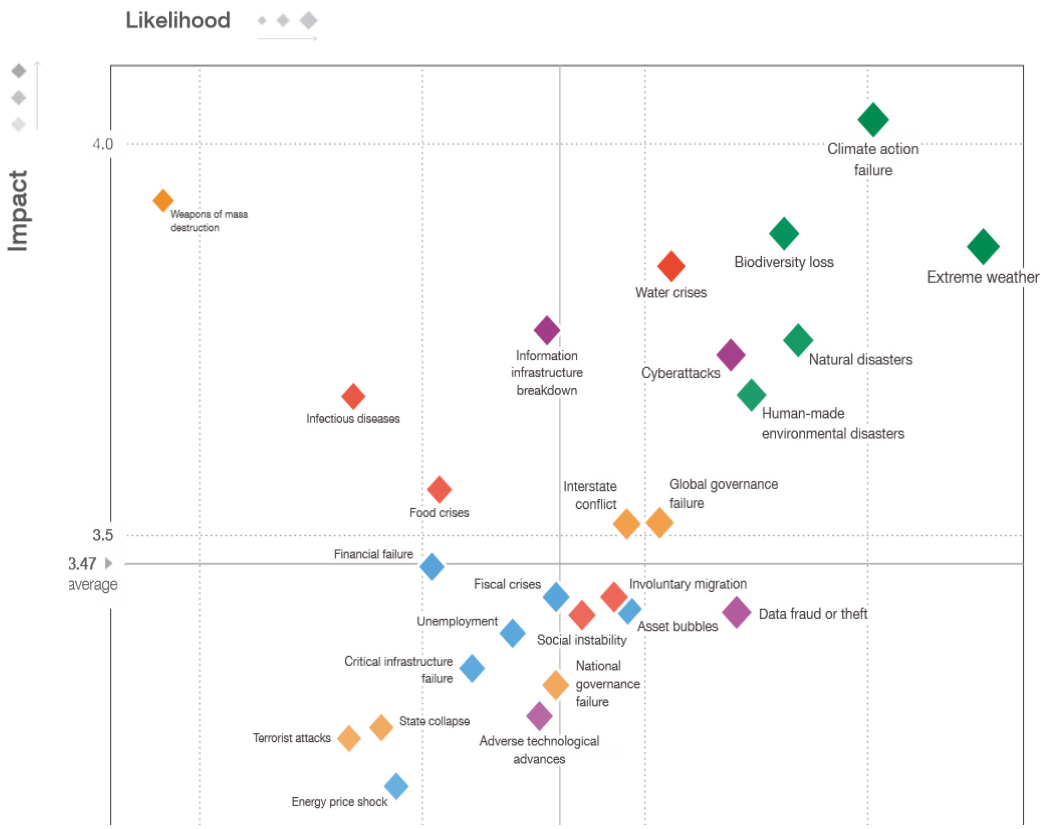
Topic 5: Water

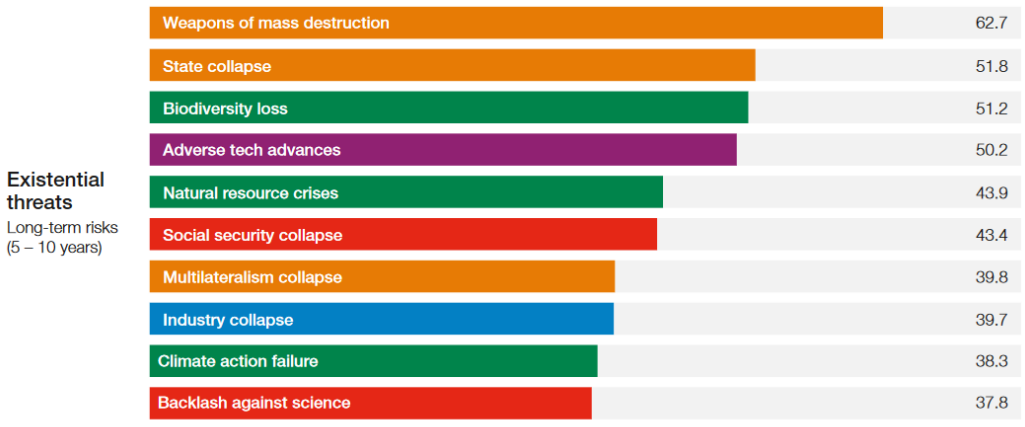
5.1 Importance of water resource → 5.2 Problems and Inefficiencies in water allocation → 5.3 Ways to improve efficiency of water use

"When the Well's Dry, We Know the Worth of Water"

-Benjamin Franklin, Poor Richard's Almanack (1746)



Source: World Economic Forum: Global Risk Report 2020.



Source: World Economic Forum Global Risks Perception Survey 2020

Source: World Economic Forum: Global Risk Report 2021.

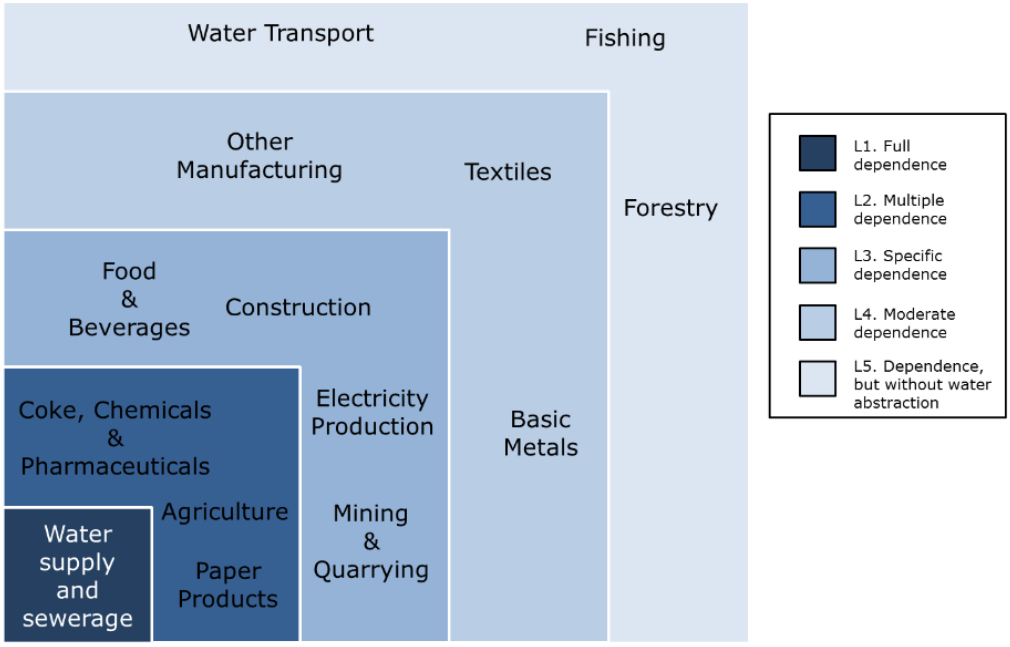
5.1 The importance of water resource

Water is one of the essential elements of life. Human needs intake of water to replace the continual loss of body fluids. Some food sources depend on water to survive.

The importance of water on economy

- **Direct use values of water**: Water as an input for supply and sewage, raw materials for production of goods and services, other economic sectors (e.g., comparing the value added created by water use and the cost of water using data on market prices). A significant underestimation is expected due to abundant availability water; water is underpriced; or sometimes not priced at all.
- **Indirect use values of water**: the benefits of water to people's wellbeing that are not included in market prices. Avoided cost method could be used to hypothetically assess the increased costs of using alternatives for reduced water resources such as switching from surface water to ground water or investment in irrigation systems. In addition, some values of water for amenity and environment such as role of water in eco-system may not be reflected in market price.
- **Non-use values of water**: the value of water quality to reach good status for water bodies estimated by willingness to pay.

The EU's economic sectors that are highly dependent on water



- "The EU's water-dependent sectors generate EUR 3.4 trillion or 26% of the EU's annual Gross Value Added (2015)"
- "The EU's water-dependent sectors employ around 44 million people, i.e., 24.2% of the total employment, and include 16.3 million enterprises"

Source: ECORYS (2018). The Economic Value of Water - Water as a Key Resource for Economic Growth in the EU

5.2 Problems and inefficiencies of water resource allocations

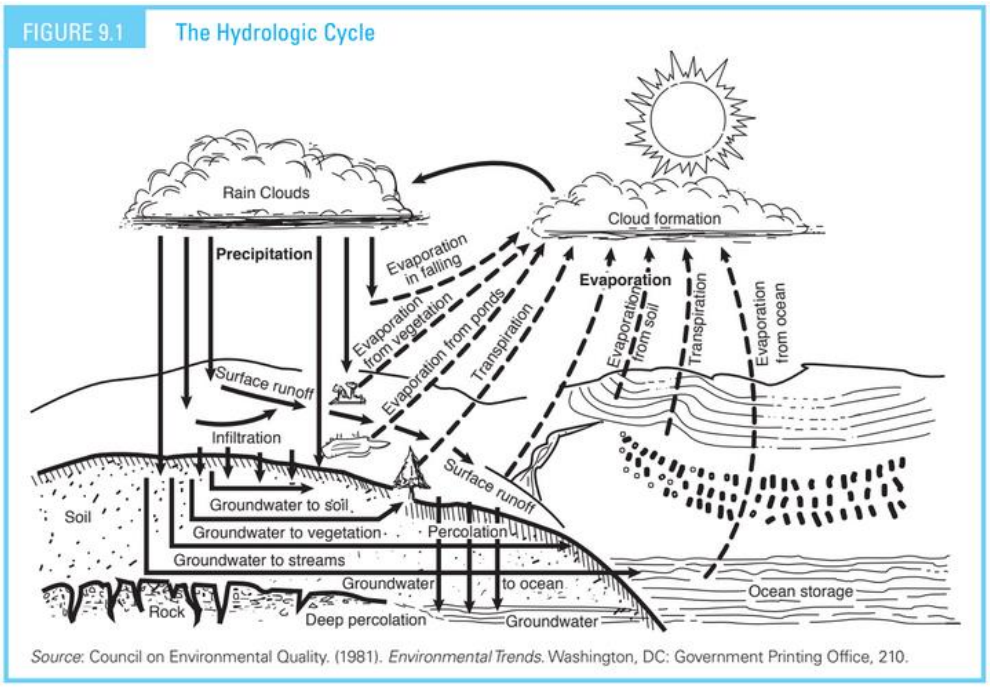
I. Problems related to water resources

a. **Water scarcity**:

"Water scarcity can mean scarcity in availability due to physical shortage, or scarcity in access due to the failure of institutions to ensure a regular supply or due to a lack of adequate infrastructure. *Water scarcity will be exacerbated as rapidly growing urban areas place heavy pressure on neighbouring water resources. Climate change and bio-energy demands are also expected to amplify the already complex relationship between world development and water demand."* *UN Water*

There are two main water sources:

- **Surface water** consists of the freshwater in rivers, lakes and reservoirs that collects and flows on the earth's surface.
- **Groundwater** is the water present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. A unit of rock is sometimes called an aquifer (ชั้นหินอุ้มน้ำ) when it can yield a usable quantity of water.



- Only 2.5% of estimated total water volume on earth is freshwater
- Less than 1% of all freshwater resources is available for human consumption and for ecosystems.

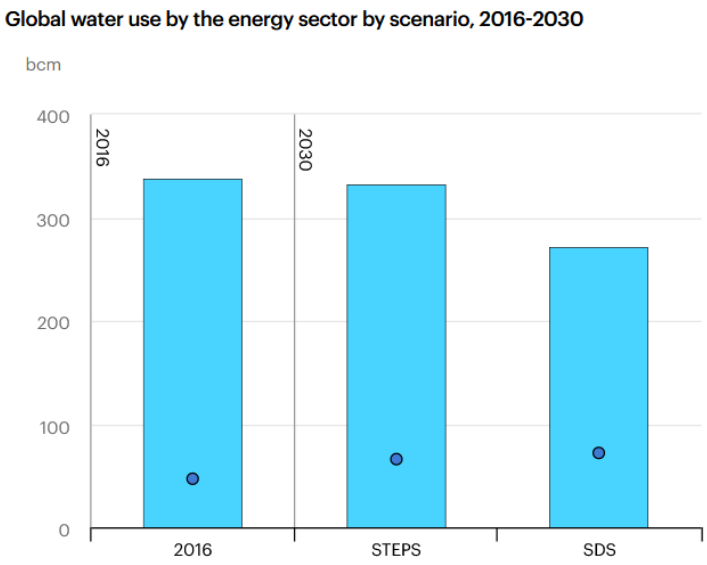
b. Access to clean water is a growing problem.

Looking at the current statistics of UN SDG (Sustainable Development Goals) indicator at https://sdg6data.org/indicator/6.1.1

- **Drinking water:** "Access to safe drinking water in homes, healthcare facilities, schools and workplaces effectively reduces water-borne disease and malnutrition, which are leading causes of death among children under five. Indicator 6.1.1 Drinking water tracks the proportion of population using safely managed drinking water services, i.e., from an improved drinking water source that is accessible on the premises, available when needed, and free of fecal and priority chemical contamination."
- **Water stress:** "The level of water stress is defined as the ratio between total freshwater withdrawals by all economic activities and total available freshwater resources, after taking into account environmental flow requirements. Environmental flow requirements are essential to maintaining ecosystem health and resilience."

c. Water demand for energy is growing at alarming rate.

- International Energy Agency (IEA) predicts that water demand for energy could reach 135 billion cubic meters (bcm) by 2035 equivalent to i) four times the size of the largest reservoir in the United States, Lake Mead. Ii) the amount of household water consumed in the U.S. over a 3-year period (IEA 2012, Tietenberg and Lewis 2015)
- In 2016, the global water use by the energy sector already increased far beyond what predicted earlier, reaching more than 300 bcm in 2016.



Source: IEA website. https://www.iea.org/topics/energy-and-water#key-findings

- **SDG indicator on Water-use efficiency**: "the value added in US dollars per volume of water withdrawn in cubic meters, by a given economic activity. Some sectors, for example, agriculture, industry, energy and municipal water supply are particularly relevant due to their high water use.

d. Water quality is also a problem

- Available water is polluted with chemicals, radioactive materials, salt, or bacteria. Note that this problem is also caused by water pollution. This also increases the problems of limited supply for drinking water.
- **SDG indicator on Water quality**: Investments in measures to protect, restore and monitor water quality have positive effects on both terrestrial and marine ecosystem health more broadly, and lower the costs for drinking water treatment. Indicator 6.3.2 monitors the proportion of bodies of water with good ambient water quality, as per national water quality standards and based on measurements of five water quality parameters that inform on the most common pressures on water quality at the global level.

II. Efficient allocation of scarce water

- **Surface water**: The efficient allocation must
  - Strike a balance among a host of competing users (e.g., drinking water suppliers vs. farmers) – the water should be allocated so that marginal benefit is equalized for all uses.
    - An efficient allocation maximizes benefits, any allocation that fails to equalize marginal net benefits could not have been efficient.
    - If marginal net benefits have not been equalized, it is possible to increase net benefits by transferring water from those users with low net marginal benefits to those with higher net marginal benefits.
  - Supply an acceptable means of handling the year-to-year variability in water flow (e.g., surface water supplies are not constant, in some years, less water may be available for allocation than in others). This requires a system to allocate the amount of water
    - As long as the supply level can be anticipated, the equal marginal net benefit rule still applies. But, different supply levels may imply very different

allocations among users, leading to inefficient problem when high-priority users receiving a guaranteed amount.

- **Groundwater**: As groundwater is depletable, withdrawing water now does affect the availability of water to future generations. An efficient allocation in this case considers the opportunity cost associated with the unavailability in the future of any unit of water used in the present.
    - In efficient groundwater markets, the water price would rise over time until the point of exhaustion, the point at which the marginal pumping cost becomes prohibitive or when the MC of pumping equals to the next-least-expensive source of water (MC = P)
    - The difference between the price of water and the marginal extraction cost would decline over time, reaching zero at the exhaustion point.

II. Sources of Inefficiency

a) **Restrictions on Transfers**. With a well-structured system of water property rights, efficiency can be a direct result of the transferability of the rights. Those with lower marginal net benefits would trade their rights to those who would receive higher benefit. Unfortunately, the existing mixed system of property rights coupled with quite restrictive laws and regulations have diminished the degree of transferability

- "**Beneficial use" or "use it or lose it" principle**: One of earliest restriction required users to fully exercise their water property rights or else they would lose them. The regulations strongly discourage conservation (no incentive to conserve)
- "**Preferential use**": A restriction establishes a value hierarchy of uses, for example, the government attempts to establich alloation priorities across categories of water. This lower the likelihood that marginal net benefits would be equalized.

b) **Subsidies and agricultural water pricing**: For example, the subsidies to irrigated agriculture project in the Westlands Water District, California resulted in negative net benefits, leading to estimated $217per irrigated acre or $500,000 per year for the average-sized farm.

c) **Municipal and industrial water pricing:** The prices charged by water distribution utilities do not promote efficiency. In general, the price is too low and rate structure does not reflect the costs of providing service to different types of customers. Water fees and charges should reflect costs of storage, treatment, and distribution of the water to customers

- Water is considered an essential commodity, so regulated prices are typically low (not reflecting marginal cost of supply the last unit of water – marginal scarcity

rent is excluded). Low pricing and ignoring the marginal scarcity rent promote an excessive demand for water.

5.3 Ways to improve efficiency of water use.

- **Water markets** can enhance efficiency by allowing water to flow to its highest valued use. Water markets can be used to transfer water seasonally via short-term leases or on a long-term basis. For example, Australian government facilitated the transition to water market in 1993 with water reforms that allowed water and land entitlements to be separated. This unbundling created two primary types of waters which are tradable water access entitlements and tradable water allocations. This improved efficiency and cost-effectiveness of water trading by allowing more flexibility for users in terms of water deliveries.
- **Water price** reforms to align the right incentives for water use, for example, the use of block rate, charging a lower price for the first units consumed (cost per unit increases with additional units of consumption), to encourage conservation by ensuring that marginal costs of consuming additional water are high.

Reference:

- **[TL]** – Tietenberg, T. and Lewis, L. Environmental Natural Resource Economics, 2015 (10th edition), Pearson, Chapter 9.
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