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5.1 Some facts about Economics of water:

- People don’t value what they don’t pay for;
- he global water economy is severely stressed, with nearly 4 billion people facing severe water scarcity at least one month per year and 61% of the population living in areas with declining water storage;
- Agriculture consumes roughly 70% of global freshwater withdrawals;
- Water insecurity costs the global economy roughly $500 billion annually, with drought alone costing $307 billion;
- Over 80% of wastewater is released into the environment without treatment, representing a massive missed opportunity for water reuse and economic value;
- Groundwater provides about 25% of all water used for irrigation;
- Roughly 2.2 billion people lack safely managed drinking water;
- In some countries (e.g Australia, Chile) water is tradable (commercial good) and a formal market allow for reallocating water from low-value (often agriculture) to high-value uses (industrial or urban).

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5.2 Why water economy ?

Water economics is the study of how to manage water resources efficiently when demand outstrips supply (يتجاوز العرض). It treats water not just as a survival necessity, but as an **economic asset** with specific **values**, **costs**, **and** allocation to balance demande and supply. It refers also to the study and application of economic principles to manage water resources **efficiently**, addressing issues such as **pricing**, and **pollution prevention**, to promote rational consumption and protect water as a public good.

By 2030, global demand for freshwater is expected to outstrip sustainable supply by 40%. This projected, significant shortfall, often described as an imminent global water crisis, is driven by population growth, urbanization, and rising consumption in agriculture and industry. Without immediate action, nearly half the world's population could face severe water stress by 2030. (World economic froum,2023)

The paradox is that water is essential for life but **often free** as a result there is an overuse, depletion and misallocation.

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6.3 Water Supply and Demand:

Water economy should make balance firstly between supply, demamnde then ensure equity.

6.3.1 Water Supply: The amount of water stored and accessible for use, primarily sourced from **surface water** (rivers, lakes, dams reservoirs), **groundwater** (aquifers) and **desalination** in current days.

Groundwater (23%): Constitutes a significant portion of freshwater.

Surface Water (70%): Includes rivers, lakes, and reservoirs, with rivers providing a large, accessible portion despite being a small percentage of total water.

Desalination & Water Reuse(7%): Growing alternative sources, particularly in water-stressed regions.

These percentage are the best estimation by 2025, note that desalination and water reuse are increase year over year.

6.3.2 Water Demand: The total water usage of an area over time, driven by three main sectors:

- **Agricultural:** consuming roughly **70%** of freshwater; it is the largest user, primarily for irrigation, livestock, and aquaculture. In low-income countries, this share can rise to as high as 90%.
- **Industrial (20%):** Includes manufacturing, mining, and energy production (cooling for power plants). High-income countries typically allocate a much larger portion to industry compared to developing nations.

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- **Public/ domestic usage (10%):** it Covers household needs (drinking, sanitation) and public services.

This share distribution of water demand is varying on country economy, climate region and climate change over time.

6.3.3 Regional water demand component share distribution:

The table below give the "typical" share changes based on a country's economic profile.

Region Income level	Agriculture	Industry	Municipal
Global average	70%	20%	10%
Low-Income Countries	90%	2%	8%
High-Income Countries	44%	40%	16%
Western Europe	5%	73%	22%
South Asia	91%	2%	7%

Sources: FAO Aquastat, World Bank

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6.4 Water physical scarcity vs. economic scarcity : Physical water scarcity occurs when there is not enough water to meet demand, often in arid regions. Economic water scarcity occurs when water is available, but inadequate infrastructure, capital, or, governance prevents access. Both are driven by climate change and population growth.

We already have seen water physical scarcity which is: The water demand exceeds the available, sustainable supply of water resources due to the following cause: Arid climates, overexploitation of groundwater, and excessive consumption. It occur explicitly in North Africa, parts of the Middle East, and West Asia.

In the other hands Economy scarcity means water exists, but human, institutional, and financial capital limitations prevent its access. The main cause for situation are: Lack of investment in infrastructure (pipes, pumps), poor governance, and poverty. The most known example of this is the Sub-Saharan Africa countries and parts of the Indian subcontinent.

6.5 Opportunity cost: water economics is built on the idea of opportunity cost—the value of the best alternative use of a resource. Opportunity cost is the value of the next best alternative benefit foregone (abandonné) when water is allocated to a specific use, such as the loss of agricultural production when water is diverted for municipal use. It represents the true cost of using water—particularly in water-scarce areas—and is vital for efficient allocation.

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Definition & Formula: It represents the benefits forgone from possible alternative uses. It is a critical component of the **Full Economic Cost** (Full Supply Cost + Opportunity Cost + Externalities)

Usage Examples:

Agriculture vs. Urban: Allocating water to low-value agriculture rather than high-value urban or industrial uses, resulting in a loss of economic efficiency.

Ecosystem vs. Industry: Water used for manufacturing rather than maintaining wetlands for fish and wildlife habitat.

Hydropower: The electricity revenue lost when water is released for irrigation instead of through turbines.

Opportunity costs are near zero when water is abundant but increase substantially as basins become "densely used" or arid. Ignoring these costs leads to severe misallocations and underinvestment.

6.6 Water demand and economic valuation:

Water demand and valuation are critical for sustainable resource management, urban planning, and economic policy. Demand measures the volume of water needed by different sectors (e.g., domestic, agriculture, industry), while valuation assigns monetary or qualitative worth to that water beyond its simple cost.

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Water demand is already explained and you are studying the water drinking supply as module so you have an idea about temporal variations that not need more explanation here.

The water economic valuation s the process of estimating the economic, social, and environmental benefits of water. It is distinct from "price" (what is paid) or "cost" (expense to supply).

The main economic valuation methods estimate the monetary value of goods, services, or resources (often environmental) that are not traded in markets. They are broadly classified into revealed preference methods (based on actual market behavior) and stated preference methods (based on hypothetical scenarios), this will help and allow decision-makers to weigh costs and benefits, such as in environmental management or business asset valuation.

6.6.1 Revealed Preference Methods These methods use data from actual market transactions to infer the value of non-market goods, here is some .

Market Price Method: Uses direct prices from commercial markets for resources like timber or other goods.

Production Function Method: Estimates the value of an ecosystem service based on its contribution to producing a marketed good (e.g., cleaner water for aquaculture).

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Replacement/Damage Cost Methods: estimate the value of ecosystem services by calculating the expense of replacing them with man-made infrastructure or repairing damage caused by their loss. Common examples include valuing wetlands by the cost of building levees, or measuring water purification services by the expense of water treatment plants

6.6.2 Stated Preference Methods (Hypothetical Scenarios): These methods use surveys to ask people how much they would be willing to pay (WTP) or accept (WTA: Willing to Accept) for changes in a resource, often used for non-use values.

Contingent Valuation Method (CVM): Directly asks people their WTP for a specific environmental improvement. In addition to its flexibility the CVM predicts user demand and revenue better.

Choice Experiment / Contingent Choice: it is a stated preference survey method used in water economics to determine the monetary value of water services and improvements**.** It presents individuals with scenarios containing various attributes (e.g., price, quality, supply reliability) and asks them to choose their preferred option

Its benefits are mainly:

- Reduction in water supply disruptions.
- Better wastewater treatment programs.

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6.7 Water Pricing & Tariff Design: Water demand follows the **general law of demand**: as price increases, quantity demanded decreases. See, the below table for a household consumption.

Price P (DZD/m 3)	Volume V (m3)
0	40
0.50	35
1.00	30
2.00	20
3.00	10

From the upper table we can get the following formula:

$$V = 40 - 10*P$$

We can see that at 0.50 DZD /m^3, households use 35 m^3 and at 2.00 DZD/m^3, consumption drop to 20 m^3.

In general pricing works in the purpose to reduce water use and value the water reuse. Not all water uses have a market price (e.g., environmental flows).

The water pricing and tariff design policies involve setting rates to **cover utility costs**, **ensure financial sustainability**, and **promote conservation**, often using volumetric or fixed charges.

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6.7.1 Water Pricing & Tariff Design goals and principles:

Water Conservation: Encouraging consumers to reduce waste, often achieved through higher rates in higher consumption blocks.

Equity and Affordability: Providing essential water at lower costs for low-income households, while ensuring higher-usage users pay proportionally more.

Financial Sustainability: Ensuring the service provider can cover the full costs of operation, maintenance, and capital investment.

Efficiency: Setting prices that encourage efficient water use, often aiming for marginal cost pricing.

6.7.2 Water Tariff Structures:

Uniform Volumetric Tariff: All units of water are charged at the same rate, regardless of consumption level, providing a clear signal of the cost.

Increasing Block Tariff (IBT): A step-wise structure where the price per unit increases as water consumption increases, often used for promoting conservation and providing affordable basic water.

Fixed Charge: A flat rate independent of consumption, ensuring revenue for infrastructure upkeep.

Two-Part Tariffs: Comprises a fixed charge (for fixed costs like administration) plus a variable volumetric charge.

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Decreasing Block Tariff (DBT): The rate per unit of water is higher for the initial block of consumption and decreases as consumption rises, often used to incentivize high-volume users, though less common now. This is used when the prices are not subsidized.

6.7.3 Water tariff implementation challenges:

Metering Requirement: Volumetric tariffs necessitate reliable, widespread water meters.

Administrative Difficulty: Designing a fair, effective, and socially acceptable tariff system is complex.

Social and Political Sensitivity: Water is often viewed as a human right, making price increases politically challenging.

6.7.4 Common solutions approaches:

Purpose-based classification: Different rates for residential, commercial, or industrial customers.

Meter size-based classification: Charging based on the size of the service pipe.

Advisory Committees: Using committees to oversee rate changes and ensure transparency.

In many countries of the world water is a natural monopoly by state. Water distribution has high fixed costs (pipes, treatment plants) and low marginal costs. In developed countries people can not pay the real price of the cubic meter of water without subsidizing from the state.