A Drop in the Ocean? Strategies and Technologies to Conserve Water for Current and Future Generations

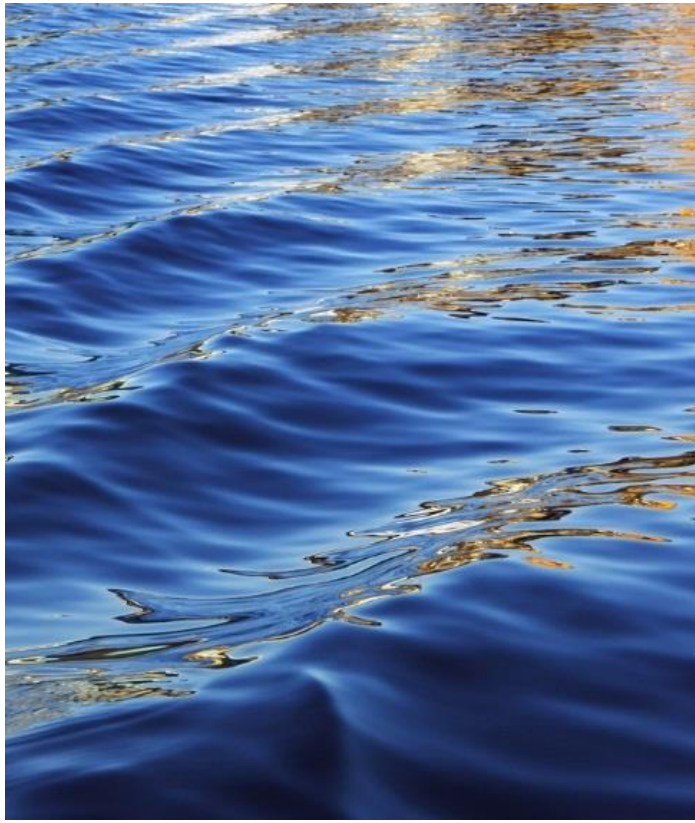
Abigail Dahlberg

Today's session

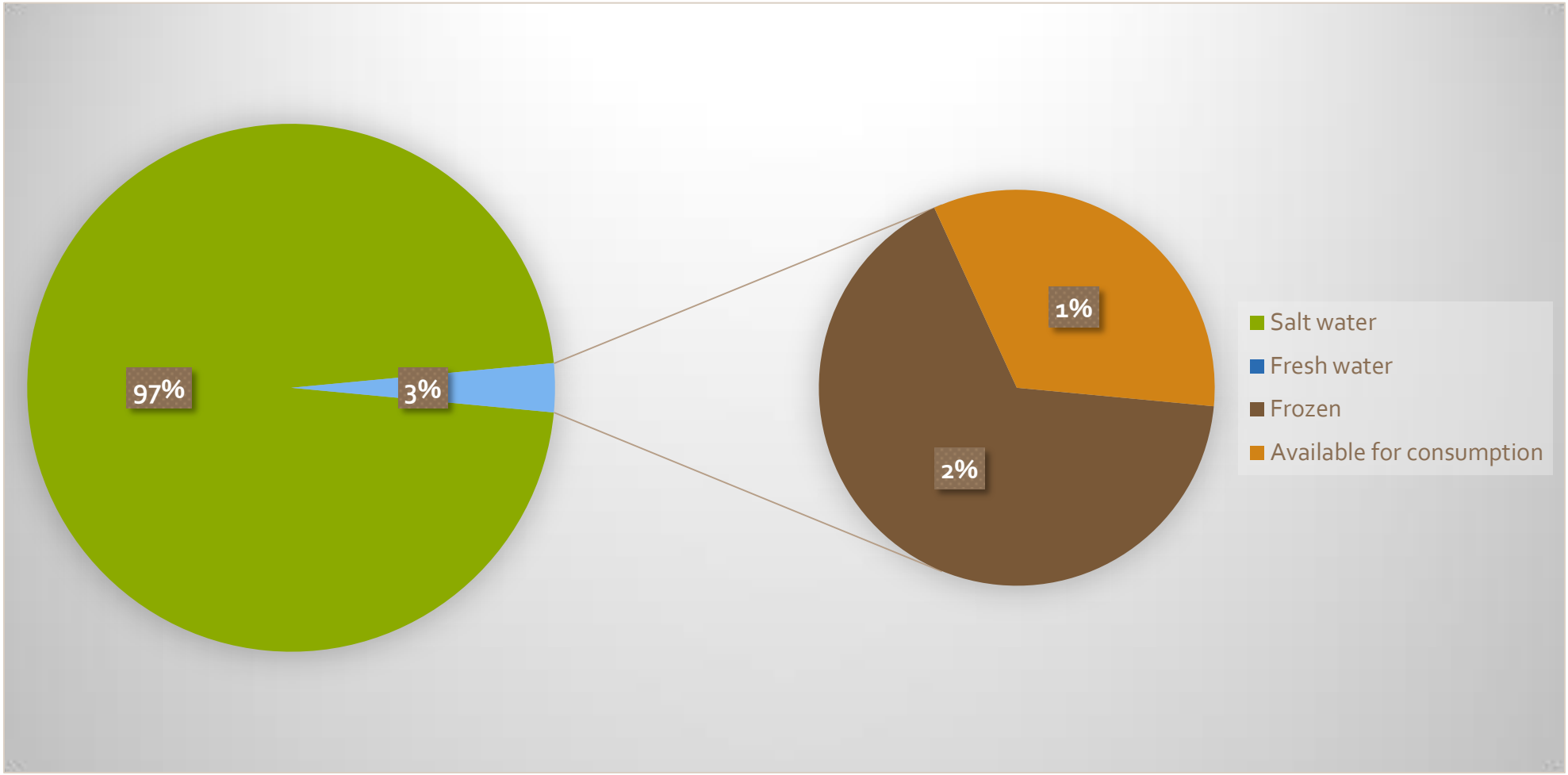
- Dwindling supply
  - Water scarcity
  - Quantity vs. quality
- Growing demand
  - Population growth
  - Prosperity
  - Water usage
  - Climate change
- Water conservation techniques and strategies
  - Reducing losses
  - Innovative technologies
  - Desalination?

The problem

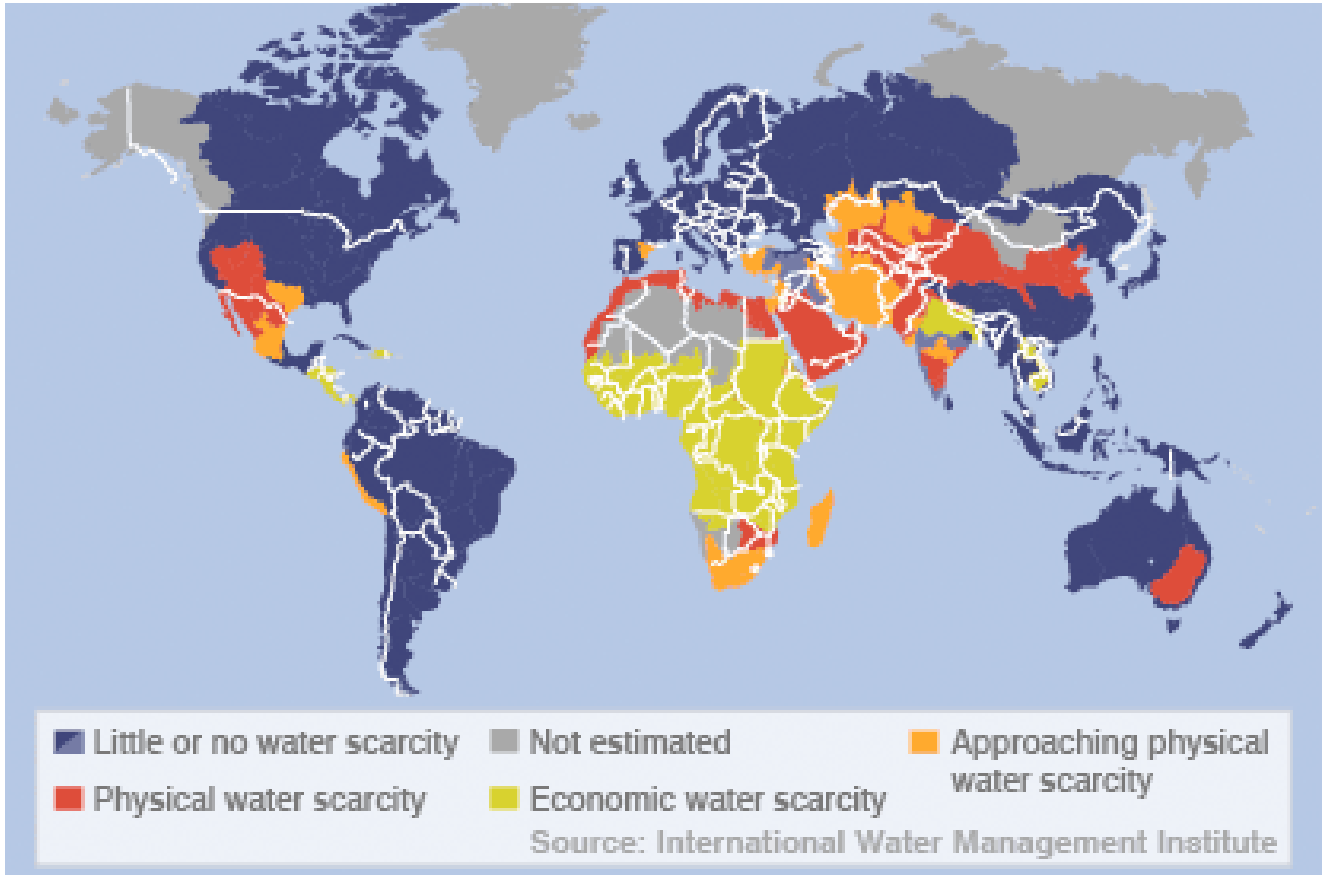
Dwindling supply and growing demand



Our planet's water resources



Water scarcity



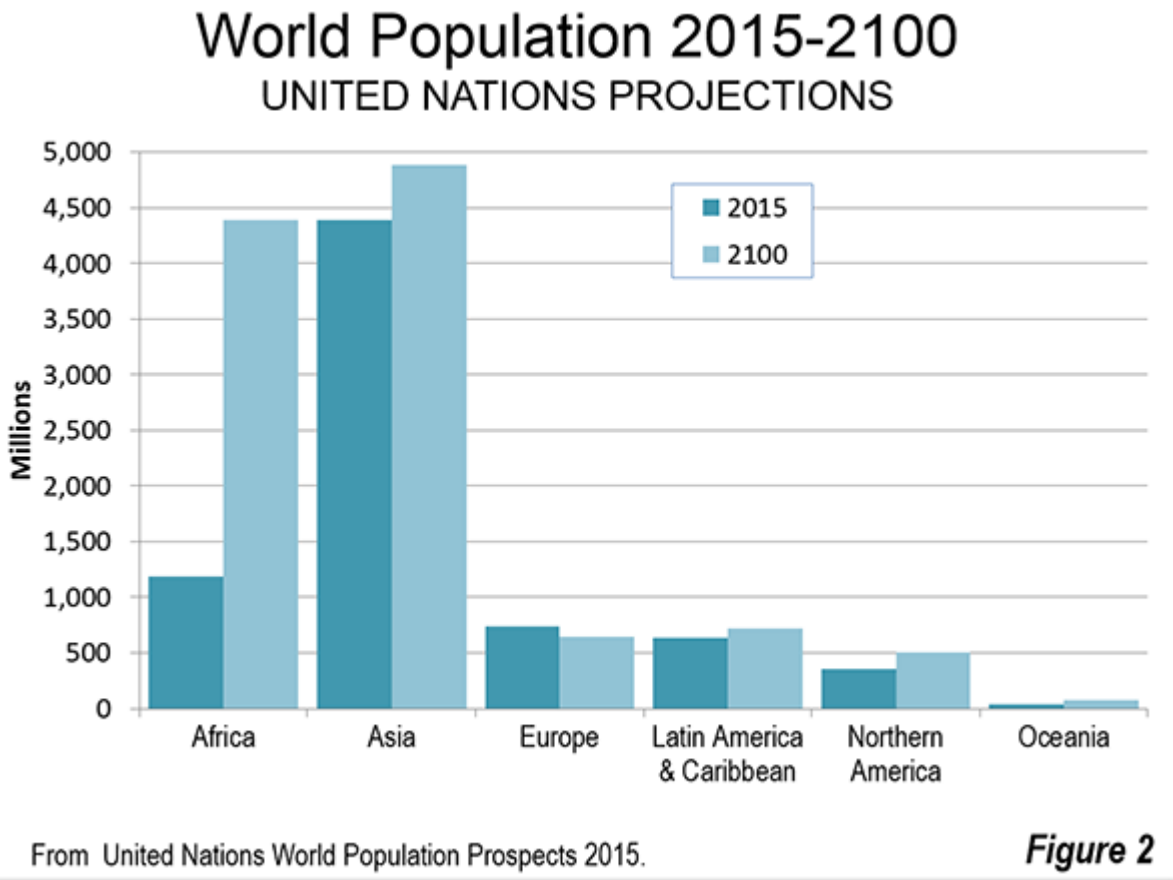
Defining water stress, water scarcity and absolute scarcity – the Falkenmark indicator

Water Stress Index Renewable fresh water (m^3/person/year)	
> 2,500	OK
2,500 - 1,700	Water vulnerability
1,700 - 1,000	Water Stress
1,000 - 500	Water Scarcity
< 500	Absolute Water scarcity

How much water do we need?

l/day and capita	Essential	Abundant	Quality
Drinking	2	4	***
Domestic	40	400	**
Food (Evapotranspiration)	1000	5000	*

A growing population

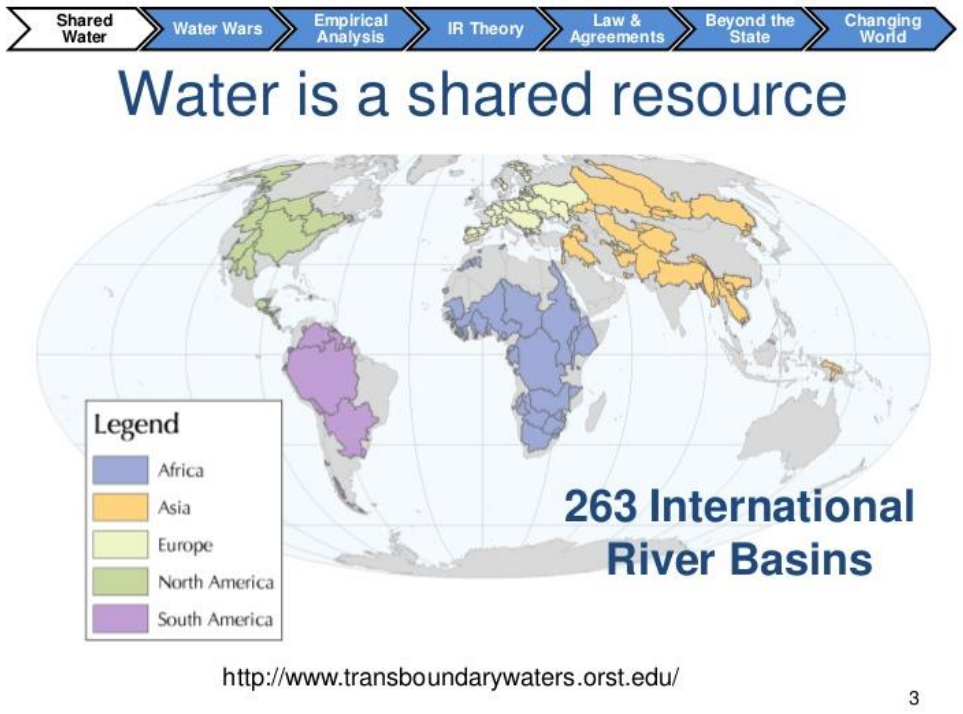


From United Nations World Population Prospects 2015.

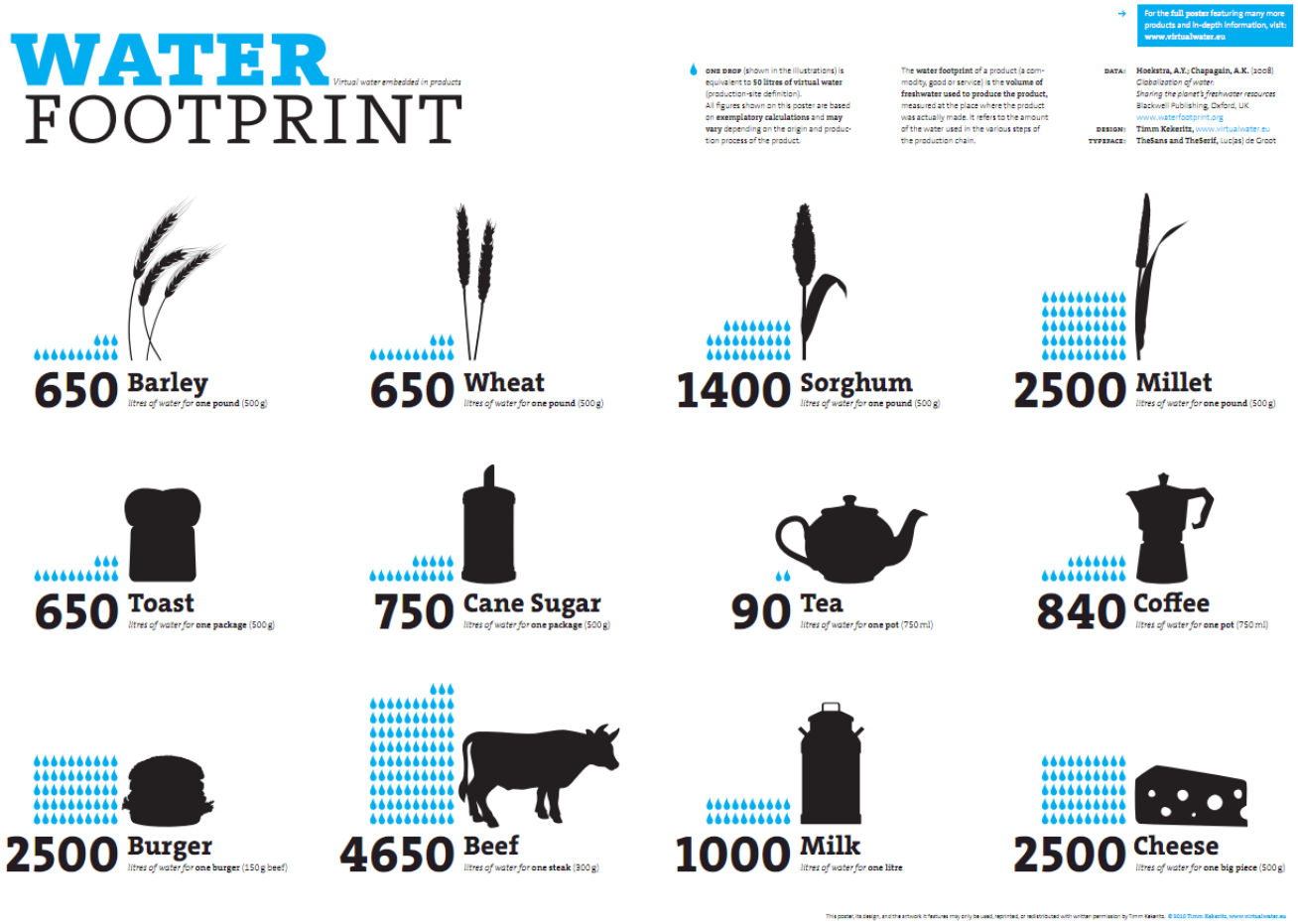
Figure 2

Migration and urbanization

Transboundary water basins - the Nile River



Increasing disposable income



Climate change

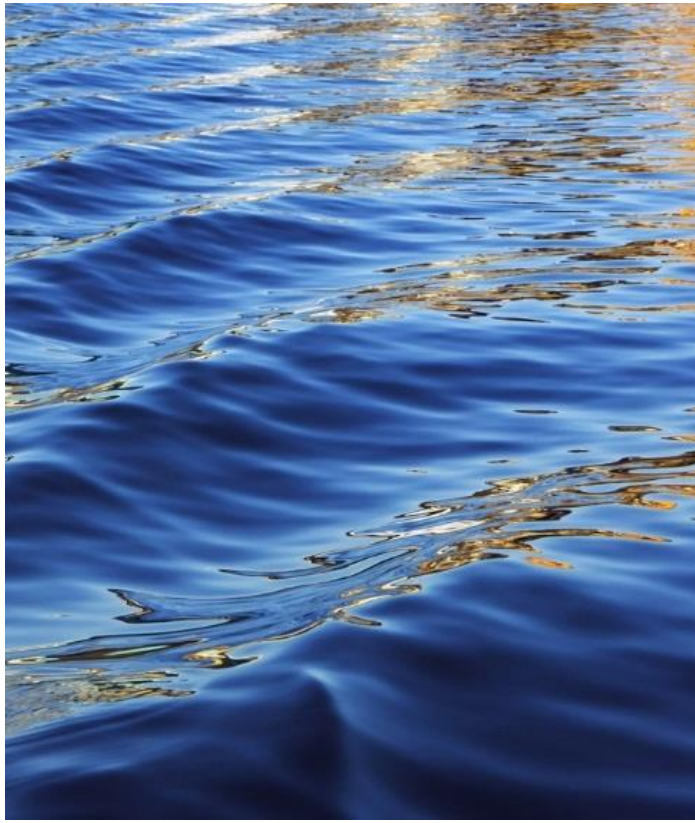
Climate change

Intergovernmental Panel on Climate Change Technical Paper on Climate Change and Water

- "Observational research and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems."
- Climate model simulations for 21st Century are consistent in projecting increases in precipitation in high latitudes and decreases in some sub-tropical and lower mid-latitude regions.
- Water supplies stored in glaciers and snow cover are projected to decline this century.
- Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution.
- Changes in water quality and quantity due to climate change are expected to affect food availability, stability, access and utilization.
- But: mitigation measures can reduce the magnitude of impacts of global warming on water resources.

Water resources

Quality matters



Water quality

Water quality


treatment
across
agents
thoroughly
toilet
sewers
contact
solid
systems
runoff
microbiological
improving
chemical
facilities
waste
sewage
Wastes
wastewater
animal
even
excreta
means
dry
personal
communities
households
surface
washing
Providing
urine
need
domestic
garbage
sullage
Inadequate
reuse
word
transportation
practices
promoting
impact
collection
disposal
agricultural
engineering
plant
hand
urine-diverting
Sanitation
cause
refers
significant
biological
disease
toilets
health
prevention
change
conveyance
requires
septic
people
provision
approach
simple
problems
pit
conditions
beneficial
methods
physical
tanks
proper
focussing
maintenance
behavior
major
human
management
hygienic
services
generally
safe
soap
world-wide
sanitary
industrial
technologies
solutions
hygiene
feces
user
experience
latrines
hazards
greywater


Millions without
a toilet
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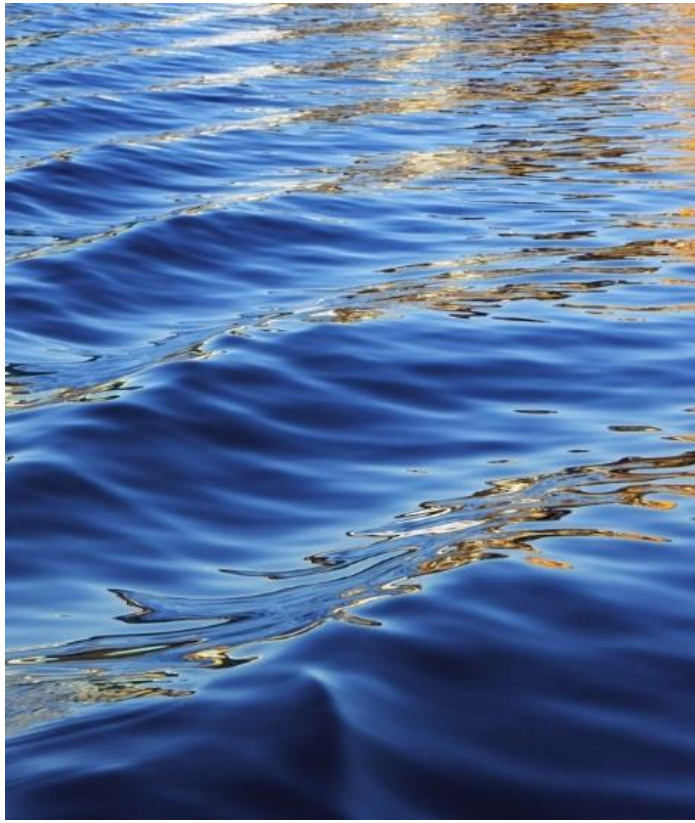
Water conservation

Past progress – Future goals



What is water conservation?

- Definition (OECD): "the preservation, control and development of water resources, both surface and groundwater, and prevention of pollution."
- Definition (DEFRA): "includes all the policies, strategies and activities to sustainably manage the natural resource of fresh water, to protect the hydrosphere, and to meet the current and future human demand."

Goals: The Three Es

- Ensure availability for future generations
- Enhance water quality.
- Enable more efficient use.

Millennium Development Goal 7C

- **Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation**
- The international community met the target of halving the proportion of people without access to improved sources of water, five years ahead of schedule.
- Between 1990 and 2015, 2.6 billion people gained access to improved drinking water sources.
- Worldwide 2.1 billion people have gained access to improved sanitation. Despite progress, 2.4 billion are still using unimproved sanitation facilities.

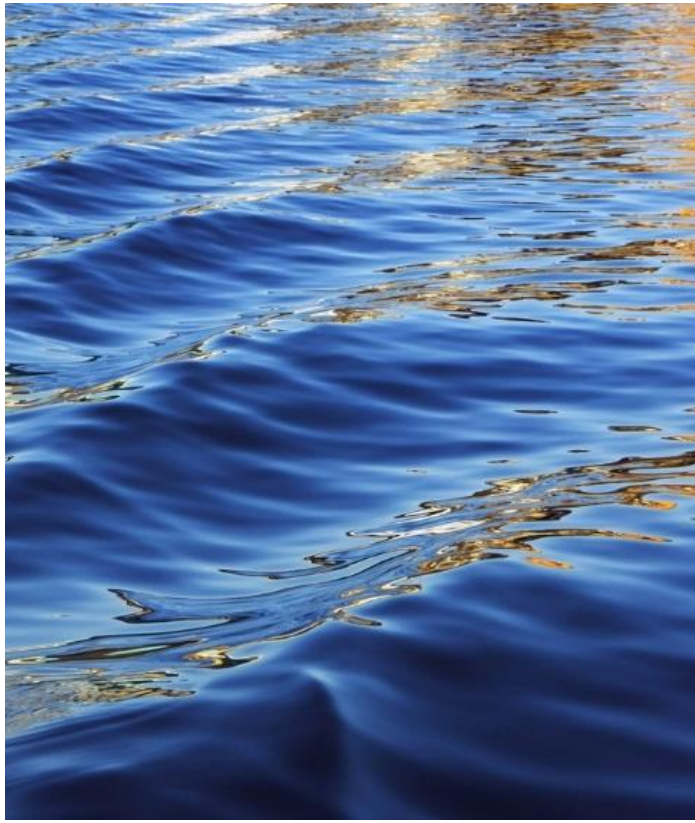
Sustainable Development Goals

SDG 6: Ensure access to water and sanitation for all

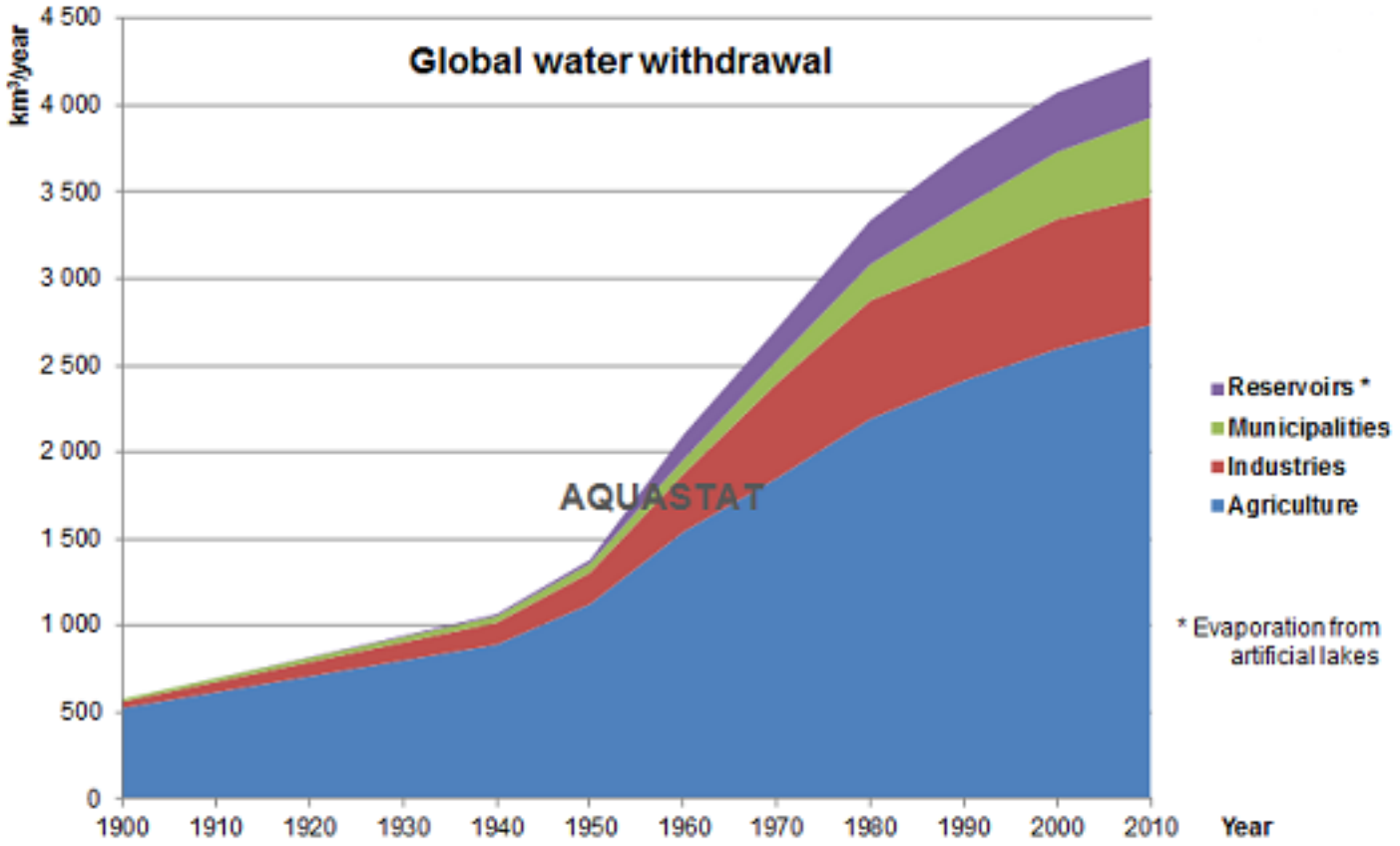
- By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
- By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- Support and strengthen the participation of local communities in improving water and sanitation management

Competing uses

A fine balancing act



Water usage – agriculture, industry, household



Integrated water resources management

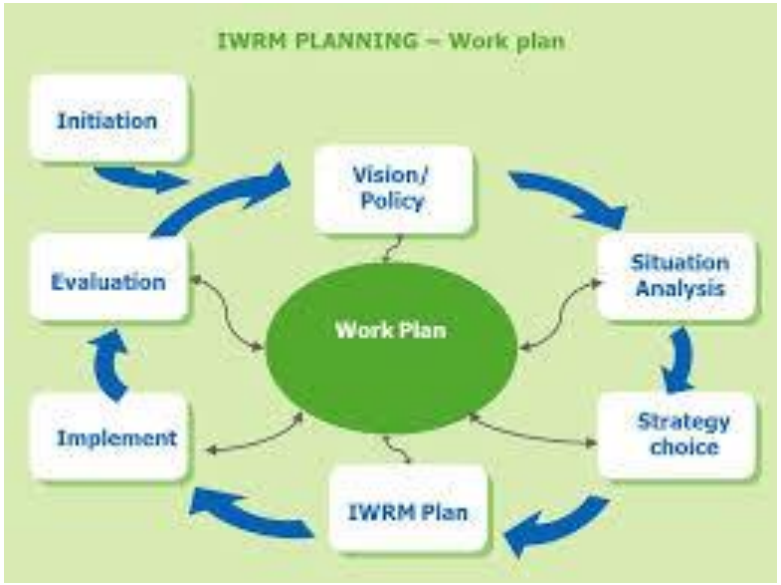
Integrated water resources management (**IWRM**) is defined by the Global Water Partnership (GWP) as:

"a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."

Three major tenets:

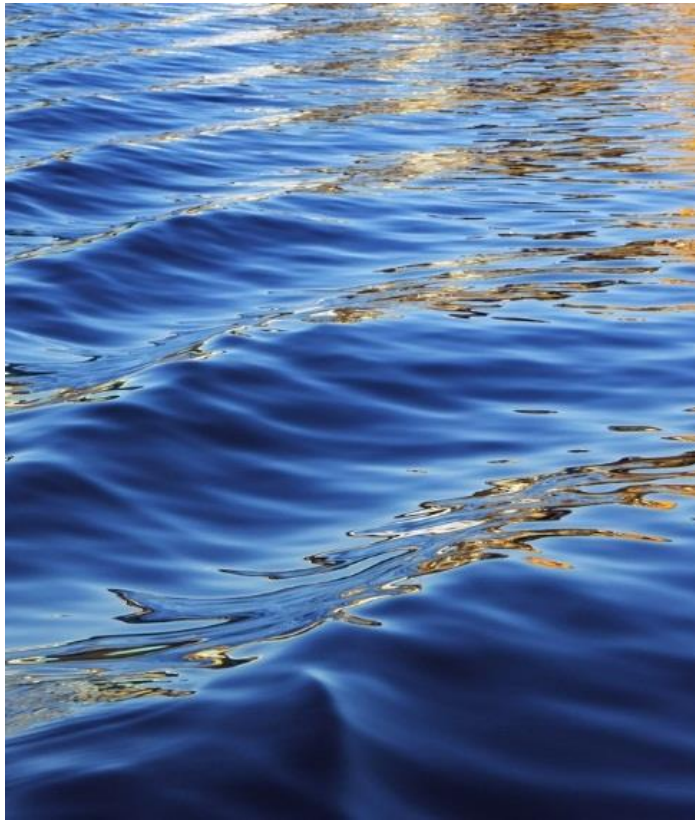
- Social equity: ensuring equal access for all users (particularly marginalised and poorer user groups) to an adequate quantity and quality of water necessary to sustain human wellbeing.
- Economic efficiency: bringing the greatest benefit to the greatest number of users possible with the available financial and water resources.
- Ecological sustainability: requiring that aquatic ecosystems are acknowledged as users and that adequate allocation is made to sustain their natural functioning.

IWRM (continued)



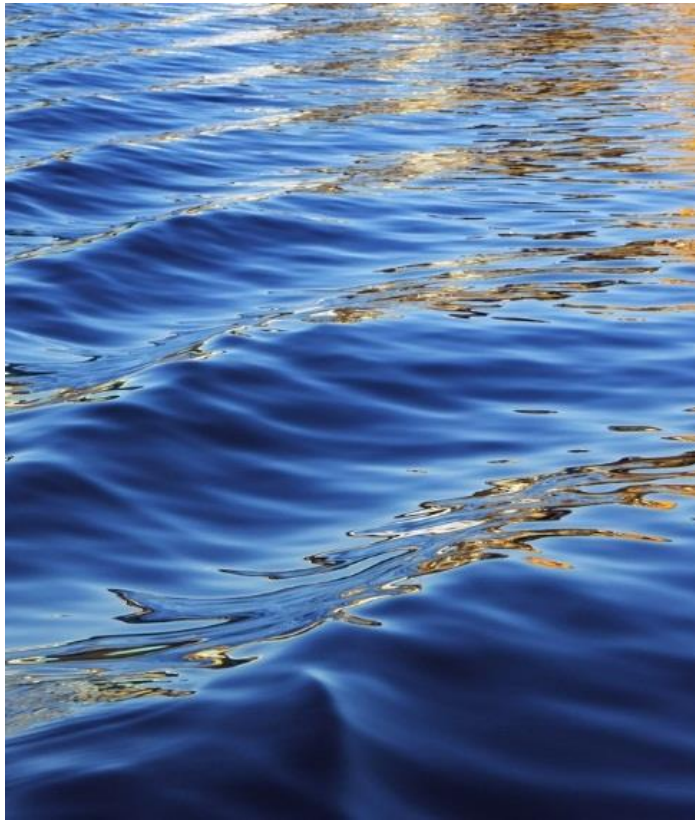
The solutions?

Water conservation technologies



Water conservation technologies

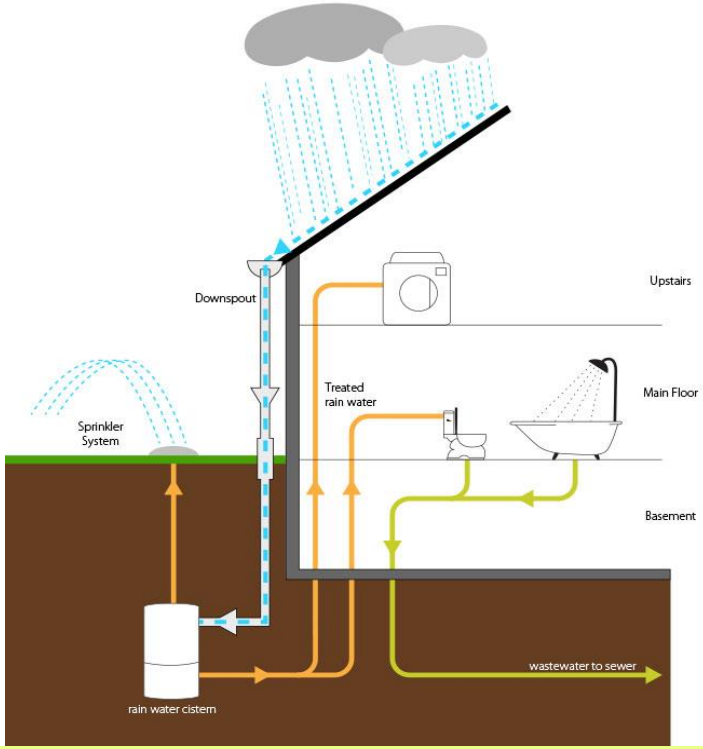
Maximizing water resources



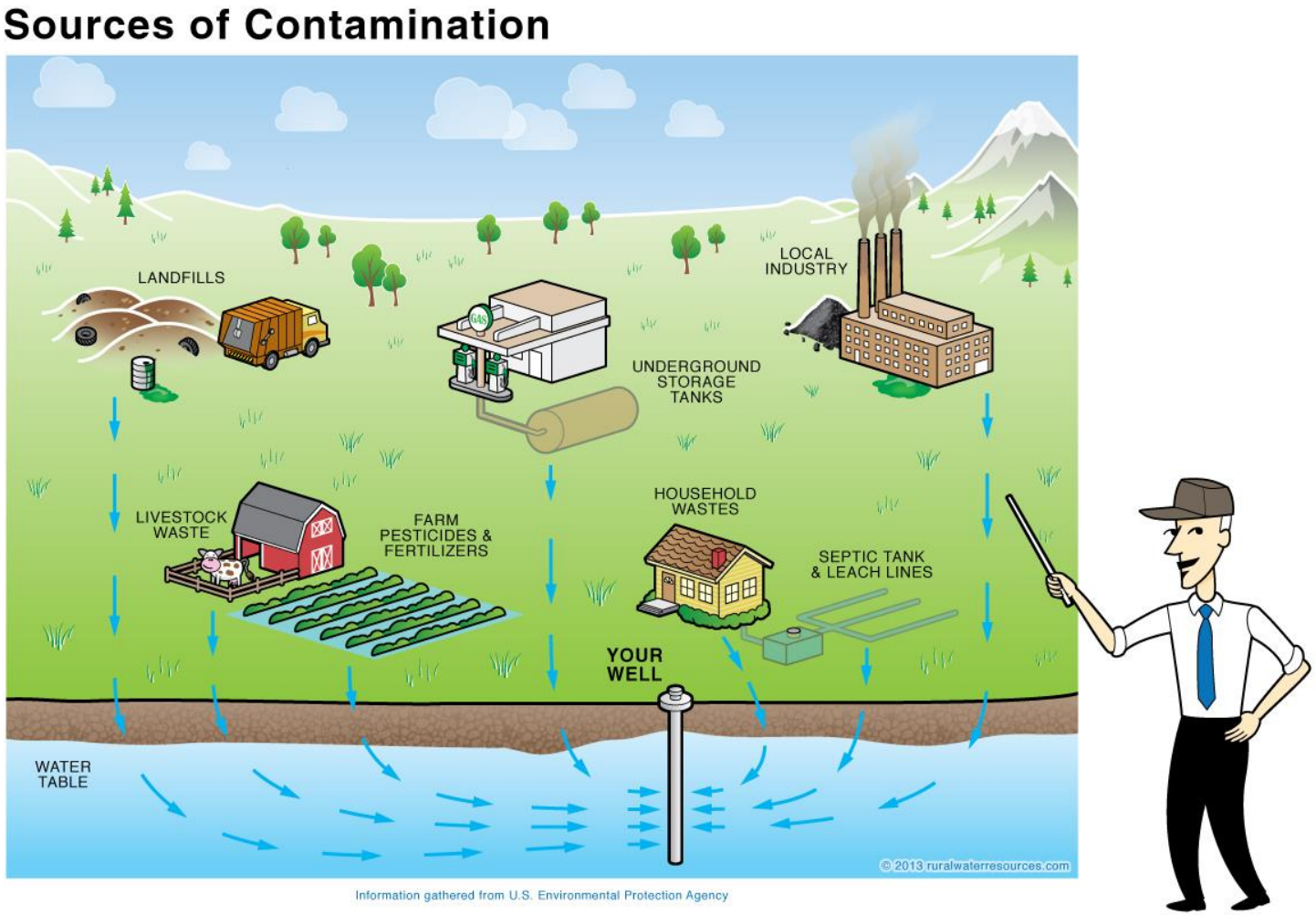
Rainwater harvesting

- Reduces demand on wells, helping to sustain groundwater levels
- Cheap and reliable source of clean water
- Can range in complexity from systems that can be installed with minimal skills to automated sophisticated systems:
- Low-tech options – rooftop systems, surface water capture and cisterns.
- High-tech options – include pumping and filtration systems

General layout of rainwater system

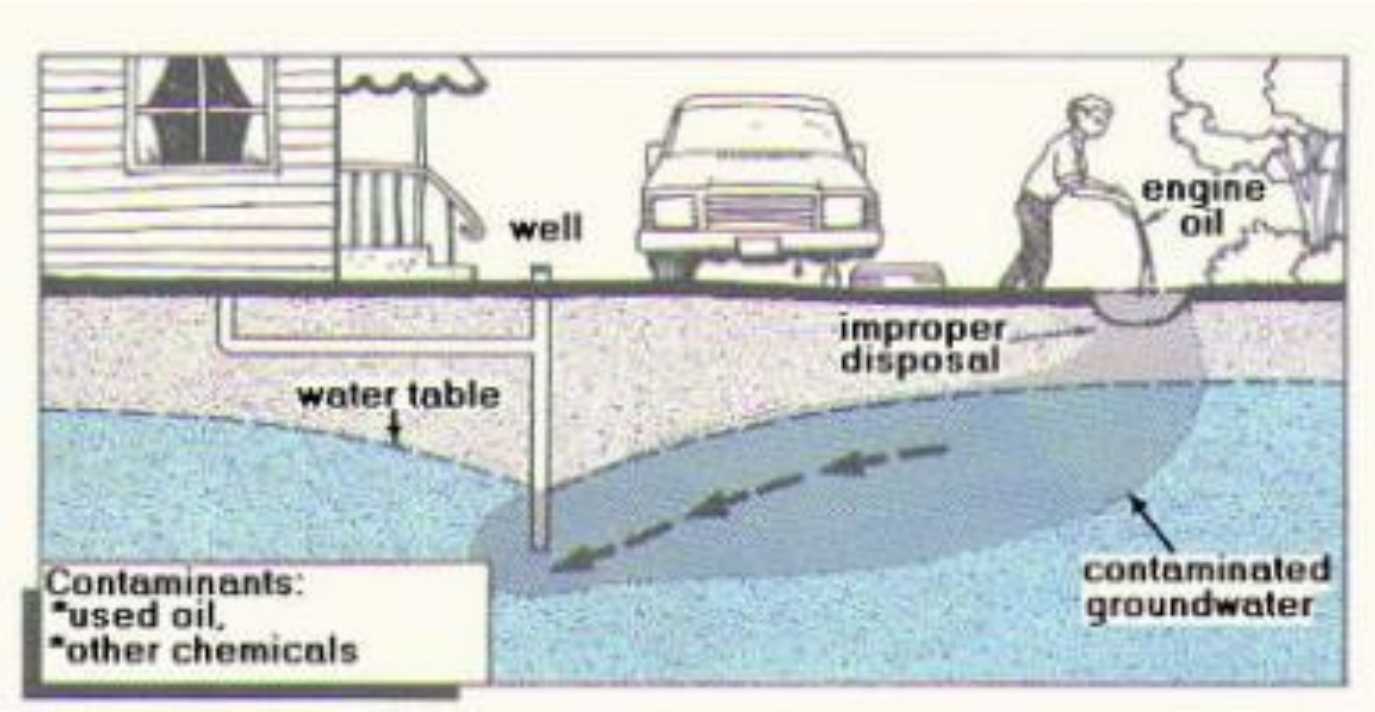


Preventing water contamination



Preventing water contamination

- Reduce chemical and pesticide use
- Check septic tanks and storage tanks regularly
- Properly dispose of waste containing contaminants



Preventing water loss

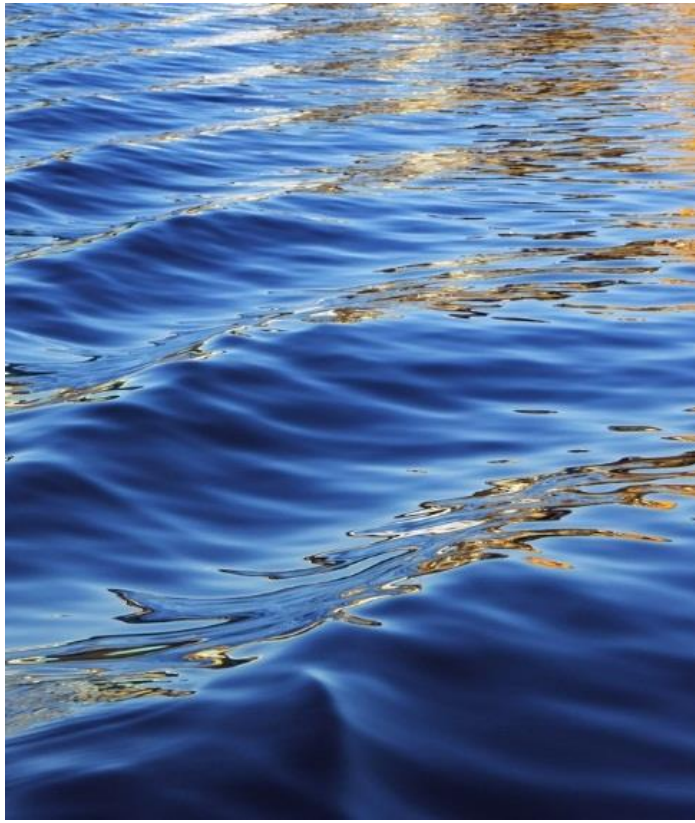
- Real or physical losses are defined as leaks **caused by outdated and improperly maintained networks.**
- Apparent losses caused by **theft and meter inaccuracies** (e.g. consumer is not billed for water, leading to utilities losing out on revenue and not having money available to make required investments in updating technology and training staff)

In 2006, the World Bank estimated that about 45 million cubic metres of water are lost daily through water leakage in distribution networks – enough to serve almost 200 million people.

Smart metering and sensors

Water conservation technologies

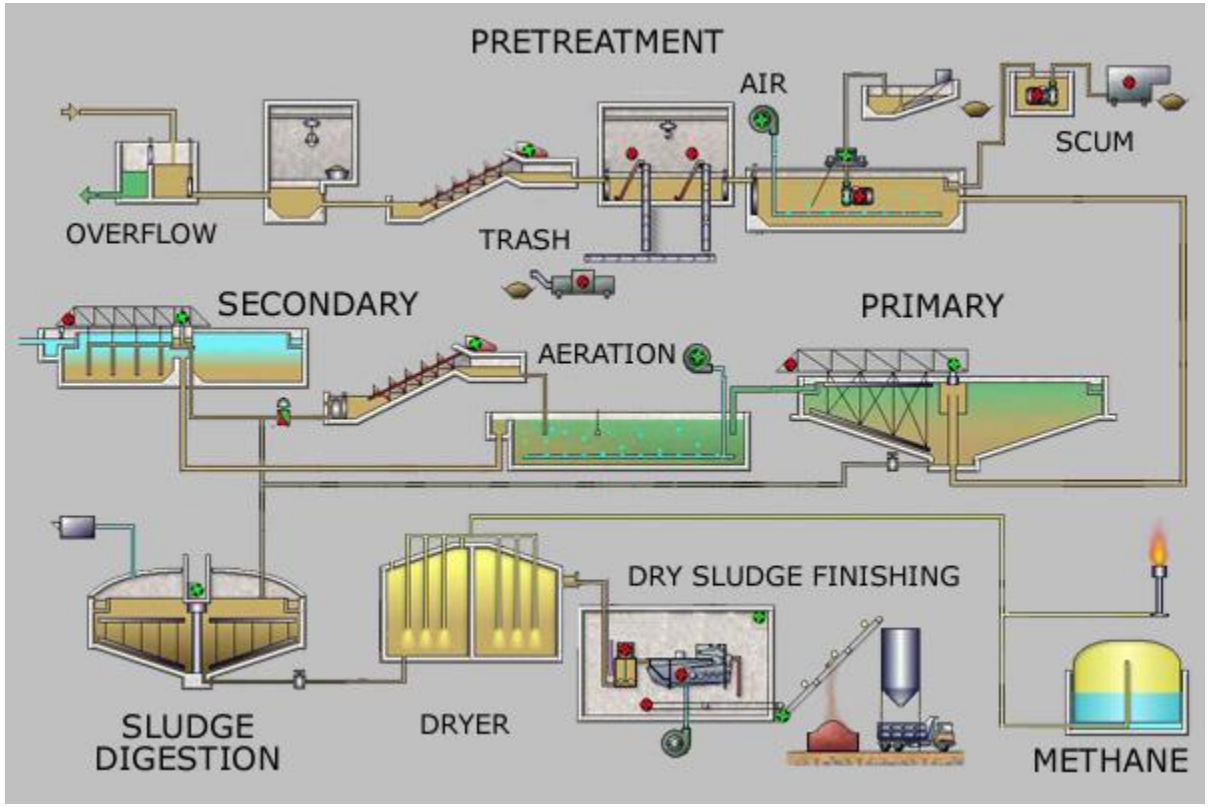
Wastewater recycling



Wastewater reuse

Toilet to tap?

Wastewater treatment



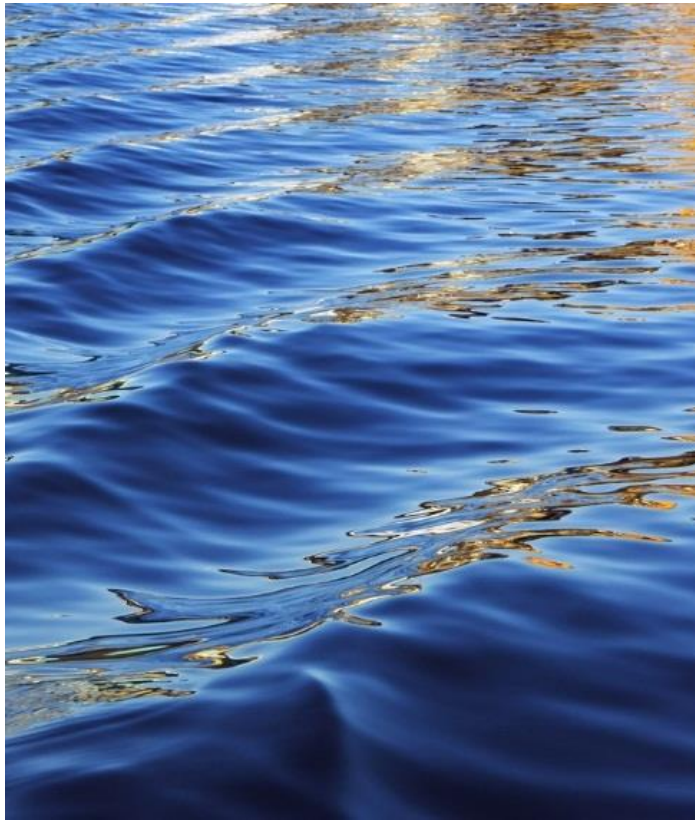
What about desalination?

- Desalinating sea water is generally more costly than using fresh water from rivers or groundwater because of the energy needed to run the process.
- Most current desalination plants also run on fossil fuels or nuclear energy.
- Most common technologies: distillation and reverse osmosis
- Other issues: Brine and other by-products
- Location is key! Proximity to a large water body improves economics (vs. pumping or transporting desalinated water to large cities)
- Desalination is especially popular in the MENA region (e.g. Kuwait produces a higher proportion of its water than any other country, totaling 100% of its water use).
- International Desalination Association: 18,426 desalination plants operated worldwide, producing 86.8 million cubic meters per day, providing water for 300 million people in June 2015.

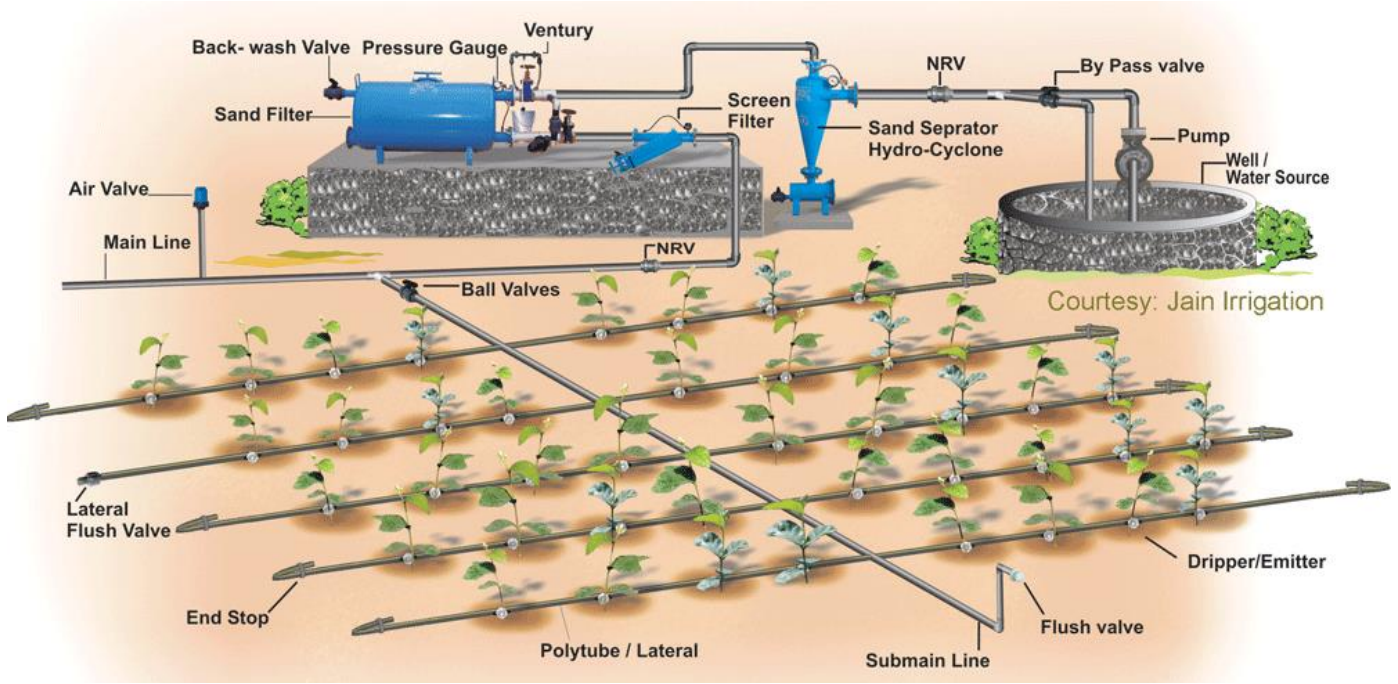
Desalination – in two minutes

Water conservation technologies

Agricultural

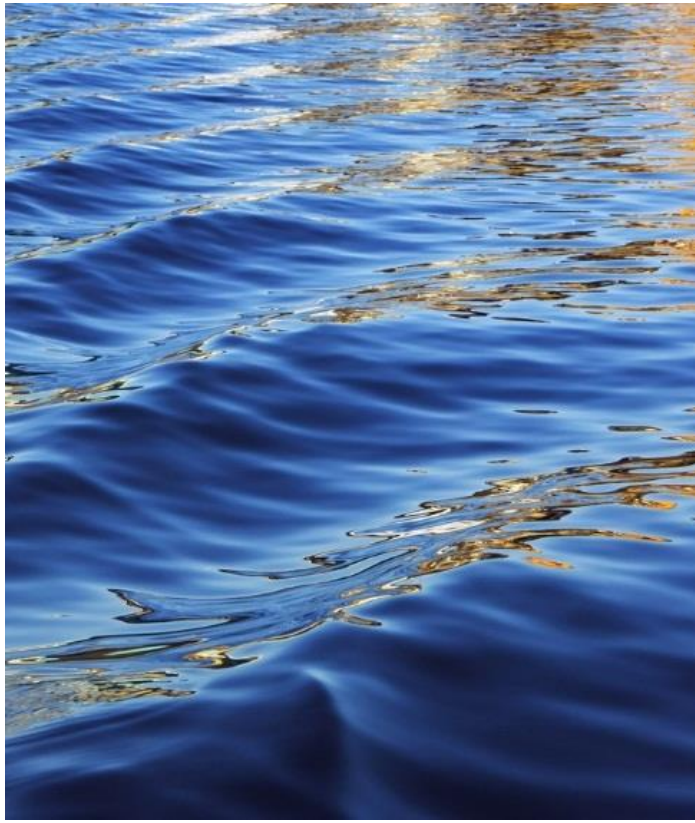


Drip irrigation



Water conservation technologies

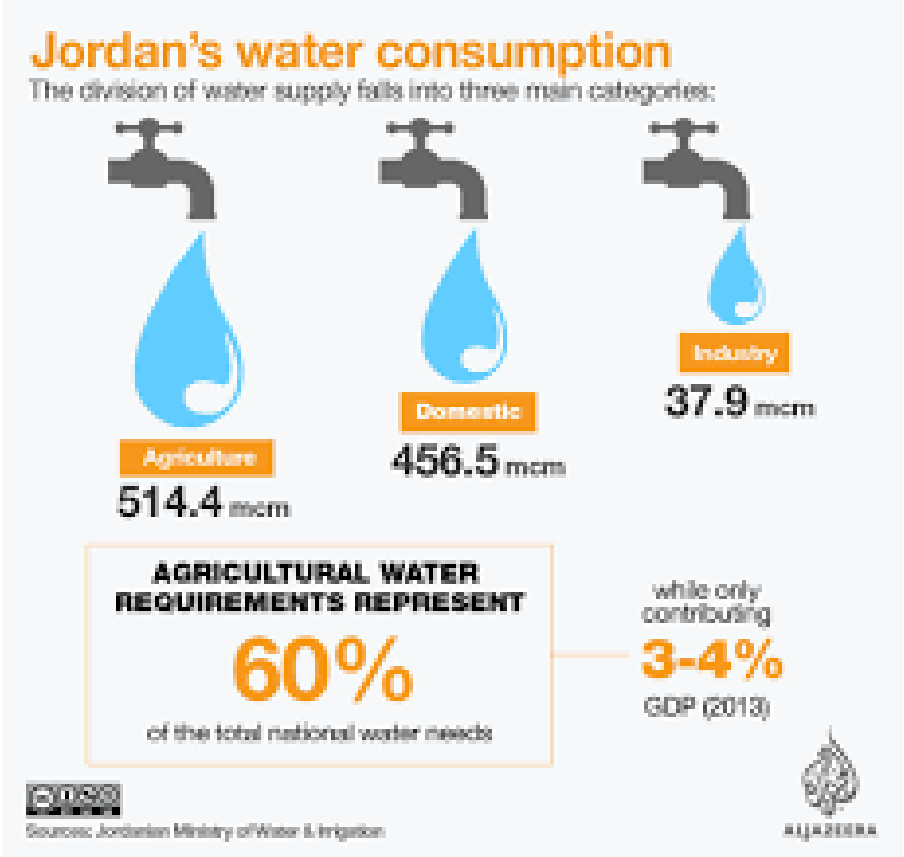
Household



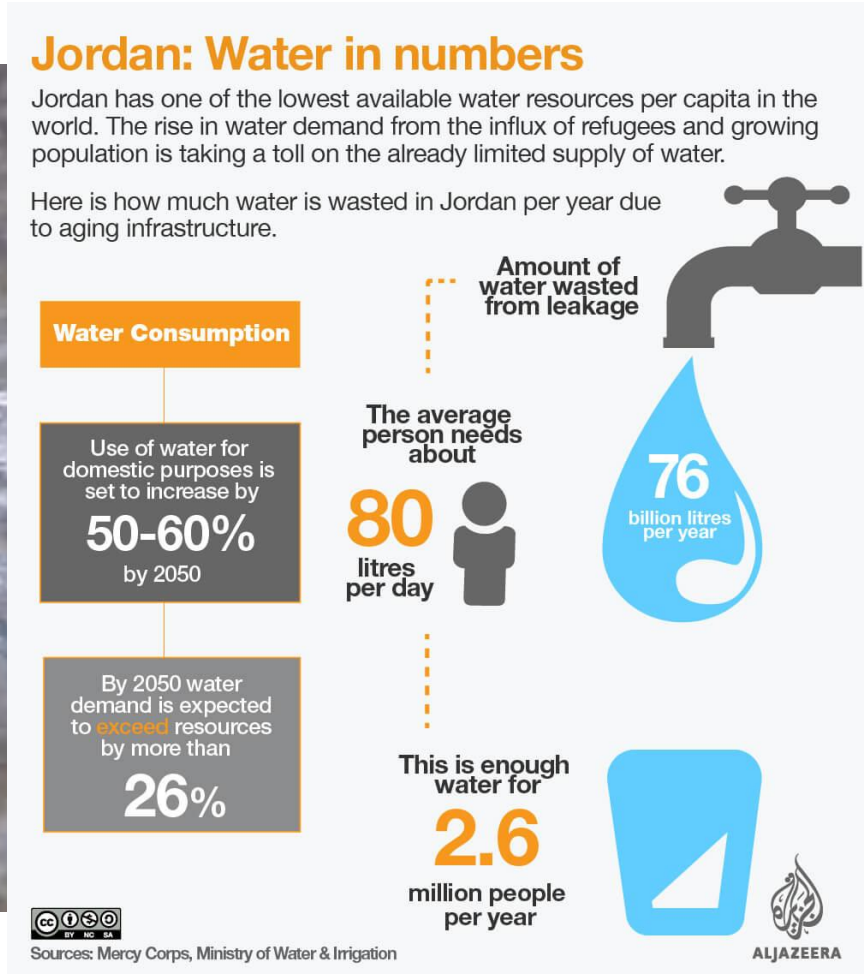
Water-saving technologies for homes

- Low-flush toilets/shower heads
- Wastewater recycling
- Rainwater harvesting
- High-efficiency washers
- Weather-based irrigation
- Hot water recirculation system
- Xeriscaping
- Composting toilets

Case study: Jordan



Water loss in Jordan



International development in Jordan

Foreign aid for investments in Jordan's water sector represent about 30% of water investments.

Conclusion?

Well, sadly, no. The Water Footprint Network in the Netherlands calculated that it takes an average of 29 gallons of water to produce a single glass of wine

Glossaries

- http://www.emwis.net/thematicdirs/glossaries
- https://www.lexicool.com/online-dictionary.asp?FSP=C16&FKW=hydrology
- https://water.usgs.gov/glossaries.html
- https://www.lenntech.com/water-glossary.htm (also in German, French, Spanish and Dutch)
- http://www.fao.org/nr/water/aquastat/data/glossary/search.html