



THE FUTURE OF SCIENCE™



The Global Water Scenario: Human & Socio-Economic Impacts & Solutions

*The Future of Science
10th World Conference - 'The Eradication of Hunger'
18-20 September 2014
Venice, Italy*



Stella Thomas
Managing Director
Global Water Fund
www.globalwaterfund.com
stthomas@globalwaterfund.com
+41 762 431 606

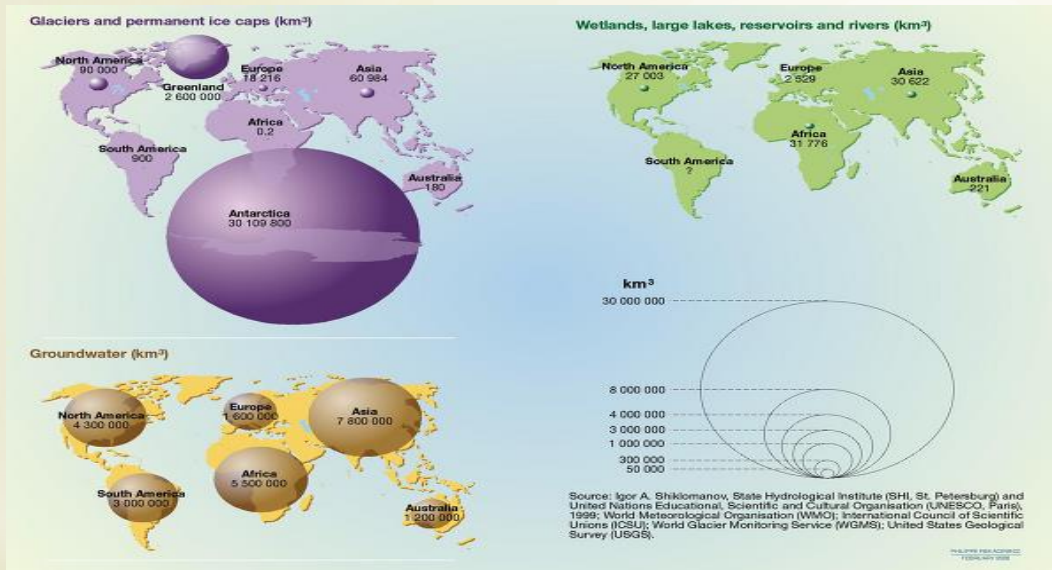


THE FUTURE OF SCIENCE™

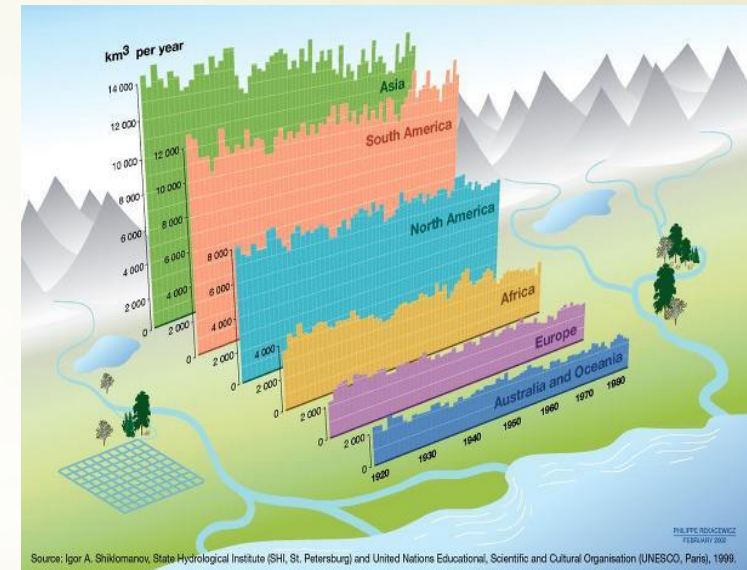


Global Water Crisis

Volume of Water



Runoff Volumes



Six countries have half of the world's total **renewable** freshwater resources:
Brazil, Canada, China, Columbia, Indonesia, and Russia;

Water **within** countries is not evenly distributed;

Timing is an important factor in water access.

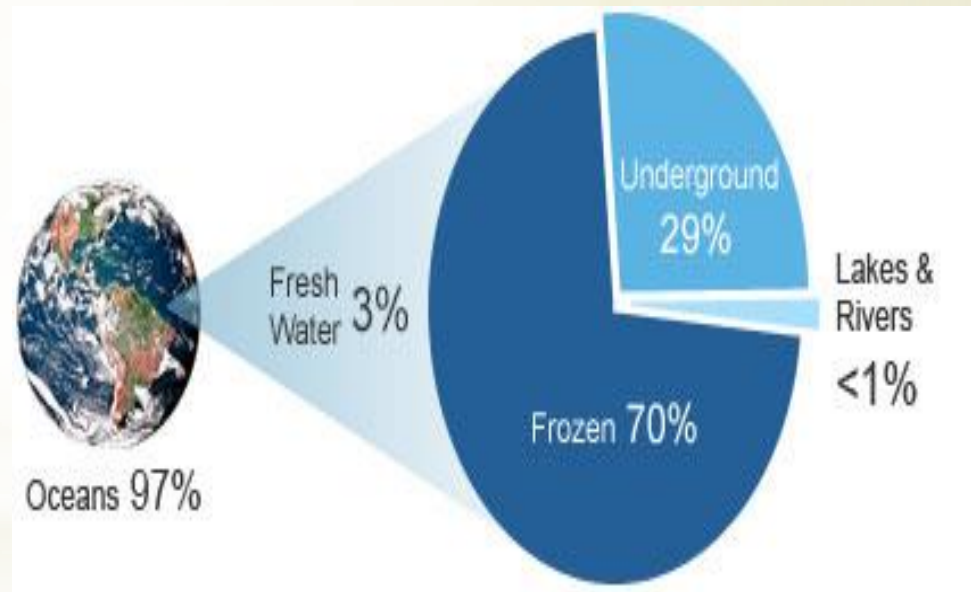
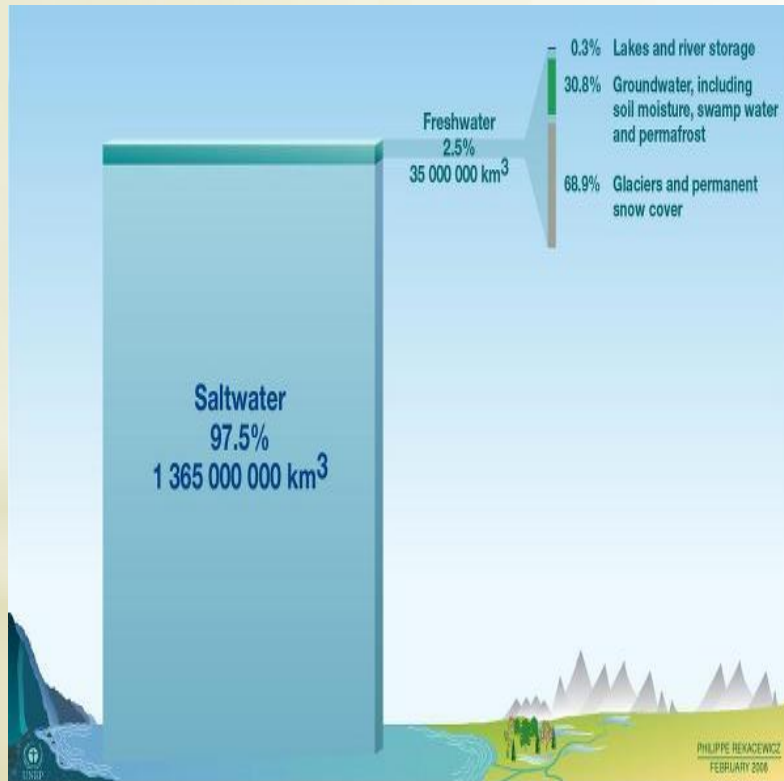


THE FUTURE OF SCIENCE™



Available Water

<1% of Earth's total water available for human consumption
97.5% Saline, 70% glaciers, 29% aquifers



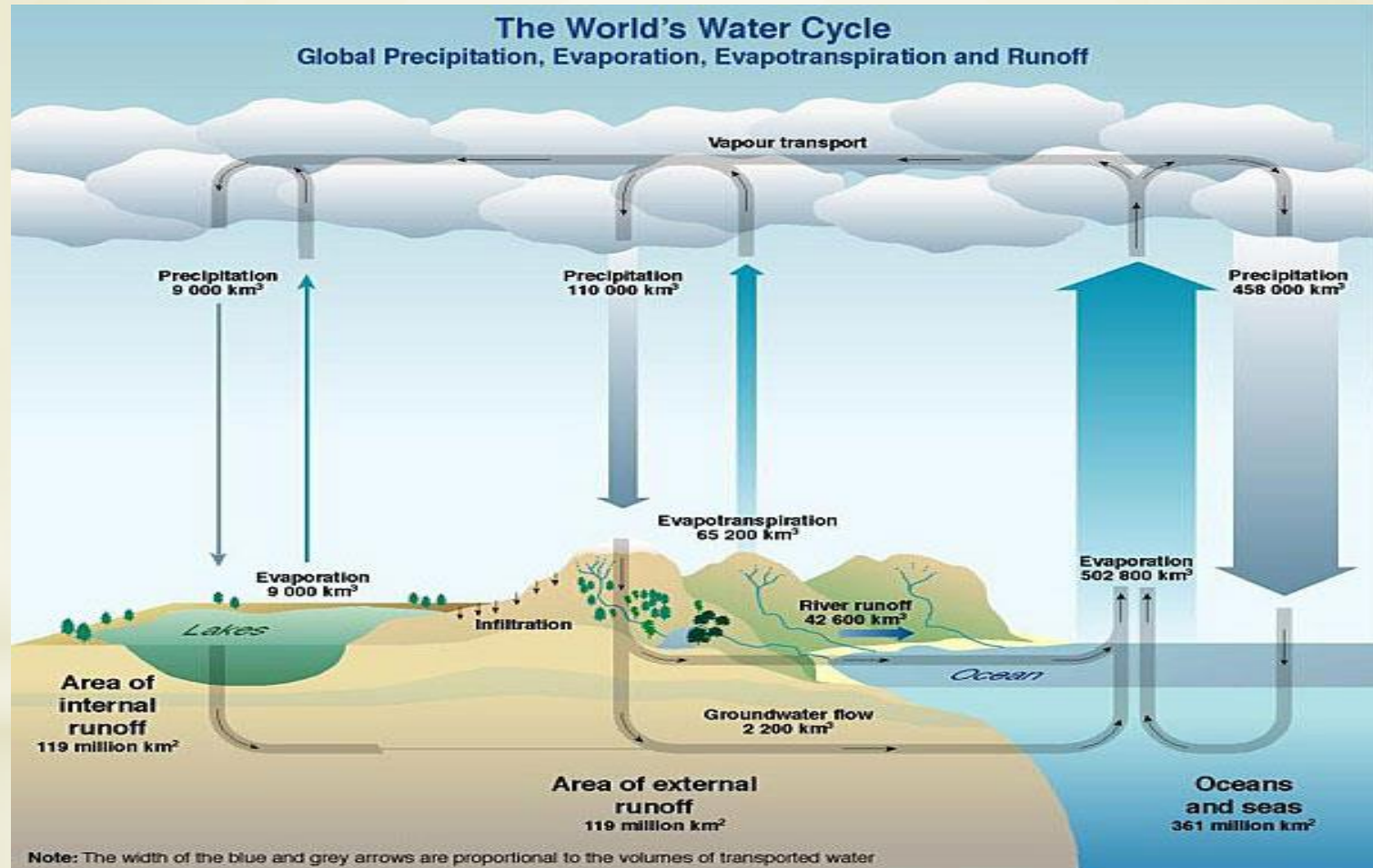
Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.



THE FUTURE OF SCIENCE™



Hydrological Cycle



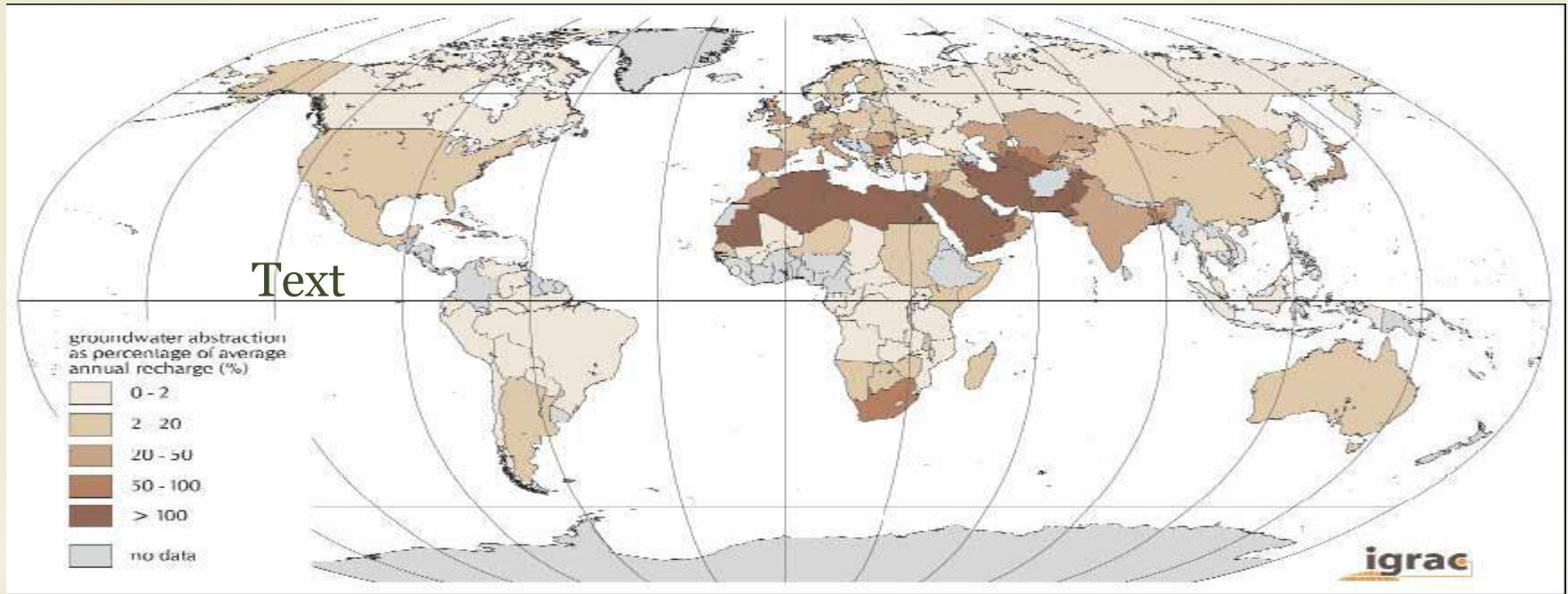
Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999; Max Planck, Institute for Meteorology, Hamburg, 1994; Freeze, Allen, John, Cherry, Groundwater, Prentice-Hall: Engle wood Cliffs NJ, 1979.



THE FUTURE OF SCIENCE™



Groundwater Abstraction As A Percentage of Mean Recharge



GEOGRAPHIC BREAKDOWN OF WATER ABSTRACTION:

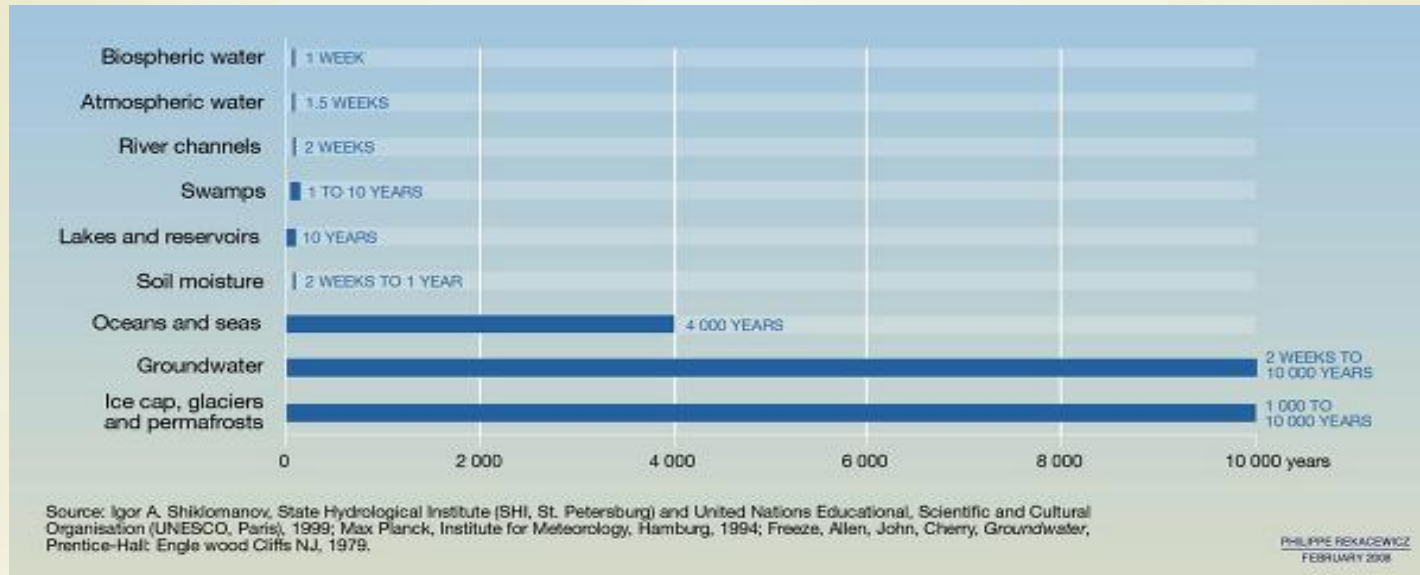
ASIA	55%
NORTH AMERICA	19%
EUROPE	9.2%
AFRICA	4.7%
SOUTH AMERICA	3.3%
REST OF THE WORLD	8.8%



THE FUTURE OF SCIENCE™



Groundwater Residence Time



<u>Component</u>	<u>Mean Residence Time</u>
Permafrost zone & Ground Ice	10,000 years
Polar Ice	9,700 years
Oceans	2,500 years
Mountain Glaciers	1,600 years
Groundwater (excluding Antarctica)	1,400 years
Lakes	17 years
Swamps	5 years
Soil Moisture	1 year
Atmosphere	8 days
Biosphere	Several hours

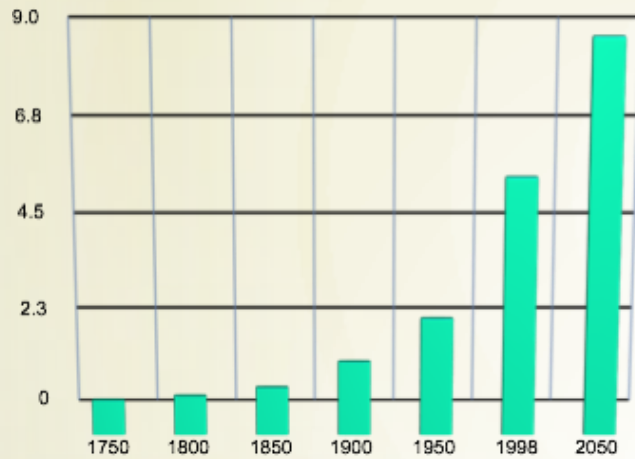


THE FUTURE OF SCIENCE™

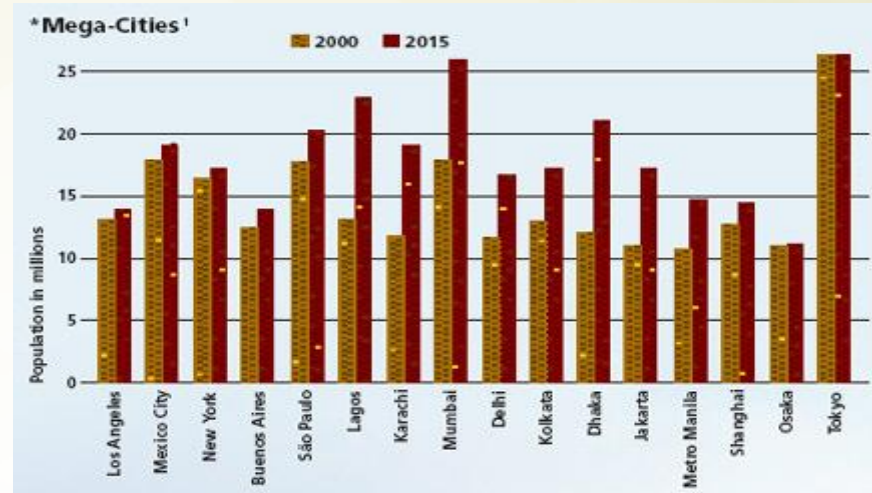


Population Growth & Demographics

Population Growth

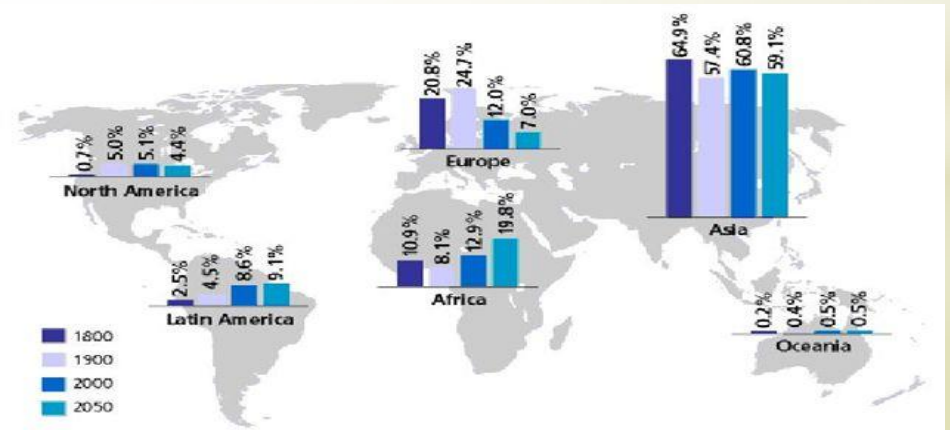
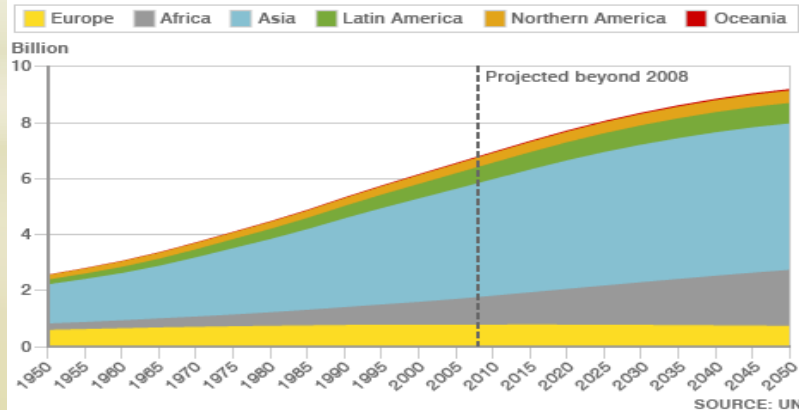


Urban Growth



Global Population Shift

The world's rising population, 1950-2050



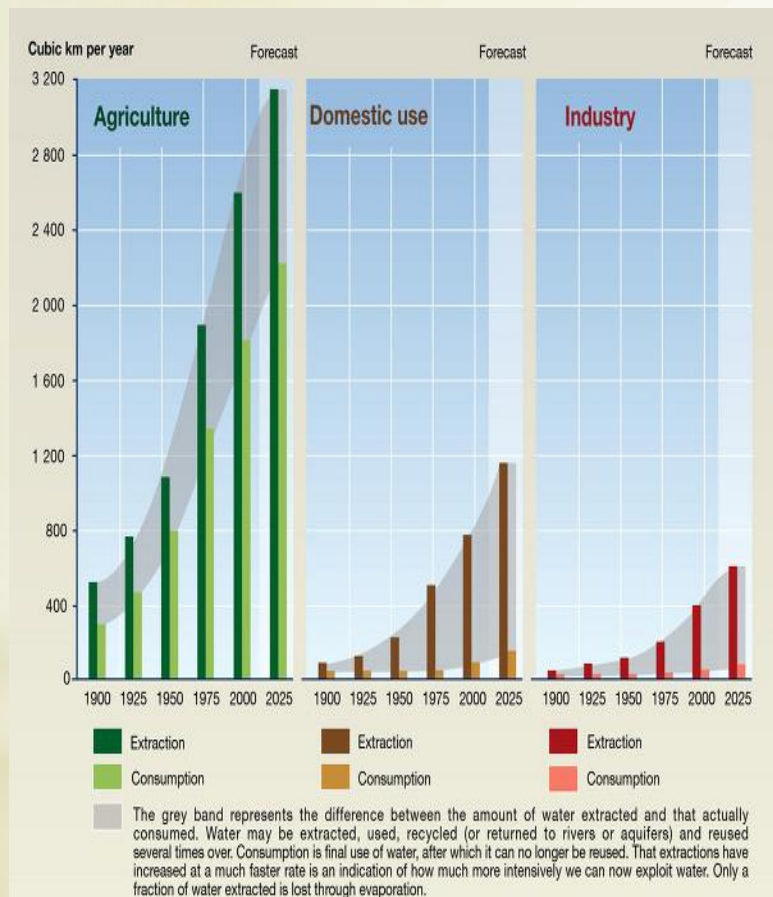


THE FUTURE OF SCIENCE™

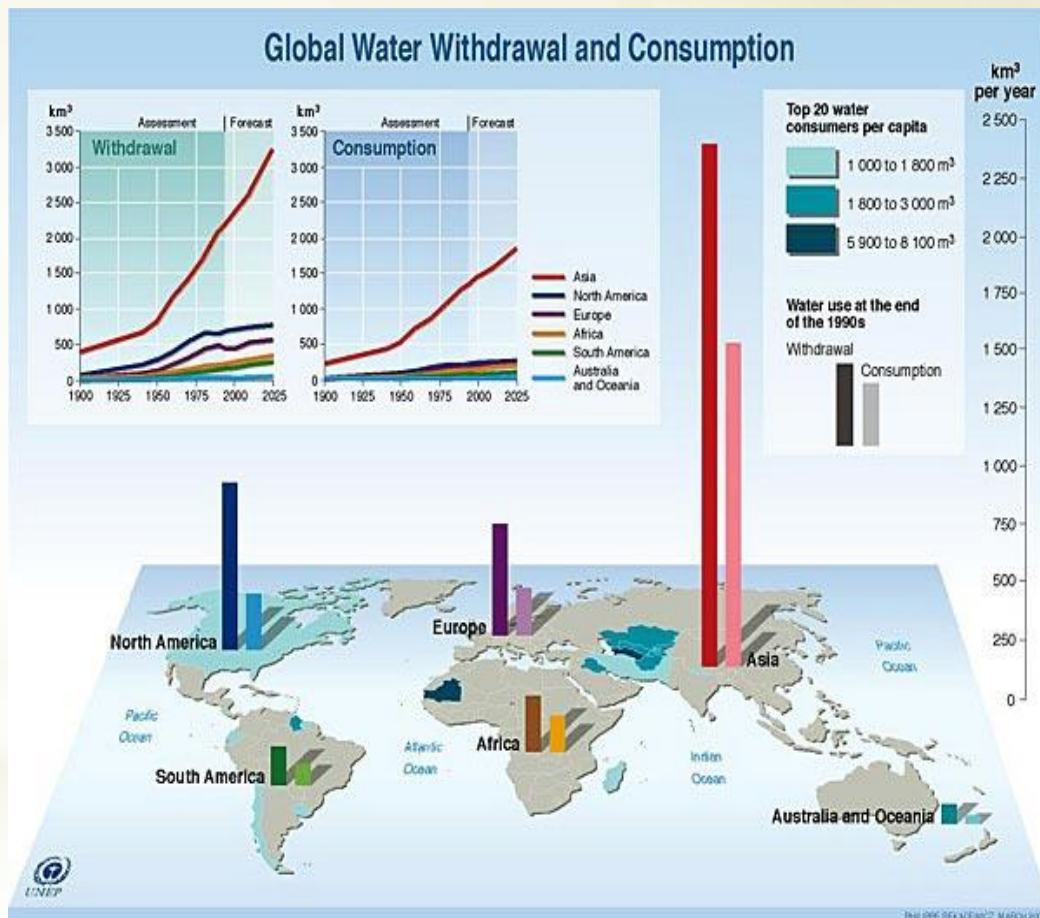


Patterns of Consumption

Water Withdrawals per Sector (Cubic Kilometers per Year)



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999; World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life, World Resources Institute (WRI), Washington DC, 2000; Paul Harrison and Fred Pearce, AAAS Atlas of Population 2001, American Association for the Advancement of Science, University of California Press, Berkeley.



THE FUTURE OF SCIENCE™

Water Availability Per Capita & Region



Water availability per capita (1950=100)

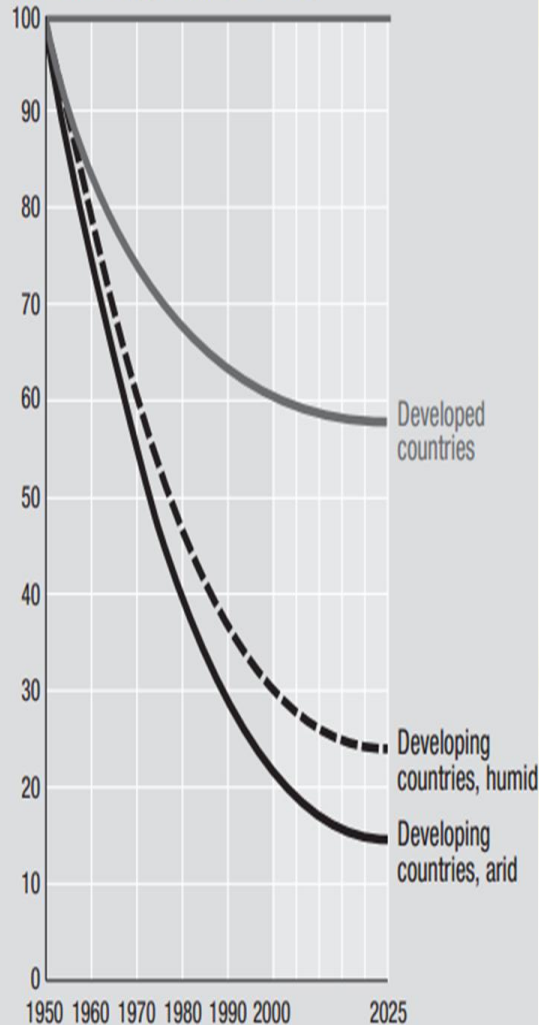
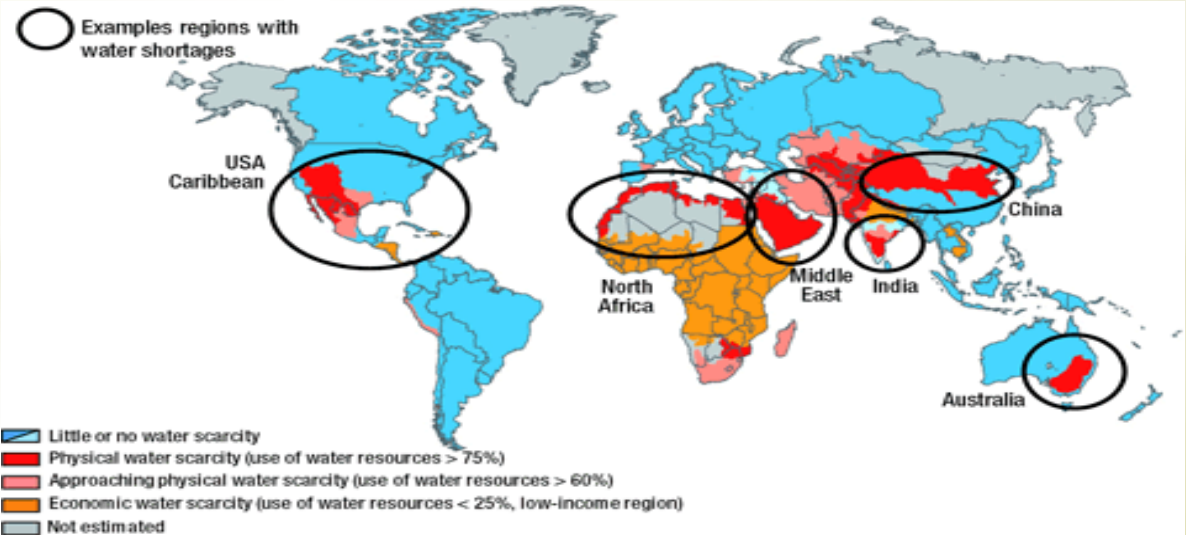
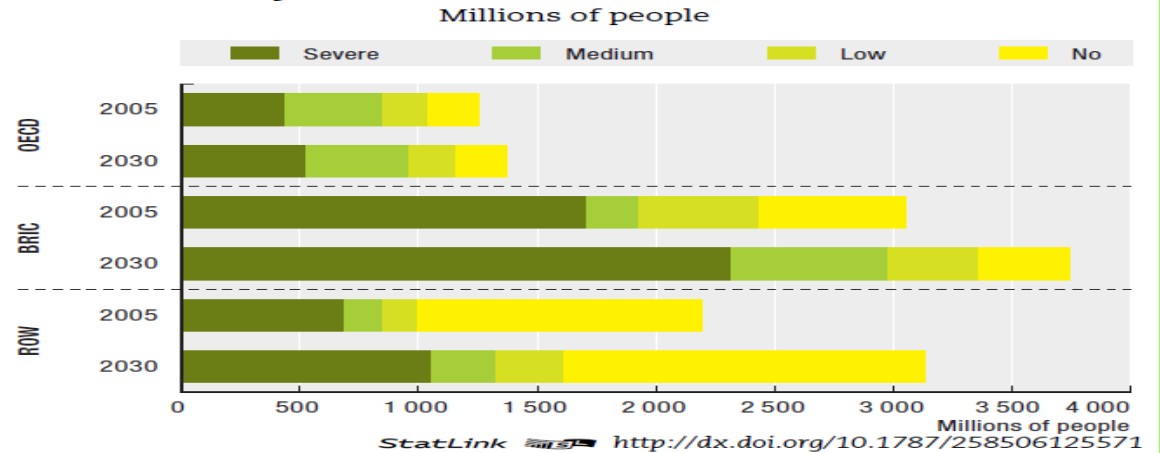


Figure 0.3. People living in areas of water stress, by level of stress, 2005 and 2030





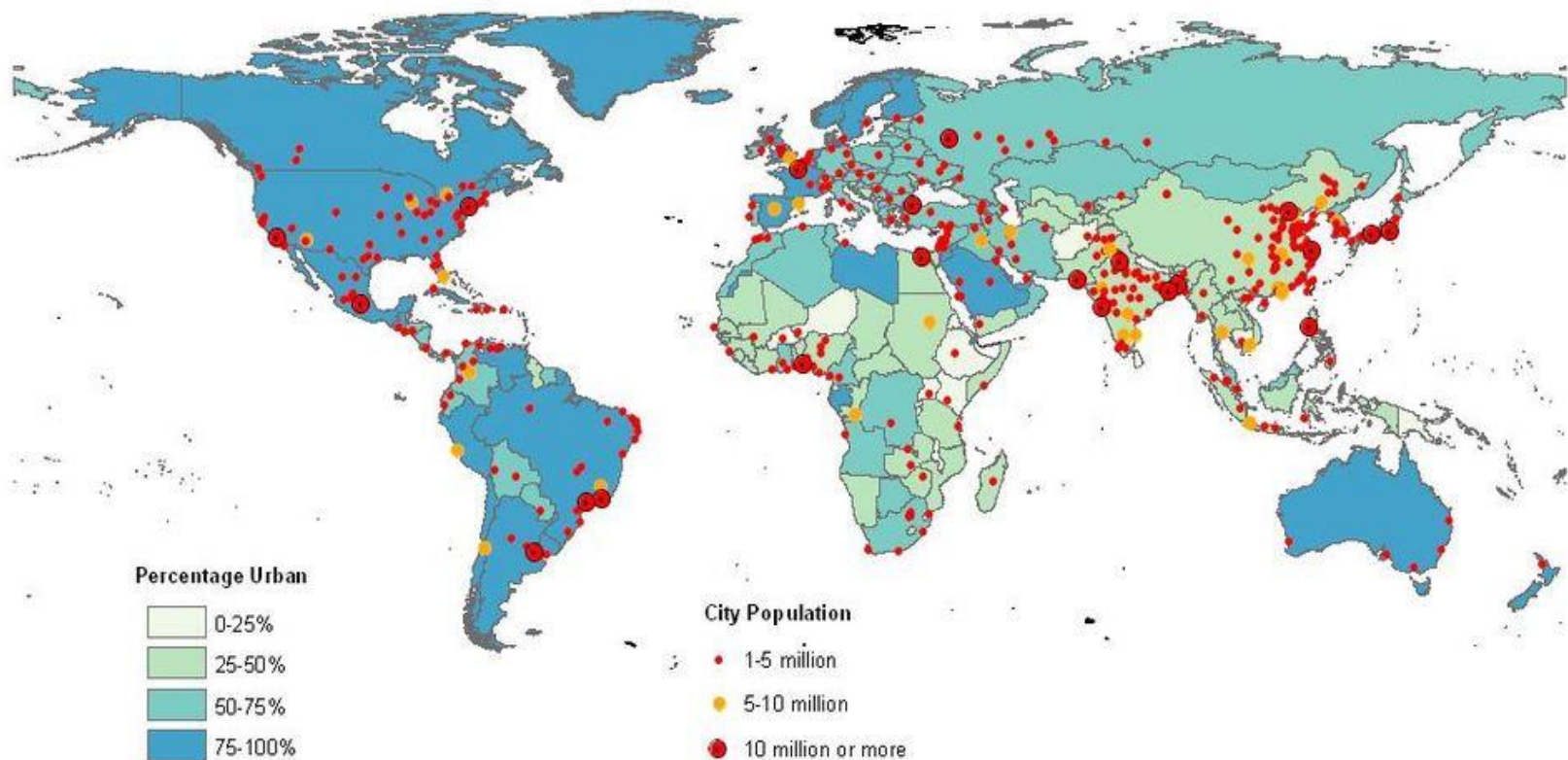
THE FUTURE OF SCIENCE™



Urbanization vs Agriculture

World Urbanization Prospects, the 2009 Revision

Map 1: Urban Agglomerations in 2009 (proportion urban of the world: 50.1%)



Select year: [1975](#) [2009](#) [2025](#)

Source: United Nations, Department of Economic and Social Affairs, Population Division: *World Urbanization Prospects, the 2009 Revision*. New York 2010

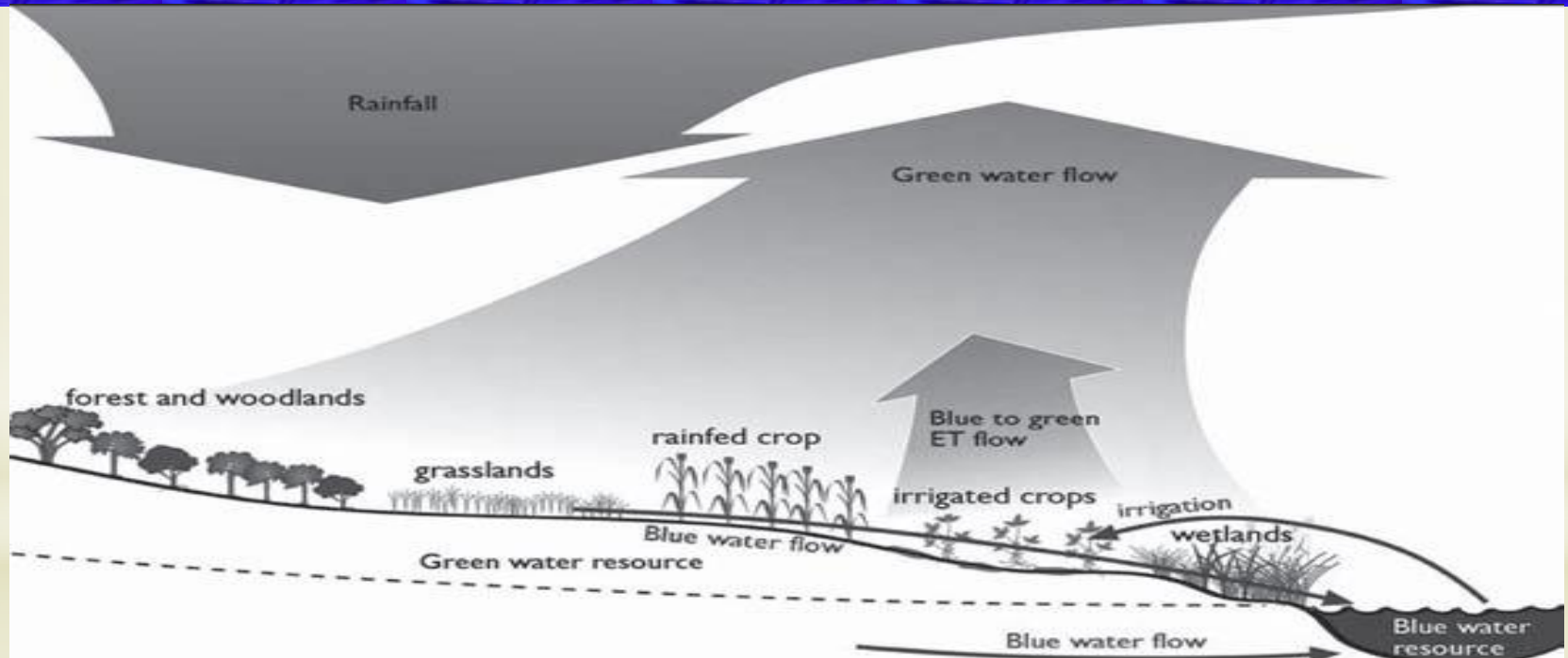
Disclaimer: This thematic map is for data illustration purposes only.

The boundaries, names shown and designations used on this map do not imply official endorsement or acceptance by the United Nations.



THE FUTURE OF SCIENCE™

Blue versus Green Agriculture

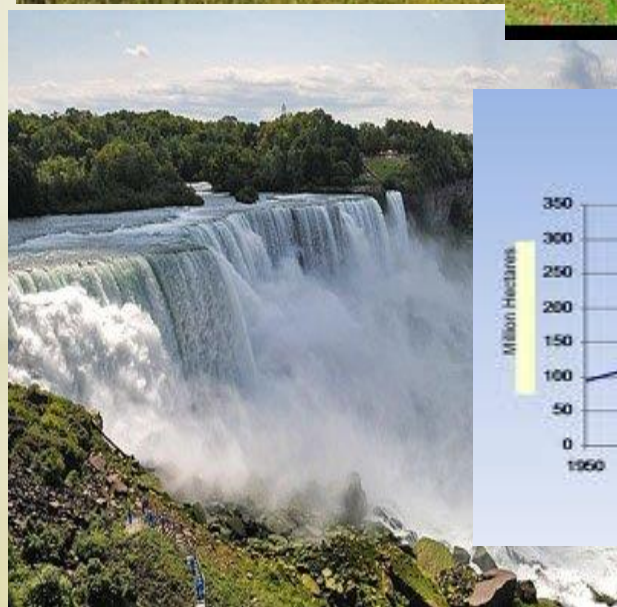




THE FUTURE OF SCIENCE™



World Irrigated Land





Estimates of Water Embedded in Different Products



Portion	Litres	Portion	Litres	Portion	Litres
Pint of beer, 568ml	170	Cup of coffee, 125ml	140	Glass of orange juice, 200ml	170
Sheet of A4, 80 g/m ²	10	Cotton tee-shirt, medium 500g	4100	Microchip, 2g	32
Cup of tea, 250ml	35	Glass of wine, 125ml	120	Orange, 100g	50
Slice of bread, 30g	135	Bread with cheese, 30g + 10g	90	Bag of potato crisps, 200g	185
Egg, 40g	135	Tomato, 70g	13	Hamburger, 150g	2400
Potato, 100g	25	Apple, 100g	70	Bovine leather shoes	8000



THE FUTURE OF SCIENCE™

Our Water Footprint



Our Water Footprint

How Much Water does it take to Produce...



1 Litre Tap Water



1 Litre

1 Litre Bottled Water



5 Litres

1 Cup Tea



30 Litres

1 Cup Coffee



140 Litres

1 Kg Corn



900 Litres

1 Kg Wheat



1300 Litres

1 Kg Soybeans



1800 Litres

1 Loaf Bread



960 Litres

1 Whole Orange



50 Litres

1 Glass Orange Jc



170 Litres

1 Whole Apple



70 Litres

1 Glass Apple Jc



190 Litres

1 Dozen Eggs



2400 Litres

1 Kg Chicken Meat



3900 Litres

1 Kg Pork



4800 Litres

1 Kg Beef



15,500 Litres

Choose more often to **DRINK TAP WATER**, **EAT WHOLE UNPROCESSED FOODS**
and reduce your carbon footprint by **BUYING LOCAL PRODUCTS**

Visit www.waterfootprint.org to learn more

supported by
SQUAMISH
can
climate action network



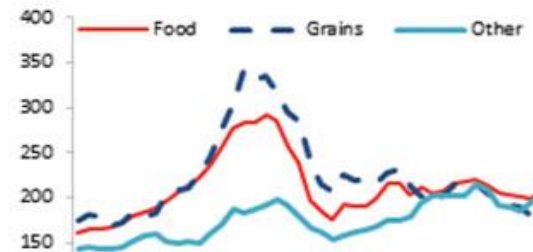
THE FUTURE OF SCIENCE™



Food Price Rises



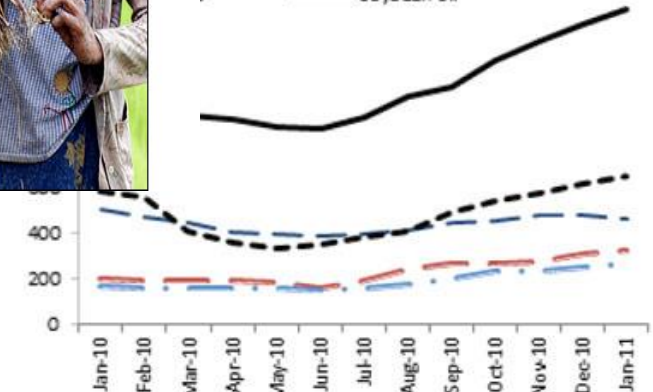
Figure 1. World Bank Food Price Indices



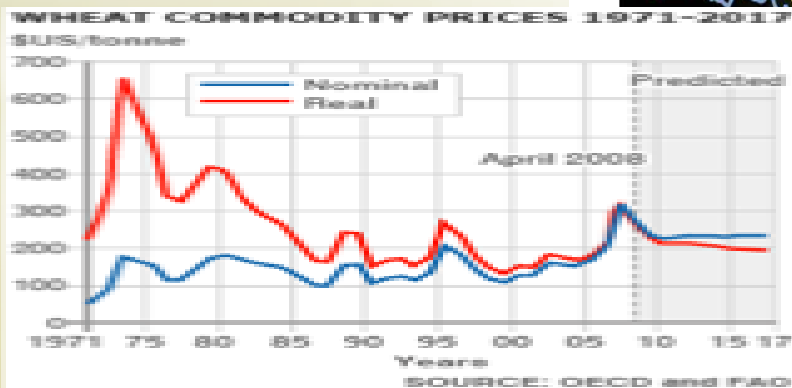
8M01 2009M01 2010M01 2011M01
Development Prospects Group.

Prices of Key Food

ice(25%) Wheat Sugar
Soybean oil



Source: World Bank Development Prospects Group.

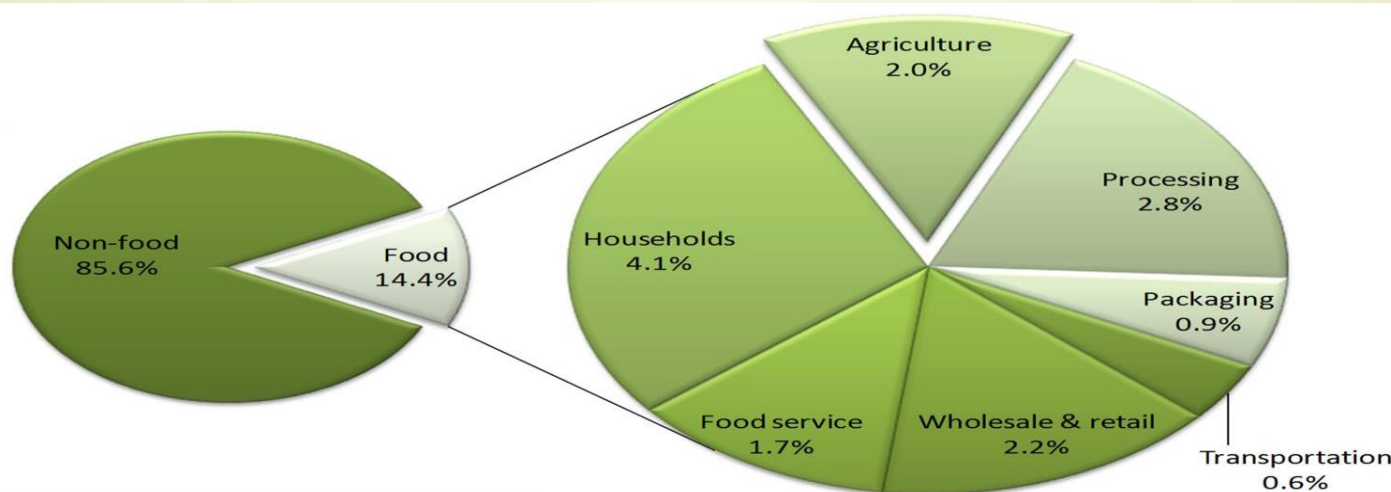




THE FUTURE OF SCIENCE™



Food for Energy

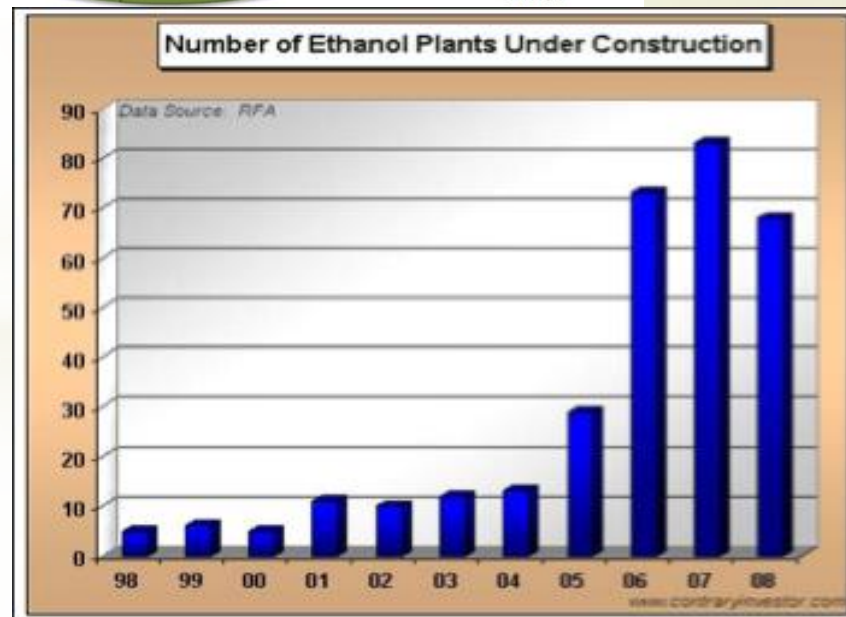


Crowding Out Food

Corn used for ethanol as a percentage of U.S. corn production



Source: USDA





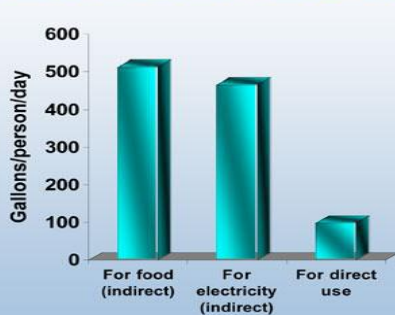
THE FUTURE OF SCIENCE™



Water for Energy

Energy Requires Water

Water used to produce household electricity exceeds direct household water use



GALLONS PER PERSON PER DAY

- 510 for food production
 - includes irrigation and livestock
- 465 to produce household electricity
 - Range: 30 to 600 depending on technology
- 100 direct household use
 - includes bathing, laundry, lawn watering, etc.

Source: derived from Gleick, P. (2002), *World's Water 2002-2003*.

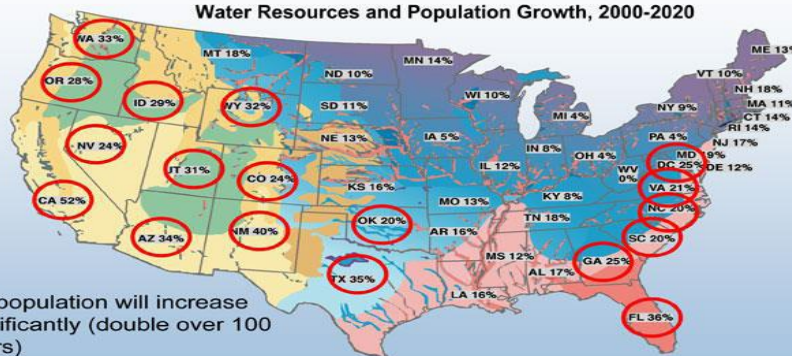
EAO Energy Analysis Office
Understanding Energy Issues

NREL National Renewable Energy Laboratory

Water Supplies Are Vulnerable

Population Growth is 20% to 50% in Most Water-Stressed Areas

Water Resources and Population Growth, 2000-2020

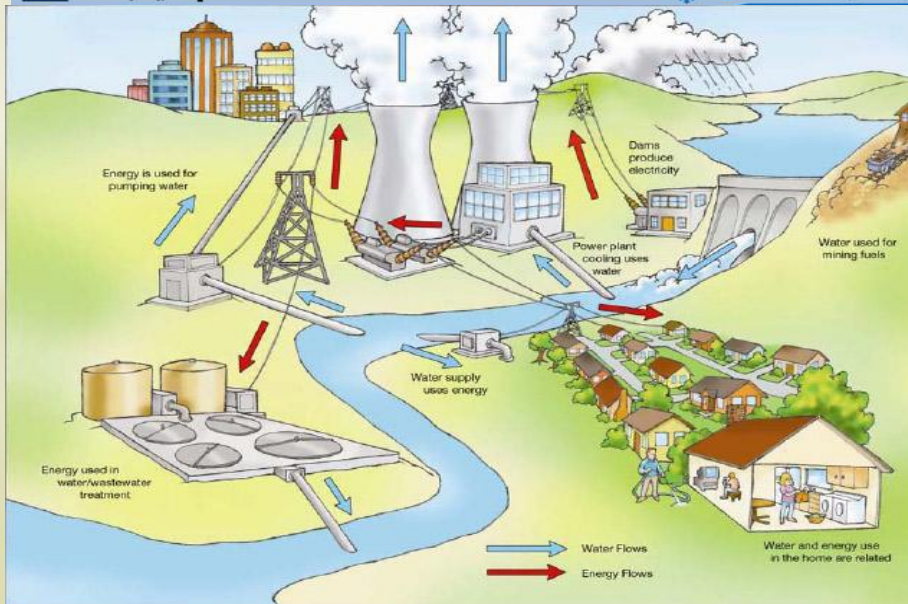


US population will increase significantly (double over 100 years)

Less Water More Water

Source: DOE/NETL (M. Chan, July 2002)

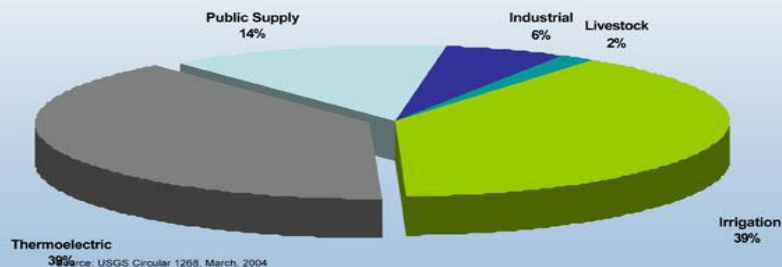
NREL National Renewable Energy Laboratory



Energy Requires Water

Cumulative Water Use for Electricity Production Equals Water Use for Irrigation

Estimated Freshwater Withdrawals by Sector, 2000



Source: USGS Circular 1258, March, 2004

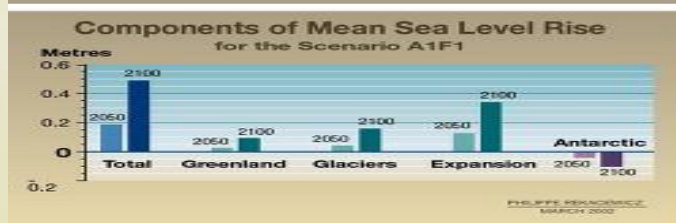
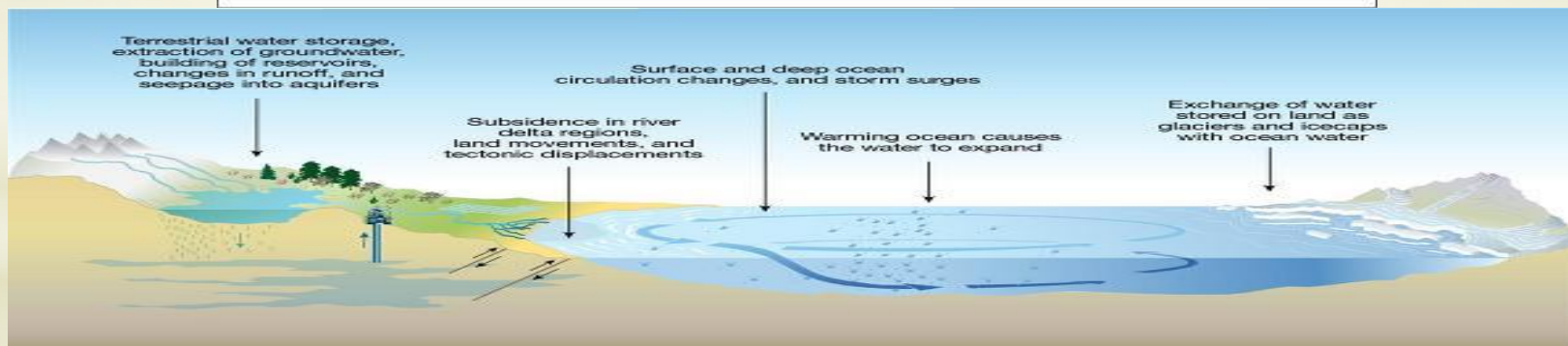
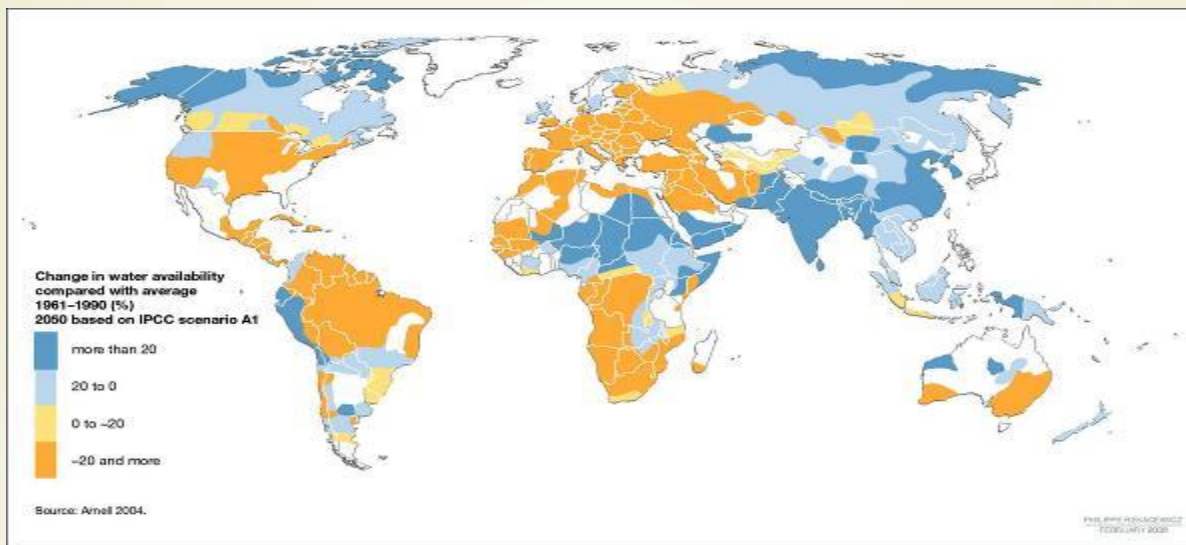
EAO Energy Analysis Office
Understanding Energy Issues

NREL National Renewable Energy Laboratory



THE FUTURE OF SCIENCE™

The Contribution of Climate Change to Declining Water Availability



The A1 scenario family describes a future of rapid economic growth, a global population that peaks in the middle of the 21st century and then declines, and the rapid introduction of new and more efficient technologies. The major underlying themes are convergence among regions, capacity-building, and increased cultural and social interaction, with a substantial reduction in regional differences in per capita incomes. The A1 scenario family develops into three groups with alternative directions of technological change according to their energy systems: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance of both (A1B).

Source: David Griggs, in *Climate Change 2001: Synthesis report, Contribution of working groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, 2001.

Pollution – Poor Water Quality





THE FUTURE OF SCIENCE™

Mismanagement of Natural Resources Lake Chad & Aral Sea



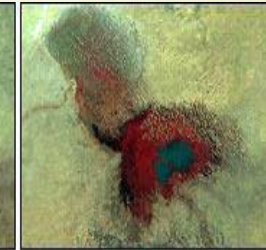
July - September, 1989



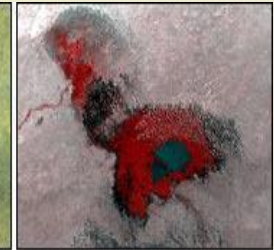
August 12, 2003



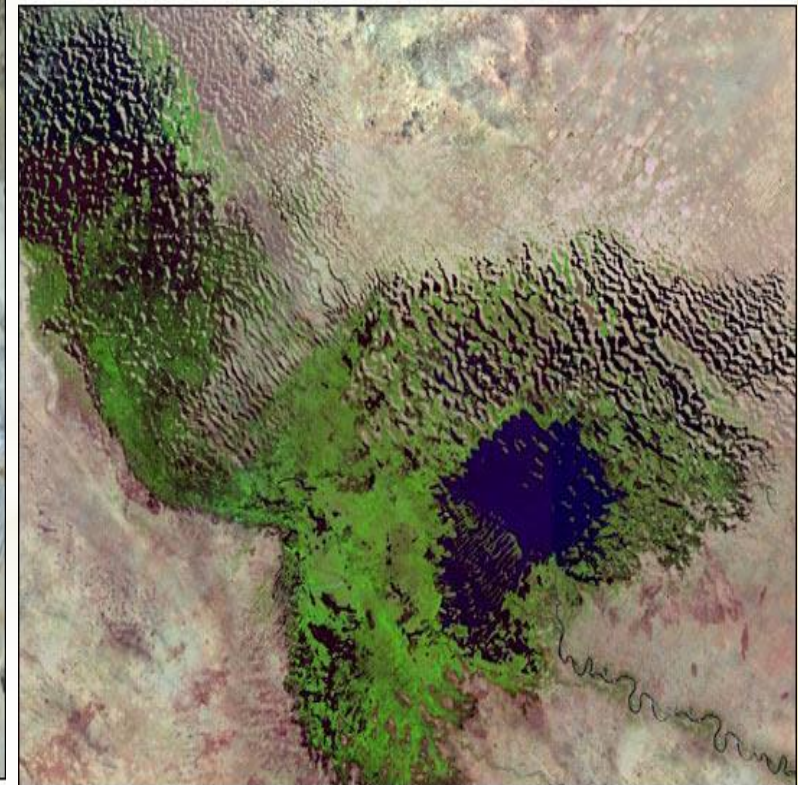
1973



1987



1997



2001



Valuing our Ecosystems



Forests account up to 15 per cent of the annual carbon emissions caused by human activity;

Only 1/5th of the planet is still covered in Forests. Forests have completely disappeared in 25 countries;

The world has lost 50 per cent of its Wetlands. In the United States, about two and a half acres of Wetlands are being lost every minute. California has lost over 90% of its Wetlands;

Up to 80 % of Mangroves have disappeared in some countries;

The Ocean's Marine Species has been reduced by some 90%;

20 % of the World's Coral Reefs have been destroyed and 30 % have been severely affected by pollution.



THE FUTURE OF SCIENCE™

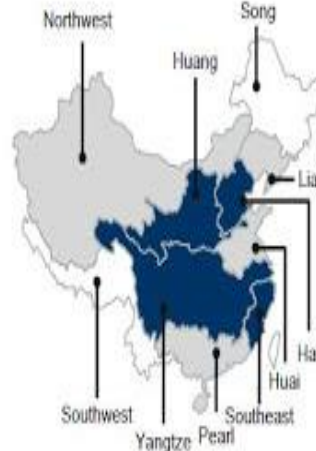
Water/Food Nexus: The Case of China & Brazil



China - Water supply and demand gap

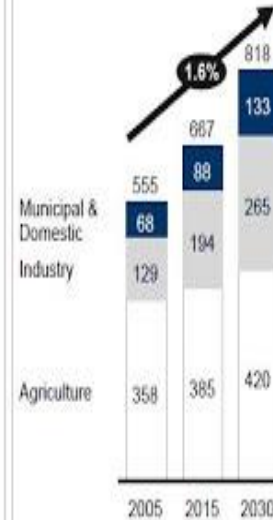
Gap between existing supply and projected¹ demand in 2030
Percent of 2030 demand

Size of gap
 □ Surplus
 ■ Moderate (0% to 20%)
 ■ Severe (20% to 80%)



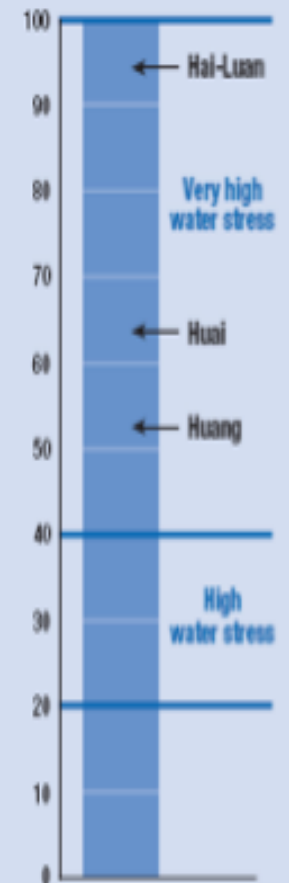
Water demand by sector
Withdrawals, billion m³

CAGR
2005-30
Percent



¹ The unconstrained projection of water requirements under a static policy regime and at existing levels of productivity and efficiency
 SOURCE: China Environment Situation Fact book; China Agriculture Annual book; Study of China water resources strategy; China grain security planning; basin annual bulletin; press search; 2030 Water Resources Group

Water use relative to gross availability, 2000 (%)

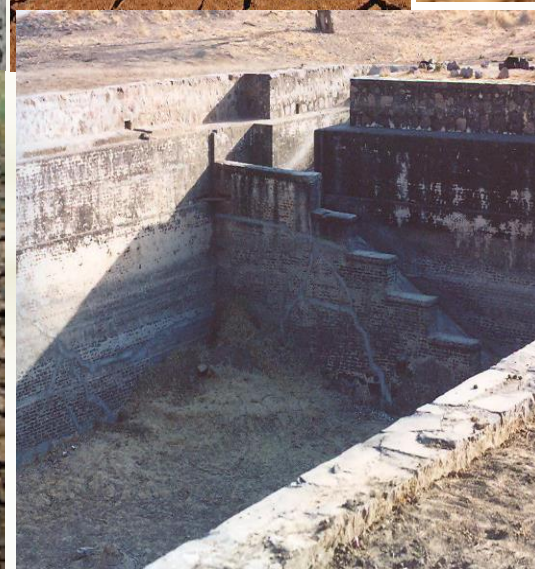


Source: Shalizi 2006.



THE FUTURE OF SCIENCE™

Environmental Destruction Loss of Biodiversity





THE FUTURE OF SCIENCE™



The Fertile Lands of Africa

Turning food to fuel on the hungry continent

1 Ghana



A single firm plans to plant one million hectares of potentially toxic jatropha with government support

2 Benin



Millions of hectares of fields and forest to be switched to jatropha and sugar cane to produce biodiesel for export

3 Ethiopia



Government drive to open up land to foreign biofuels investors threatens 85% of population who are subsistence farmers

Countries growing crops for biofuels



4 Uganda



Government attempt to destroy half of Mabira rainforest to make way for ethanol plantations halted after protests

5 Tanzania



Thousands of small-scale maize and rice farmers evicted to make way for sugar cane and jatropha plantations

6 Zambia



Thousands of 'out-growers' bound into debt in 30 year contracts to grow biofuel feed jatropha for big investors

7 South Africa



Biodiversity disaster looms in Eastern Cape as millions of hectares earmarked for corn-based ethanol



Graphic: ROB BROOKS



THE FUTURE OF SCIENCE™



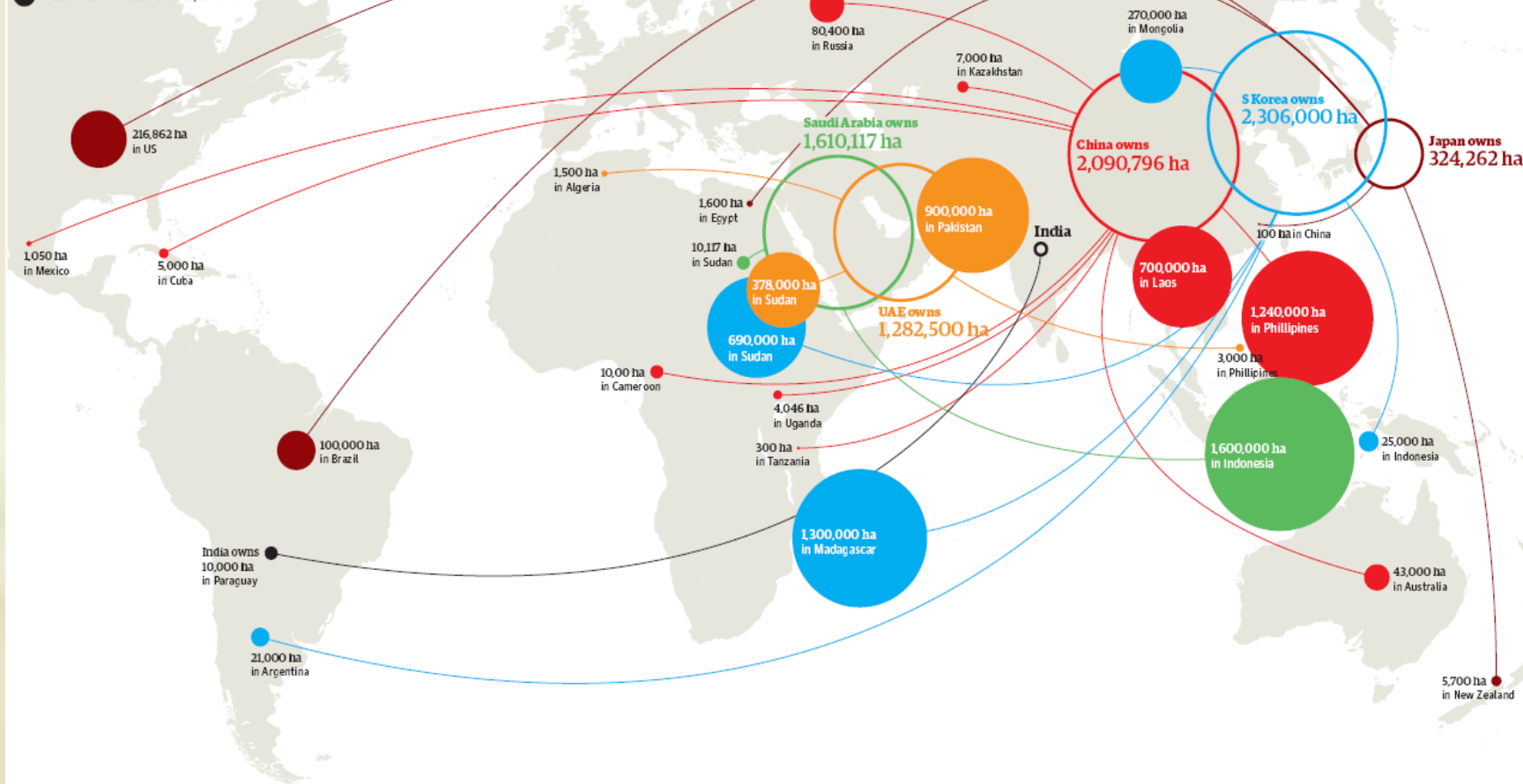
Foreign Land Acquisitions

World land grab

Land purchased by government and private companies from each country, where areas are known

○ Total area purchased by country

● Countries in which land has been purchased



SOURCE: GRAIN.ORG



THE FUTURE OF SCIENCE™

Water & Ethics



WHAT IS THE HUMAN DEVELOPMENT COST?

Over 800 Million People Have No Access To Food

Almost 800 Million People Have No Access to Clean Water

Over 1 Billion People Still Have No Access to Sanitation

Hunger, illness, and lost education opportunities in childhood, create a lifecycle of disadvantage and leads to adult poverty which affects the economics of a country.



Water Footprint



WATER FOOTPRINT =
TOTAL VOLUME OF WATER USED IN THE
PRODUCTION OF GOODS AND SERVICES

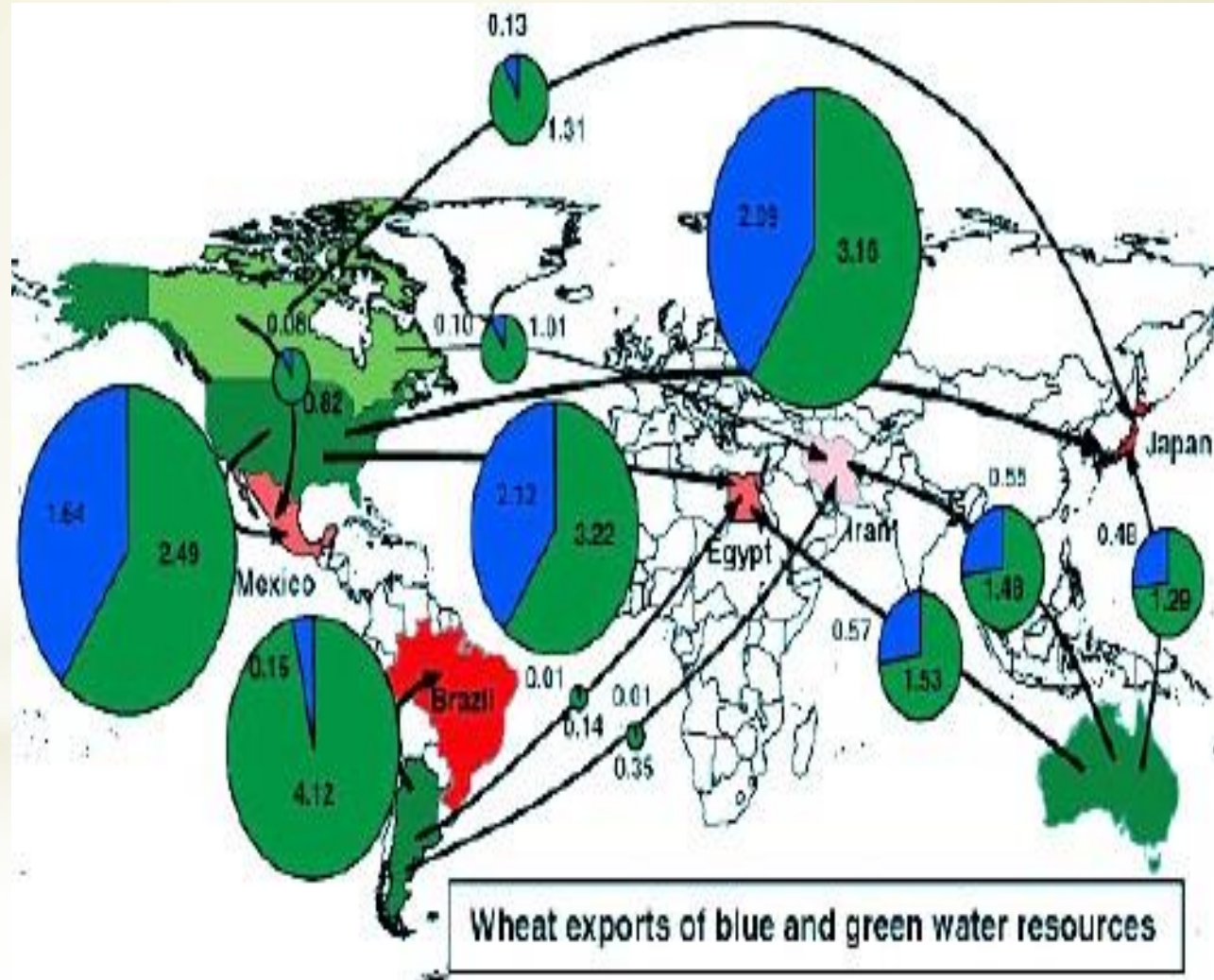
INTERNAL WATER FOOTPRINT =
VOLUME OF WATER USED FROM DOMESTIC
WATER RESOURCES

EXTERNAL FOOTPRINT =
WATER USED IN OTHER COUNTRIES TO
PRODUCE THE GOODS IT IMPORTS



THE FUTURE OF SCIENCE™

Global Water Trade In Wheat

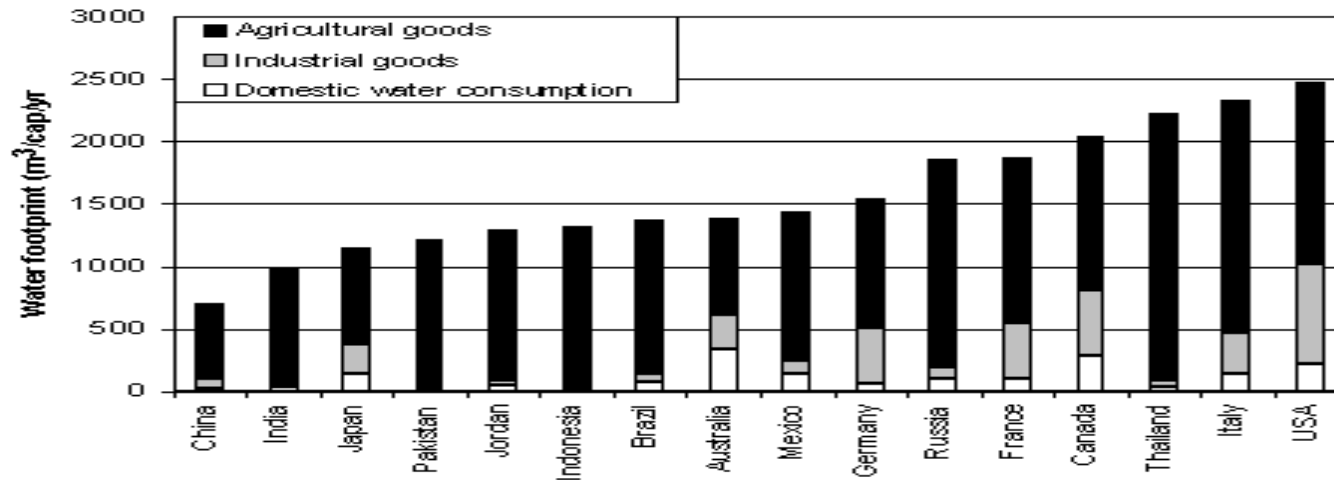




THE FUTURE OF SCIENCE™



Key Factors Determining a Country's Water Footprint



1. Volume of Consumption
2. Consumption Pattern (Vegetarian or Meat Consumption)
3. Climate (Growing Conditions)
4. Agricultural Practices (Efficiencies)

The United States has a water footprint of 2,480 m³ per capita a year

China has a footprint of 700 m³ per capital a year.

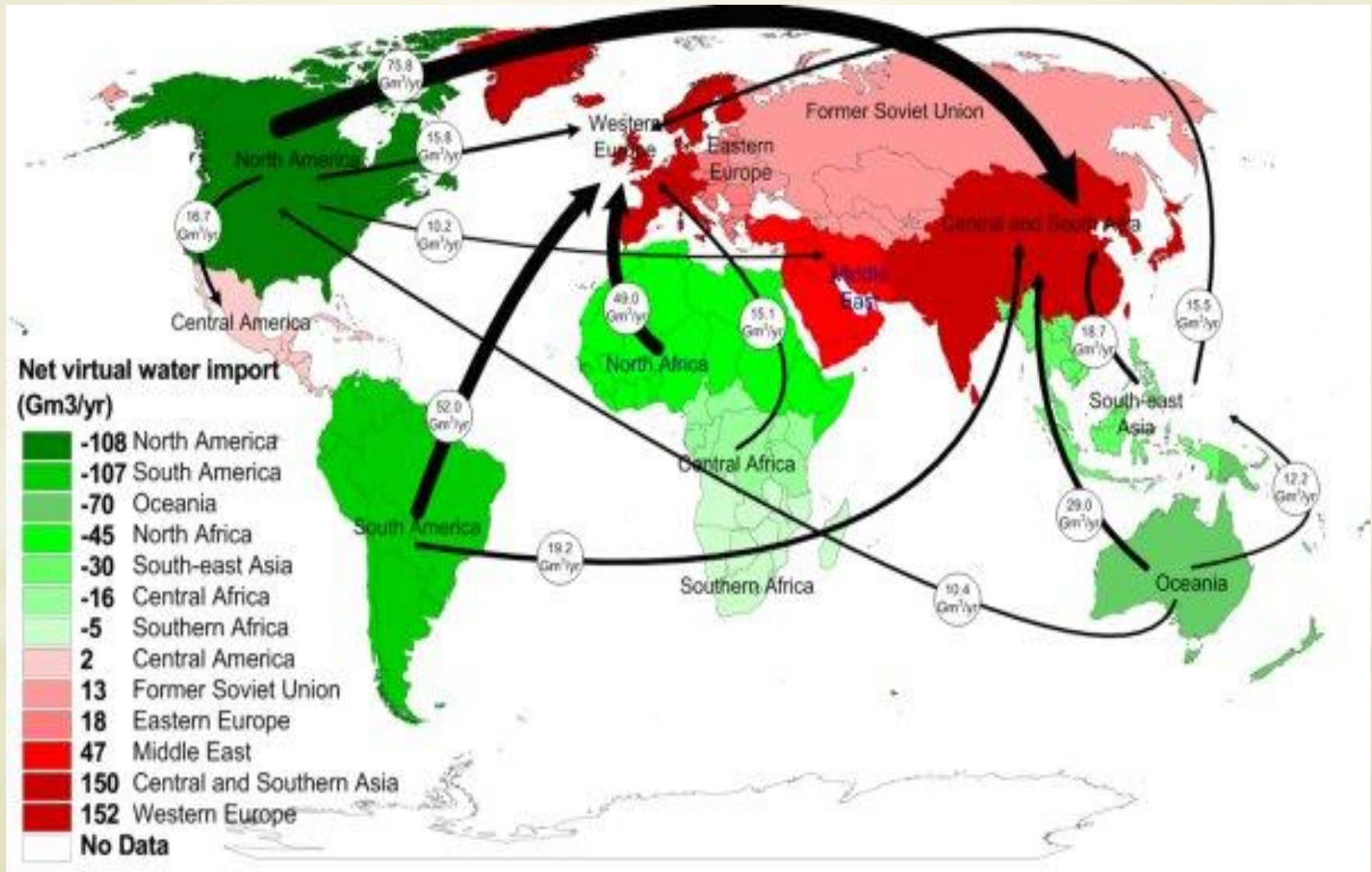
The Global Water Footprint is estimated at 1,240 m³ per capital a year



THE FUTURE OF SCIENCE™



Global Virtual Water Trade





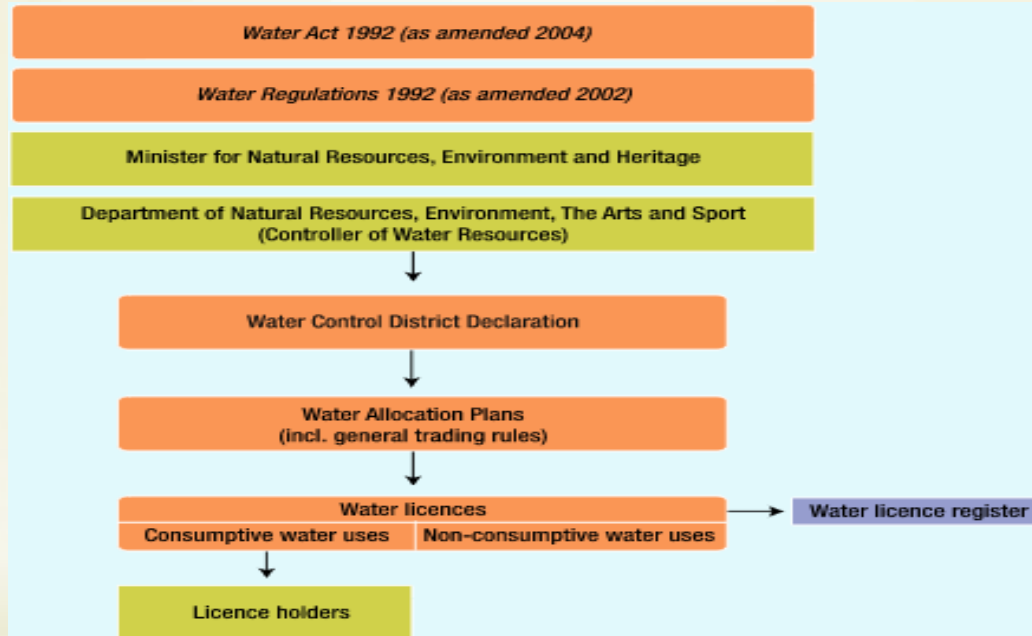
THE FUTURE OF SCIENCE™

Water Markets

Australian Water Market



Water markets can serve as a mechanism to balance supply and demand and to address inefficiencies.



Within the agricultural sector, inter-farm trades can be beneficial in terms of farm productivity and result in increased crop outputs and higher incomes for farmers.

Within the urban sector, irrigation has a higher value.

Inefficient irrigation can be traded up towards higher value products for urban or industrial purposes.

The rural/urban trade can be an interesting water market, however both parties **MUST** be willing to trade.



Valuing Water



In considering water economics, the following basic principles apply:

- 1. Water rights need to be clearly defined and enshrined in legislation;**
- 2. Water rights need to include water for human needs and also for drinking, bathing, cooking, etc;**
- 3. Lands, oceans and ecosystems need to have the right to water and all decision should consider impacts on these resources;**
- 4. Land and water rights should be separated in order to encourage water trading and efficiency measures**
- 5. The cost of water should include 'ability to pay';**
- 6. Water should be valued depending on availability of resources'**
- 7. Water prices for provision should include the full cost – such as maintenance and expansion;**
- 8. Water should be measured with meters, information technology platforms and other management practices.**

Examples of Economic Solutions

Public Payment Schemes

Private Payment Schemes

Private Party Purchase

Water Cap & Trade

Polluter Pays

Environmental Taxes

Certification

Water Labeling





Examples of Technical Solutions



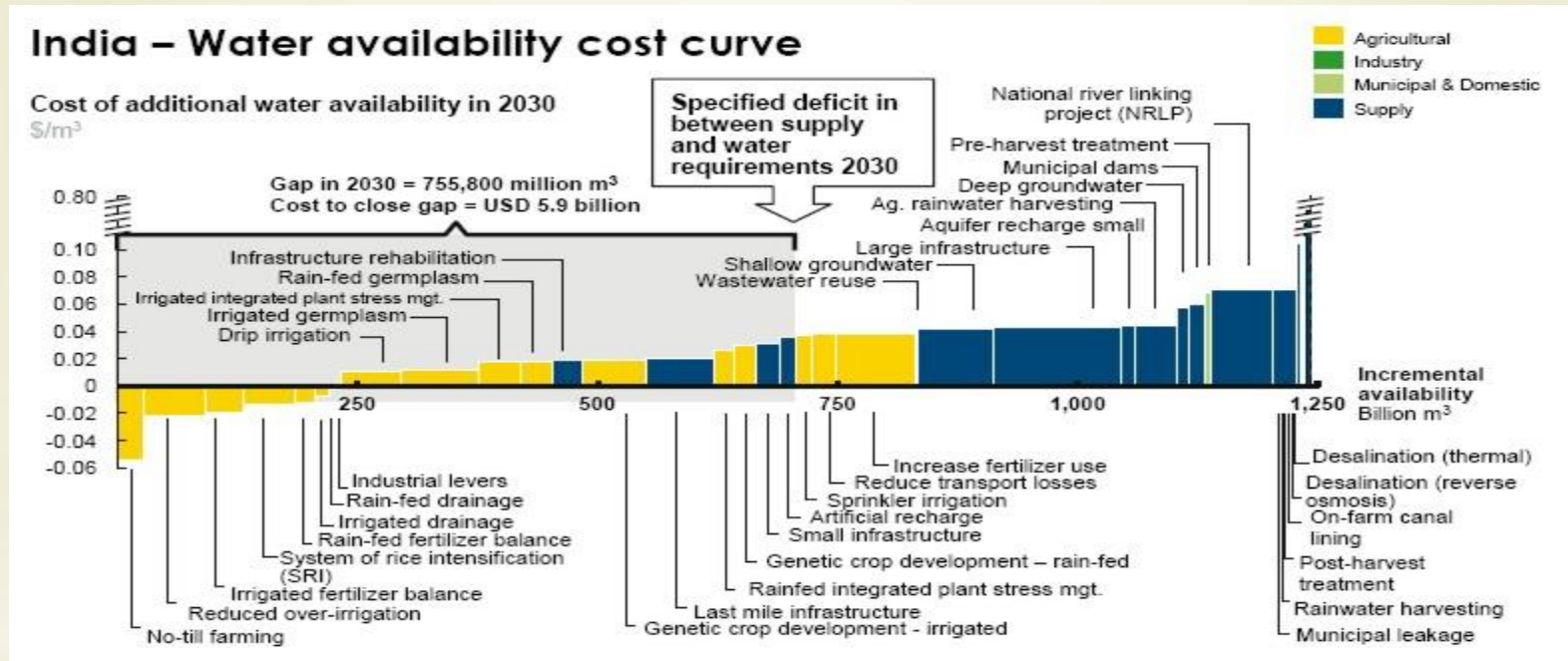
- Improved maintenance of existing irrigation systems;
- Drip irrigation;
- Drought resistant seeds;
- IT Platforms to measure volumes;
- Mobile technology;
- Altered tillage and soil management;
- Changes in cropping patterns (e.g. reduce hectares cropped, and switch from rice to less water intensive crops);
- The lining of irrigation canals;
- The replacing of open canals with underground pipes;
- The switching from gravity irrigation to more efficient irrigation techniques such as drip or sprinkler irrigation systems.
- Rain water harvesting would also be another useful technique of storing water from the rain.



THE FUTURE OF SCIENCE™



India & Irrigation Gains



In India, aggregate agricultural income could increase by \$83 billion per year by 2030.

Drip irrigation alone has an aggregate potential to increase revenues by \$30 billion annually and create net savings for India's farmers.

Reducing the amount of fertilizers required by up to 40% and increasing yield by up to 60 % .

The use of better seeds on both rain fed and irrigated land, can increase Indian agricultural incomes by \$5-30 billion annually.



Investment in Agriculture

The development of the agriculture sector is an effective instrument to alleviate poverty:

From 1993 to 2002, fall of rural poverty rate from 37 to 29 percent;
Decrease in rural poverty is highly attributed to better rural conditions through infrastructure developments and improvements in agricultural productivity and technology standards.

Agriculture is a significant source of economic growth:

In developing countries, agriculture generates on average 29 % of GDP and employs 65 % of labor force;
Agriculture also plays an important role in transforming and urbanized economies, where industries and services linked to agriculture account for more than 30 % of GDP.

A more developed agricultural sector enhances food security:

Agriculture is often characterized by undercapitalization, low technology, poor market access, and underutilized or degraded land.

These factors increase transaction costs that weaken the production and sale of agricultural commodities.

By investing in agriculture and addressing the deficiencies of the sector, food supplies are secured and trade, greater productivity and economic growth.



THE FUTURE OF SCIENCE™

Risks in Investing in Agriculture



PRODUCTION RISK

MARKET RISK

FINANCIAL RISK

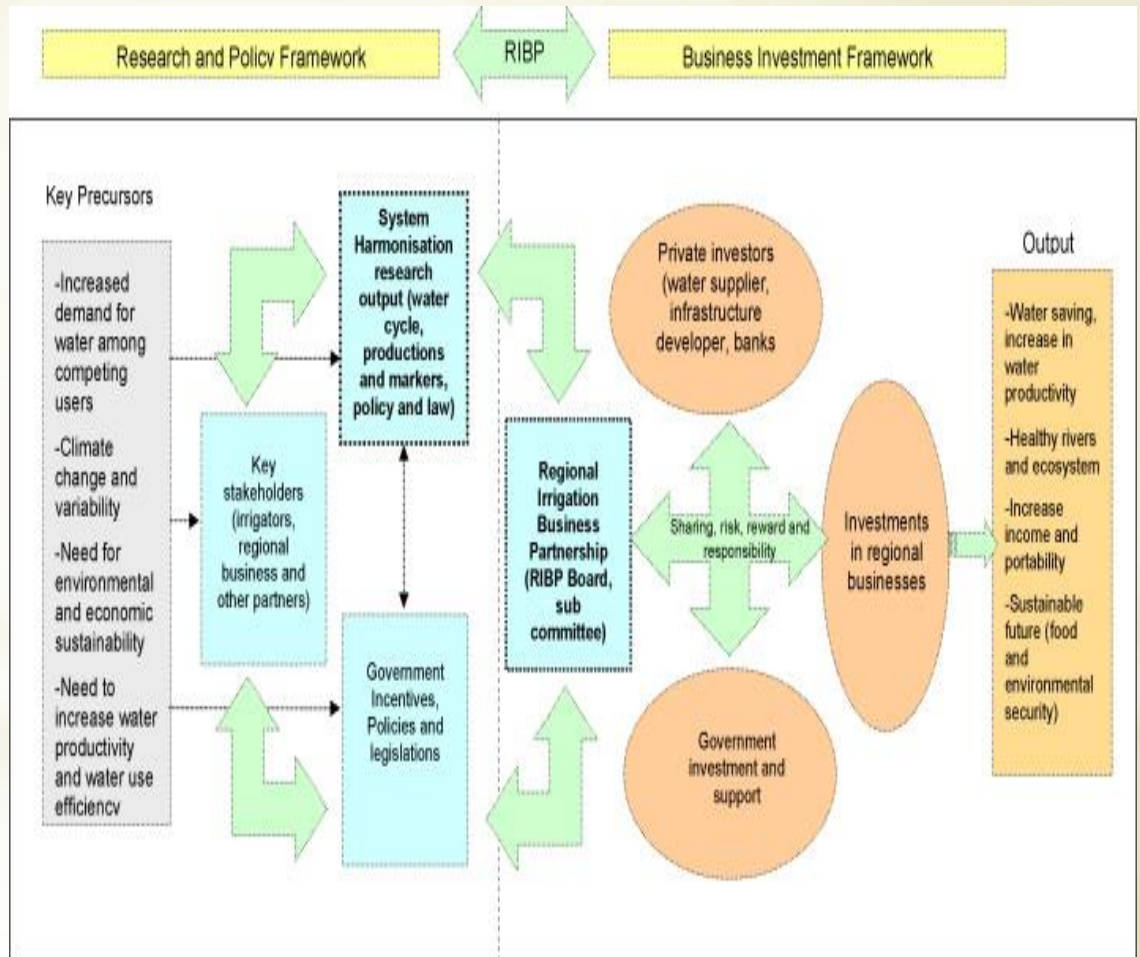
INSTITUTIONAL RISK

SYSTEMIC RISK

MARKET DISTORTIONS

TIME HORIZONS

POLITICAL RISK

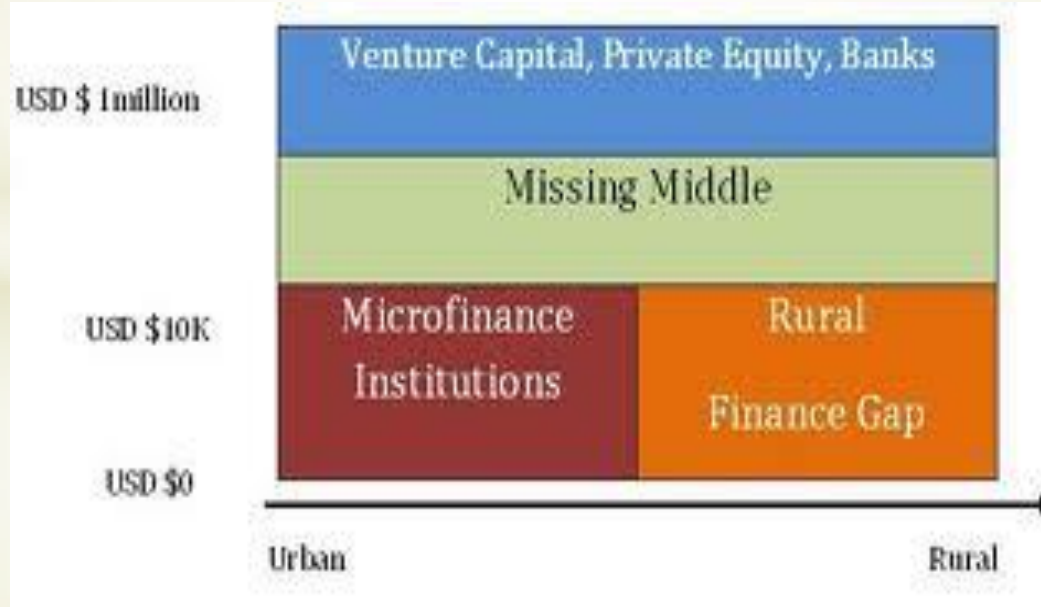
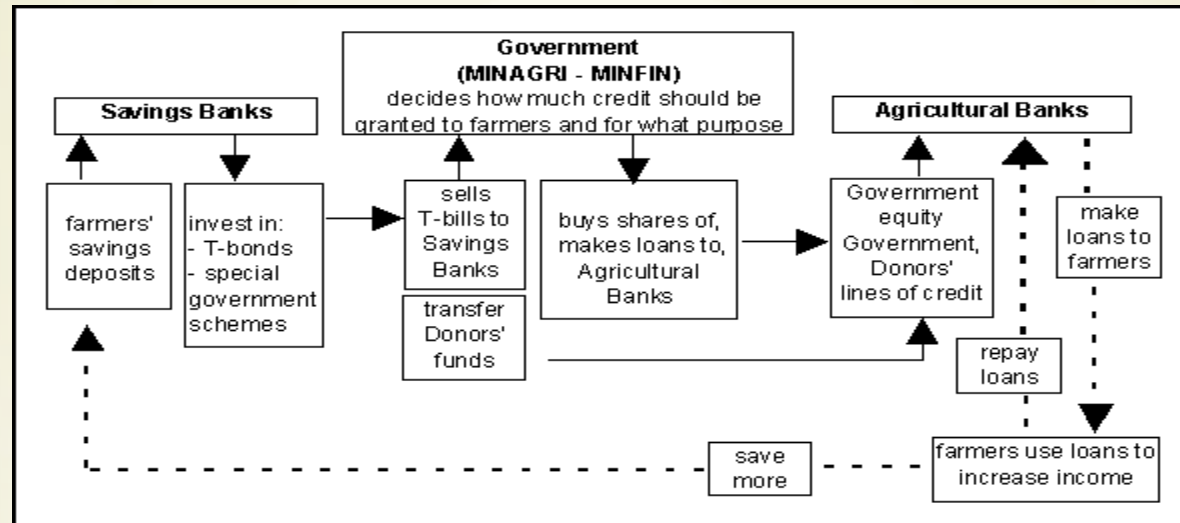




THE FUTURE OF SCIENCE™



Rural Finance Gap





The 21st Century Water Challenge **must involve a** **Multi-Stakeholder Approach**



Political/Economic Choices

- Regulations
- Define Water Rights
- Develop Markets
- Incentive Mechanisms
- Agency Involvement
- Governance Reform

Technology Choices

- Innovative Financing Schemes
- New Efficient & Low Carbon Technologies
- Public-Private Partnerships

Invest/Business Choices

- Corporate Social Responsibility
- License to Operate
- Bottom of Pyramid
- New Markets
- New Leadership

Social Choices

- Indigenous Solutions
- Best Local Practices
- Understanding Realities on Ground

