global carbon emissions coming from forest loss, the benefit for both the world’s climate and rainforests could be major.
  – REDD could form a key part of the package of measures that will replace the Kyoto Protocol in 2013.
Ecosystem Service - “Opportunity Costs”

- On-going studies (Nepstad, Stickler, Laporte – Woods Hole Research Center)
  - Brazil: ~ US$5/ton enough to compensate ranchers and to double the income of smallholders and rubber tappers. Total cost to reduce deforestation to zero in 10 years ~US$1.5 billion per year.
  - Central Africa: ~US$ 20-65 per ton to stop slash and burn agriculture
  - Highest cost in SE Asia due to population density and higher value, land uses e.g. rubber, palm oil.
  - Still need to resolve (1) how to protect really vulnerable forests (not cheapest!); (2) Prevent leakage (national baselines); (3) Ensure local people’s needs and concerns are considered and accounted for in managing the forests, (4) how to reward countries who have very little deforestation.
Protect Existing Forests where there is currently little deforestation

- Proactive Investment in Natural Capital – PINC (vs REDD)
- Guyana model - Ecosystem Services: 20 yr instrument
- Coupon adjusted every 5 yrs re atmospheric ppm
- Incentives for (1) rich countries to reduce emissions; (2) recipient nations to conserve forests; and (3) private investors to invest
- Pension fund interest in long term assets