

# Hydrosphere

Water Resources: Part 2

ENVI 10.01 | G FELICIANO

# 2.4% of water on Earth is freshwater.



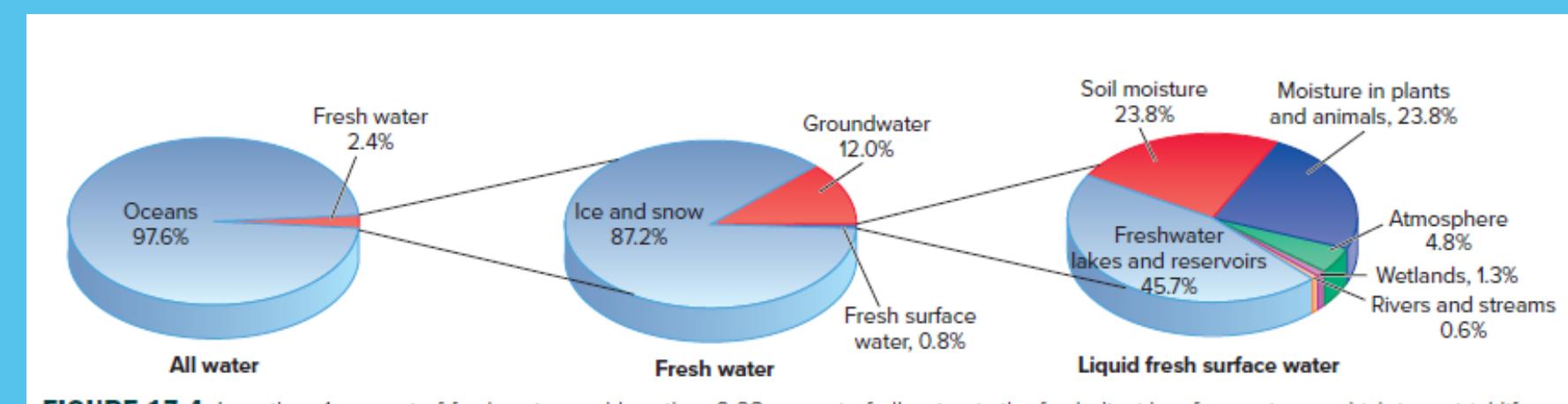
87.2% of freshwater is stored in ice caps, glaciers, and snowfields



12% of freshwater is held in groundwater.



0.8% of freshwater is surface water.



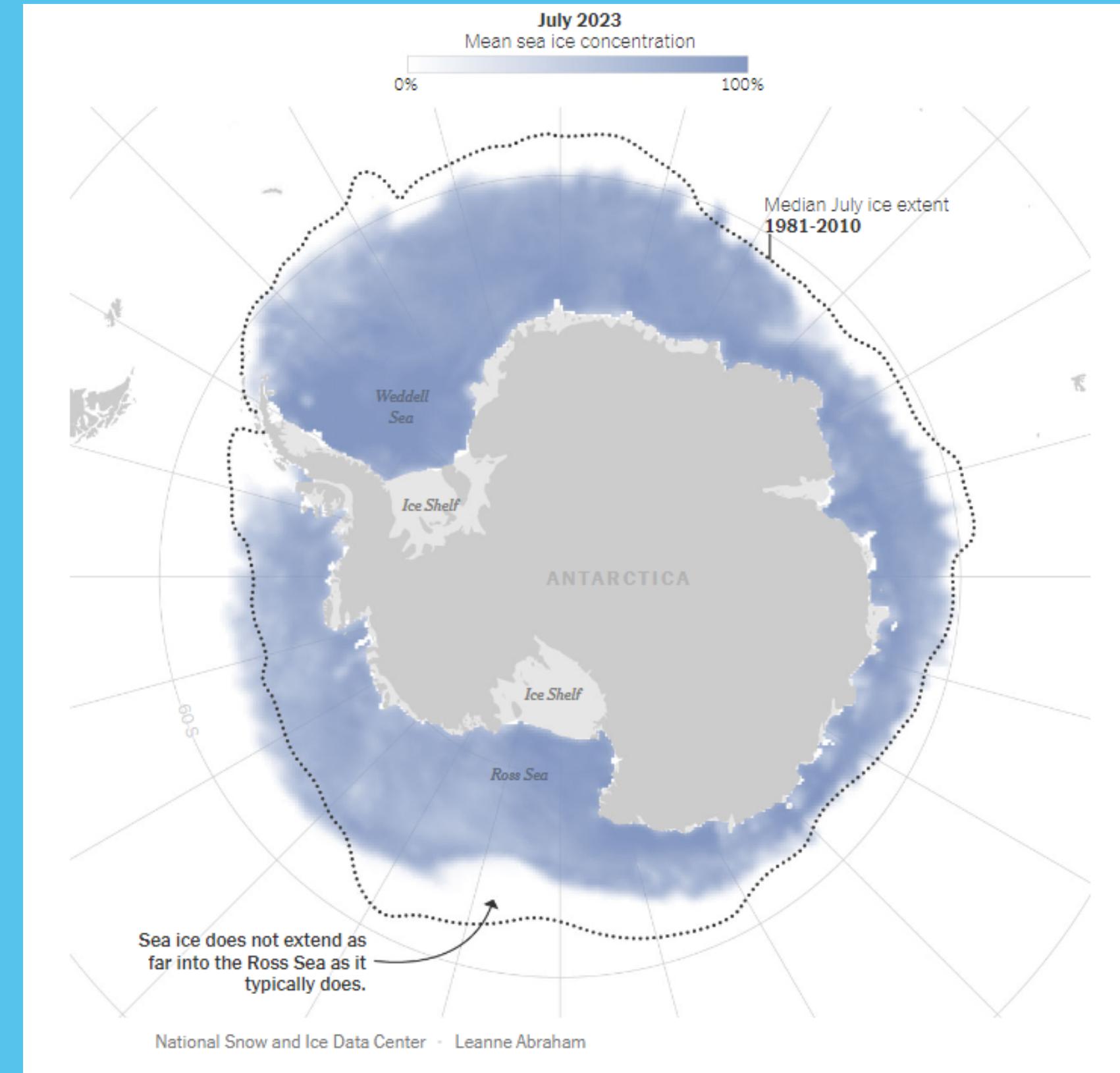
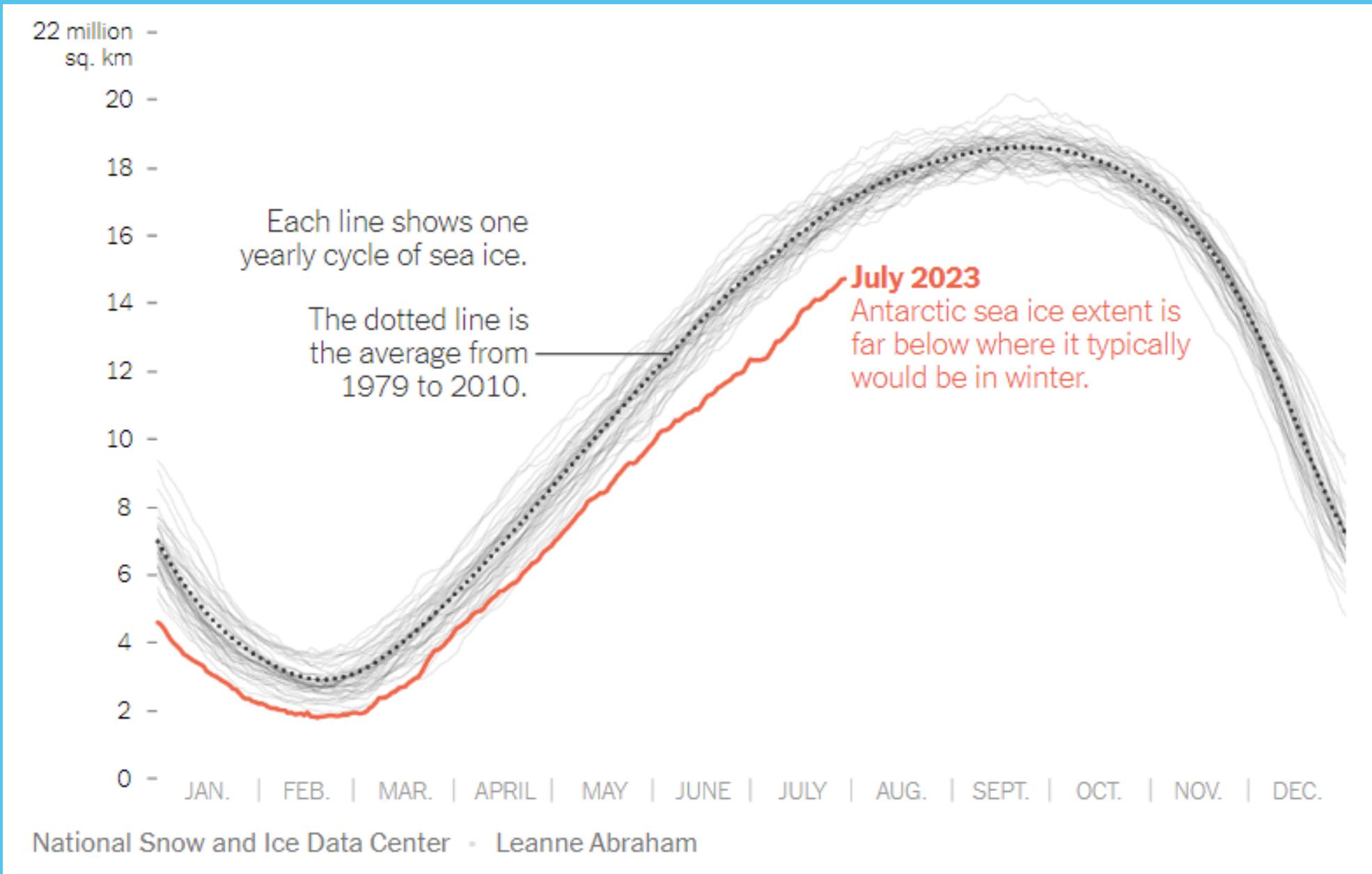
**FIGURE 17.4** Less than 1 percent of fresh water, and less than 0.02 percent of all water, is the fresh, liquid surface water on which terrestrial life depends.  
Source: U.S. Geological Survey

# Threats to glaciers, ice, snow

- Global warming limits ability for ice to reform during cold seasons
- Possible drought and sea level rise over time
- Recall: impacts of climate change

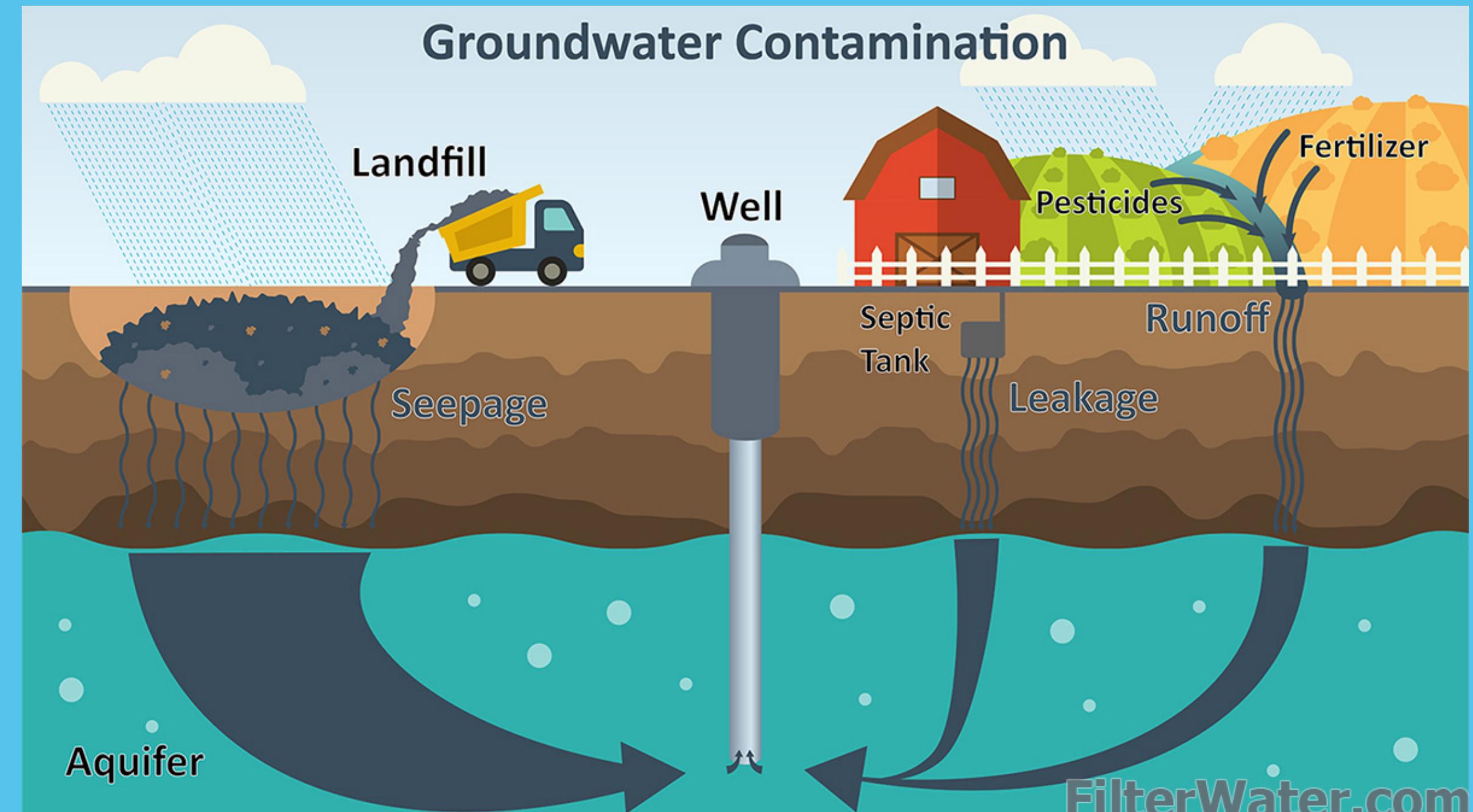


# Antarctic Sea Ice, 2023



# Threats to groundwater

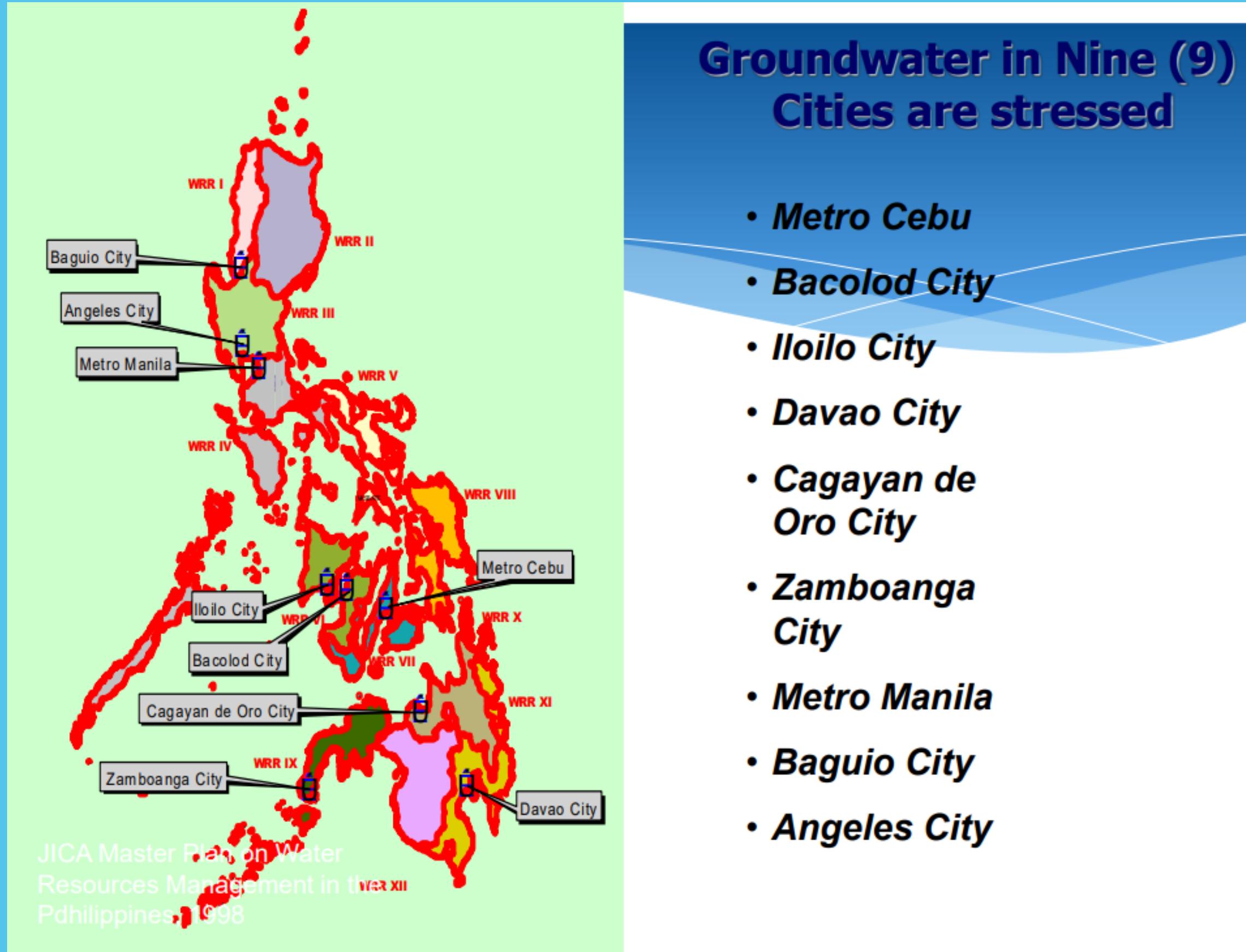
- Overextraction and subsidence
- Urbanization, road building and development
- Contaminated and polluted surface water (e.g., acid rain)
- Saltwater intrusion and leachates from landfills



# Status of water resources: Philippines

Water Resources Status					
Water Resources Region	Groundwater	Surface Water (80% dependable flow)	Total Water Potential	Water Demand December 2018	Estimated Available Water
I	1248	3250	4498	4021.122	476.878
II	2825	8510	11335	9492.305	1842.695
III	1721	7890	9611	24117.785	-14506.785
IV	1410	6370	7780	16162.36	-8382.36
V	1085	3060	4145	3289.04	855.96
VI	1141	14200	15341	6274.32	9066.68
VII	879	2060	2939	3656.45	-717.45
VIII	2557	9350	11907	2876.2	9030.8
IX	1082	12100	13182	1515.27	11666.73
X	2116	29000	31116	6740.972	24375.028
XI	2375	11300	13675	5953.967	7721.033
XII	1758	18700	20458	7332.06	13125.94
Total	20197	125790	145987	91431.851	54555.149

# Status of water resources: Philippines



# Solid wastes and plastics pollution



**FIGURE 18.19** Beach pollution, including garbage, sewage, and contaminated runoff, is a growing problem associated with ocean pollution.

John Lund/The Image Bank/Getty Images



**FIGURE 18.20** A deadly necklace. Marine biologists estimate that castoff nets, plastic beverage yokes, and other packing residue kill hundreds of thousands of birds, mammals, and fish each year.

Joe Lucas/Marine Entanglement Research Program/National Marine Fisheries Service NOAA

## PLASTIC POLLUTION

**Philippines dominates global ocean plastic pollution chart at 36%, shows study**

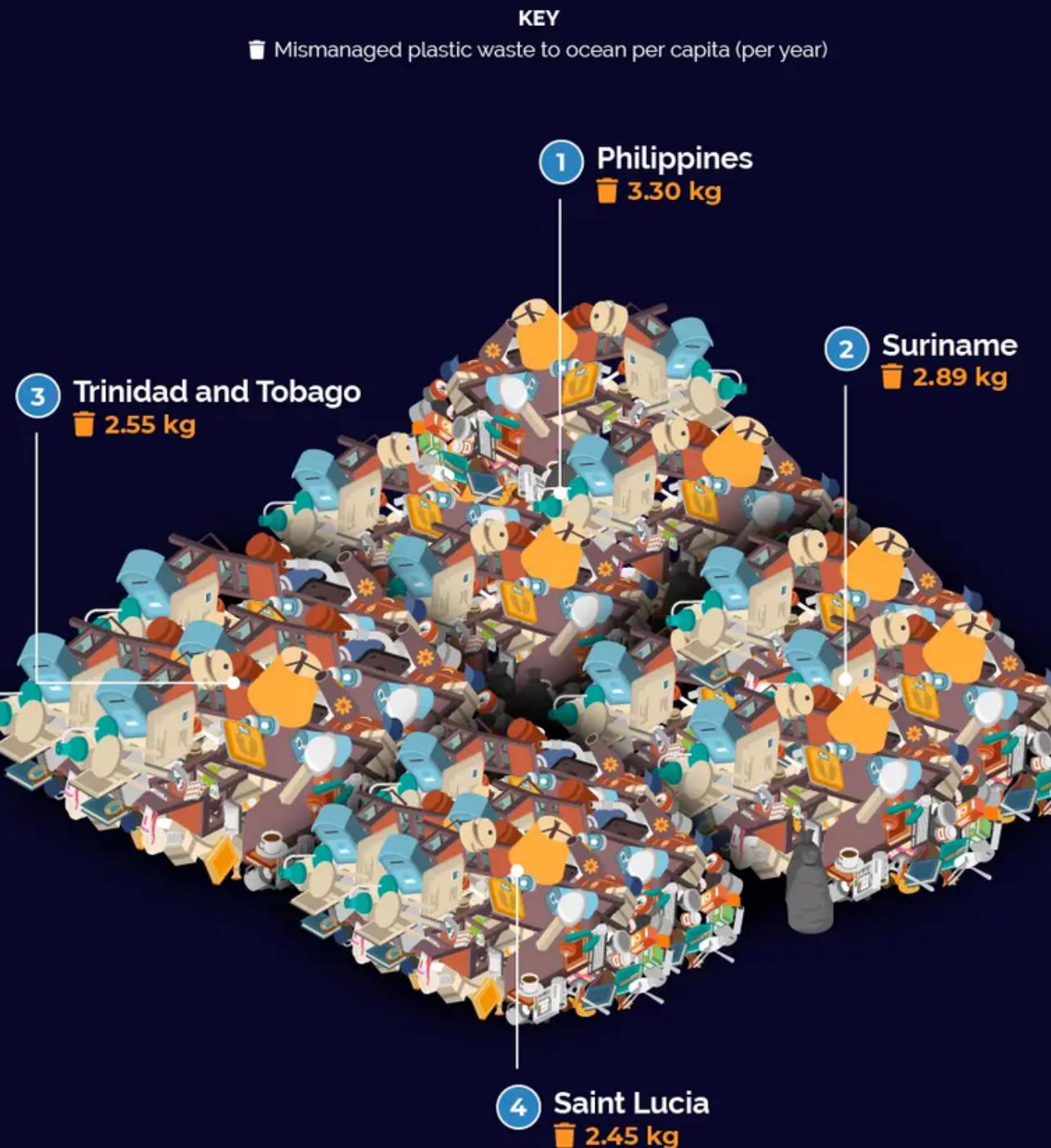
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CONG CORRALES

“The Philippines takes the top spot, emitting 3.30kg of plastic waste into the ocean per person each year. In total, more than 350,000 tonnes of plastic waste enter the ocean from the Philippines each year, which is 36% of the world’s total.”

*Utility Bidder's Plastic Pollution Study (2023)*

Countries emitting the **most plastic waste** into the ocean per person each year



# Microplastics

SCIENCE

## One Liter of Bottled Water May Contain 240,000 Tiny Plastic Fragments

A new technique reveals that the liquid may contain 10 to 1000 times more plastic pieces than previously thought



Shi En Kim

Reporter

January 8, 2024

Every time we step on a synthetic carpet, rip open a plastic container, spin our tires when we drive on the road or do laundry, there's a good chance we're spewing out thousands of micro- and nanoplastic shavings unseen. "Plastic is much more like skin than we realize," says Mason. "Like skin, it's constantly flaking off."

# Major categories of water pollutants

Category	Examples	Sources
<b>A. Causes health problems</b>		
Disease-causing agents	Bacteria, viruses, parasites	Human and animal wastes
Organic and inorganic chemicals	Pesticides, plastics, detergents, oil, gasoline, metals, salts	Industrial water, household waste, mining, weapons, power plants
Radioactive materials	Uranium, thorium	Mining, weapons, power plants

# Major categories of water pollutants

Category	Examples	Sources
<b>B. Causes ecosystem disruption</b>		
<b>Sediment</b>	Soil, silt	Land erosion
<b>Plant nutrients</b>	Nitrates, phosphates, ammonium	Fertilizers, sewage, manure
<b>Oxygen-demanding wastes</b>	Animal manure and plant residues	Sewage, agricultural runoff, food processing
<b>Thermal</b>	Heat	Power plants, industrial cooling

# Status of water resources

WMO State of Global Water Resources 2022 report - A... Copy link

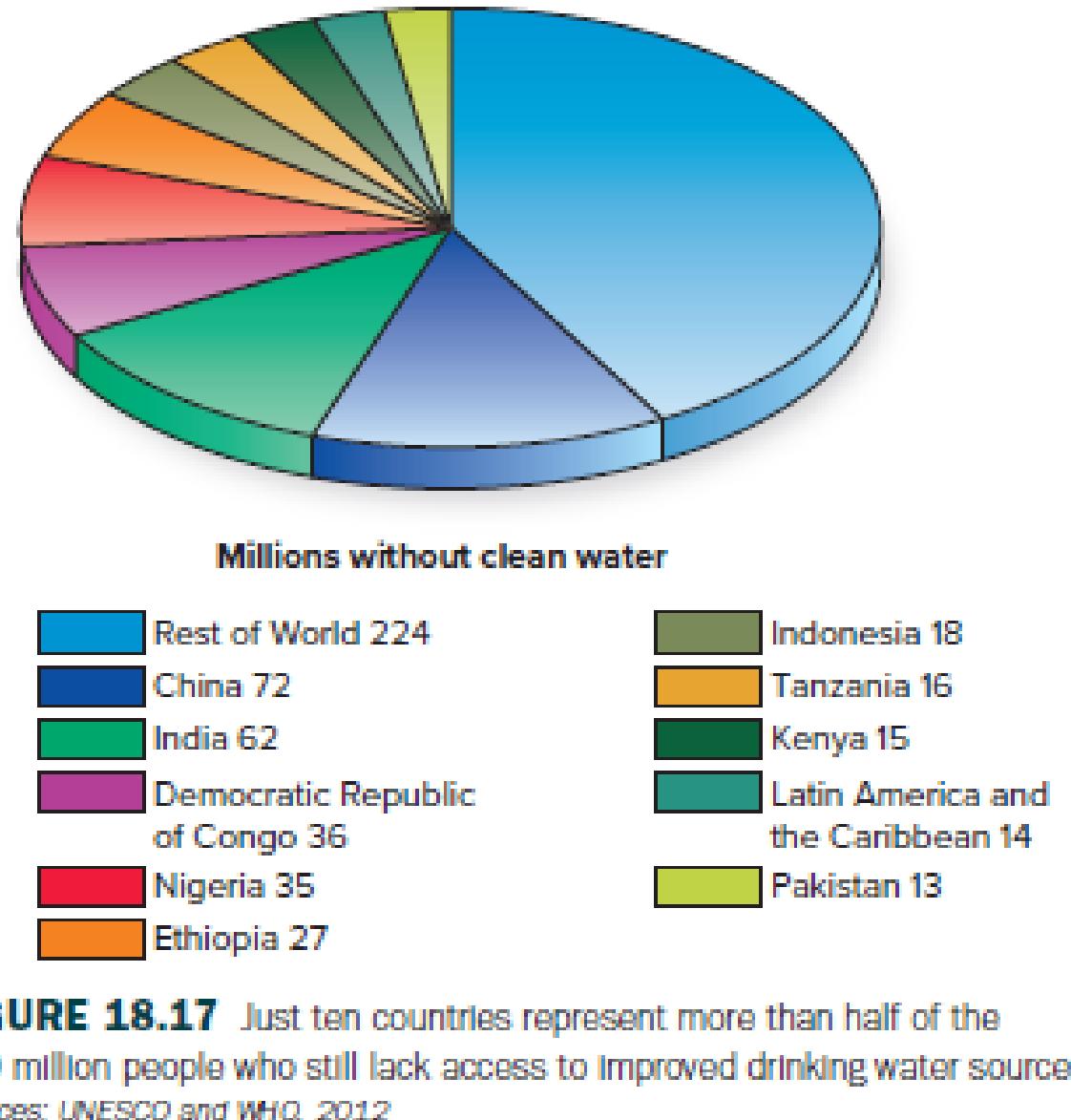
Climate change · Climate change refers to long-term shifts in...

WMO State of Global Water Resources 2022 report

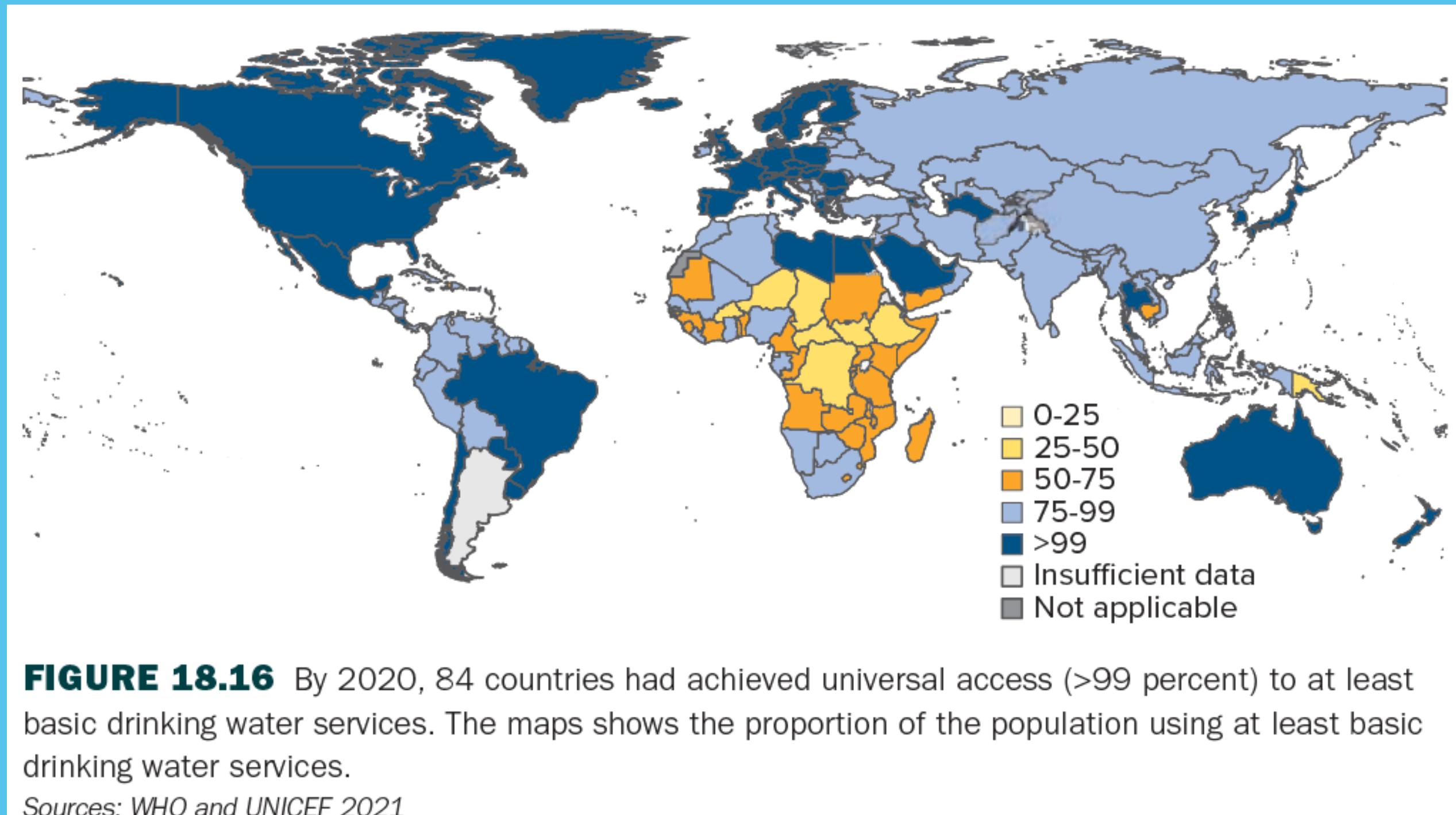
Watch on YouTube

WMO State of Global Water Resources 2022 report

# Status of water resources

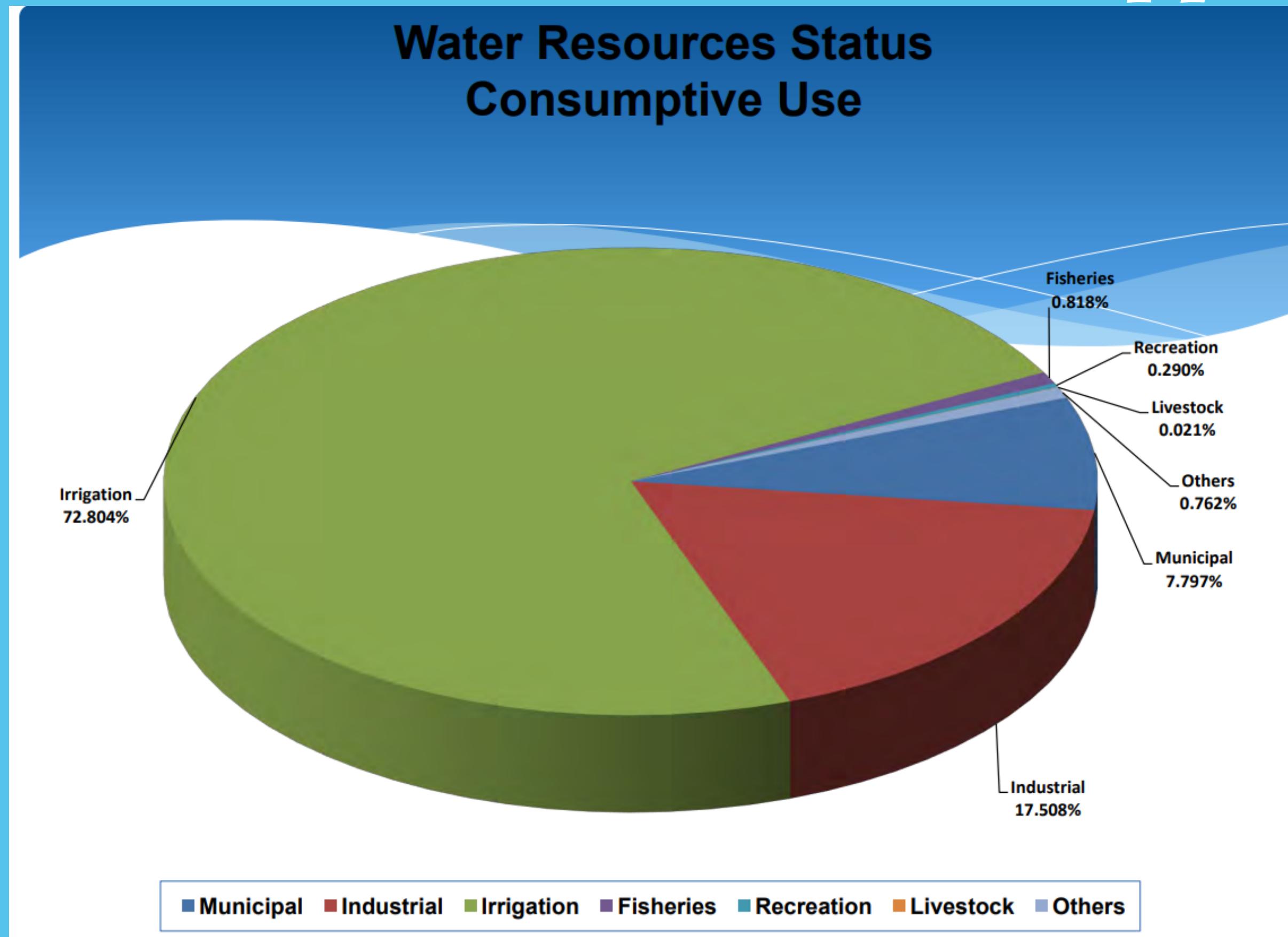


**FIGURE 18.17** Just ten countries represent more than half of the 540 million people who still lack access to Improved drinking water sources.  
Sources: UNESCO and WHO, 2012

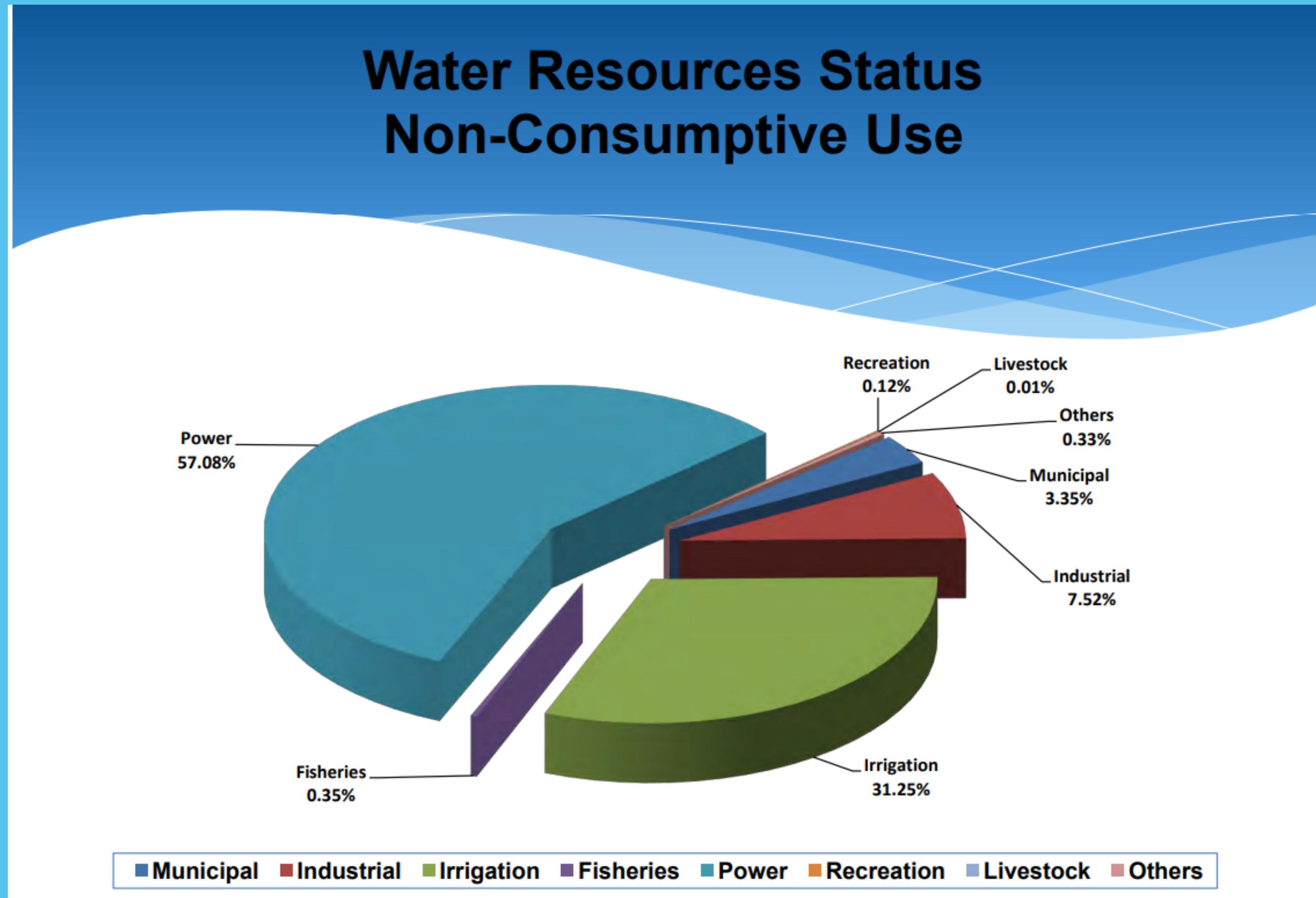


*Sources: WHO and UNICEF 2021*

# Status of water resources: Philippines



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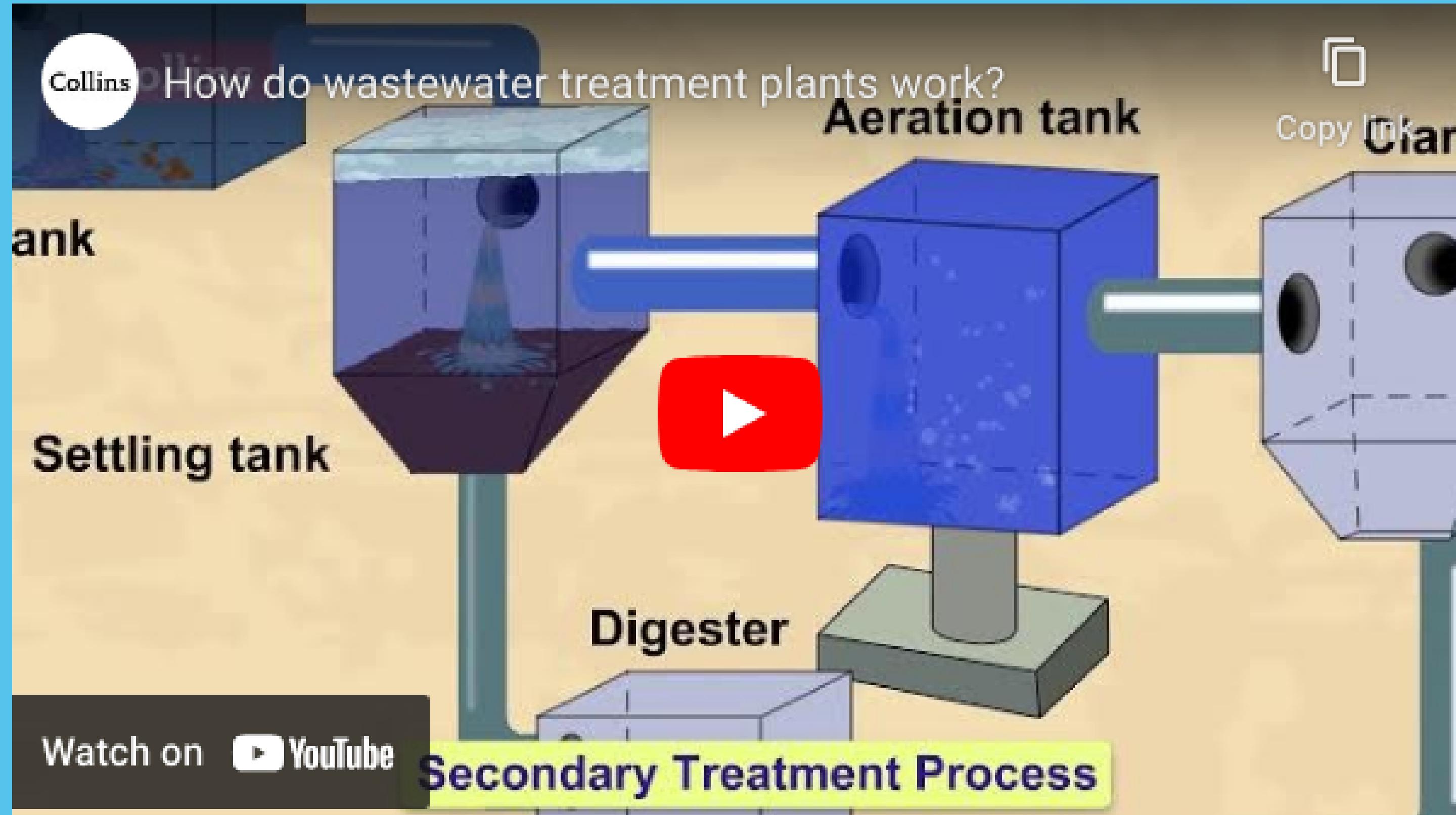


Water Resources  
Management  
is a Shared  
Responsibility

NATIONAL WATER RESOURCES BOARD  
8th Floor, NIA Building, EDSA, Quezon City, Philippines  
Telefax Nos. 02-9202641 /02- 9202365 /02-9202724  
Website: [www.nwrb.gov.ph](http://www.nwrb.gov.ph)  
Email add: nwrbphil@gmail.com

The cheapest and most effective way to reduce water pollution is to **AVOID PRODUCING POLLUTANTS** and **KEEPING THEM AWAY FROM WATER SYSTEMS!**

# Wastewater treatment: removing contaminants from sewage



# Wastewater treatment on campus



The Loyola Schools Decentralized Wastewater Treatment System, or DEWATS (left), processes wastewater from nearby buildings and helps irrigate nearby green spaces.

The treated wastewater is collected and transported for campus grounds maintenance (right)



International Residence Hall have their own Building Wastewater Treatment Systems

# The Philippine Clean Water Act of 2004 (RA 9275)



establishments should have a connection to a sewage line



affluent standards,  
freshwater quality  
guidelines c/o DENR



bans discharging wastewater directly into water bodies



bans dumping of sewage sludge, solid wastes, and medical wastes into water bodies

# DENR Freshwater classification

**Table 1. Water Body Classification and Usage of Freshwater**

<b>Classification</b>	<b>Intended Beneficial Use</b>
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest PNSDW
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the latest PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	<ol style="list-style-type: none"><li>1. Fishery Water for the propagation and growth of fish and other aquatic resources</li><li>2. Recreational Water Class II – For boating, fishing, or similar activities</li><li>3. For agriculture, irrigation, and livestock watering</li></ol>
Class D	Navigable waters

For drinking after  
disinfection

For drinking after  
treatment

Note: For unclassified water bodies, classification shall be based on the beneficial use as determined by the Environmental Management Bureau (EMB).

# Water availability and use



**1,000 m<sup>3</sup> of water per person per year** is the minimum necessary to meet basic human needs.

1 m<sup>3</sup> = around 8 medium-sized balikbayan boxes

# Constraints on water availability



Drought

Increasing water use

Agriculture

Water contamination

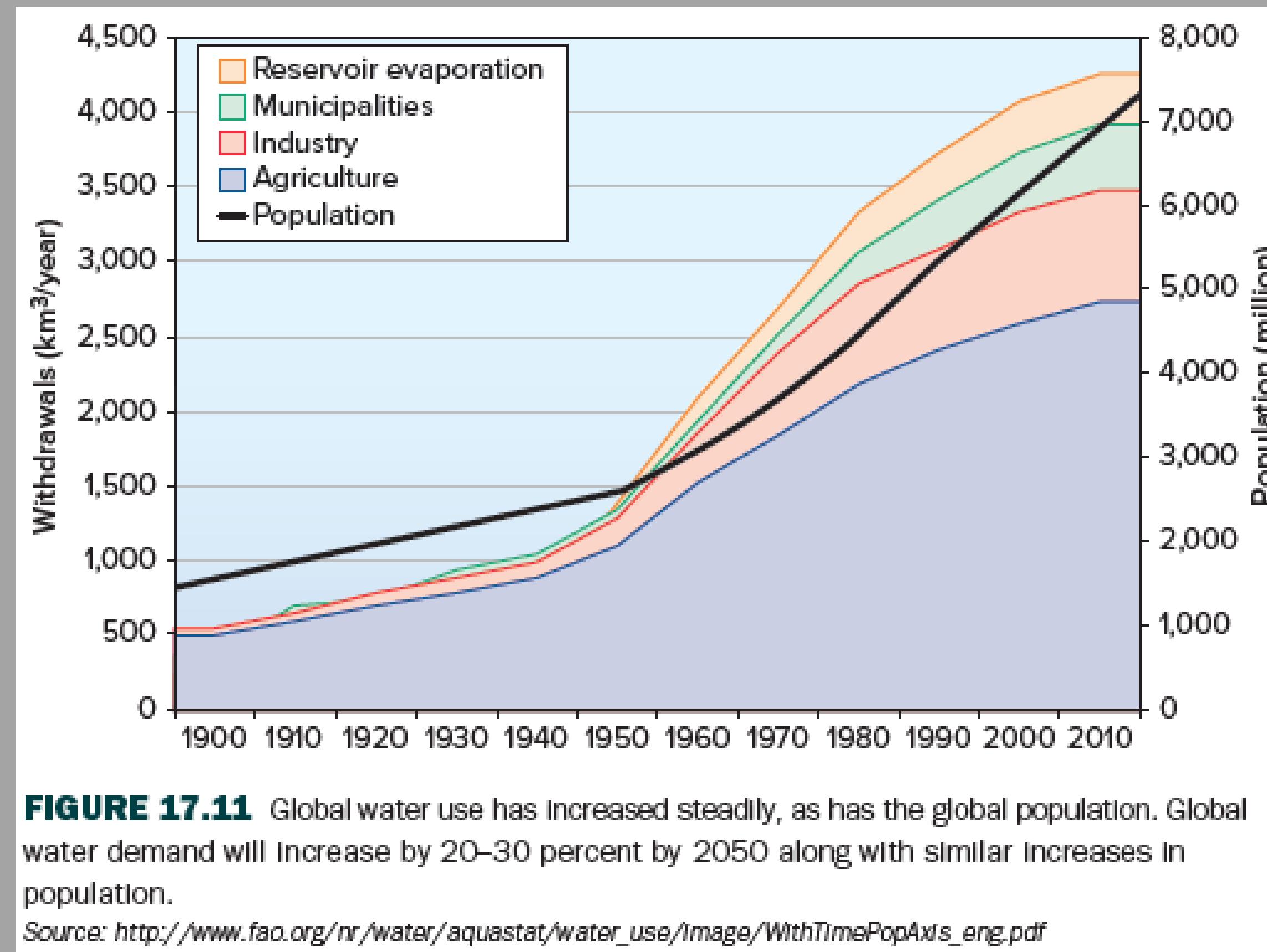
# Drought

There is no simple definition of drought.

In general, drought is an **extended period of consistently below-average precipitation that has a substantial impact on ecosystems, agriculture, and economy**.



# Increasing water use



# Water use: Agriculture

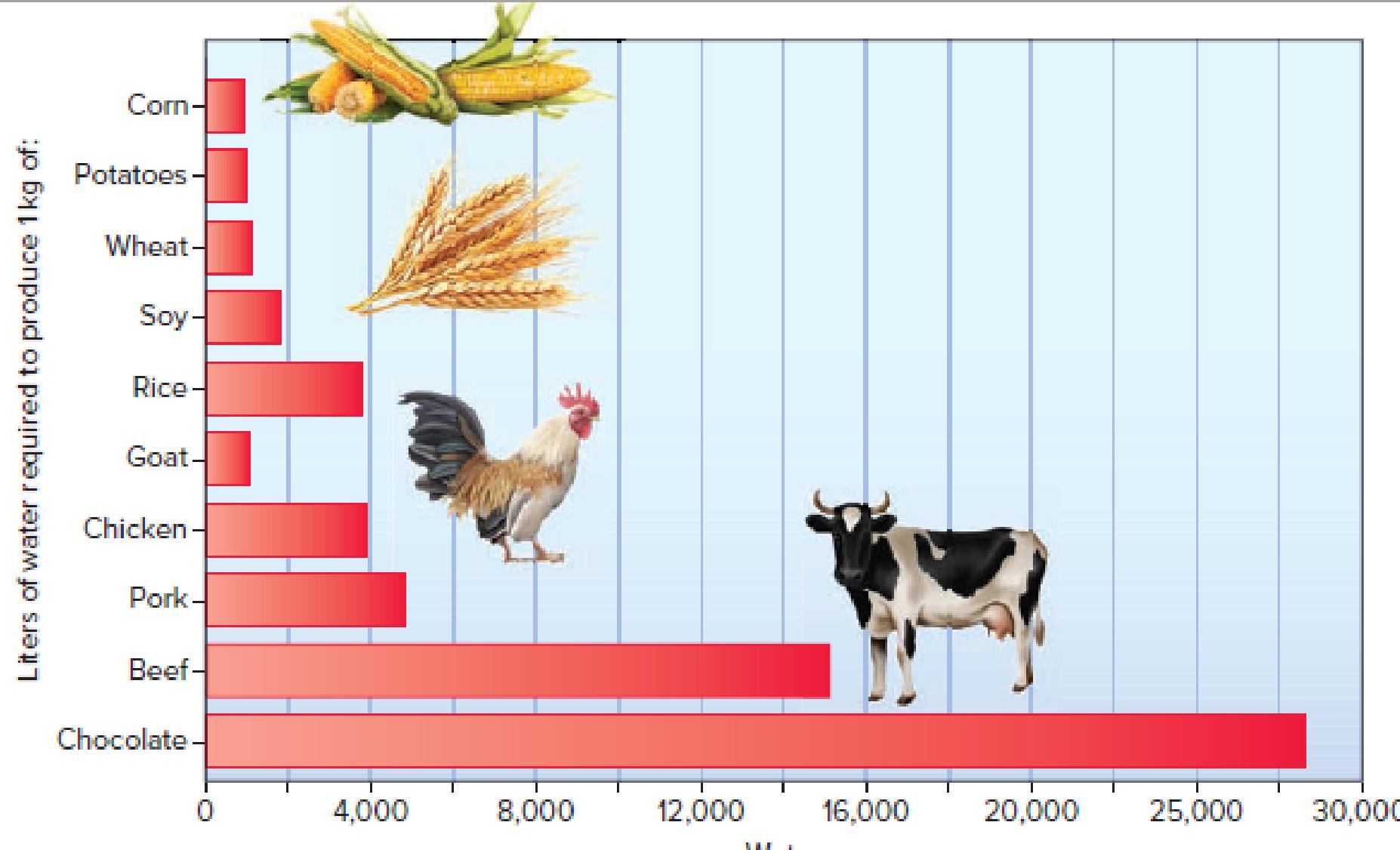


FIGURE 17.12 Water required to produce 1 kg of some important foods.

Water required to grow and prepare our food also depends on:

- level of processing
- dietary demands
- method of farming/irrigation

Our diet contributes to our water footprint too!

# Agriculture: Irrigation methods



(a) Flood Irrigation



(b) Rolling sprinklers



(c) Drip Irrigation

**FIGURE 17.13** Agricultural Irrigation consumes more water than any other use. Methods vary from flood and furrow (a), which uses extravagant amounts of water but also flushes salts from soils, to sprinklers (b), to highly efficient drip systems (c).

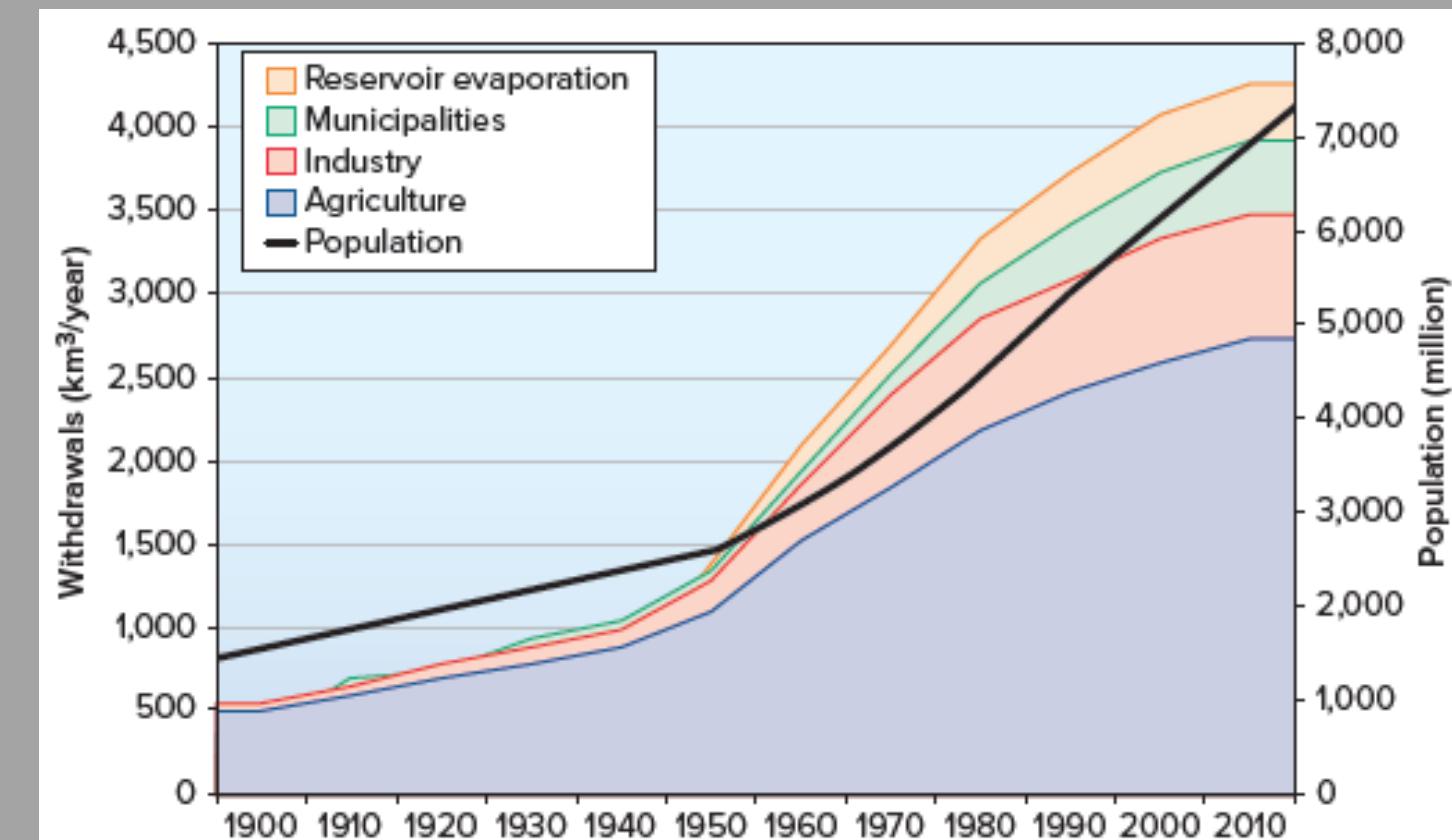
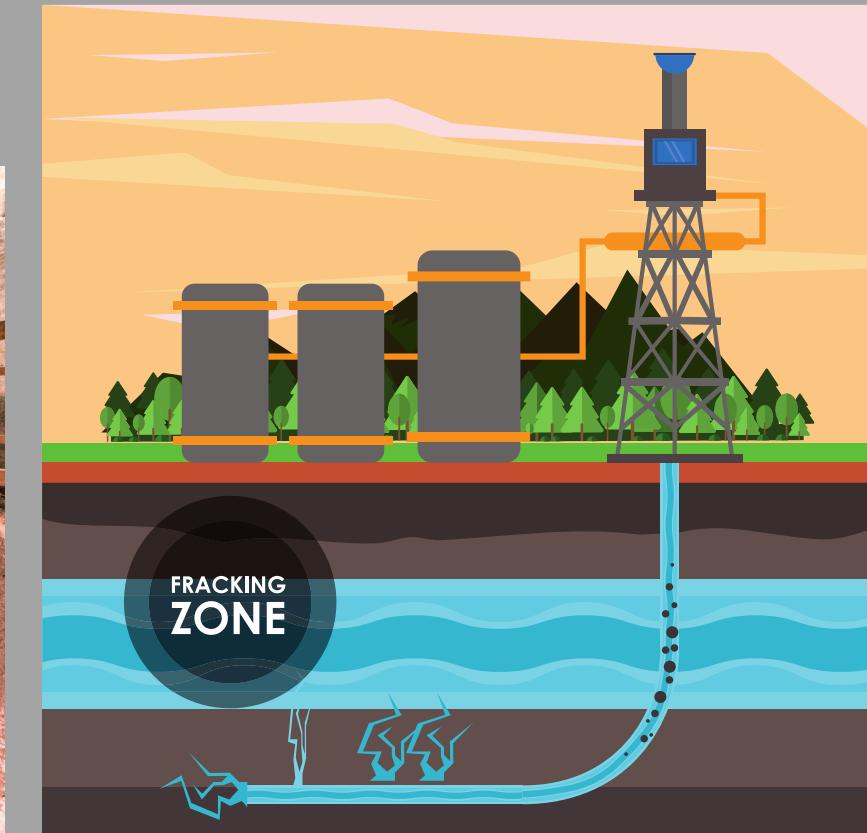
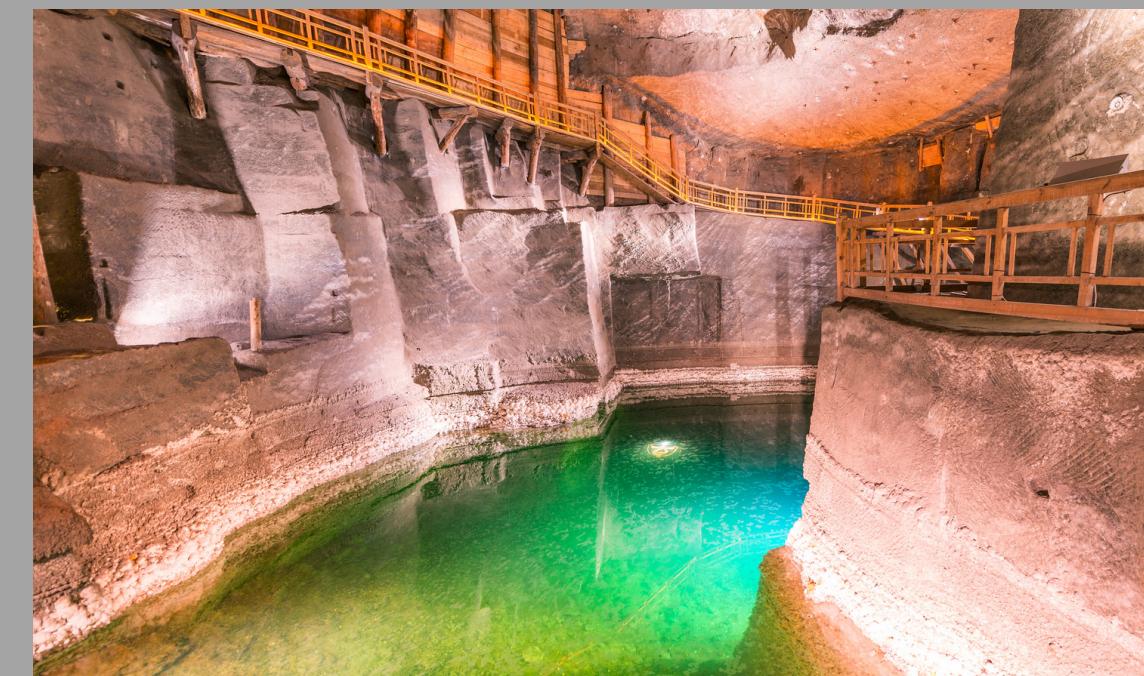
(a) Photo by Jeff Vanuga, USDA Natural Resources Conservation Service; (b) Cecilia Lim/123RF; (c) Photo by Lynn Betts, USDA Natural Resources Conservation Service

Poor irrigation practices can also cause water-logging, which can be harmful to plants.

# Water use: Industry

Industry accounts for ~20% of global freshwater withdrawals:

- energy production
- mining
- oil and natural gas extraction



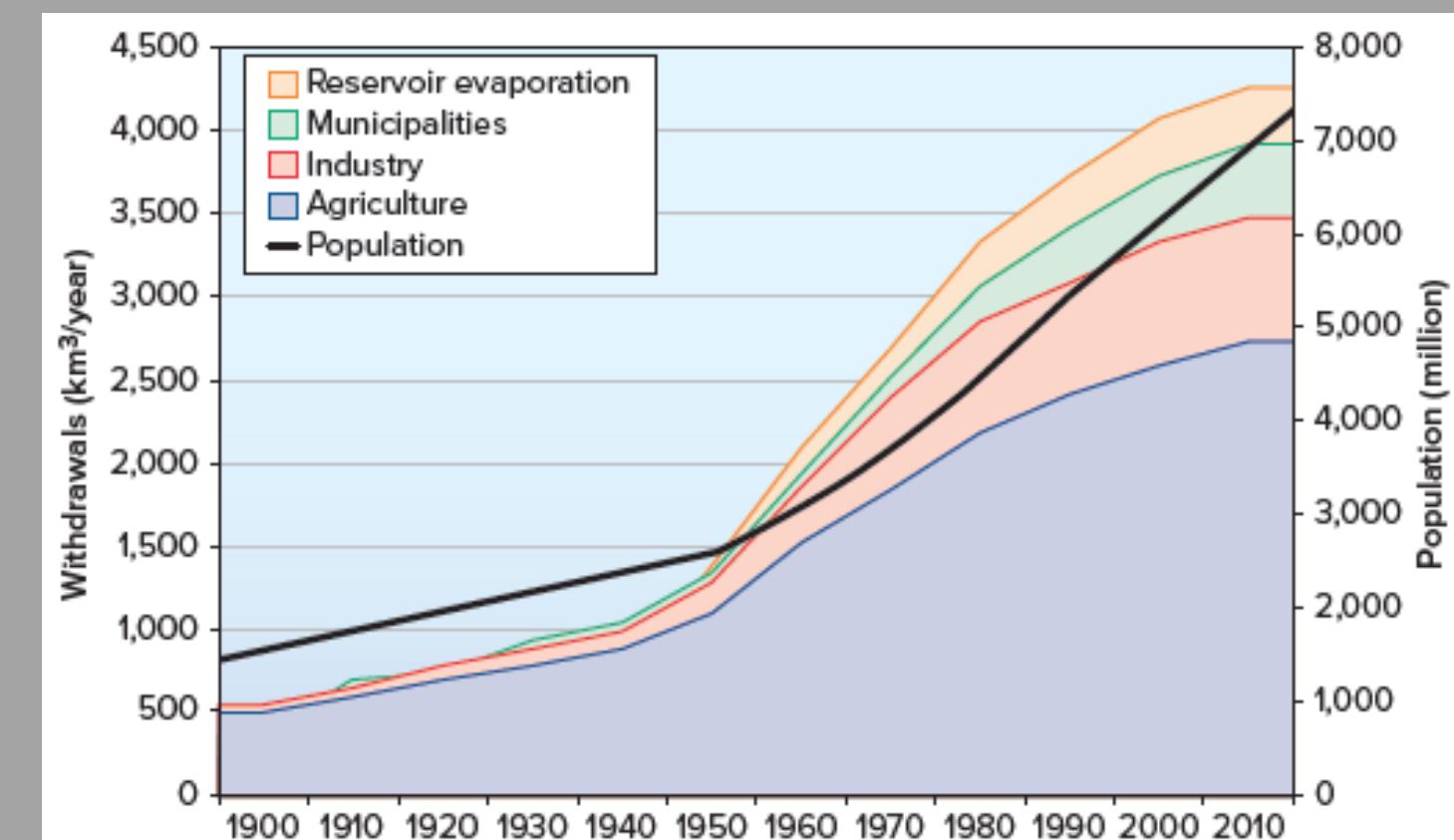
**FIGURE 17.11** Global water use has increased steadily, as has the global population. Global water demand will increase by 20–30 percent by 2050 along with similar increases in population.

Source: [http://www.fao.org/nr/water/aquastat/water\\_use/image/WithTimePopAxes\\_eng.pdf](http://www.fao.org/nr/water/aquastat/water_use/image/WithTimePopAxes_eng.pdf)

# Water use: Domestic (Municipalities)

In wealthy countries, each person uses **500-800 liters per day**.

In developing countries, each person uses **30-150 liters per day**.



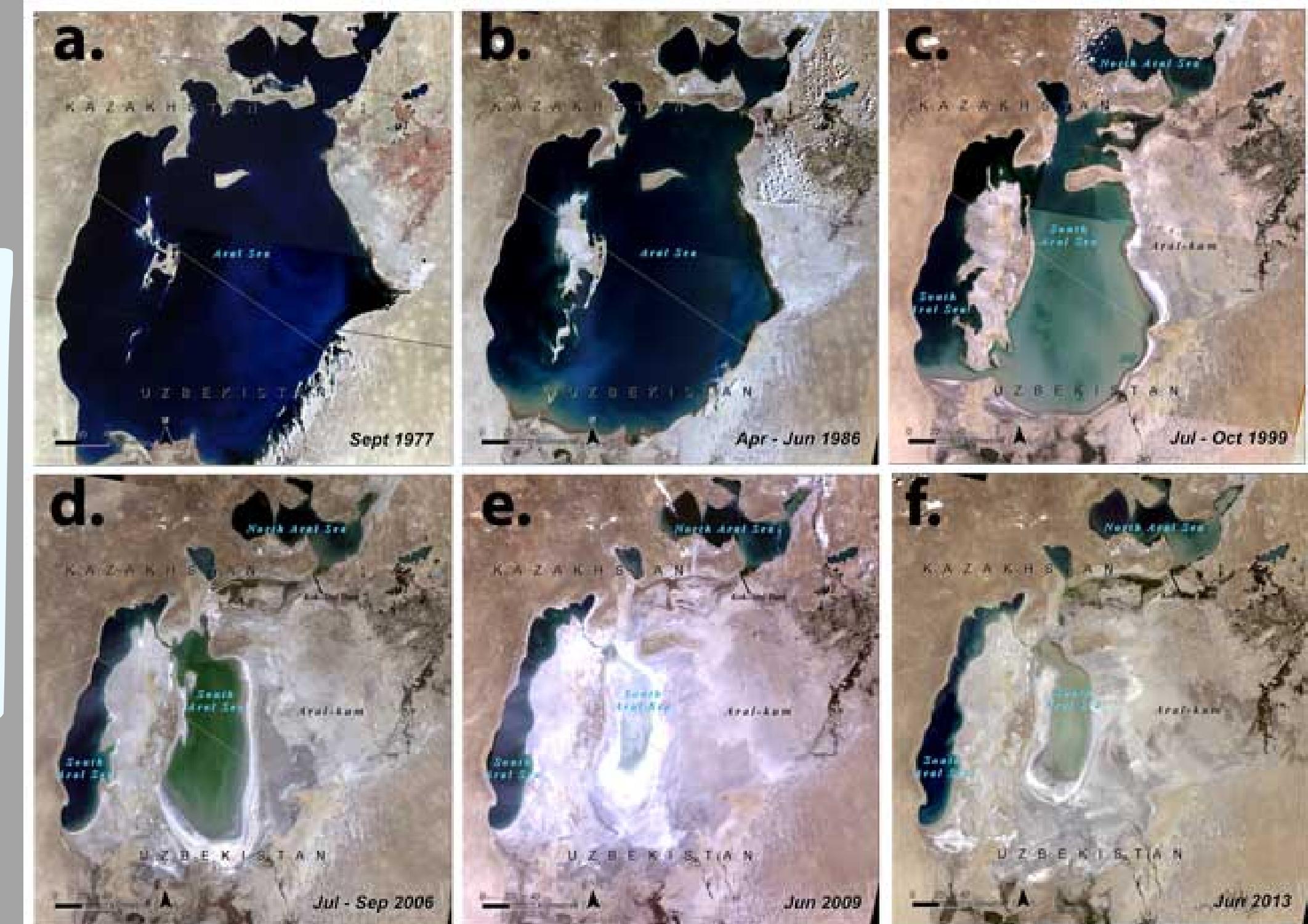
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# Water use: Reservoirs

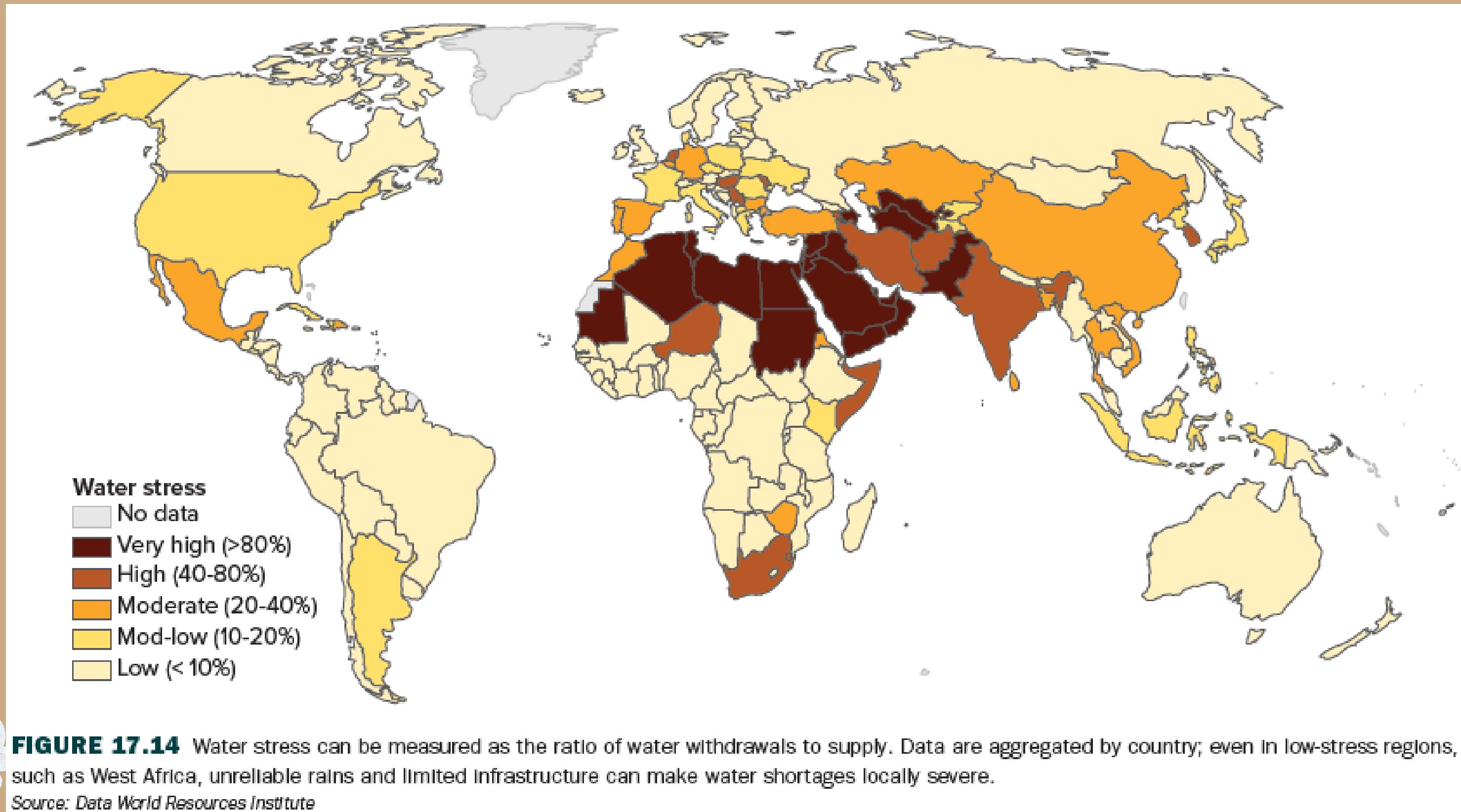
Recall: impact of **dams** on the hydrologic cycle

**Diversion projects and manipulation of reservoirs affect water distribution and availability.**

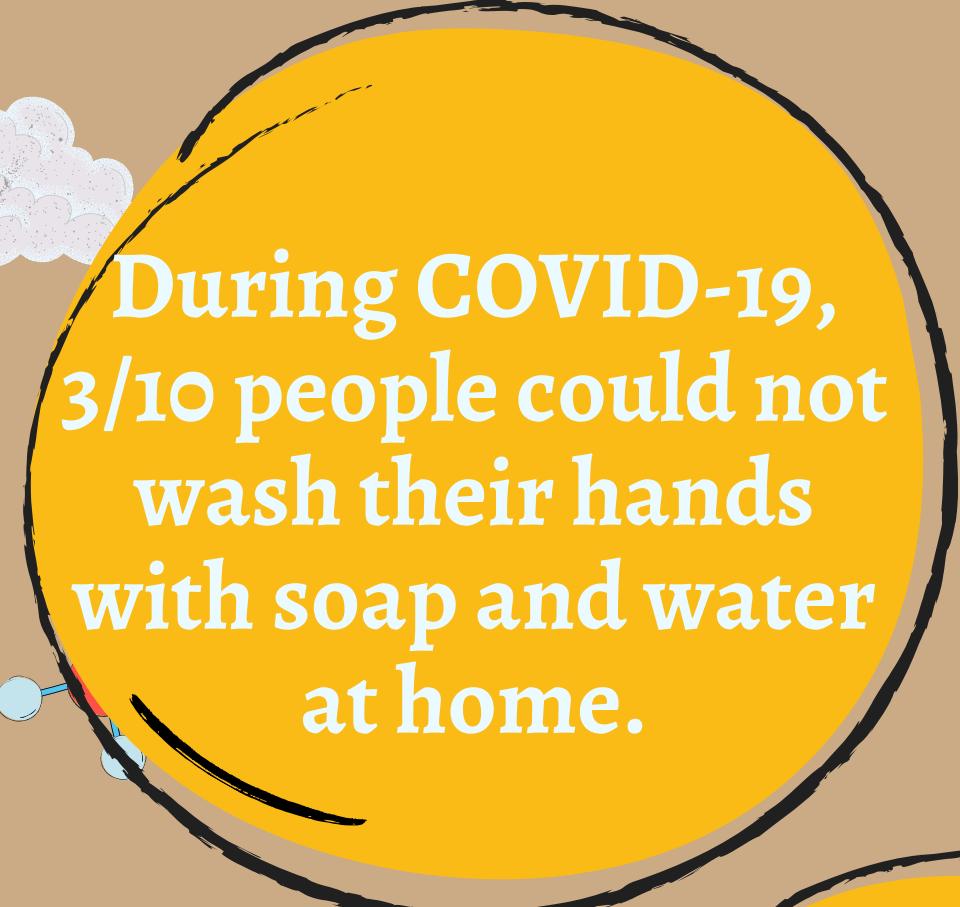


Aral Sea, Central Asia

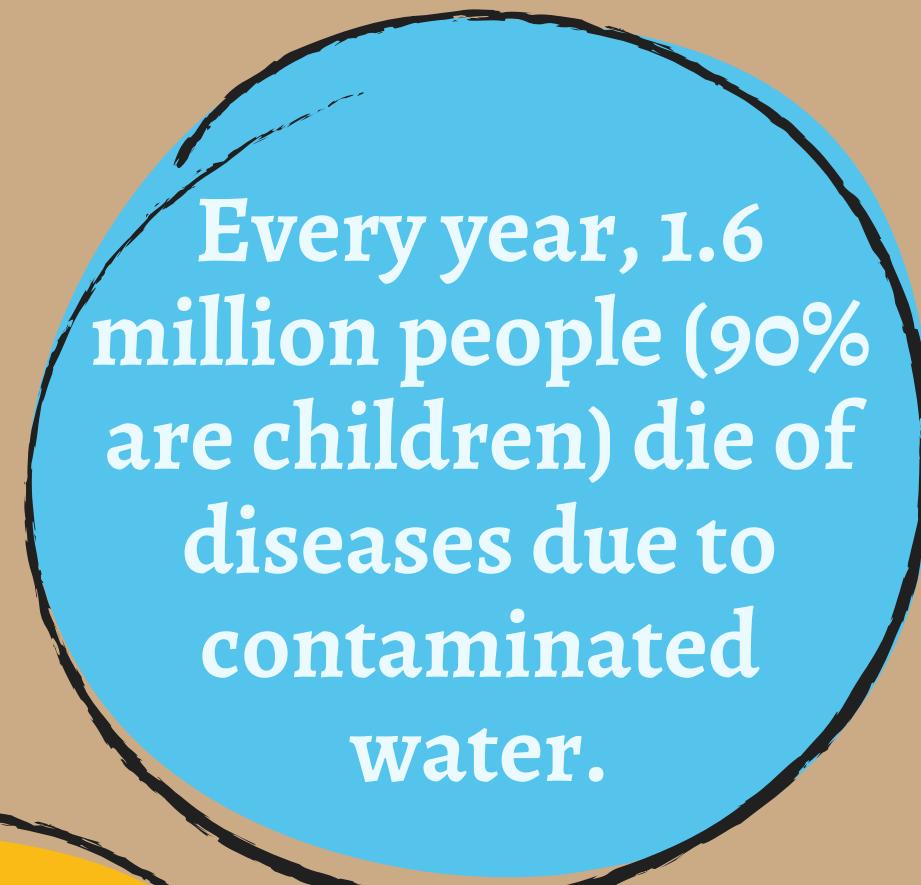
# Freshwater shortages



# Fast facts on freshwater shortages



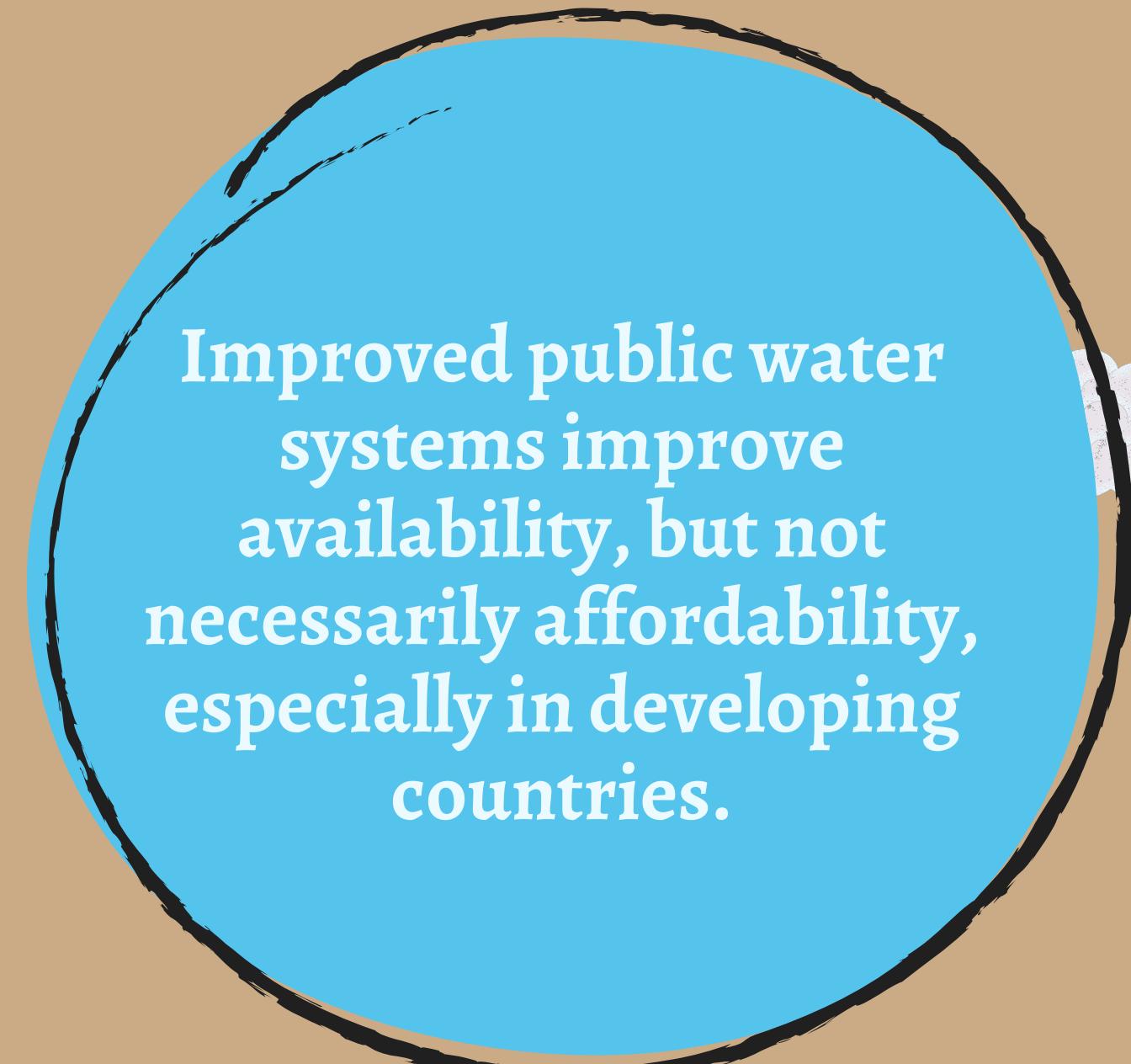
During COVID-19,  
3/10 people could not  
wash their hands  
with soap and water  
at home.



Every year, 1.6  
million people (90%  
are children) die of  
diseases due to  
contaminated  
water.



>2/3 of the world's  
households have  
to fetch water  
from outside the  
home.



Improved public water  
systems improve  
availability, but not  
necessarily affordability,  
especially in developing  
countries.

# Water conservation

## Land banking

- Farmers are encouraged to fallow land in dry years

## Wetland flooding

- Farmers take turns flooding fields so that waterfowl will still have a place to feed

## Water recycling

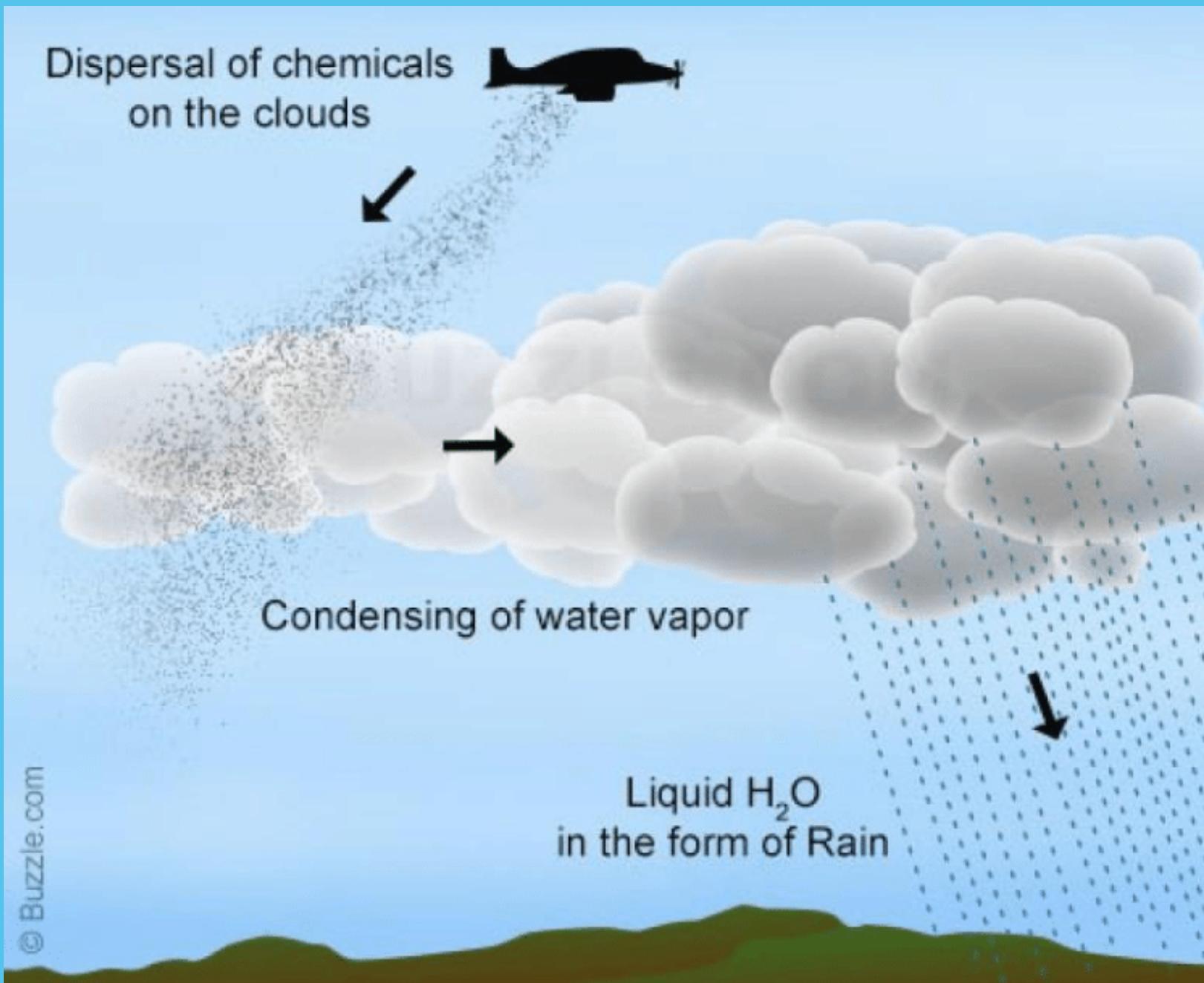
## Better farming techniques



**FIGURE 17.24** A flock of snow geese rises from the Lower Klamath National Wildlife Refuge. Millions of migrating birds use these wetlands for feeding and resting.  
*Alan and Sandy Carey/Getty Images*

# Emerging technology

## Cloud seeding



© Buzzle.com

## Desalination



# What can you do?

## What Can You Do?

### Steps You Can Take to Improve Water Quality

Individual actions have important effects on water quality. Here are some steps you can take to make a difference.

- Compost your yard waste and pet waste. Nutrients from decayed leaves, grass, and waste are a major urban water pollutant. Many communities have public compost sites available.
- Don't fertilize your lawn or apply lawn chemicals. Untreated grass can be just as healthy, and it won't poison your pets or children.
- Make sure your car doesn't leak fluids, oil, or solvents on streets and parking lots, from which contaminants wash straight into rivers and lakes. Recycle motor oil at a gas station or oil-change shop.
- Create a "rain garden" to capture and filter surface runoff. This helps recharge groundwater aquifers and keeps nutrients and toxins out of rivers and lakes (fig. 18.28).
- Use minimal amounts of salt if you need to deice your steps, driveway, or sidewalk. These salts end up in your local stream, lake, or groundwater.
- Visit your local sewage treatment plant. Often, public tours are available or group tours can be arranged, and these sites can be fascinating.
- Keep informed about water policy debates at local and federal levels. Policies change often, and public input is important.

## What Can You Do?

### Saving Water and Preventing Pollution

Each of us can conserve much of the water we use and avoid water pollution in many simple ways.

- Take short showers; don't flush every time you use the toilet; wash your car infrequently.
- Don't let the faucet run while washing hands, dishes, food, or brushing your teeth. Draw a basin of water for washing and another for rinsing dishes. Don't run the dishwasher when half full.
- Dispose of used motor oil and household hazardous waste responsibly. Don't dump anything down a storm sewer that you wouldn't want to drink.
- Avoid using toxic or hazardous chemicals for simple cleaning or plumbing jobs. A plunger or plumber's snake will often unclog a drain just as well as caustic acids or lye.
- If you have a lawn, use water sparingly. Water your grass and garden at night, not in the middle of the day. Consider planting native plants, low-maintenance ground cover, a rock garden, or some other xerophytic landscaping.
- Use water-conserving appliances: low-flow showerheads, low-flush toilets, and aerated faucets.
- Use recycled (gray) water for lawns, house plants, and car washing.
- Check your toilet for leaks. A leaky toilet can waste 50 gallons per day. Add a few drops of dark food coloring to the tank and wait 15 minutes. If the tank is leaking, the water in the bowl will have changed color.



# Any questions?