Managing Water for Sustainable Food Security

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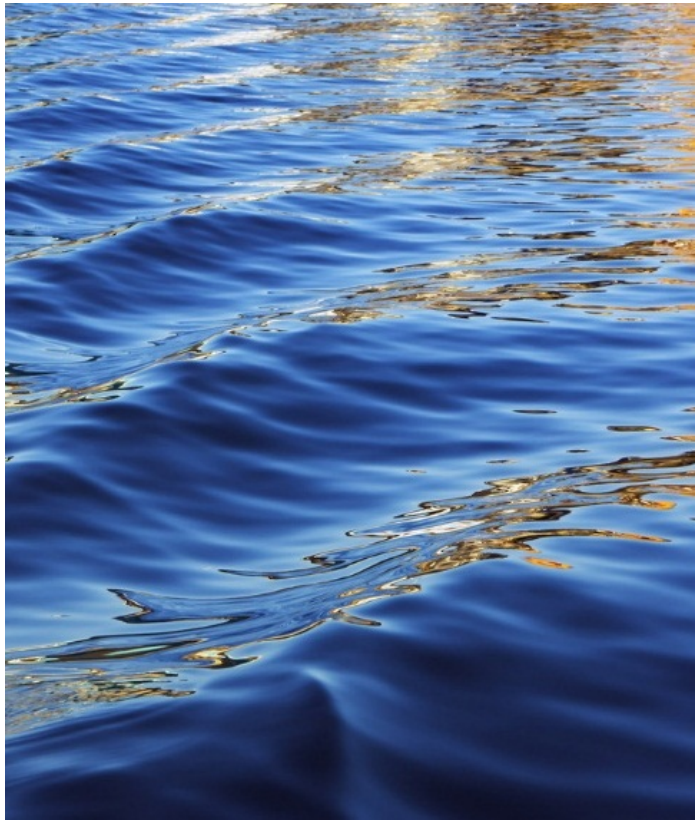
Outline

- Pathways and Challenges for Water, Agricultural Development and Food Security
- Strategies and Policies to Address Water Security, Agricultural Development and Food Security

Pathways and Challenges for Water, Agricultural Development and Food Security



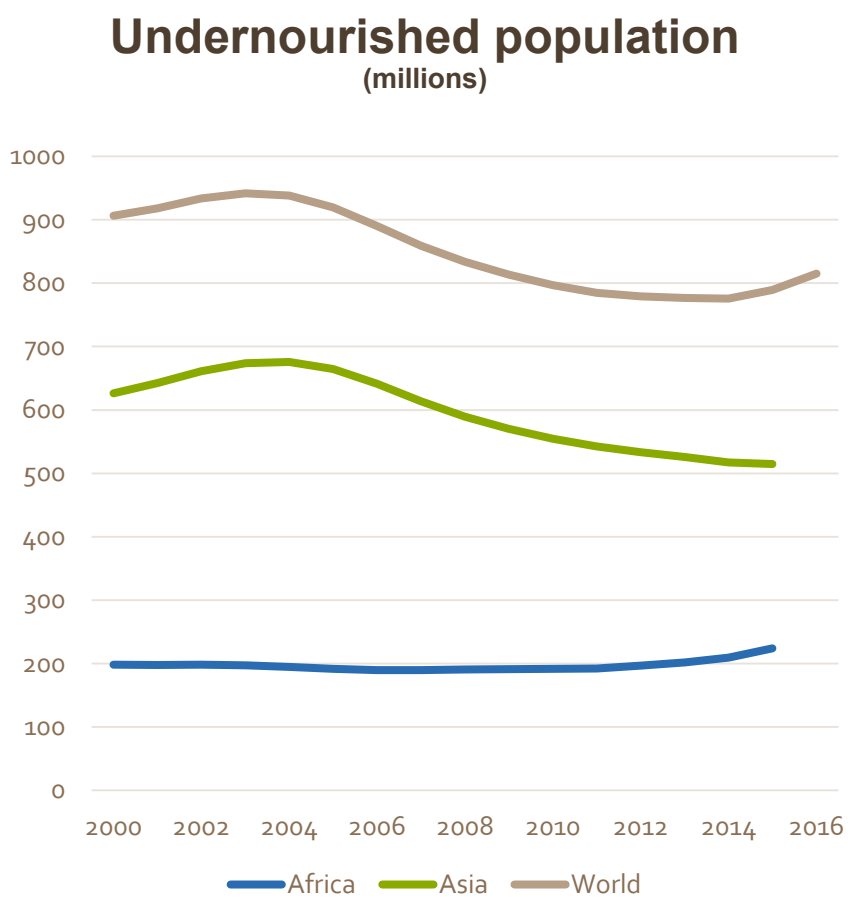
Water Security Influences Agricultural Development and Food Security through Multiple Pathways

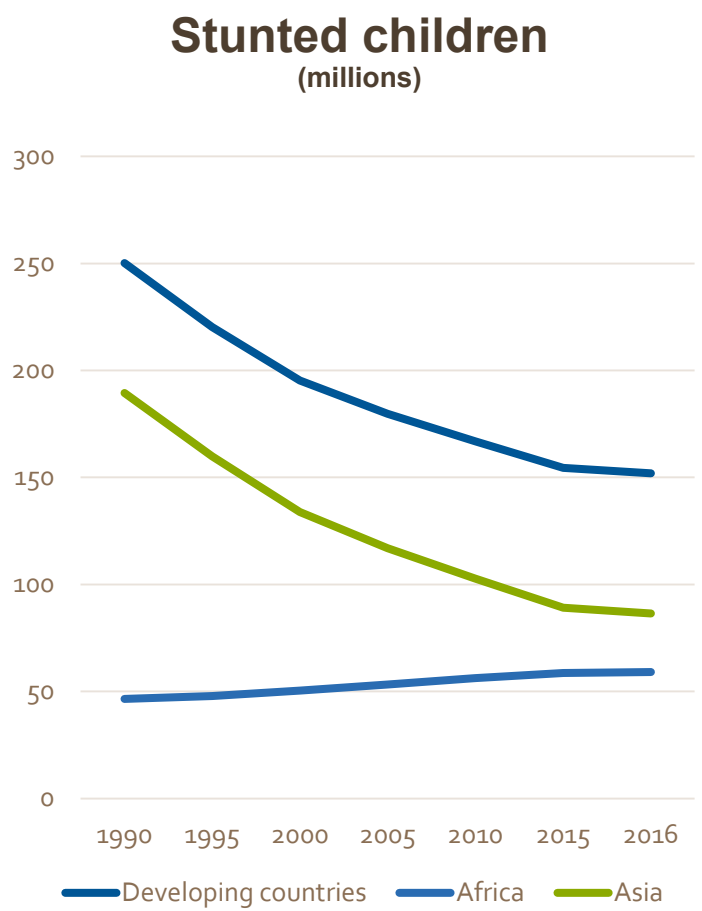
- Irrigation contributes to
  - Increased food production and farm income
  - Risk reduction through improved resilience against weather variability
- Higher food production – can reduce food prices for consumers, improving food affordability
- Increases in agricultural diversification – enhance dietary diversity, micronutrient-rich foods (fruits, vegetables, animal-sourced foods)
- Improvements in proximity and cleanliness of water sources and technologies for water extraction - support women's empowerment through time savings and health gains

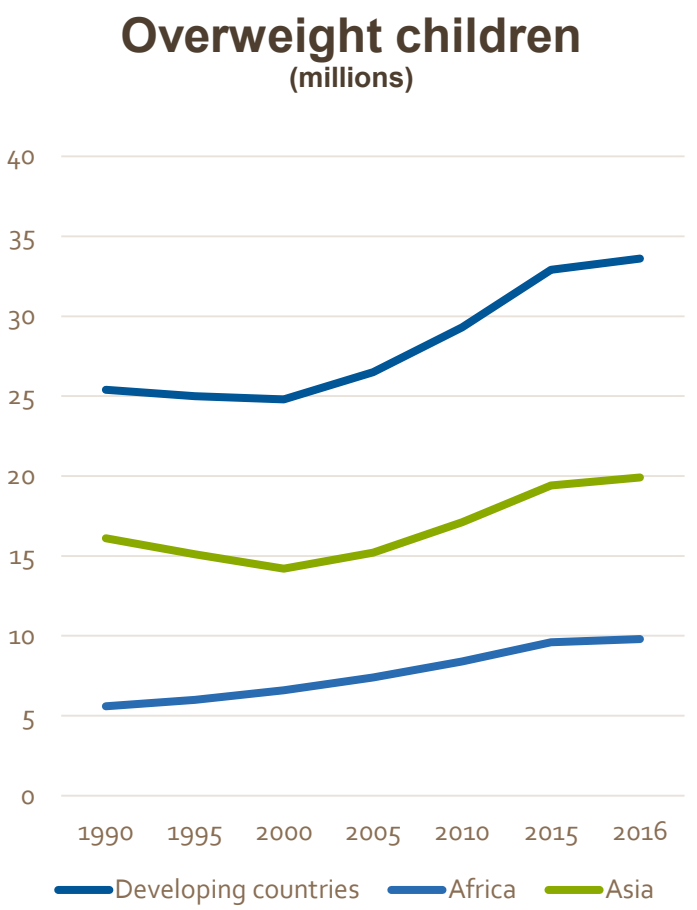
Water Security Influences Agricultural Development and Food Security through Multiple Pathways

- High-performing water, sanitation, and hygiene (WASH) sector –important for achieving food security and nutrition goals
- Access to safe water
  - Reduced incidence of enteric infection, incidence of disease in pregnant women
  - Important for reducing maternal and neonatal mortality rates—especially for in-house piped water
- Important new pathway to open - enhanced cooperation and integration of policies between the agricultural water sector and WASH sectors

Hunger and Undernutrition Persist and Alarming Rise in Overnutrition



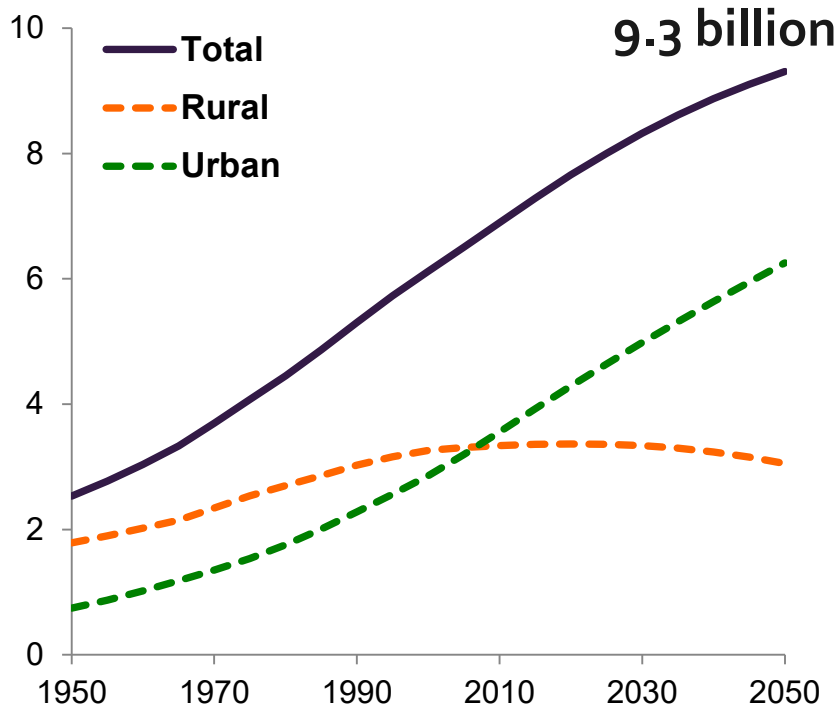




Source: FAO 2017, UNICEF/WHO/WB 2017

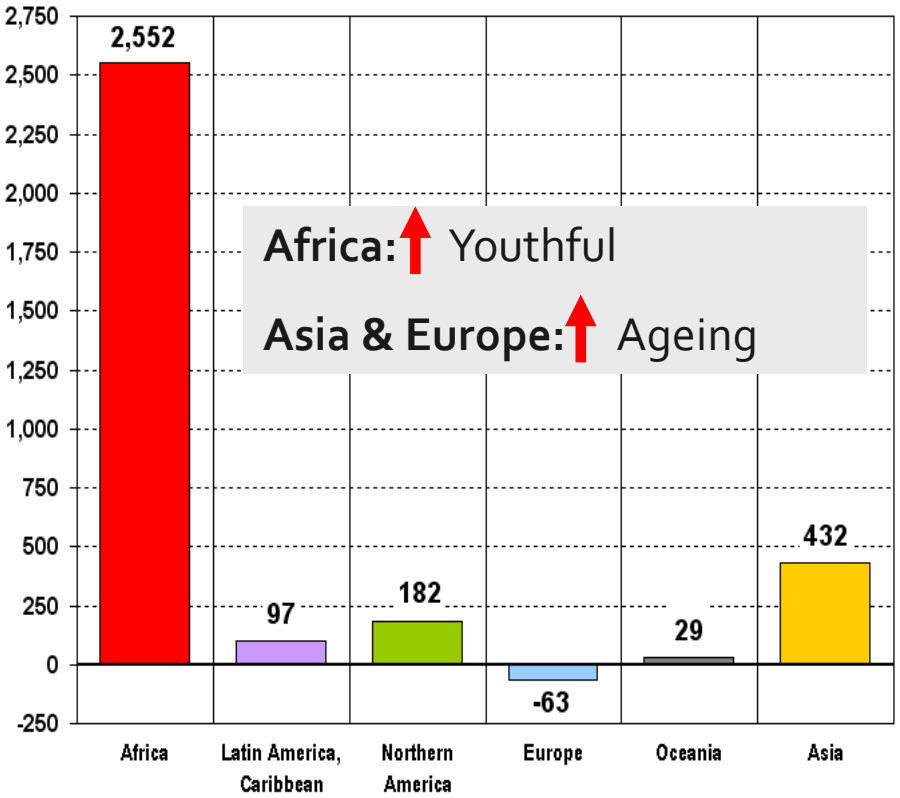
Increasing Population and Demographic Shifts

World population (billions)



Source: Data from UN 2011

Population change by region, 2010-2100 (millions)

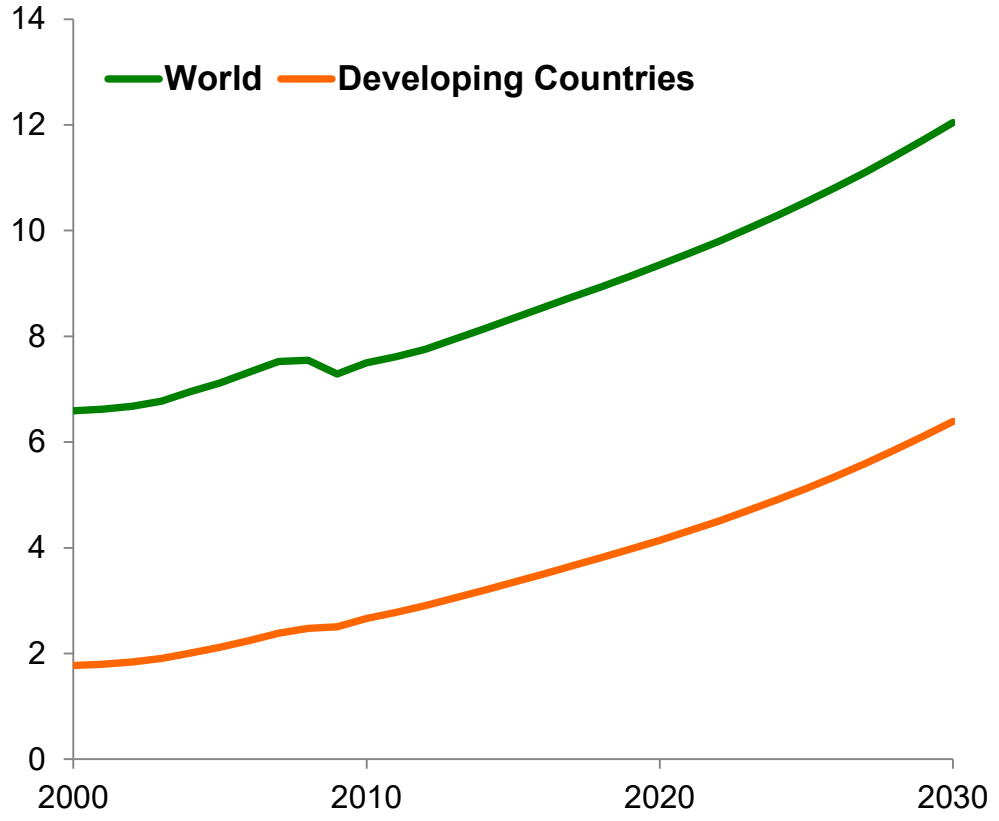


Source: UN 2011

Larger and more urban population will demand more and better food

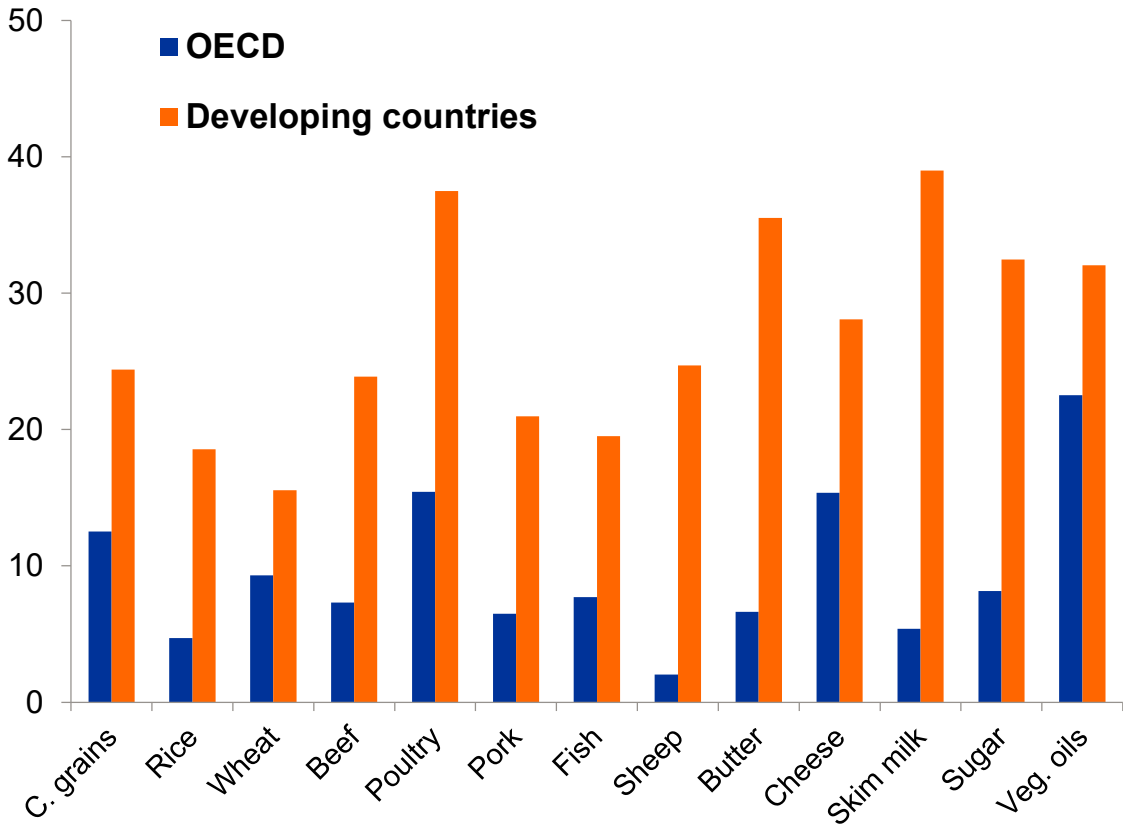
Rising Incomes and Demand and Diet Changes

GDP per capita $US ('000s)



Source: ERS-USDA 2012

Change in consumption of agric. products 2009-11 to 2021 (%)



Source: OECD-FAO 2012

Irrigation Plays a Key Role in Agri-food Systems

Less than one-third of the world's harvested land is irrigated,

BUT irrigated crop areas generate 40% of global food production

Total harvested area by region, 2010 and projected 2030
(million ha)

	2010		2030	
Region	**Irrigated**	**Rainfed**	**Irrigated**	**Rainfed**
East Asia and the Pacific	136	139	145	151
South Asia	114	114	131	106
Former Soviet Union	13	94	14	99
Africa south of the Sahara	9	185	13	224
Middle East and North Africa	23	44	26	48
Latin America and the Caribbean	20	123	23	148
Developing countries	315	709	354	786
Developed countries	36	206	40	211
World total	351	915	394	997

90% of total projected increase in irrigation is expected to be in developing countries

Source: Ringler 2017

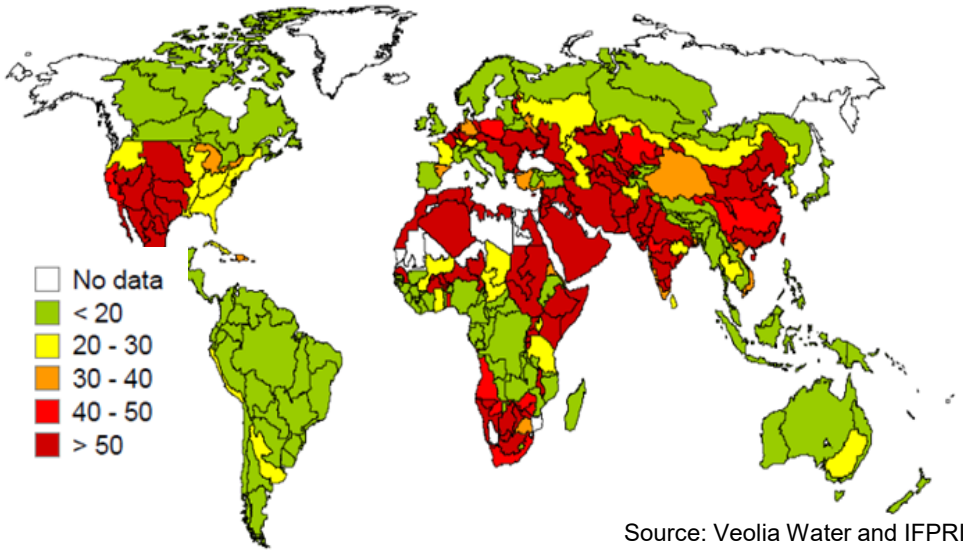
Water Stress is Increasing World-Wide

Agriculture uses:

70% *of* **WATER CONSUMPTION**

Source: Farming First 2012

Water stress
Total renewable water withdrawn, BAU, 2050 (%)



Source: Veolia Water and IFPRI 2011

Water stress risk

36%	population	52%
39%	grain production	49%
22%	global GDP	45%

TODAY

Total population living in water scarce areas

2.5 BILLION PEOPLE

Global GDP generated in water scarce regions

US$9.4 TRILLION

By 2050

Total population living in water scarce areas

4.7 BILLION PEOPLE

90%

Global GDP generated in water scarce regions

US$63 TRILLION

570%

Source: Veolia Water and IFPRI 2011

Challenges for Water Policy

- Increasing costs of developing and delivering water
- Wasteful use of already developed supplies encouraged by subsidies and distorted incentives
- Depletion of groundwater, water pollution, declining water quality
- Climate change, extreme weather, increased variability in precipitation and streamflow
- Billions of people still without access to safe drinking water, adequate hygiene and sanitation (water pollution, agricultural runoff, poor wastewater treatment)

Challenges for Water Policy

- Billions still without access to safe drinking water, adequate hygiene and sanitation
  - Water pollution
    - Biological, chemical and industrial pollutants, fertilizer runoff
    - Affects human nutrition, health, economic development, and environment
    - Contributes to diarrhea and other diseases
  - Poor water quality
    - Leads to increased competition among water users for shrinking supplies of unpolluted water
    - Increasingly constrains agricultural and economic development in densely populated regions that experience water scarcity and plagued by poor wastewater treatment

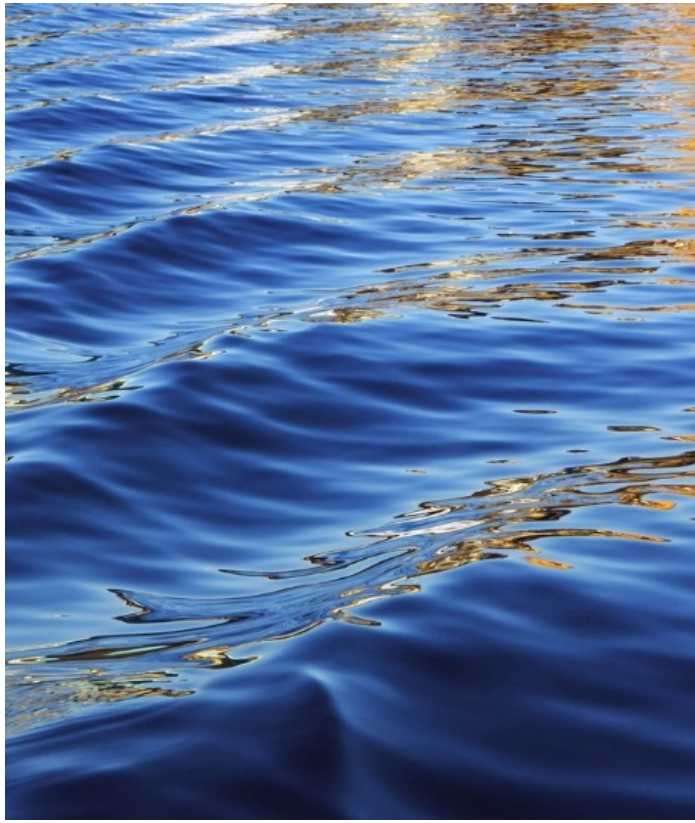
Challenges for Water Policy: Mobilizing Resources

- Barriers to financing: Irrigation and WASH
  - Relatively low rates of return and high financial risks – difficult to estimate risk under climate change
  - Political interference during project management – leads to water fees below sustainable levels for private investors or banking sectors
  - Government's concern – private sector selling water to industries rather than to agricultural users or domestic water suppliers to reap higher rates of return
  - WASH sector – underpriced services, cost recovery risk, ROI timeline, capital intensive, public health vs. private sector benefits

Challenges for Water Policy: Value Chains

- High levels of post harvest losses (PHL) claimed = 30-40%
- But field level research on value chains from farm to retail markets show much lower losses = 8-20%, highest for fruits and vegetables
- Still significant potential to reduce food losses and embedded water
- PHL in developing countries
  - Constraints in harvesting methods and techniques
  - Lack of storage and/or cooling facilities
  - Poor marketing and transport system
- PHL in developed countries – waste at the retail and consumption level

Strategies and Policies to Address Water Scarcity, Agricultural Development and Food Security



Strategies to Address Water and Food Security

- Water rights
- Crop breeding
- Technology
- Incentives and subsidies
- Governance
- Investment
- Non-traditional sources of water and food
- Agricultural trade
- Balanced diets

Establish Strong, Well-defined Water and Land Rights

- Water rights are a cornerstone of efficient and equitable water management, empowering users by requiring consent and awarding compensation for reallocation
- Water rights provide incentives for investment in improve technology and water management – farmers know they can retain water rights when investing in farm improvement, new crop varieties, and improved irrigation technology and crop management
- Best defined as perpetual right to share of all allocations made in the river basin or system; in each season, share of actual allocation based on available water
- Establish guidelines for water rights comparable to the FAO Voluntary Guidelines on Responsible Governance of Tenure of Land

Invest in Crop Breeding for Yield per Unit of Water and Land

- Plant breeding - improve plant biomass/unit of water through
  - More efficient transpiration
  - Efficiency of biomass growth per unit of transpiration
- Effective breeding for drought tolerance and other traits to get more yield per unit of water
  - Availability of diverse genes is essential
  - Tools of biotechnology should be employed
    - marker-assisted selection,
    - cell and tissue culture, and
    - gene editing, even if countries elect to forego transgenic breeding

Adopt New Irrigation Technology and Farming Systems

- Farmers adopt advanced technology (drip and sprinkler irrigation, precision farming, greenhouse production, remote sensing) for
  - Increased income from higher value crops
  - Convenience
  - Labor-saving
  - Lower pumping costs
- Improve nutrition through higher income, production diversification, women's empowerment, and multiple uses including sanitation
- But real system-wide water savings are more difficult to achieve and often limited

Adopt New Irrigation Technology and Farming Systems

- New technology: alternative water saving outcomes
  - Save water that would otherwise evaporate unproductively or flow to sinks, providing net system water saving
  - Divert water that would otherwise be used downstream by others - merely shifts water use between farmers, rather than generating new benefits
  - Induce increased water use by increasing profitability of irrigation for individual farmers rather than saving water

Adopt New Irrigation Technology and Farming Systems

- Achieving potential water savings is promoted by a water allocation system that recognizes the hydrological realities of the interconnectedness of water in the river basin
- Well-specified water rights that establish a cap on water use and the incentives to optimize economic value of water

Eliminate Generalized Subsidies and Target Specific Goals

- Reduce water, energy and fertilizer subsidies that distort production decisions and cause overuse of inputs and environmental degradation
- Invest budget savings in:
  - agricultural and water research and development
  - compensatory income support to small farmers
  - targeted smart subsidies to achieve specific water management goals
- Invest additional research funds in breeding for yield per unit of water and land: more efficient transpiration and photosynthesis; drought and heat tolerance

Improve Water Resource Governance at Basin, System, and Subsystem levels

- Strengthen capacity of public institutions
  - Coordinate across water, agriculture, and energy ministries
  - Improve tools for planning and monitoring
- International cooperation over water—in the form of treaties and transboundary watershed agreements—has helped prevent conflict
- Improved transboundary management requires transparent, adaptive transboundary watershed management institutions, provision for monitoring and clear legal mechanisms for conflict resolution
- Integrated water resource management is often costly and politically difficult or impossible to implement; second-best solutions that are less costly and take account of local conditions may be more effective (Giordano and Shah 2014, Molden et al. 2010)

Improve Water Resource Governance at Basin, System, and Subsystem levels

- Devolve sub-basin water management functions to community-based water user associations (WUA), farmer groups, or other private-sector actors
- Top-down implementation of WUA has not generally worked well.
- Design and implementation of WUA should involve prospective members and emphasize provision of improved water delivery services, not just farmer obligations such as fee payments

Increase Investment in Irrigation and WASH

- Irrigation infrastructure investment - reduced role globally compared with past decades: US$8-12 billion per year (IFPRI 2017)
- Large additional investments in water treatment and sewage disposal plants required
  - Global access to improved water and sanitation services = US$27 billion per year (WHO 2012)
  - Global access to regulated in-house piped water supply with quality monitoring and in-house sewerage connection with partial treatment of sewage = US$171-205 billion per year (Lloyd Owen 2011)

Improve Value Chains for Quality and Efficiency

- Reduction in PHL requires improved rural infrastructure through public and private sector investments
  - Blended finance
  - Loan guarantees
- New technology potential: sensors revolutionizing value chains; development of cold chains
  - Full tracking of food from source to final use; monitoring quality through the chain
  - Can reduce food loss and waste with consequent reduction in water use, GHG emissions and improvement of food security

Expand Non-traditional Sources of Food and Water

- Global area of *urban irrigated croplands* (within cities of at least 50,000 population) = about 24 million hectares, 11% of all irrigated croplands (Thebo et al. 2014)
- Municipal government legislation and regulation could help expand—but temporary nature, health risks from drainage runoff and raw sewage, and lead and other contaminants in soils and in air are constraining
- Municipal water demand is 11 percent of global water withdrawal; 3 percent is consumed, 8 percent discharged as wastewater
- Realistic goal: provide *clean treated wastewater* to areas that are currently being irrigated with raw and diluted wastewater, 5-20 million hectares globally (Drechsel and Evans 2010)

Expand Non-traditional Sources of Food and Water

- Large scale *wastewater recycling* plants tend to be energy intensive and produce sludge that is difficult to dispose
- Newer technologies are developing new sludge byproducts and moving toward recycling at net zero energy cost by capturing biogas (Damania et al. 2017)
- *Desalination* provides around 1% of the world's drinking water; projected to reach 5% of total demand by 2100, concentrated on coasts including North Africa and Middle East (Voutchkov 2017, Kim et al. 2015)
- Need to reduce costs, energy intensity, and harmful byproducts

Reduce International Agricultural Trade and Macroeconomic Distortions

- Support open trading regimes to share climate risk and promote effective use of virtual water
- More urgent as climate change increases the reliance of many developing countries on food imports
- As water scarcity worsens and climate variability increases, imports of food (and the virtual water embodied in that food) will be crucial in water-scarce countries to ensure food security
- Facilitates short-term imports to address food shortages caused by weather-induced production shocks

Promote balanced diets for health and sustainability, including reduced water use

- Schools can be a platform for early nutrition education, setting healthy eating behaviors in school meals
- Corporations can convey health messages and promote healthier sourcing and products
- Health and nutrition campaigns can improve diets and nutrition by carefully targeting populations, communication activities and channels, message content and presentation

Policies Need to be Region Specific

- Water policy, institutional, and management reform and investments must be tailored to underlying conditions
  - Levels of development
  - Agroclimatic conditions
  - Relative water scarcity
  - Level of agricultural intensification
  - Degree of water competition
- Solutions are difficult and take time, political commitment, and money