

Fundamentals on Environment and Sustainability



WATER - Water resources (the urban water cycle)

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Douro river



WATER - the urban water cycle



Natural water cycle

• Exists for billions of years.

• Water is always cycling around, through and above the Earth.

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• This natural water cycle is our planet's way of recycling water and is essential for life on Earth.

evaporation — condensation precipitation — infiltration — run-off transpiration



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WATER – Water Resources (the water cycle; water management)

WATER – Water Resources (the urban water cycle)



















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6 CLEAN WATER AND SANITATION

3 GOOD HEALTH AND WELL-BEING

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HOW MANY PEOPLE LIVE WITHOUT ACCESS TO WATER AND SOAP?







GOOD HEALTH AND WELL-BEING

NO Poverty



6 CLEAN WATER AND SANITATION WHO / UNICEF 2019 -two out of five people or three billions of people in the world don't have basic conditions for wash hands at home :

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- 1,6 billions have limited facilities without water or soap.
- 1,4 billions don't have any facilities
- WHO / UNICEF 2022 :
- Water: 2.2 billion still lacked safely managed drinking water, including 115 million people drinking surface water.
- Sanitation: 3.5 billion people still lacked safely managed sanitation, including 419 million who practiced open defecation.
- Hygiene: In 2022, 2 billion still lacked basic hygiene services, including 653 million with no facility at all.
- Menstrual health: Adolescent girls and women living in rural areas are more likely to use reusable materials, or no materials at all, to manage menstruation.
- Gender: 1.8 billion people still do not have drinking water onpremises, and in two out of three households, women are primarily responsible for water collection.





INFECTIOUS DISEASE RISKS

DIARRHOEAL DISEASE



WASH-related deaths are from diarrhoeal disease.¹

- Diarrhoea is the second leading cause of death among children aged under 5 years.
- Just 2 pathogens, rotavirus and *Escherichia coli*, are responsible for most cases of moderate-to-severe diarrhoea in low-income countries. Other important pathogens include *Cryptosporidium* and *Shigella*.²
- **Cholera can kill within hours if left untreated.** Cholera is still endemic in 69 countries, resulting in an estimated 2.9 million cases and 95 000 deaths per year worldwide.³

Water, sanitation, hygiene and health A PRIMER FOR HEALTH PROFESSIONALS © World Health Organization 2019

WASH - Water, sanitation, hygiene and health

WHO WATER, SANITATION AND HYGIENE STRATEGY 2018-2025









 Nearly three quarters of the population of the Least Developed Countries lack soap and water handwashing facilities.

(OMS / UNICEF 2022)

 Almost 900 million children around the world lack a basic hygiene service in their schools. (OMS / UNICEF 2022)



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- About 297,000 children more than 800 every day under the age of five die annually from diarrheal diseases due to poor sanitation, lack of hygiene or clean water. (OMS / UNICEF 2019)
- Children under 5 years of age in countries in conflict are 20 times more likely to die from causes linked to unsafe water and sanitation than from direct violence. (OMS / UNICEF 2019)





- 1 million deaths per year are associated with births without conditions. Infections are responsible for 26% of neonatal deaths and 11% of maternal mortality. (OMS / UNICEF 2019)
- Hygiene promotion is the most cost-effective health intervention. (World Bank 2016)



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- Access to water is "essential to enjoy the right to life".
 - Therefore, (July 2010) the United Nations General Assembly recognized access to clean water and sanitation as a fundamental and universal human right.
- without water and sanitation there will be no just societies



NOW Fundamentals on Environment and Sustainability

WATER - the urban water cycle

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The water-centric 17 Sustainable Development Goals for each sector (United Nations 2015c; Makarigakis and Jimenez-Cisneros 2019;







Population growth







Data sources: Up to 2015 OurWorldinData series based on UN and HYDE. Projections for 2015 to 2100: UN Population Division (2015) – Medium Variant. The data visualization is taken from OurWorldinData.org. There you find the raw data and more visualizations on this topic.





2013 - 7.1 Billions inhabitants

- **1.2** Billions without acess to safe water
- 2.5 Billions without sanitation



2050 - 9.3 Billions inhabitants

6.2 Billions without acess to safe water



7 Billions in cities





Our World in Data

Urban and rural population projected to 2050, World, 1500 to 2050

Total urban and rural population, given as estimates to 2016, and UN projections to 2050. Projections are based on the UN World Urbanization Prospects and its median fertility scenario.



Source: OWID based on UN World Urbanization Prospects 2018 and historical sources (see Sources) OurWorldInData.org/urbanization • CC BY



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Urban Population per continent in 1950 e 2020 (%)



Source: U.N. Population Division



Source: UN World Urbanization Prospects (2018) Note: Urban populations are defined based on the definition of urban areas by national statistical offices. OurWorldInData.org/urbanization • CC BY



JAKARTA 1976



CHENGDU, CHINA 1990





CHENGDU, CHINA 2000



JAKARTA 2004



(urban areas in green) 18,2 millions inhabitants)

(urban areas in purple) 4,6 millions inhabitantes)



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Share of the population with access to drinking water facilities, 2020



Safely managed Basic Limited Unimproved No access (surface water only)

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Share of the population with access to drinking water facilities, 2020



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Source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation OurWorldInData.org/water-access • CC BY







Share of the population with access to safely managed drinking water, 2020



Safely managed drinking water is water from an improved water source which is located on premises, available when needed and free from contamination.





Share of the population without access to an improved water source, 2020

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Improved drinking water sources are those that can deliver safe water. They include piped water, boreholes or tube wells, protected dug wells, protected springs, rainwater, and packaged or delivered water.





Number of deaths by risk factor, World, 2019



Total annual number of deaths by risk factor, measured across all age groups and both sexes.





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Deaths by risk factor, World, 2021

The estimated annual number of deaths attributed to each risk factor¹. Estimates come with wide uncertainties, especially for countries with poor vital registration².



Data source: IHME, Global Burden of Disease (2024)

OurWorldinData.org/causes-of-death | CC BY

Note: Risk factors¹ are not mutually exclusive. The sum of deaths attributed to each risk factor can exceed the total number of deaths.







Share of the population with access to sanitation facilities, 2020



Safely managed Sasic Limited Unimproved Open defecation





Source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation OurWorldInData.org/sanitation • CC BY



Share of the population with access to sanitation facilities, 2020



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📕 Safely managed 📕 Basic 📒 Limited 📕 Unimproved 📕 Open defecation



Source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation

OurWorldInData.org/sanitation • CC BY



Share of population using safely managed sanitation facilities, 2020



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Safely managed sanitation is improved facilities which are not shared with other households and where excreta are safely disposed in situ or transported and treated off-site.



Source: WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) OurWorldInData.org/sanitation • CC BY
Share of the population without access to improved sanitation, 2020

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Improved sanitation facilities are designed to hygienically separate excreta from human contact. They include flush to the piped sewer system, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs.



Source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation OurWorldInData.org/sanitation • CC BY



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In **1993**, the General Assembly of the United Nations designated **March 22nd** as World Water Day, with each year given a designated theme. The 2017 theme for World Water Day is "Wastewater", which is defined as any water that has been used in a home, business, industry, or agriculture.

- Following the global population growth, the amount of wastewater produced and the pollutants it carries are increasing as well.
- increase awareness of how wastewater can be considered as a sustainable source of water, energy, nutrients, and other materials that can be recoverable.
- In general, the potential of wastewater as a sustainable resource is being neglected as an offset to the growing water crisis. According to U.N. statistics, the global demand for potable (drinkable) water is expected to increase by 50% by 2030.







About Our Work

Partners Impact

Tools Portal

Message from UN Secretary-General to the SWA Sector Ministers' Meeting

30 Mar, 2019



It is a pleasure to greet this important meeting on sanitation and water for all.

Learn & Share

Achieving safe and sustainable water and sanitation access for all is an urgent challenge.

Every year since the 1980s, global water use has increased.

- But this does not mean that everyone has access to reliable and safe water.
- Two billion people today live without safe water at home.

And 4.5 billion people do not have safely managed sanitation.

Moreover, population growth and rapid urbanization, coupled with poor management, have increased water demand and stress in many parts of the world.





And climate change is adding dramatically to the pressure.

We have a lot of work ahead of us.

We need to triple current annual investments in the water and sanitation sector to ensure that everyone has access to safe water and sanitation.

I commend your leadership and efforts to increase awareness about the root causes of inequalities in water and sanitation.

Ensuring that everyone, everywhere, has access to safe drinking water and adequate sanitation is about fulling our promise to leave no one behind.

I count on you to develop concrete plans and solutions to overcome this significant challenge and look forward to learning about the results of your discussions.

Thank you.





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World Water Development Report United Nations - Water









WATER: GIFT OF NATURE OR PLANNING CHALLENGE?







How much do you know about the urban water cycle in your country?



Have you ever thought about this?

What are the problems?.....If there is any....

Where does water come from?

And what about wastewater?

Do you pay for water? How much?

And for wastewater treatment?

"Water" is a utility. How do you compare what you pay for it with other utilities (energie suplly, internet....)



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Water distribution

Oceans [saline seawater] (97,5%)





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Percentual distribution of water consumption by sector and by continent







Facts and Figures

Water, food and energy a nexus at the heart of sustainable development

Agriculture is the largest consumer of the world's

frehwater resources, and water is used to produce most forms of energy

Water, food, energy and ecosystems

72% of all water withdrawals are used by agriculture, 16% by municipalities for households and services, and 12% by industries. (UN-Water 2021)

- It typically takes between 3,000 and 5,000 litres of water to produce 1 kg of rice, 2,000 litres for 1kg of soya, 900 litres for 1kg of wheat and 500 litres for 1kg of potatoes. (WWF, 2006)
- While almost 800 million people are currently hungry, by 2050 global food production would need to increase by 50% to feed the more than 9 billion people projected to live on our planet. (FAO/IFAD/UNICEF/WFP/WHO, 2017)





Virtual Water – Water consumptions









Indus Valley Civilization Bronze Age NW (South) Asia,3300 and 1300 BC; 2600 and 1900 BC.

Water supply and drainage

Transporting water over long distances, overcoming slopes



Gard Bridge (aqueduct), Nîmes, France - UNESCO's list of World Heritage sites -1985

Built before the Christian era to allow the Nîmes aqueduct (which is almost 50 km long) to cross the River Gard.





Why to treat water?

To make it safe

Aesthetic aspects







Water sources:

superficial ground water



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Why do we need to treat water?

There are many impurities in the raw water

These "impurities" can be grouped into three categories:

Physical: materials that do not dissolve (suspended solids) in water and make the water appear "dirty".

Chemical: substances dissolved in the water from both natural and man-made processes or even lack of some substances.

Biological: viruses, bacteria, algae, and other small living organisms.





Portugal

Water

Water catchment:

Freshwater – 256

Underground – 5 912

Treatment: WTP – 220

(mini WTP) – 3 369 Chlorine point– 1 077

Pumping stations – 2 425

Storage (tanks) – 8 860

Mains & networks – 119 442 km





Water Treatment Steps





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WATER TREATMENT PROCESS





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Groundwater Treatment Process











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Drainage and Wastewater treatment in Europe, 2017





Portugal

Sanitation

Sewer networks – 64 436 km

Pumping stations – 6 088

Treatment: WWTP – 2 768 community septic tanks – 1 601

emergency discharges – 1 594

Disposal:

Submarine emissaries–23

(Fonte: DEFINING FUTURE OPTIONS, "Portuguese Water Supply and Sanitation – Outlook 2020", Março 2021)





Wastewater Treatment Plant















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Urban water cycle

Linear Economy







MOVED BY WATER MOVED BY CIRCULAR ECONOMY

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Circular aproach to urban water cycle



WWTP to WWRRF

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Wastewater Treatment Plant to Wastewater resources recover facilities





World Business Council for Sustainable Development (WBCSD)

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Urban water cycle in Circular Economy



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New masters programme launched for sanitation professionals

IWA's **An Avoidable Crisis** identified a "staggering" skills gap and labour shortage in the sanitation sector, and called on "multiple actors to ensure sustained, adequate professional and technical capacity." In a first-of-itskindresponse, the **IHE Delft Institute for Water Education** and the **Bill & Melinda Gates Foundation** launched a new Masters of Science Programme in Sanitation, which "seeks to meet demand in the sector for overall sanitation experts with all-around capacity,"









What now??????

- use and reuse of water, including rainwater
- resources recover
- separate rainwater treatment
- separation of constituents in production and differentiated treatments
- adaptation of technologies to remove compounds of emerging concern
- adaptation and mitigation of climate change
- component separation: grey water; black waters; industrial water/domestic wastewater
- centralized systems vs decentralized (spread) systems
- use of collector networks as treatment systems
- water certification



5 Wastewater Regulations to Know in 2025

🗸 Urban Wastewater Treatment Directive (UWWTD)

Updates mandate that urban wastewater treatment plants achieve net energy neutrality by 2045

New "polluter pays principle": the industrial discharger is responsible for paying for any advanced treatment of micropollutants discharged

Industrial Emissions Directive (IED)

Emphasizes adoption of Best Available Technology (BAT) to minimize emissions and pollutants

Adds greater protection for citizens by enabling right to seek compensation for any health effects due to pollution

Circular Economy Action Plan (CEAP)

Encourages industrial facilities to implement water recycling systems and minimize waste to align with EU's Green Deal

Microplastics and Emerging Contaminants

New goal to reduce microplastic releases by 30% by 2030

New measures under multiple directives require advanced wastewater treatment for microplastics and pharmaceutical residues

Sewage Sludge Directive

Increases the amount of sludge used in agriculture while minimizing the amount of toxic chemicals and heavy metals applied to soil











"VIRA – Turn concepts and mentalities"





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(*) For a consumption of 10m3 per month; Data: 2019, except where indicated otherwise

ORTUGUESE WATER AND SANITATION OUTLOOK

MARCH 2021 Pg. 4

(Fonte: DEFINING FUTURE OPTIONS, "Portuguese Water Supply and Sanitation – Outlook 2020", Março 2021)



Just to remind

- A tap open for **1 minute** can waste **12 liters of water**. Always check that the taps are closed and be aware of the "ping-ping" as it also has an impact on the monthly bill;
- In a **5-minute shower** with the tap on, you can spend **60 litres**, while with the tap off, only **24 litres**.

When brushing your teeth with the tap on, you can use **36 liters**, while with the tap off, only **0.3 liters**. So, turn off the tap during daily hygiene and remember that with this gesture you save a lot of water and money;





Paris sewage

Georges-Eugène Haussmann e Eugène Belgrand – design of sewage network of Paris XIX





2600 Km ⇔ Paris – Moscovo











Before



Now



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²⁰¹⁰ Lisboa



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Germany after the flood





Germany after the flood





Indonésia - Jacarta moves to Nusantara







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Mexico City

Mexico City is sinking at rates of **up to 50 cm per year** due to groundwater extraction, with subsidence possibly reaching as much 30 m over the next 150 years











We need

Smart cities / Wise cities

Water sensitive urban design (WSUD)

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Renaturalization of the Cheonggyecheon River in Seoul – South



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Utrecht (Netherlands), 2020

Restoration of Catharijnesingel removes vehicular traffic and brings back water to rewild a new public space for the city and make it accessible for cyclists and pedestrians.



Singapore is considered to be one of the most water-stressed countries in the world. It is heavily dependent on rainfall due to the **lack of natural water resources**, and limited land is available for water storage facilities.

How does Singapore manage to secure a sustainable supply of water?

- 1. With separate rainwater and used water collection systems, good land use planning policies and strong environmental controls, the collected rainwater is protected from pollution.
- 2. Reuse water endlessly: Recycling water is the most sustainable and cost-effective way to increase Singapore's water supply.











Sustainability









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Humor, art and Engineering at the service of Environment



WATER - the urban water cycle







WATER - the urban water cycle







WATER - the urban water cycle









1. What are the challenges, solutions and opportunities that you consider most relevant in the urban water cycle?

2. What day-to-day measures are you willing to take to preserve the water resource?