Every drop counts.

Water and swimming pools

Understanding the uses of water and the impact of swimming pools

FLUIDRA

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Preface

Water is the source of life on our planet. Despite its abundance, this precious resource faces serious threats from climate change, pollution and unsustainable use. At our company, we not only recognise the critical importance of water but also feel a deep responsibility to protect it.

Every drop of water counts. While the water used in the operation and maintenance of swimming pools may seem minimal compared to other uses, every action we take has an impact. Our commitment to water stewardship goes beyond corporate responsibility; it is a passionate mission that drives us to lead in sustainable solutions. This dedication inspires us to pioneer initiatives that benefit not only our industry but the entire planet.

Our firm commitment to transparency and progress in protecting water is a testament to our efforts and achievements. It is a promise to our community that we will continue to work tirelessly for a more sustainable future.

We believe that with determination and collaboration, we can make a significant difference. Together, we can ensure that water, the source of all life, is protected and conserved for present and future generations. We invite everyone to join us on this transformative journey towards a world where living in harmony with water is balanced and sustainable.

Eloi Planes

Executive Chairman
FLUIDRA

Prologue

Water is at the heart of life and prosperity because of its impact on health, wellbeing, economic development and food security.

Water is also a source of renewable energy. What is more, until a major technological leap forward is made, water is the only economically viable way of storing energy on a large scale for long periods of time. However, without adequate treatment, containment and channelling infrastructure, water can destroy, erode, and spread disease and pollution.

At the Instituto Español de Analistas (Spanish Institute of Analysts), we recognise that sustainable development and societal wellbeing heavily rely on effective resource and waste management. In this context, we understand that due to climatic diversity, the characteristics of the productive sectors, the success of tourism, the significant disparities in population density across different regions and the complex administrative structures, water management presents a major challenge. It is a cross-cutting issue that concerns a large portion of society and the Institute.

We congratulate Fluidra, its team of professionals and collaborators on this report, which systematically clarifies some of the most relevant aspects and issues within this broad subject. The report is particularly timely and we hope that its publication and presentation will spark profound debate. We envision this document as the first in a series dedicated to analysing the management of this resource from various perspectives, leading to proposals that guide us towards effective, efficient and sustainable solutions.

We align with those who believe that this challenge must be met with qualified technical responses based on objective environmental, social and strategic criteria. We view these considerations as essential in designing a sustainable framework.

In Spain, the geographical and climatic diversity, the concentration of population in specific areas and the importance of agriculture and tourism present a unique challenge for water management. For these same reasons, first-class infrastructure and expertise have been developed.

There is still lots to be done.

However, rather than being discouraged, expert opinion – or at least some of it - suggests with pragmatic optimism that the cost is bearable. Experts emphasise that addressing imbalances requires securing the support of stakeholders in implementing the mechanisms for a much-needed rational redistribution. Additionally, it is evident that investment must not overlook the necessity of maintaining and improving infrastructure.

For all these reasons, we at the Instituto Español de Analistas embrace this new challenge with enthusiasm. We hope that reading this report will inspire both experts and interested individuals to join us in seeking solutions to the challenges that water represents.

Alfredo Jiménez
General Secretary of the Instituto Español de Analistas

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FUNDACIÓN

Executive summary

Water – a precious resource

Water, the most essential and common substance on our planet, is paradoxically one of the most valuable and often wasted resources. Beyond being fundamental to all forms of life, water is crucial for industrial, agricultural and everyday activities.

Although our planet is known as "the blue planet," the vast majority of Earth's water, 97.5 %, is saline and unsuitable for human consumption. Only 2.5 % is fresh water. Most of this fresh water is trapped in glaciers and ice caps, making it inaccessible for everyday use. Only a tiny fraction, about 1 %, is readily accessible for human use and is found in rivers, lakes and underground aquifers.

The water, or hydrological, cycle is a continuous process involving the movement and transformation of water in, on and below the Earth's surface. This cycle is essential for regulating climate, purifying water and sustaining ecosystems. However, human activities such as industry, deforestation and urbanisation can disrupt these natural processes, impacting local climates and water availability.

Freshwater resources are both limited and unevenly distributed across the globe. Arid and semi-arid regions, which house approximately one-third of the world's population, experience significant water shortages. Conversely, regions like the Amazon and Congo basins, though rich in water resources, face challenges related to sustainable management and pollution control.

Water use

Global water demand continues to grow, due to population growth, rapid industrialisation and intensive agricultural practices.

This growing demand requires a sophisticated approach to sustainable water management to ensure that future generations have access to this vital resource. Sustainable management seeks to balance human needs with the capacity of ecosystems to maintain water supplies. Technological innovations, policy reforms and public education are key to promoting sustainable water use and mitigating the impacts of climate change on water resources.

Swimming pools and water

Swimming pools provide valuable recreation, exercise and relaxation for millions globally. They offer a welcome break from the summer heat and an opportunity to socialise and enjoy the outdoors. However, their construction, maintenance and operation have an impact on water consumption and quality, key factors in environmental sustainability. It is estimated that swimming pools account for approximately 0.75 % to 1 % of total domestic water use, including both initial filling and ongoing maintenance. This figure varies depending on factors such as pool size, how they are used, evaporation rates and the technology used for water recirculation and treatment. This underscores the importance of adopting water-efficient policies and technologies to minimise the environmental impact of swimming pools and promote sustainable domestic water use.

Available analyses are based on estimates, highlighting the need for more effective methods of measuring water use in swimming pools. Accurate metering would enable more efficient management of water resources and promote sustainable household water use practices.

Effective pool management calls for strategies for conserving water, balancing personal enjoyment with ecological responsibility. Understanding the water cycle in swimming pools, including loss through evaporation, filtration, splashing and filter cleaning, is crucial to identifying ways of optimising the use of water resources.

At Fluidra, we believe that by embracing best practices and innovative technologies, we can significantly reduce the environmental impact of swimming pools while still enjoying their many benefits.

Chapter 1

Water – a precious resource

Water, the most abundant substance on our planet, essential to all known forms of life, is paradoxically one of the most valuable and frequently wasted resources.

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Water, both ubiquitous and paradoxically precious, is one of Earth's most vital yet frequently wasted resources. Essential to the existence of all known life forms, it not only constitutes a significant portion of living organisms but also serves as an indispensable element in the fabric of human civilisation. From sustaining life to enabling industrial and agricultural activity, water plays a fundamental part in our daily existence.

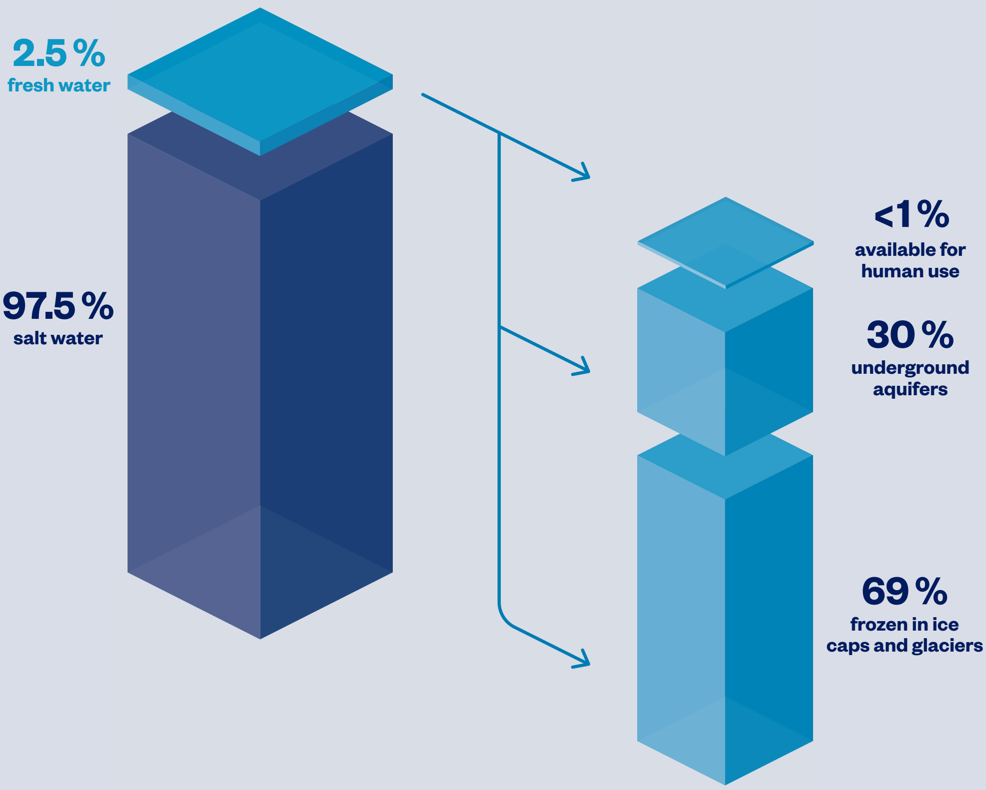
This chapter looks at the current state of the world's water resources, examines the geographical variability of these resources and highlights the critical importance of sustainable water management.

1.1. Water on Earth

The image of our blue planet as seen from space, with its vast oceans and seas, can deceive us into believing there is an unlimited abundance of water on Earth. Although most of the Earth's surface is covered by water, most of it is salt water and unfit for human consumption. The responsible management of fresh water is essential if humanity is to ensure a sustainable supply for the needs of people, industry and agriculture.

Most of the water on Earth, an astronomical 97.5 %, is salt water, found in the oceans and the seas. It is unsuitable for direct consumption or for most agricultural or industrial uses. The remaining 2.5 % is fresh water, most of which is trapped in glaciers and ice caps and is inaccessible for human use.

Figure 1. **Distribution of water on Earth by percent.**



Own work. Sources: NASA and the United States Geological Service

The image below **(Figure 2)** shows that the amount of water on Earth, in proportion to the size of the planet, is very small. The oceans cover much of the surface but are only a thin film of water

The **largest blue sphere** represents **all the water on Earth.** Its diameter is approximately 1,384 km (the distance from Barcelona in Spain to Manchester in the UK) and it has a volume of approximately 1,386,000,000 cubic kilometres (km^3). It includes all the water in the oceans, icebergs, glaciers, lakes, rivers, groundwater, water in the atmosphere and even the water contained in all living things on the planet.

The **medium-sized sphere** represents **the world's liquid fresh water** (groundwater, lakes, swamps and rivers). The volume equals approximately 10,633,450 km^3, the vast majority of which is underground and much of which is not accessible to humans. The diameter of this sphere is approximately 273 kilometres (slightly further than the distance between Paris in France and Brussels in Belgium).

The **smallest sphere** represents **the fresh water available** in all the lakes and rivers on the planet. The volume of this sphere is approximately 93,113 km^3 and its diameter is approximately 56 kilometres. Most of the water that people and life on Earth need and use every day is contained in this tiny sphere.

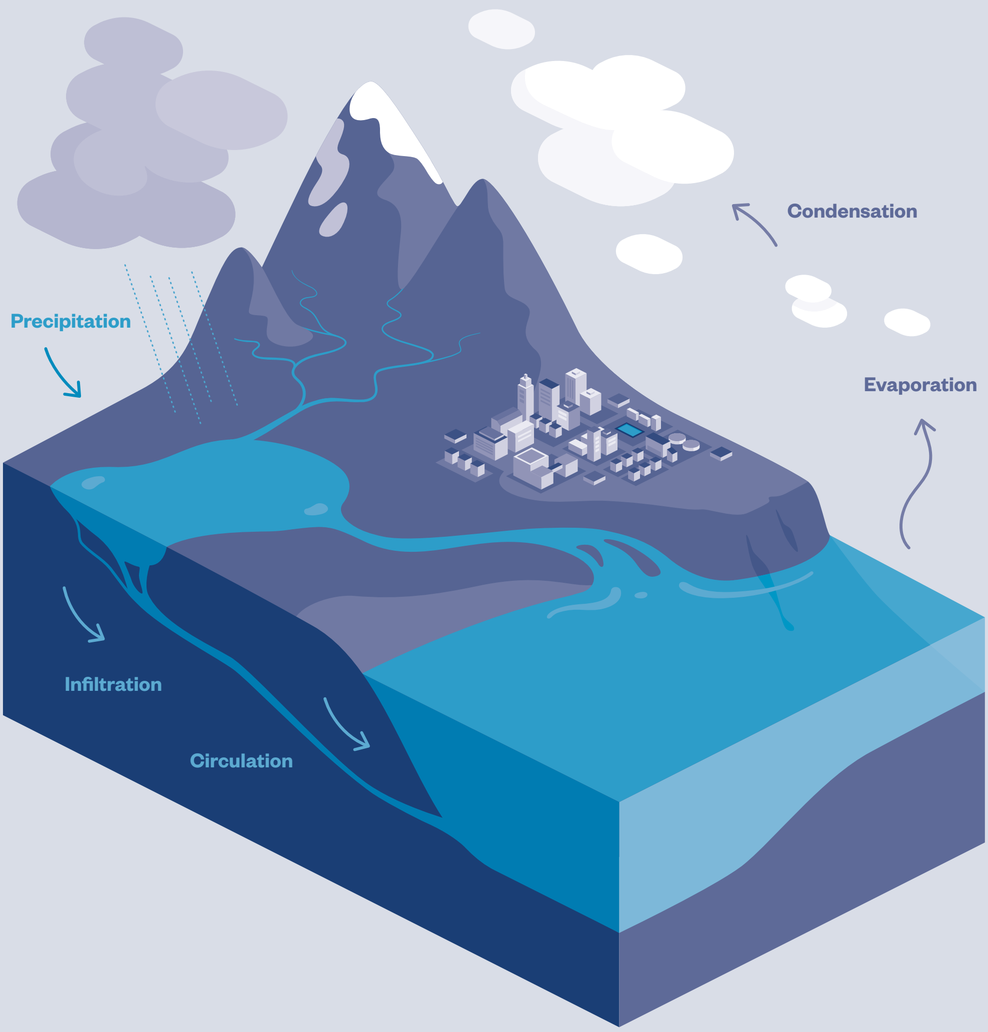
Figure 2. **Total volume of water on Earth.**

Own work. Sources: NASA and the United States Geological Service.

1.2 The water cycle

The water cycle, also known as the hydrological cycle, is a continuous and essential process that describes the movement and transformation of water across the Earth's surface, including in the atmosphere and underground. This cycle is crucial to sustaining life on our planet as it regulates climate, purifies water and supports ecosystems. Understanding the relationship between human activity and this cycle is essential.

Figure 3. **The water cycle.**



Own work.

The main phases of the water cycle are described below, highlighting the impact of human activities on this natural process

Definitions:

- **Evaporation:** the process by which water is converted from liquid to vapour. This phase occurs mainly in oceans, seas and other bodies of water, but can also occur on the earth's surface and in plants during transpiration. The sun's heat provides the energy that causes water to evaporate. Large quantities of water are transformed into vapour and rise into the atmosphere. Notably, almost 90 % of atmospheric water vapour comes from ocean evaporation, underlining the importance of the oceans in the global water cycle.

  Human Impact: industrial activities and deforestation can increase the rate of evaporation, reducing water levels in reservoirs and affecting local climates.

- **Transpiration:** in addition to direct evaporation, water is also transferred to the atmosphere by plants through a process called transpiration. Plants absorb water from the soil and release it as water vapour through tiny pores in their leaves, known as stomata. This process is not only vital for the water cycle but is also essential for the cooling and thermal regulation of the plants themselves.

  Human Impact: urbanisation and agriculture can alter natural vegetation, affecting transpiration rates and local moisture levels.

Raising awareness about the importance of conserving freshwater, a vital resource for both humans and biodiversity, is crucial. The scarcity of this resource poses a global challenge that demands collective action and informed decisions to ensure its long-term availability

- **Condensation:** once in the atmosphere, water vapour cools and begins to change back to liquid, a process known as condensation. This change manifests itself in the formation of clouds and fog. Condensation is crucial because it is the precursor to precipitation. Condensation nuclei, such as dust or salt particles, play a vital role in providing a surface on which water vapour can condense and form water droplets.

  Human impact: air pollution and increased greenhouse gases can influence atmospheric temperatures, affecting cloud formation and weather patterns.

- **Precipitation:** when water droplets in clouds become too heavy to remain suspended in the air, they fall to earth as precipitation - whether as rain, snow, hail or drizzle. Precipitation is essential for transporting water from the atmosphere back to Earth, thus nourishing terrestrial ecosystems and replenishing bodies of water. Interestingly, the distribution of precipitation is not uniform globally, influenced by factors such as geography, topography and atmospheric currents.

  Human impact: climate change, driven by human activities, can alter precipitation patterns, leading to more erratic and extreme weather events such as heavy rainfall or prolonged droughts.

The water cycle is a vital and intricate process that sustains life on Earth. Understanding its phases and the impact of human activities is crucial to developing sustainable practices to protect our water resources.

- **Runoff and infiltration:** after precipitation, water follows two possible pathways once it reaches the land's surface - runoff or infiltration. Runoff occurs when water flows over the surface, eventually returning to rivers, lakes and oceans. Infiltration refers to the process by which water seeps into the ground and percolates through the soil, recharging groundwater. These processes are crucial for determining the distribution and availability of water in an area, refilling aquifers and preventing floods.

  Human impact: overexploitation of groundwater for agricultural and urban use can deplete aquifers, while impervious surfaces such as concrete can reduce infiltration. Urban development and deforestation can also increase surface runoff, leading to soil erosion, flooding and contamination of bodies of water.

The water cycle is fundamental to supporting life on Earth, providing fresh water for drinking, growing food and maintaining natural ecosystems. It also plays a critical role in regulating the global climate and mitigating the effects of climate change.

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Water is an essential resource for the maintenance and development of life on Earth. This necessity affects both freshwater-dependent and saltwater-dependent organisms. Human use of fresh water introduces substantial changes to ecosystems, altering its availability and the economic benefits derived from anthropogenic activities.

Rafael Mujeriego
Chairman of the Consejo Asesor
para el Uso Sostenible del Agua

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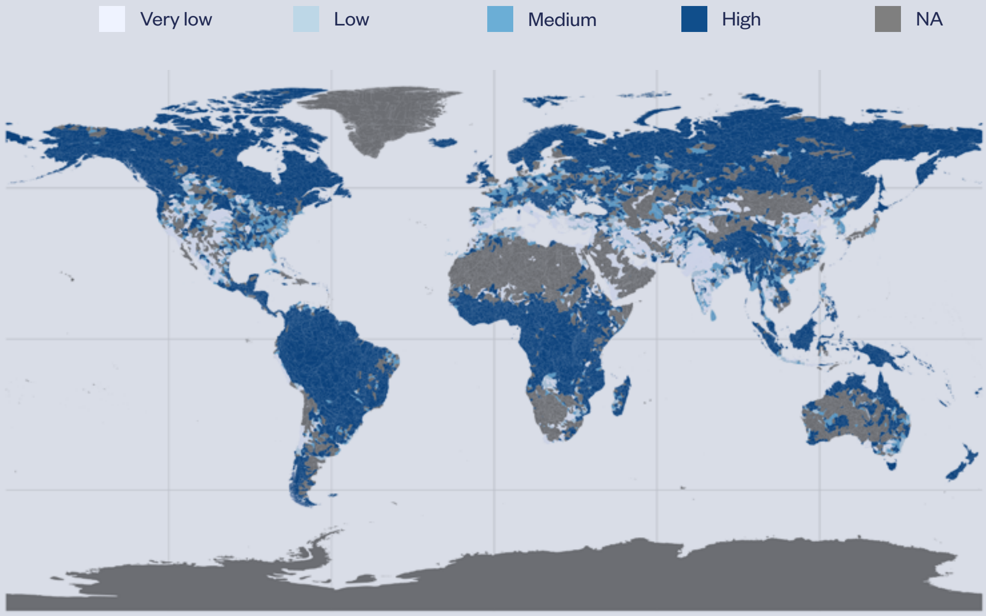
1.3 The uneven distribution of water

Limited water availability is further constrained by the uneven geographicand temporal distribution of rainfall and renewable water resources.

Figure 4. **Total water availability by hydrographical basin.**



Own work. Sources: World Resource Institute and AQUASTAT (2020)

Broadly speaking, different regions can be defined according to common characteristics:

Arid and semi-arid regions

Arid regions, which comprise approximately 41% of the earth's surface, are characterised by low rainfall. These regions, home to approximately one third of the world's population, are experiencing declining water security. Overexploitation of aquifers has led to an alarming decline in water tables, with some, such as the Ogallala aquifer in North America, at risk of being exhausted.

Water-abundant regions

In contrast, regions such as the Amazon and Congo basins enjoy abundant water resources. However, these same regions face challenges such as sustainable water management, protection against pollution and balancing nature conservation and economic development.

Island and coastal regions

Island and coastal regions are highly dependent on rainwater and the desalination of sea water. They are particularly vulnerable to the effects of climate change. Rises in sea level not only threaten infrastructure and daily life in these areas, but also causes the intrusion of salt water that contaminates freshwater aquifers.

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The total amount of water on the planet has not changed and will not change. What is changing, due to human interventions and climate change, is its distribution across space and time, and therefore its availability to humans and the natural environment in a usable form.

Nicolas Jarraud
Senior Specialist
Global Water Partnership (GWP)

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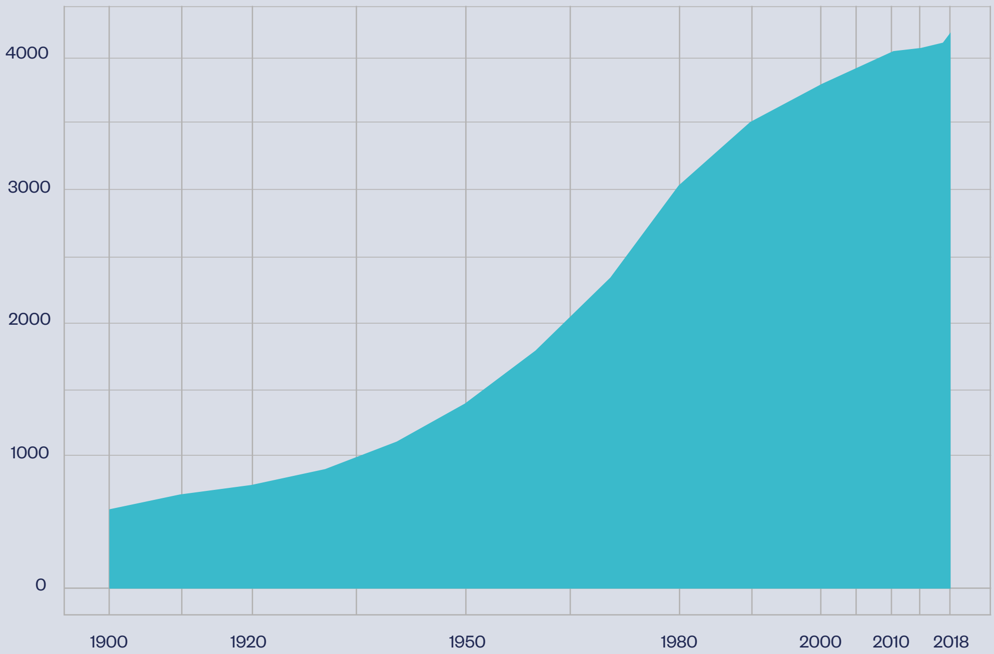
1.4 Water demand

With the world's population exceeding 8 billion people and growing steadily, coupled with the rapid industrialisation of many emerging economies and more intensive use of irrigation in agriculture, water demand continues to increase exponentially.

Globally, water use is estimated to have increased by approximately 1 % per year over the last 40 years.

Figure 5. **Evolution of total global water withdrawals 1900 to 2018 (km^3/year).**



Own work. Source: AQUASTAT

1.5. Per capita water indicators

Sustainable water management is one of the most important challenges facing society. To understand and improve our use of this vital resource, different water indicators are used. Two that are often used are per capita water footprint and per capita water resources. Although they sound similar, these terms represent very different concepts. Let's examine what each one means and when it is appropriate to use them:

Per capita water footprint

Per capita water footprint refers to the total amount of fresh water used to produce the goods and services consumed by an average person in a specific population over a given period. It includes both direct and indirect use of water. Indirect use of water is the water used throughout the production chain of the goods consumed by that person. The per capita water footprint indicator:

- Measures total water use, including the 'virtual' water contained in products.
- Includes water used in agriculture, industry and households.
- Is an excellent indicator for assessing sustainability and the impact of consumption on global water resources.

The per capita water footprint is used to analyse the impact of our consumption on global water resources. For example, a company can calculate the water footprint of its products to improve water efficiency or inform consumers about sustainability. It also helps in understanding the importance of preserving areas crucial to the production of the goods we consume.

Per capita water resources

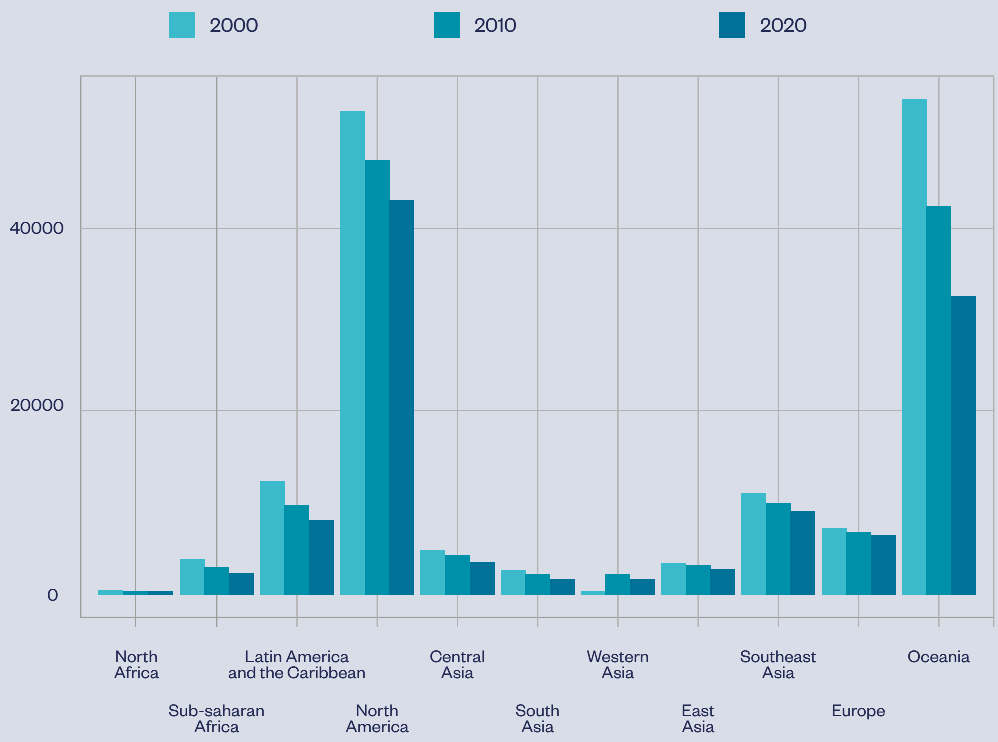
Per capita water resources are defined as the total volume of a country's available fresh water divided by its population. This is usually measured in cubic metres per person per year. This indicator does not measure water use, but water availability. The per capita water resources indicator:

- Focuses on renewable fresh water supply.
- Includes naturally available surface water and groundwater (excluding water transfers).
- Is useful for planning water management policies and assessing the water vulnerability of a region.

Per capita water resources are more suitable for national and regional public policy design and resource management. This indicator helps determine a country's capacity to meet its population's water needs and how prepared it is for situations of water scarcity, and to design strategies for adapting to climate change and other environmental challenges.

The graph below shows the large disparities in the availability of renewable water resources per capita between regions. It also shows how the trend in every region indicates a significant decline in the availability of water resources globally.

Figure 6. **Evolution of the availability of renewable water resources per capita by geographic region. M^3/inhabitant/year.**



Own work. Source: AQUASTAT (2020)

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All projections for 2050 indicate significant increases in global water demand across all sectors, from agriculture to industry. This rising demand, coupled with reduced supply due to climate change, is expected to intensify water stress in various regions worldwide.

Xavier Amores
Director
Catalan Water Partnership

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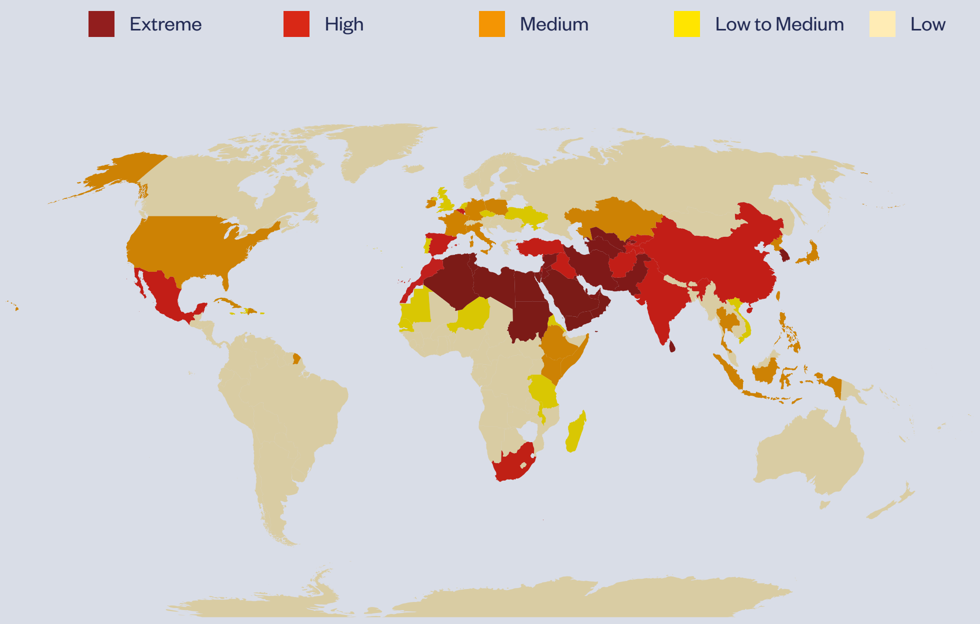
1.6. Water stress

Water stress is a crucial metric used to assess the pressure exerted on freshwater resources in a region or country. This metric measures the ratio between total water withdrawals, including domestic, agricultural and industrial consumption, and the available renewable water reserves, taking into account natural recharge and managed inputs.

Water stress can be calculated in several ways: one is the ratio of annual fresh water use to total renewable supply. Organisations such as the World Resources Institute (WRI) have defined thresholds that classify levels of water stress:

- **Low stress:** use of less than 10 % of renewable water resources.
- **Low to medium stress:** use of 10-20 % of renewable water resources.
- **Medium to high stress:** use of 20-40 % of renewable water resources.
- **High stress:** 40-80 % of renewable water resources.
- **Extremely high stress:** use of more than 80 % of renewable water resources.

Figure 7. **Global water stress.**



Own work. Sources: World Resource Institute and AQUASTAT (2020)

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In regions with a Mediterranean climate, increased rainfall irregularity is being observed, leading to fluctuations in water resource availability. These areas experience periods of intense and prolonged droughts, alternating with episodes of heavy rainfall that cause flooding.

Rafael Mujeriego
Presidente de la Asociación Española
de Reutilización Sostenible del Agua

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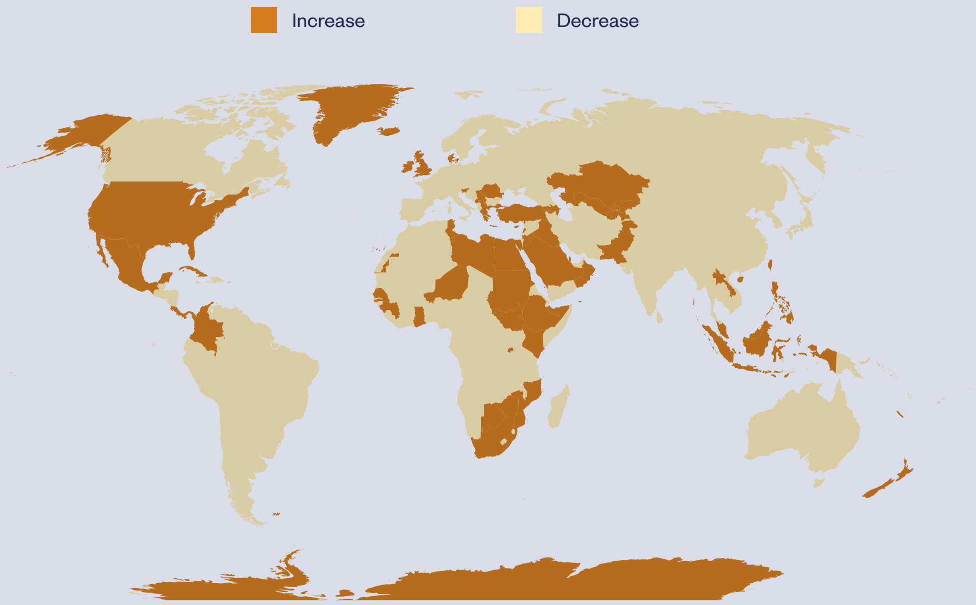
Bearing in mind the seriousness of the situation reflected in the above map, it should be mentioned that in recent decades changes and improvements have been made at all levels (governments, businesses and consumers) to try to improve water stress indicators.

Figure 8. **Water stress: comparison between 2010 and 2020.**



Own work. Sources: World Resource Institute and AQUASTAT (2020)

The map above compares global water stress between 2010 and 2020. It reveals that while the situation improved in some countries, it worsened in many others. New data, when published, will almost certainly show that water-related problems have accelerated in the current decade, and water stress indicators have generally deteriorated.

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We are in a critical and complex scenario with many interconnected challenges: water scarcity; the impact of climate change; water pollution; unequal and insufficient access to water and sanitation; local and international conflicts; and inefficient policies, governance and legislation.

Sergi Martí
Chairman
AQUA ESPAÑA

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1.7. The importance of sustainable water management

Sustainable water management has become a major global concern. Its importance lies in the need to balance human demands with nature's ability to recharge supplies and maintain healthy ecosystems.

Water and sustainable development

Water is fundamental to life on Earth. It is an essential component of economic development, of the production of food, energy and the regulation of ecosystems. The United Nations 2030 Agenda for Sustainable Development recognises fresh water as a key resource; the UN Sustainable Development Goal (SDG) 6 focuses specifically on the sustainable management of water and on ensuring access to water and sanitation for all. However, population growth, economic development and the effects of climate change require more sophisticated and sustainable water management so as not to compromise the ability of future generations to meet their own needs..

The challenge today is not only to meet the growing demand for water but to do so sustainably. This means improving water use efficiency across all sectors, protecting aquatic ecosystems and ensuring equitable access to safe drinking water. Encouraging responsible consumption practices and supporting innovative technologies that enable more efficient use are essential. Additionally, continued investment in infrastructure and education on the importance of conserving this vital resource is required.

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We should promote strong policies and regulations that support the water transition across all sectors of the economy. Prioritising investment in wastewater treatment, alternative water sources such as regeneration, and desalination, digitisation and restoring the environment is essential.

Xavier Amores
Director
Catalan Water Partnership

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Innovation in water management

Technology and innovation play key roles in improving water efficiency and reducing the wastage of water. From precision irrigation systems in agriculture to waste water treatment and recycling technologies, innovation offers ways to use water more efficiently and mitigate water scarcity, such as the adoption of "green" infrastructures that mimic natural processes. The use of economic instruments and public policies can incentivise more sustainable water use.

Challenges in water management

Climate change is a formidable challenge in water management. Changing precipitation patterns, intensifying droughts and floods, and melting glaciers alter water availability and increase water variability. In addition, pollution reduces the amount of usable water and increases treatment costs. These challenges require adaptive management that can respond to uncertain changes and dynamic conditions.

Water governance

Effective water governance is crucial for its sustainable management. This includes policies, laws and decision-making processes that ensure equitable water use, protect water resources and promote cooperation between different users. Participation of local communities and transparency and accountability are essential for sustainable water management.

Education and awareness

Education and awareness-raising are key to changing how water is used and to encouraging sustainable water use practices. Educational programmes that emphasise the importance of water and how to conserve it can lead to a change in public perception and a more conscious and efficient use of this valuable resource.

Success stories and lessons learned

Valuable lessons can be learned from success stories from around the world. For example, Singapore has implemented a comprehensive water management strategy that includes rainwater harvesting, reuse of treated waste water and desalination. Another example is the 'payment for ecosystem services' initiative in Latin America, where users contribute to funds that are used to conserve the watersheds that provide them with water..

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Key areas of water management must be addressed, such as sustainable agriculture, efficient water use in cities, households and industry, effective water resource management and legislation, and innovation and technology. All these areas significantly impact the preservation and efficient use of water.

Sergi Martí
Presidente
AQUA ESPAÑA

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Chapter 2

The uses of water

Water is essential to all aspects of life and human activity; it is fundamental to our existence.

FLUIDRA

Water is essential to all aspects of life and human activity; it is fundamental to our existence.
This chapter explores the main uses of water globally, highlighting how this vital resource flows through various types of activity that are critical to livelihoods and the economy.
The importance of water in agriculture is analysed, emphasising its role not only in the essential irrigation of crops that sustain global food supplies but also in the conservation of agricultural ecosystems.
In industry, water is crucial for various processes, including cooling machinery and manufacturing products. For people, water is fundamental to ensuring adequate hydration, maintaining personal hygiene, facilitating domestic cleaning and upholding public health.

2.1. General description of global water use

Three major uses are defined for global water usage: agricultural, industrial and municipal use.

Agricultural use

The agricultural sector includes activities such as irrigation systems that optimise crop growth, livestock farming, the care and raising of animals for food production, and aquaculture, the breeding of aquatic species in controlled conditions. These activities are fundamental for the production of food and raw materials. It is important to note that this category does not include agricultural activities in urban areas but focuses on large-scale operations in rural areas.

Industrial use

The industrial sector uses water in industrial processes and in cooling systems in factories and plants. This includes activities such as manufacturing, mining, power generation and heavy industry. Industrial use is characterised by higher water usage rates and often requires specific treatment and management practices to mitigate environmental impact.

Municipal use

This refers to water used in a wide variety of applications within urban and suburban communities. Municipal water use encompasses:

Domestic use

Households are significant consumers of water. This category includes:

- **Drinking and cooking:** clean and safe water for usage and food preparation.
- **Sanitation:** hygiene, including bathing, laundry and toilet flushing.
- **Gardening and landscaping:** watering lawns, gardens and other vegetative elements in residential areas.
- **Cleaning:** general household tasks such as washing dishes and cleaning.

Services

Various municipal services depend heavily on water, including:

- **Healthcare:** hospitals, clinics and other medical establishments use water for hygiene, patient care and facility maintenance.
- **Education:** schools and universities require water for drinking fountains, cafeterias, bathrooms and cleaning.
- **Public services:** firefighting, public swimming pools and parks rely on the municipal water supply for their operations.

Commercial use

Businesses and commercial establishments use water in various ways:

- **Restaurants and cafeterias:** for cooking, cleaning and serving customers.
- **Retail stores:** cleaning and sanitary facilities for staff and customers.
- **Office buildings:** water for employee hydration, bathrooms and cleaning.

Hotels

The hospitality industry is another significant user of water, especially in certain regions.

- **Guest rooms:** ensuring a comfortable stay with clean water for showers, sinks and toilets.

Water usage around the world is influenced by a wide range of geographical, economic and cultural factors. Addressing disparities in water usage is essential not only to ensure water security for all regions but also to protect the health of global ecosystems in an increasingly uncertain future.

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The agriculture sector is the main consumer of water and needs urgent efficiency improvements. We must contribute to the water transition of all sectors of industry and the economy and promote more efficient domestic water use throughout the entire water cycle.

Xavier Amores
Director
Catalan Water Partnership

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- **Laundry:** washing sheets, towels and guests' clothing.
- **Recreational facilities:** pools, spas and gyms.

Light industry
Industries without large-scale manufacturing processes also depend on municpal mains water:

- **Manufacturing:** light manufacturing plants use water for cooling, cleaning and processing products.
- **Workshops and studios:** art studios, automotive workshops and similar establishments use water for various operational needs.
- **Agribusiness:** small-scale urban agriculture, including greenhouses and hydroponic systems, depends on the mains water supply.

By understanding these diverse applications, municipalities can better manage and allocate their water resources to ensure sustainability and efficiency. Effective water management strategies not only support the current needs of urban environments but also assist in planning for future growth and development.

Table 1. **Summary of water uses by sector and subsector.**

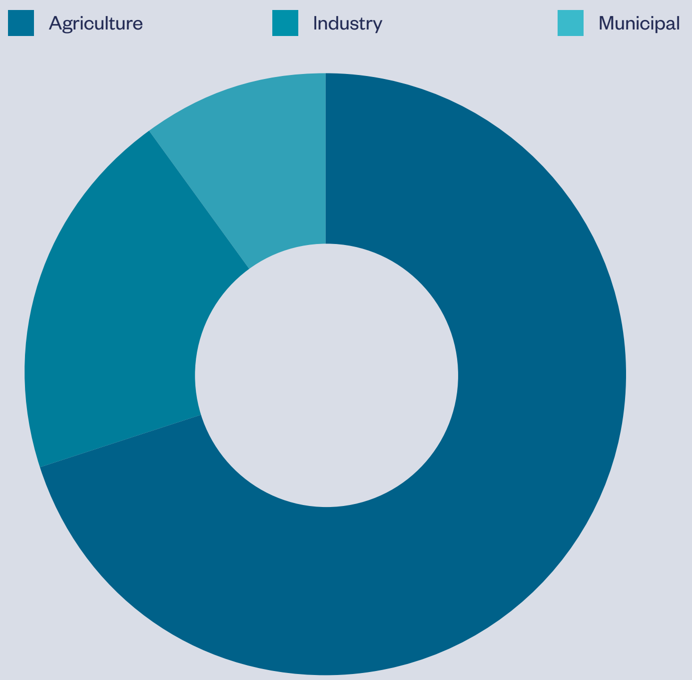
Sector / Use	Subsector	Supply
Agriculture	Irrigation	Own
	Livestock	
	Aquaculture	
Industry	Heavy industry	Own
	Thermoelectric	
	Mining	
Municipal	Households	Mains
	Services	
	Commerce	
	Hotels	
	Light industry	

Own work. Source: AQUASTAT 2024.

2.2. Water usage by type of use

Statistics indicate that globally agriculture uses around 70 % of available fresh water, followed by industry with 20 %. Domestic use accounts for approximately 10 %.

Figure 9. **Global water usage by use. Percentage of total water used.**



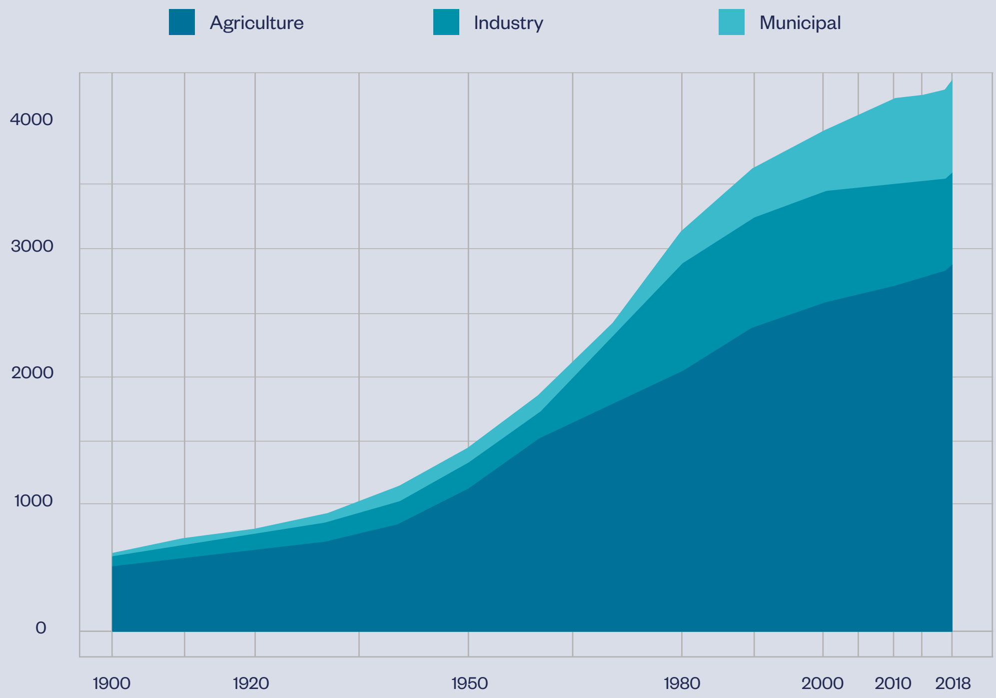
Own work. Source: AQUASTAT 2020.

An important aspect of the above graph **(Figure 9)** is that it allows us to clearly measure the relative weights of each sector and, therefore, clearly see the potential impact that improvements in each sector would have.

For example, a 5 % improvement in agricultural water use would mean a 35 % increase in water available for domestic use; the same 5 % improvement in industrial water use would result in a 10 % increase in water available for domestic use.

The relative weights of each sector have remained constant over time, while overall water usage has grown exponentially. The graph below **(Figure 10)** shows this trend. It also illustrates how, in recent decades, the industrial sector has been losing weight (becoming more water efficient) while domestic use has grown rapidly.

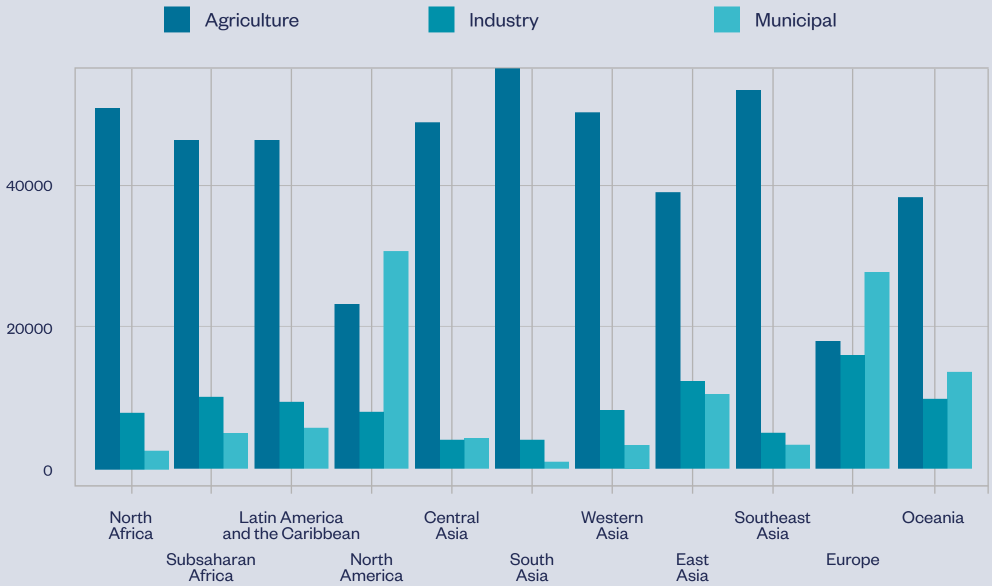
Figure 10. **Evolution of global water usage by sectors.**



Own work. Source: AQUASTAT 2020.

Water usage by sectors **(Figure 11)** varies significantly in different regions of the world, reflecting a complex interaction between climatic, economic, cultural and technological factors.

Figure 11. **Water usage by sectors and regions. Distribution of total water withdrawals in billions of m³/year.**



Own work. Source: AQUASTAT 2020.

Water usage is influenced by several fundamental factors:

- **Climate:** arid or semi-arid regions such as the Middle East or parts of Africa face water scarcity, limiting its availability for domestic, agricultural and industrial use.
- **Economic development:** developed countries demand more water for industry and services, while in emerging or developing economies, agricultural use is predominant.
- **Technology and water management:** the efficiency of water management varies, with some regions using advanced technology while others rely on less efficient traditional methods.
- **Culture and politics:** local traditions and government policies influence how water is valued and used in different societies.

Figure 12. **Comparison of water uses in Italy, France, Spain, Australia and Germany. Percentages of total water use.**

Own work. Source: AQUASTAT 2020.

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We need to go beyond a traditional approach of reducing our own water footprint through simple volumetric targets to one where the private sector, along with all other actors in society, work together in an integrated and collective approach to keep our watersheds healthy and sustainable.

Nicolas Jarraud

Senior Specialist de
Global Water Partnership (GWP)

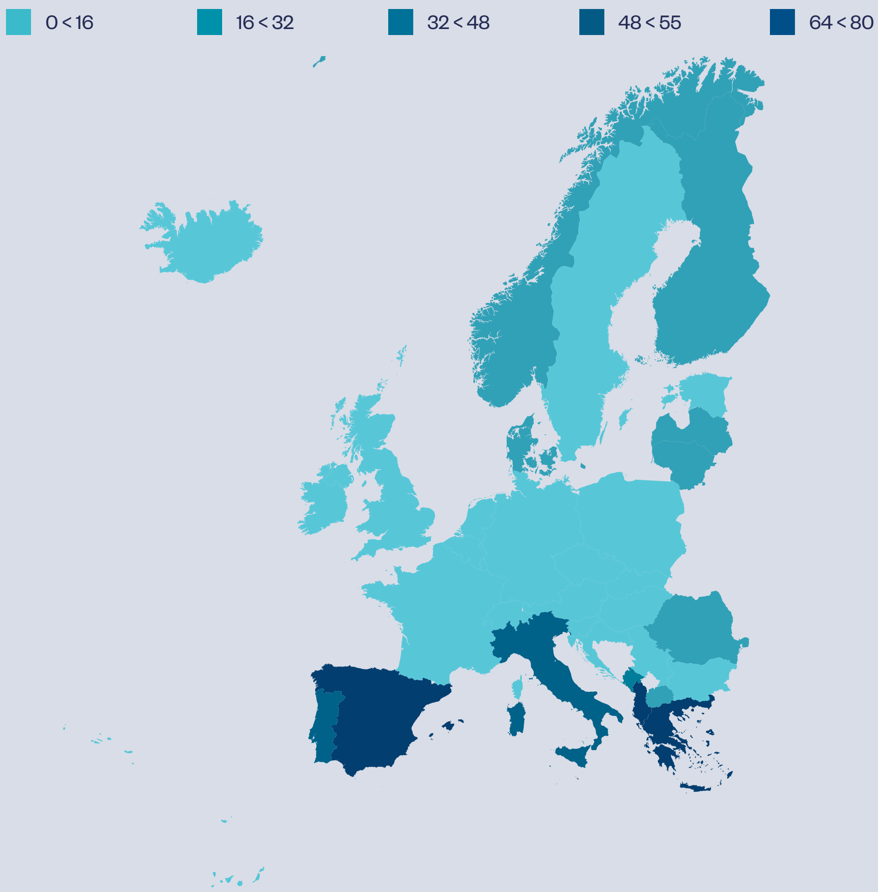
"

2.3. Agricultural water usage

Globally, agriculture relies on both rainwater (rain-fed agriculture) and extracted water for irrigation (irrigated agriculture). While rain-fed agriculture is limited by natural precipitation patterns, irrigated agriculture allows for greater intensity and diversity of production but often involves intensive and sometimes unsustainable water use..

Europe has a wide variety of climates and agricultural practices, from Mediterranean regions, which face water scarcity and rely heavily on irrigation, to northern and central areas, where rain-fed agriculture is more common.

Figure 13. **Agricultural water use as a percentage of total water use in European countries.**



Own work. Source: AQUASTAT 2020.

Table 2. **Ranking of agricultural water usage as a percentage of total water use in the top 15 European countries.**

Position	Country	%
1	Greece	80.0
2	Albania	69.3
3	Spain	65.3
4	Portugal	55.7
5	Denmark	54.0
6	Italy	50.1
7	Malta	38.0
8	Norway	31.3
9	Ukraine	30.9
10	Latvia	30.5
11	North Macedonia	29.6
12	Russian Federation	28.7
13	Finland	28.5
14	Belarus	27.6
15	Lithuania	22.4

Own work. Source: AQUASTAT 2020.

The European Union Common Agricultural Policy (CAP) has evolved to address water sustainability by imposing regulations and promoting efficient water use practices.

The challenges facing European agriculture in terms of water usage include:

- **Water scarcity:** climate change is exacerbating water scarcity in many regions, especially in southern Europe.
- **Water pollution:** runoff from fertilisers and pesticides contaminates rivers and aquifers, deteriorating water quality.
- **Inefficient irrigation:** despite technological advances, there are still many inefficient irrigation systems.
- **Climate change:** variability and changes in precipitation patterns affect the availability of water for agriculture.

The sustainability of water in European agriculture demands a multifaceted approach that integrates technology, policies and innovative management practices. Collaboration between governments, industry and agricultural communities is essential to ensure that European agriculture meets the challenges of the 21st century, guarantees food security and protects water resources.

To address these challenges, several recommendations are proposed:

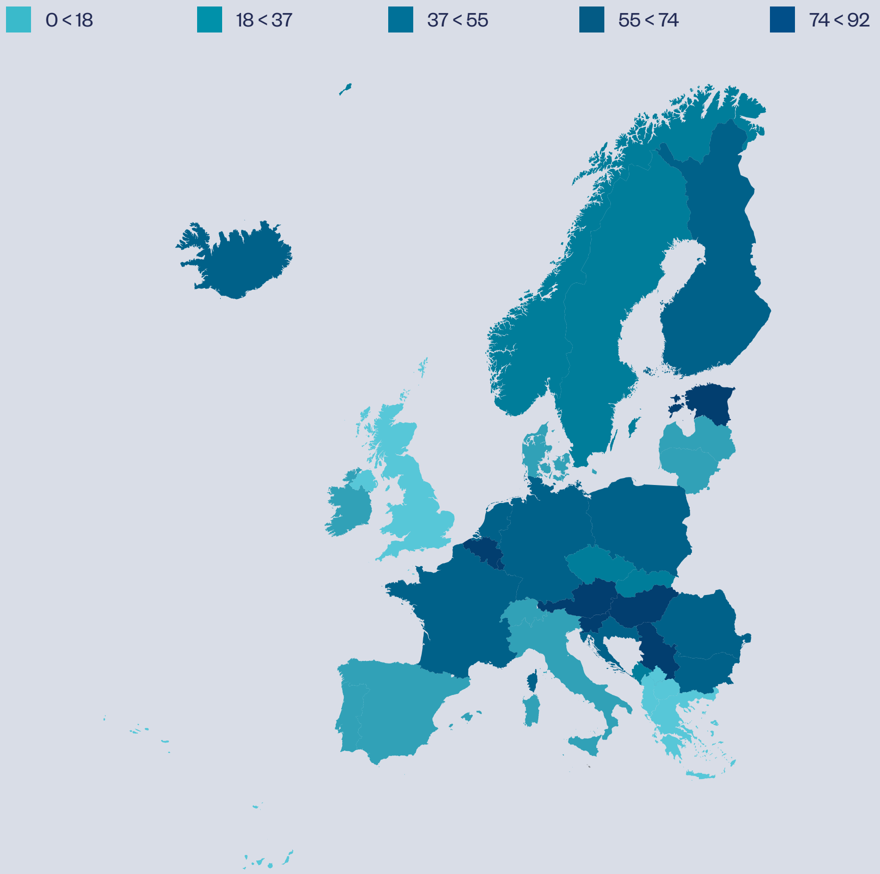
- **Improve irrigation efficiency:** adopt precision irrigation technologies, such as drip irrigation and computer-controlled irrigation systems, to minimise water wastage.
- **Integrated water resource management:** implement management practices that consider all water uses from source, balancing agricultural needs with ecological and domestic requirements.
- **Climate-resilient crops:** encourage the use of crop varieties that require less water and are more resilient to variable climatic conditions.
- **Policies and subsidies:** revise agricultural policies and subsidy systems to incentivise efficient water use practices and the adoption of innovative technologies.
- **Education and training:** increase awareness and provide training for farmers on sustainable water management practices.

2.4. Industrial water usage

Globally, we have seen that the industrial sector accounts for approximately 20 % of total water usage **(Figure 9)**. However, this number varies considerably between countries and regions, depending on the industrial structure, water management policies and availability of water resources. Industry requires high-quality water for most of its processes. This water is then often contaminated with chemicals, heavy metals and other waste, posing significant challenges for its treatment and reuse.

In Europe, industrial water usage also varies significantly between countries, reflecting economic diversity and political priorities in water management.

Figure 14. **Industrial water use as a percentage of total water use in European countries.**



Own work. Source: AQUASTAT 2020.

Table 3. **Ranking of industrial water usage as a percentage of total water use in the top 15 European countries.**

Position	Country	%
1	Estonia	92.0
2	Slovenia	82.7
3	Belgium	81.3
4	Austria	77.1
5	Serbia	74.8
6	Hungary	74.1
7	Moldova	72.8
8	Netherlands	71.5
9	Iceland	71.1
10	Bulgaria	68.5
11	France	67.6
12	Poland	63.7
13	Germany	62.0
14	Romania	60.8
15	Finland	57.1

Own work. Source: AQUASTAT 2020.

The European Union has adopted several directives aimed at protecting water quality and promoting efficient industrial water use, such as the Water Framework Directive (WFD) and the Urban Waste Water Treatment Directive (UWWTD).

The main **challenges** for the European industry in terms of water usage and management include:

- **Water scarcity:** limited water availability in some regions affects industrial operations and increases costs.

- **Water pollution:** industrial waste water may contain harmful substances that require advanced treatment before discharge or re-use.

- **Water use efficiency:** although there have been improvements, there is still significant room for improvement to increase water efficiency in many industrial sectors.

- **Environmental regulations:** meeting increasingly stringent regulations on water quality and waste management can be costly.

European industry faces significant challenges in terms of water management and usage. However, by adopting advanced technologies, improving water management practices and supporting effective policies, it is possible to move towards more sustainable industrial water use. This will not only help protect Europe's valuable water resources but also ensure the long-term sustainability of its industries.

To address these challenges and promote more sustainable industrial water, the following recommendations are proposed:

- **Adopt water-saving technologies:** implement more water-efficient production systems and processes, such as water recirculation in cooling processes and the adoption of zero liquid discharge (ZLD) technologies.

- **Improve waste water treatment and re-use:** invest in advanced waste water treatment technologies to enable the safe re-use of water in industrial processes or for other uses.

- **Promote collaboration and knowledge sharing:** encourage collaboration between companies, sectors and countries to share best practices and innovative technologies in water management.

- **Support research and development:** incentivise research into new water treatment and water efficiency technologies, including financial support for innovation.

- **Implement effective policies and regulations:** develop and enforce policies that incentivise water efficiency and pollution reduction, including water use charges that reflect the true value of water and penalties for pollution.

2.5. Municipal water usage

Municipal water usage represents a significant portion of the total fresh water use, encompassing daily activities such as drinking, cooking, washing, personal hygiene and garden irrigation. The percentage of municipal water use varies by country and region and uniquely reflects a society's cultural practices, standard of living and environmental awareness.

Globally, municipal water usage can vary dramatically, ranging from less than 50 litres per person per day in some regions with limited water access to more than 400 litres per person per day in countries with high levels of water usage and availability. This usage is influenced by various factors, including local infrastructure, water pricing policies and environmental awareness.

In Europe, average municipal water usage is around 100-200 litres per person per day, with significant variations between Nordic and southern countries, mainly due to climatic, economic and lifestyle differences. The European Union has actively promoted water use efficiency and sustainability through various directives and programmes, recognising the importance of water management in combating climate change and protecting ecosystems.

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Water management must be addressed in key areas such as sustainable agriculture, efficient use in cities, homes, and industry, effective water resource management and legislation, and innovation and technology. All of these have a significant impact on the preservation and efficient use of water.

Sergi Martí
Chairman
AQUA ESPAÑA

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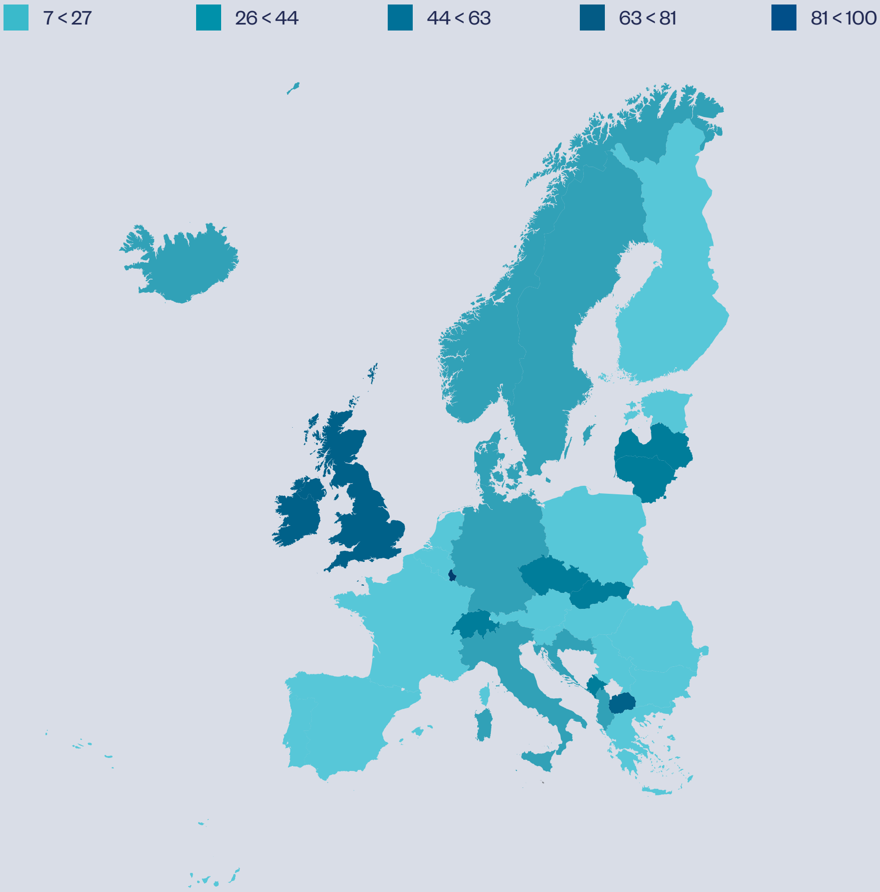
Figure 15. **Municipal water use as a percentage of total water use in European countries.**



Own work. Source: AQUASTAT 2020.

Implementing these recommendations can significantly contribute to reducing municipal water usage in Europe, ensuring the availability of water resources for future generations and protecting the environment. The success of these measures requires a joint effort from governments, industries, communities and individuals, highlighting the importance of shared responsibility in sustainable water management.

Table 4. **Ranking of domestic water usage in European countries in litres per inhabitant per day.**

Ranking	Country	Litres
1	Greece	298
2	Cyprus	269
3	France	214
4	Norway	181
5	Italy	166
6	Portugal	161
7	Switzerland	161
8	Netherlands	134
9	Serbia	132
10	Sweden	131
11	Spain	129
12	Germany	127
13	United Kingdom	126
14	Turkey	120
15	Croatia	119

Own work. Source: AQUASTAT 2020.

Table 5. **Ranking of municipal water usage as a percentage of total water use in the top 15 European countries.**

Ranking	Country	%
1	Luxembourg	100
2	Monaco	100
3	United Kingdom	73.9
4	North Macedonia	65.1
5	Ireland	63.9
6	Malta	60.3
7	Montenegro	59.9
8	Switzerland	54.5
9	Lithuania	53.8
10	Slovakia	52.8
11	Latvia	48.9
12	Czechia	46.0
13	Belarus	41.3
14	Denmark	40.9
15	Croatia	37.1

Own work. Source: AQUASTAT 2020.

Municipal water usage in Europe faces several **challenges**, including:

- **Water scarcity:** particularly in southern Europe, where dry seasons and high temperatures increase water demand.
- **Ageing infrastructure:** leaks in outdated water supply systems can result in significant water loss.
- **Consumer awareness and behaviour:** despite awareness campaigns, there is still great potential to improve water use efficiency in households.
- **Variability in policy implementation:** differences in the implementation of national and local water management strategies can affect the efficiency of municipal water use.

To address these challenges and promote more sustainable municipal water use, the following **recommendations** are made:

- **Encourage the installation of water-saving devices:** these include low-flow showers, dual-flush toilets and tap aerators.
- **Promote efficient appliances:** energy and water efficiency labels on appliances such as washing machines and dishwashers.
- **Improve water supply infrastructure:** invest in the renovation and maintenance of water networks to reduce water loss due to leakage.
- **Education and awareness:** continue with awareness campaigns about the value of water and how to use it responsibly.
- **Water pricing policies:** implement pricing systems that incentivise saving water while ensuring universal access to basic water services.

Chapter 3

Swimming pools and their relationship

This chapter delves into the relationship between swimming pools and water resources. It examines in detail the impact swimming pools have on the availability of water in their communities, considering both the water needed to fill them and the water required to keep them operational.

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Swimming pools are an invaluable source of recreation, exercise and relaxation for millions of people around the world. They offer respite from the summer heat and a unique opportunity for socialisation and outdoor enjoyment. Of course, their construction, maintenance and operation have implications for water consumption, a fundamental aspect of environmental sustainability.
This comprehensive approach seeks to provide a guide for the responsible management of swimming pools, ensuring their enjoyment in a sustainable manner for present and future generations.

3.1. The impact of swimming pools on water usage

Residential and public swimming pools require significant water for filling and maintenance. The amount needed depends on factors such as pool size, usage frequency, evaporation rates, maintenance practices and water recirculation and treatment technologies. Almost all water consumed by swimming pools falls under domestic water use.

It is important to emphasise the lack of specific and concrete data available on the use of water in swimming pools as part of municipal water consumption. The absence of precise information necessitates reliance on estimates. Developing more effective methods for measuring water consumption in swimming pools is essential. This would enable more efficient management of water resources and promote more sustainable municipal water use practices.

This topic is addressed comprehensively in research conducted by pool associations in various countries (FPP, 2020; ASOFAP, 2024), by independent studies (Lee and Heaney, 2008) and in analyses by international water-related entities under the auspices of the World Health Organization (WHO, 2023). These studies focus on understanding the impact of swimming pool water use within the context of global water use.

Although estimates vary slightly depending on the country or region, due to factors such as climate, the average size of pools and maintenance practices, there is a consensus that swimming pools use 0.75 % to 1 % of total municipal water use. This range reflects not only the initial filling of the pools but also periodic maintenance.

The table below summarises the work done on this subject by the FPP (French Federation of Pool and Spa Professionals):

Table 6. **Summary of water use in France and the impact of swimming pools.**

Water use in France	Million m³	% of total	% of municipal use
Total water extracted	26,270	100	---
Industrial use	17,780	67.68	---
Agricultural use	3,180	12.11	---
Municipals use	5,310	20.21	100
Swimming pools	40	0.12	0.75

Sources: French Federation of Pool and Spa Professionals (FPP) and AQUASTAT 2020.

The table below presents a summary of the recent model for estimating water use by swimming pools in Spain, prepared by ASOFAP (Spanish Association of Pool Professionals).

Table 7. **Summary of water uses in Spain and the impact of swimming pools.**

Water use in Spain	Million m³	% of total	% of municipal use
Total water extracted	29,023	100	---
Industrial use	19,268	66.39	---
Agricultural use	5,514	19.00	---
Municipals use	4,243	14.61	100
Swimming pools	28.6	0.10	0.67*

(*) This 0.67 % represents the impact of water use of swimming pools relative to the total amount of mains water. If the amount of water actually publicly distributed is considered (including a 25 % loss of mains water), the impact of swimming pools would be 0.90 %.

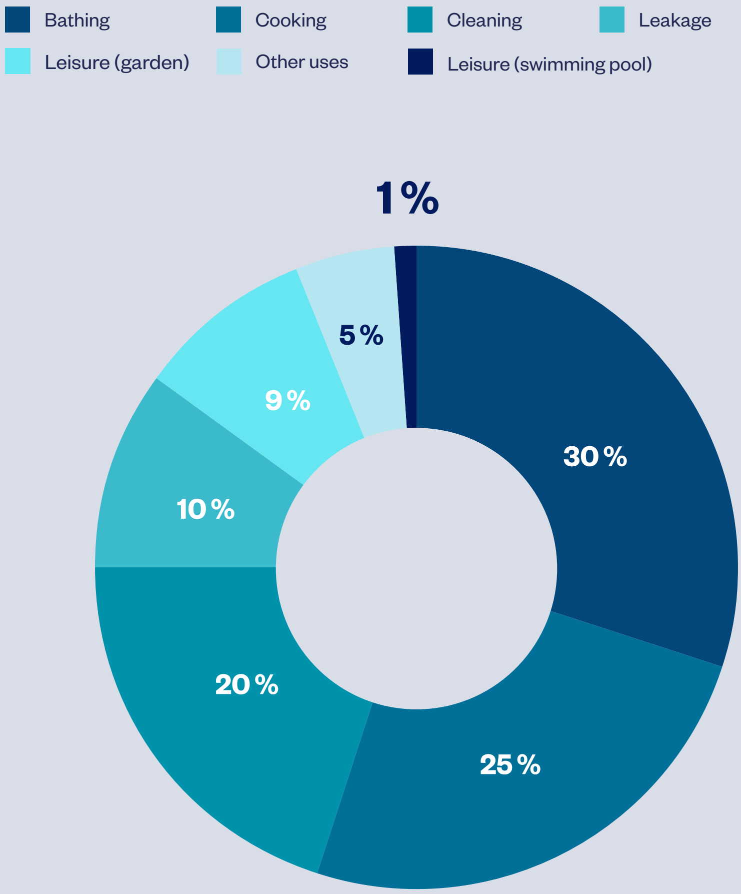
Sources: Spanish Association of Pool Professionals (ASOFAP) and AQUASTAT 2020.

This data highlights the importance of implementing water efficiency policies and technologies to mitigate the environmental impact of pool maintenance. Promoting a more sustainable use of water in the municipal sector sheds light on the correct magnitude of the situation and puts it into context.

In addition to the available data on municipal water consumption, which includes swimming pools, there are some more specific estimates on domestic water use and the weight of pools relative to other household water uses.

The variability between countries is considerable, complicating generalization; however, the following figures and tables facilitate understanding and sizing the patterns of household water consumption, including the role that pools play in this context:

Figure 16. **Distribution of global water consumption for different domestic uses.**



Own work, based on AQUAE (2024), EPA US (2024) and Water Research Foundation (2016)

Table 8. **Detailed ranking of water consumption distribution in different domestic uses globally.**

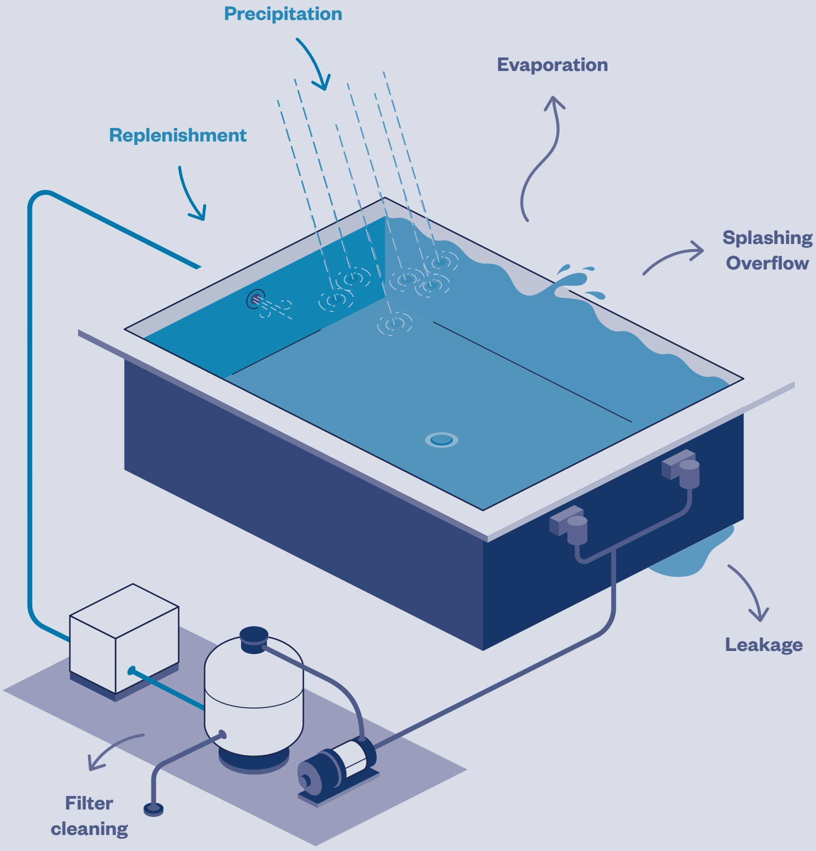
Domestic use		%
Bathing	Shower	21
Cooking	General Washing	15
Cleaning	Laundry	14
Leakage	Leakage	10
Leisure	Gardens	9
Bathing	Toilet	6
Cooking	Drinking and Cooking	5
Cooking	Dishwasher	5
Other	--	5
Cleaning	Floor Cleaning	4
Bathing	Bathtub	3
Cleaning	House Cleaning	2
Leisure	Pools	1
Total		**100 %**

3.2. The water cycle in swimming pools

To understand the relationship between swimming pools and water, it is essential to comprehend the water cycle within a swimming pool. The best way to do this is through a water balance model, which is based on the principle of conservation of mass. This model allows us to track variations in the water level of the pool over time, after the initial filling.

The model identifies two main sources of water input - replenishment and precipitation directly into the pool - and four main ways water is lost - evaporation, leakage, splashing and filter backwashing. See **Figure 17**.

Figure 17. **Diagram of the water cycle in swimming pools**



Source: Own work, based on Lee and Heaney (2008)

Definitions:

- **Precipitation:** water received by the pool through rainfall.
- **Replenishment:** water added to the pool to maintain the operational level and compensate for water loss due to various factors.
- **Evaporation:** water lost due to climatic conditions. The evaporation rate is influenced by multiple factors such as air and water temperature, humidity and the design of the pool.
- **Overflow and splashing:** water lost due to activity in the pool.
- **Leakage:** water lost due to defects or cracks in the hydraulic circuit or the swimming pool's structure.
- **Filter cleaning:** water used for necessary filter washing. The amount of water used depends on the type of filter, the duration of the season and maintenance practices.

Water balance can be expressed simply as follows, where Δ **Water** represents the variation in the pool's water level over a given time interval:

Δ Water = Inflow - Outflow
Inflow = Precipitation + Replenishment
Outflow = Evaporation + Leakage + Splashing/Overflow + Filter cleaning

While recognising the importance of every drop of water, longstanding misconceptions about the use of water by swimming pools should be demystified and corrected. Accurate measurement of water use in swimming pools and clear communication will help better inform public perceptions and promote awareness and responsible water use.

3.3. Swimming pool water management

Water is a vital and often scarce resource, necessitating responsible use. In the context of swimming pools, this means adopting strategies aimed at water conservation. Balancing personal enjoyment with ecological responsibility in swimming pool water management is essential.

Once we have clearly defined the water cycle in swimming pools and its various stages and points of inflow and outflow, we can address the complexity of its management. This understanding allows us to accurately identify the moments when intervention is necessary to manage our water resources effectively.

Two key operations are:

1. Initial filling of the swimming pool

The initial filling of a swimming pool is generally a one-time process, performed when it first comes into operation or in the case of major renovation or repair.

> **How can filling the swimming pool be managed better?**
> Fortunately, the practices of draining and refilling the pool each summer season are becoming a thing of the past. Proper maintenance will keep the pool water in good condition over time

2. Swimming pool maintenance

2.1 Replenishment due to water loss

Water replenishment compensates for the loss of water due to evaporation, leakage, overflow and splashing. Evaporation is calculated using local climatic data, while leakage is detected by unusual changes in measured water consumption. Splashing depends on the pool's design and how it is used.

> **How can loss of water due to evaporation be reduced?**
> Pool covers, when used correctly, can significantly reduce water loss from evaporation, acting as a protective barrier between the water and the atmosphere.

It is important to select a cover that fits perfectly over the entire surface of the pool and to ensure it is used whenever the pool is not in use.

The right type of cover can also provide a vital safety element, preventing accidents by stopping children, the elderly or pets from inadvertently falling into the pool.

How can rainwater be used?
Another effective measure is to have a rainwater harvesting system. Where local regulations allow, rainwater can be collected and used to compensate for water loss due to evaporation, for refilling the pool and for washing filtration equipment.

How can water loss from leakage be prevented?
Monitoring water use will detect unusual increases. Regular inspections of the state of the pool are essential. Leaks should be repaired as soon as possible.

How can the loss of water from using the pool be reduced?
Vigorous activities in the pool, such as swimming or playing, create waves and splashes that result in water loss. Every time we get out of the pool, we take some water with us. Showering before or after being in the pool also contributes to this loss. Opting for garden showers that do not exceed 6 litres per minute can generate water savings of over 20 %. Showers with buttons or sensors that limit the length of time the water flows are recommended.

2.2 Replenishment due to filter cleaning

The most common filtration systems, whether using sand or similar materials, require cleaning once the filter becomes saturated with dirt. This cleaning process uses pool water to carry impurities to the drain. Depending on the volume of water used and the duration of the cleaning process, this can result in the loss of a significant amount of water, which must then be replenished.

How can the amount of water used for cleaning filters be reduced?
Cartridge filters are a good way to save water when cleaning filters. The process is very manual but highly water-use efficient.

Robot pool cleaners greatly improve the efficiency of filtration systems. Unlike other cleaning methods that let residues accumulate in filters, these devices capture debris. This helps prolong the filter's lifespan and reduces the frequency that cleaning is required.

Automating the filter cleaning process is also highly recommended. This allows for precise adjustment of the total process time, which is crucial for optimal efficiency. Automating this process also helps avoid water loss that can occur due to inattention or neglect during manual cleaning

How can the water from filter backwashing be reused?
During the backwashing process, water flow is reversed through the filter to remove accumulated debris, including chemicals such as chlorine, fine particles and organic matter. Traditionally, this water is discarded. However, depending on local regulations and providing it can be used safely and doesn't contain excessive chemicals, in certain circumstances backwash water can be used for irrigation of green areas. For saltwater pools, low salinity electrolysis (1 mg/l) is recommended to prevent salt accumulation that could be harmful to plants and gardens.

It is also possible, using advanced technology, to purify backwash water for reuse in the pool. This contributes to a significant reduction in water consumption, though its use is less common as it requires meticulous management to not affect the quality of the water in the pool or break health and safety regulations.

Table 9. **Swimming pool water management best practices.**

Moment in the swimming pool water cycle	Area for improvement	Element	Impact	Observations
Filling	**Reduction of the use of mains water for filling and refilling the pool.**	Year-round water maintenance	High	Proper maintenance means the pool can be filled completely only once, without the need to empty and refill it each year. Not emptying the pool during the off-season can result in annual water savings of more than 30 %.
		Rainwater harvesting systems	High	Harvesting rainwater can significantly reduce the demand for mains water for pool maintenance, depending on the amount of rainfall, the rainwater harvesting system and local regulations. Replenishing the pool with rainwater implies a direct reduction in water consumption at a 1:1 ratio.
		Other water sources (wells, desalination plants)	High	Appropriate permits for water extraction must be obtained. Water must meet sanitary requirements. Water can be discharged into the sewage system.

Manteni-miento / Reposición por pérdidas	**Reduction of water loss due to evaporation**	Covers (slats, tarpaulins, telescopic covers)	High	Reduction of up to 95 % of evaporation. **Off-season (8 months)**: in place 100 % of the time. **In season (4 months)**: in place 50 %-70 % of the time, depending on type of cover (manual, automatic, etc.). Loss from evaporation reduced by approximately 85 %.
		Other covers (liquid, balls, discs)	Low	Liquid covers are less than 15 % efficient. Ball and disc covers depend on the effective covered surface and are more complex to use.
	Reduction of water loss due to leakage	Identification and repair of leakage	High	Early identification of suspected leaks and rapid repair have a high impact on preventing water loss.
	Reduction of water loss from use of the pool	Pool design	Low	Grates, gutters and slopes can act as collectors for overflowing water.
		Garden showers	Low	Showers with a flow rate < 6 l/min can result in 20 % water savings compared to standard showers.

Installing sensors to continuously monitor water consumption is highly recommended, enabling evaluation of the effectiveness of pool management strategies and identification of ways of reducing water usage.

Moment in the swimming pool water cycle	Area for improvement	Element	Impact	Observations
Mainte-nance and replenish-ment due to filter cleaning	**Reduction of water usage for filter cleaning**	Cartridge filters	High	Frequency of cleaning depends on size of cartridge. Except in self-cleaning models, the cartridge is cleaned with pressurised water. This can result in up to 80 % water saving compared to cleaning a sand filter.
		Regenerative media filter (diatomaceous earth, perlite)	High	Regenerative media filters excel at reusing the filtering medium many times before requiring replacement. Instead of washing the medium, it is replaced when it can no longer retain dirt. Regenerative media filter cleaning uses up to 90 % less water than traditional sand filters.
		Air backwash in conventional filters	Medium	This technique is commonly used in large filters for public pools. It uses air to mobilise the debris in the filter and then uses water to wash it to the drain. Water savings of over 30 % can be achieved.
		Efficient granulometric media (glass)	Medium	Filtering media using recycled glass granules, which may be treated to improve particle retention efficiency, that reduce the frequency of cleaning and require less water for washing. Water saving of approximately 20 %.
		Automated filter cleaning	Low	Automating filter cleaning can reduce water usage by: • Establishing cleaning criteria • Setting specific cleaning duration and, therefore, water consumption.
		Electric pool cleaner	Medium	Optimises the intensity and frequency of the filter cleaning cycle.
		Cleaning with rainwater	High	Direct impact on mains water usage at a 1:1 ratio.
	Reusing filter backwash water	Irrigation	Medium High	Following local regulations, water with low levels of chemicals and salt can be used for irrigating green areas. Sprinkler irrigation and watering public access areas should be avoided.

3.4. The impact of swimming pools beyond water

This report extensively analyses the relationship between swimming pools and their impact on water resources. However, it is also important to consider other significant impacts of swimming pools.
On one hand, swimming pools positively affect individual and social wellbeing, providing recreational and health benefits. On the other hand, it is imperative to address and mitigate their environmental impact on key factors such as energy consumption and the use of chemicals.

Impact on health and wellbeing

Swimming pools provide a unique and accessible way to engage in physical exercise, offering significant benefits for cardiovascular and muscular health. Recognised for its low impact on joints, swimming is an inclusive activity that people of all ages and physical conditions can enjoy. Aquatic activities also have a therapeutic effect and are used in rehabilitation programmes for people with injuries or disabilities, improving not only mobility and strength but also confidence and autonomy

**Swimming pools are fundamentally human spaces.
It is important to consider the balance between their negative aspects, such as water, chemical and energy consumption, and the positive, including health, wellbeing and community benefits.**

Social impact

Swimming pools not only serve as spaces for leisure and exercise but also play a crucial role in fostering social cohesion, family wellbeing and community inclusion. Pools act as community gathering points where individuals and families can interact in a relaxed and friendly environment. This shared space promotes the strengthening of social bonds and the development of a sense of community belonging. Organised events, group swimming classes and recreational activities in swimming pools facilitates interaction among different age and socioeconomic groups, fostering inclusion and diversity.

Energy impact

Maintaining a pool requires significant energy for filtration, heating and water circulation to keep it clean and in optimal condition. The environmental impact of this energy use can vary considerably depending on the energy source. Heated pools, in particular, consume substantial energy to maintain a comfortable water temperature. Therefore, it is essential to consider the energy impact of pools and explore alternatives that improve energy use, such as solar heating systems, efficient heat pumps and more efficient maintenance operations.

Chemical impact

Ensuring water in swimming pools is disinfected and safe from pathogens requires the use of chlorine and other chemicals. However, the release of these chemicals into the environment, whether through drainage into sewer systems or nearby water bodies, can negatively impact ecosystems. Therefore, it is important to minimise the use of chemicals and explore more sustainable alternatives, such as saline chlorination.

Expert contributors

Expert testimony on water management and sustainable development highlights the crucial importance of conserving this resource and underscores the future challenges society will face.

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Rafael Mujeriego

Chairman of the Asociación Española de Reutilización Sostenible del Agua (Spanish Association for Sustainable Water Reuse)

Professor Rafael Mujeriego has been the chairman of the Asociación Española de Reutilización Sostenible del Agua since 2008. He was a professor of Environmental Engineering at the School of Civil Engineering of the Universitat Politècnica de Catalunya (UPC) from 1976 to 2011. He was named Person of the Year 2010 in Water Reuse by the American WateReuse Association for "his significant contributions to the advancement of water reuse and his continued dedication to the water reuse community." He holds a Civil Engineering degree (1971) from the Universidad Politécnica de Madrid (UPM) and a master's degree (1973) and a doctorate (1976) from the University of California, Berkeley.

What role does water play in society, the economy and the environment?
Water is essential for life on Earth, for freshwater- and saltwater-dependent organisms. Human use of fresh water significantly alters ecosystems, affecting its availability and the economic benefits derived from its use.

What is the current global scenario for water as a resource?
We face the challenge of rapid population growth, concentrated in areas with inadequate water resources. Climate change is disrupting precipitation patterns, both spatially and temporally, compromising the reliability and consistency of water resources across various regions. While precipitation will continue, its distribution will differ significantly from historical patterns.

What future scenario is society facing in terms of water availability and usage?
In Mediterranean climates, rainfall patterns are increasingly erratic, leading to significant fluctuations in water availability. This results in alternating periods of severe and prolonged droughts with episodes of intense rainfall that can cause flooding.

Where can the most positive impact on water management be made?
To improve water management, we should focus on several key areas. First, promoting water conservation and efficient use is crucial, along with developing new hydrological projects for rainwater retention that include off-channel reservoirs and aquifer recharge. Implementing water regeneration and purification projects will help keep fresh water available. In coastal regions, desalinating seawater offers a viable alternative source of water.

How can available water resources be managed better?
Effective water management involves preserving water quality, using resources efficiently, storing water during periods of abundance and sharing resources collaboratively. Specifically, we need to significantly enhance our capacity for regulating water through off-channel reservoirs and aquifers and for generating new water resources by treating effluents and desalinating seawater.

Xavier Amores

Director of the Catalan Water Partnership

Dr Xavier Amores is the director of the Catalan Water Partnership, a non-profit organisation that promotes innovation and competitive improvement in the water sector with over 160 entities, with which he has promoted and coordinated more than 75 research and development projects related to water use. He is chairman of the *Consell per a l'Ús Sostenible de l'Aigua* (CUSA) (Council for the Sustainable Use of Water) in Catalonia. He is an industrial engineer and holds a PhD in Business Studies. He is also a professor at the University of Girona and EADA Business School.

What role does water play in society, the economy and the environment?
Water is an essential resource for human activity and the environment, but it also has an economic dimension: efficient, optimal water management that promotes reasonable use also contributes to the competitiveness of a country or region.

What is the current global scenario for water as a resource?
Managing water resources is extremely challenging, with certain regions experiencing frequent and severe extreme events such as droughts and floods. Additionally, many areas face issues of water contamination and excessive consumption, driven by factors such as population growth and activities impacting social, economic and environmental dimensions. However, awareness of the critical impact of water scarcity is growing, making it a top political priority in many countries and a focal point for investment in research and new technologies.

What future scenario is society facing in terms of water availability and usage?
All projections for 2050 forecast significant increases in global water demand across all sectors, from agriculture to industry, with greater water stress due to the combination of reduced supply as a consequence of climate change and growing demand in large areas such as the Mediterranean, the most

populated regions of Asia and the United States, Australia and South America.

Where can the most positive impact on water management be made?
There is an urgent need to improve water efficiency in agriculture, the largest consumer of water. We must support the water transition across all industrial and economic sectors and encourage more efficient domestic water use throughout the entire water cycle. Additionally, it is crucial to expand initiatives for environmental restoration and conservation, invest in technologies that improve efficiency, advance waste water management and accelerate digitalisation. Finally, a strong commitment to reclaimed water is essential for a transformative shift in water management.

How can available water resources be managed better?
At the macro level, robust policies and regulations that drive the water transition across all economic sectors need to be implemented. Prioritising investment in wastewater treatment, alternative water sources such as regeneration and desalination, digitalisation and environmental restoration is crucial. At the business level, the initial step involves monitoring and controlling resource use, assessing our impact across the entire value chain with tools like water footprint analysis, and investing in measures to enhance resource efficiency.

Sergi Martí

Chairman of AQUA ESPAÑA

Sergi Martí is the chairman of AQUA ESPAÑA, the Spanish association of water sector companies. He is the managing director of STENCO, a company specialising in water analysis, treatment and the prevention of legionella in all industrial and service sectors, and the CEO of the Spanish business group MTA. He is a chemical engineer and has a master's degree in Environmental Management from the Universitat Politècnica de Catalunya (UPC), an MBA from the University of Nottingham and is graduate in executive education from IESE business school. He is the co-author and coordinator of the book "Stenco - Water Treatment" (5 editions, latest edition July 2022). He has over 30 years of professional experience in water analysis, treatment and the prevention of legionella.

What role does water play in society, the economy and the environment?
Water plays an essential role. Water is an indispensable resource for life, for survival, health, economic development, the environment and sustainability.

What is the current global scenario for water as a resource?
The global water situation is critical and complex, facing multiple interconnected challenges. These include water scarcity, the effects of climate change, water pollution, uneven and inadequate access to water and sanitation, local and international conflicts, and inefficiencies in policies, governance and legislation.

What future scenario is society facing in terms of water availability and usage?
Now and in the future we face a critical situation marked by multiple interconnected challenges, including droughts, climate change, population growth, pollution and ineffective water resource management.

Where can the most positive impact on water management be made?
Water management should focus on key areas including sustainable

agriculture, efficient water use in cities, homes and industries, effective resource management and legislation, and the adoption of innovation and technology. Each of these areas plays a crucial role in preserving and using water efficiently.

How can available water resources be managed better?
Holistic management of water resources requires an integrated approach that effectively addresses efficiency, sustainability, equity and resilience across all relevant aspects.

Nicolas Jarraud

Senior Specialist at Global Water Partnership

Nicolas Jarraud is a senior specialist in Engagement and Partnerships Development at the Global Water Partnership Organisation (GWP). Previously, he was assistant vice-president of Institutional Affairs at the Cyprus Institute (CyI) until 2022, where he was responsible for the Office of International Relations. He was the founding network manager of SDSN (Sustainable Development Solutions Network) in Cyprus where he also remaine until 2022. Dr Jarraud has almost 15 years of experience in project management and peacebuilding programmes (including over 10 years in the United Nations peacebuilding programme in Cyprus, UNDP-ACT), as well as a career in environmental research and social sciences. He has a PhD in Environmental Sciences from Imperial College London, as well as a master's degree in Science Communication and a BSc in Biology from the same university. Nicolas also has experience as a freelance journalist, contributing, for example, to the French news magazine "Le Point".

What role does water play in society, the economy and the environment?
It may sound obvious, but it needs repeating: managing the world's water resources is fundamental to every aspect of our modern society, economy and environment. Without it, we would lose our life support system, and there would be no economy, no environment, no society.

If you want to feed the world (and contribute to poverty reduction, human health and economic prosperity), pay attention to water. This interconnection of water with society, the economy and the natural environment is why GWP favours the Integrated Water Resources Management (IWRM) approach. Integrated Water Resources Management (IWRM) is a process that promotes the coordinated development and management of water, land, and related resources to maximize the resulting economic and social welfare equitably, without compromising the sustainability of vital ecosystems. IWRM is essential because water is inseparable from everything else. Similarly, the Sustainable Development

Goals (SDGs) are indivisible; this means that we cannot address SDG 6 (water) in isolation from all other development goals.

What is the current global scenario for water as a resource?
Again, this may sound obvious, but the total amount of water on the planet has not changed and will not change. What is changing, due to human interventions and climate change, is its distribution across space and time, and therefore its availability to humans and the natural environment in a usable form. This is having a significant impact on all aspects of our economies (agriculture, industry, energy, etc.) and societies (which cannot exist without the life support system that water provides). The consequence of human-driven changes on water availability is that we face three main problems: either we have too much water (e.g., more floods), too little water (e.g., more droughts), or it is too dirty for human consumption or even industrial use (e.g., pollution). According to the "State of Global Water Resources" by WMO, published in 2022, the global hydrological cycle is undergoing significant changes, primarily due to human interventions (e.g., overexploitation) and climate change. The report also highlights that our means of monitoring these changes are insufficient. Some important trends prevalent in many parts of the world include drier-than-usual catchment areas, declines in groundwater, etc., a greater prevalence of droughts and floods, but also increasing variability in water resources. According to the IPCC's Sixth Assessment Report (2022), "all components of the global water cycle have been modified due to climate change in recent decades." It identifies three major changes in particular: (i) some regions receive more precipitation and others less, (ii) many regions have seen an increase in intense precipitation, while many have seen increases or decreases in dry periods, and (iii) some regions have seen shifts towards more intense precipitation (with longer dry periods in between). In terms of the current IWRM scenario, UNEP's 2021 Progress Report on Integrated Water Resources Management presents a general message that the world is not on track to achieve SDG 6.5 (IWRM). For many countries with significant development challenges and lower levels of IWRM implementation capacity, the rate of implementation would need to more than double to meet the SDG 6.5 targets.

What future scenario is society facing in terms of water availability and usage?
All future scenarios show that our patterns of water availability will become increasingly variable and extreme, along the three axes described above (too little water, too much water, or too dirty water). In other words, more droughts, more floods, and more pollution. According to the IPCC's Sixth Assessment Report (2022), the centrality of water in climate-resilient development is

emphasized. The report projects that the terrestrial hydrological cycle will intensify through greater water exchange between land and atmosphere. It also predicts that continued warming will accelerate the melting of snow cover, glaciers, and permafrost. These changes will pose sectoral risks. For example, greater vulnerability in the agricultural sector (also fueled by increasing demand). Other sectors will also be affected, such as energy (heavily dependent on energy choices made), industrial water use, while posing risks related to water, sanitation, and hygiene (WASH) for vulnerable communities, possibly increasing the risk of water-related conflicts.

Where can the most positive impact on water management be made?
This brings us back to an IWRM approach: we can better manage water and have a greater impact by adopting a more interconnected approach, ensuring that social, environmental, and economic impacts are considered as a whole. The SDGs are indivisible and must be addressed in an integrated manner. Moreover, addressing the SDGs, including SDG 6 (water), must be a whole-of-society effort; it is no longer just about what a specific government, company, or even sector can do, but about how all social actors can work together in an integrated way to save our most valuable resource. There is much that individual companies can do to improve their own water footprint (replenishment, etc.), but regardless of the location of operations, they share watersheds with the rest of society, the economy, and the natural environment; therefore, companies need to contribute to integrated approaches to ensure that these watersheds are sustainable for all involved. It is also important to examine water footprints along value chains: Again, perhaps the construction process of a swimming pool itself may not be water-intensive, but filling it requires water, and the production of raw materials, such as the cement needed to build the pool, has a large water footprint. So this goes far beyond just setting volumetric replenishment targets (which are necessary but not sufficient to have a more positive impact) and must be applied along the entire value chain.

UNEP, in its 2021 report, also makes some recommendations to meet IWRM targets: improving coordination, increasing funding, enhancing transboundary cooperation, focusing on basin and aquifer-level management, adopting a more participatory approach, improving data and information management and sharing, capacity development, etc. Finally, in its "Blueprint for Acceleration: Sustainable Development Goal 6 Synthesis Report on Water and Sanitation 2023," UNEP suggests improvements in creating an enabling environment for sustainable water financing, gathering reliable data for decision-making, enhancing capacity development, accelerating innovation, and consolidating water governance. All these efforts need to more actively involve all sectors of society through a collective effort, including the private sector.

How can available water resources be managed better?
I think we have already discussed the answer to this, but the key message is this: we need to go beyond a traditional approach of reducing our own water footprint through simple volumetric targets to one where the private sector, along with all other actors in society, work together in an integrated and collective approach to keep our watersheds healthy and sustainable.

Final thoughts

At the end of this analysis on the relationship between water and swimming pools, it is important to reflect on the key aspects we have addressed.

Final thoughts

This report emphasises how important it is to recognise the essential role water plays in society. It especially focuses on swimming pools. Although swimming pools are often perceived as significant water consumers, they actually account for less than 1% of municipal water usage. This reality is a testament to the efficiency and management practices already in place in the industry.

Even so, efforts to reduce further the environmental footprint of swimming pools are required. We are firmly committed to minimising the impact of water use, from adopting water-saving technologies to promoting responsible water use among pool owners and advancing research into innovative water management.

By understanding the true relationship between water and swimming pools and striving for more sustainable practices, we can ensure that swimming pools continue to provide enjoyment and benefits for future generations without depleting our vital water resources.

Bibliography

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Bibliography

AQUASTAT (2024): "AQUASTAT - FAO's Global Information System on Water and Agriculture", available at: https://www.fao.org/aquastat/en

ASOFAP (2024): Study on the consumption and water efficiency of swimming pools in Spain, prepared by ASOFAP, June 2024.

CARDOSO, B.J. ET AL. (2018): "Energy and Water Consumption Characterization of Portuguese Indoor Swimming Pools", *VII Congreso Iberoamericano de las Ciencias y Técnicas del Frío*, Valencia, España 19-21 Junio.

CENTRE D'INFORMATION SUR L'EAU (2024): "Quelle est la consommation d'eau moyenne par ménage?" Maryllis Macé, Dir. Gral.; available at: https://www.cieau.com/le-metier-de-leau/ressource-en-eau-eau-potable-eaux-usees/quels-sont-les-usages-domestiques-de-leau

EPA (2024): "How we use water", US Environmental Protection Agency, available at: https://www.epa.gov/watersense/how-we-use-water

FISCHER-JEFFES, L. ET AL. (2015): "Mitigating the impact of swimming pools on domestic water demand" Water SA, vol.41, nº2, WISA.

FORREST, N. Y WILLIAMS, E. (2010): "Life Cycle Environmental Implications of Residential Swimming Pools", *Environmental Science & Technology*, vol. 44, nº 14, pp. 5601-5607.

FPP (2023): "Les piscines basse consommation en eau: une réalité déjà bien ancrée en France", Dossier de Presse, mayo 2023, available at: https://www.propiscines.fr/la-fpp/espace-presse/dossiers-de-presse

FUNDACIÓN AQUAE (2024): "¿Cómo se usa el agua en el hogar?", elaborado a partir de datos del Ministerio de Transición Ecológica, 2019, available at: https://www.fundacionaquae.org/como-utilizamos-el-agua-en-nuestras-casas/

GALLION, T. ET AL. (2014): "Estimating Water, Energy, and Carbon Footprints of Residential Swimming Pools", *Water Reclamation and Sustainability*, pp.343-359.

HOF, A. ET AL. (2018): "Swimming Pool Evaporative Water Loss and Water Use in the Balearic Islands (Spain)", *Water*, nº 10, 1883.

HOF, A. Y SCHMITT, T. (2011): "Urban and tourist land use patterns and water consumption: Evidence from Mallorca, Balearic Islands", *Land Use Policy*, nº 28, pp. 792-804.

LEE, J.G. Y HEANEY, J.P. (2008): Measure 4: Swimming Pool Water Use Analysis by Observed Data and Long-term Continuous Simulation, 1 de Abril, Conserve Florida Water Clearinghouse, Dept. of Environmental Engineering Sciences, University of Florida, available at: https://www.researchgate.net/publication/242783799_Measure_4_Swimming_Pool_Water_Use_Analysis_by_Observed_Data_and_Long_term_Continuous_Simulation/link/53db8d8a0cf216e4210bf6be/download

LIEBERSBACH, J. ET AL. (2021): "Feasibility of Grey Water Heat Recovery in Indoor Swimming Pools", *Energies*, 14.

MAGLIONICO, M. Y STOJKOV, I. (2015): "Water Consumption in a public swimming pool", *Water Science & Technology: Water Supply*, 15.6.

MARIANOPOULOS, I.S. Y KATSIFARAKIS, K.L. (2017): “Optimization of Energy and Water Management of Swimming Pools. A case study in Thessaloniki, Greece”, *Procedia Environmental Sciences*, nº 38, pp. 773-780.

NASA (2024): “Oceans”, Earth Data. Open Access for Open Science, available at: https://www.earthdata.nasa.gov/

NASA (2024): “The Water Cycle”, Earth Observatory, available at: https://earthobservatory.nasa.gov/features/Water

PHTA (2024): “The Pool and Hot Tub Alliance Encourages Water Conservation”, en: https://www.phta.org/pub/?id=b1719286-1866-daac-99fb-23dcdc1165c4

PHTA (2024): “Facts about Water Usage”, available at: https://www.phta.org/pub/?id=2c0b9720-1866-daac-99fb-3766d98636f6

PIMENTEL-RODRIGUES, C. Y SILVA-AFONSO, A. (2022): “Assessment of Measures to Increase Water Efficiency in Public Swimming Pools”, *Sustainability*, nº 14, 14726.

PWC (2018): *La gestión del agua en España. Análisis y retos del ciclo urbano del agua*, available at: https://www.pwc.es/es/publicaciones/energia/assets/gestion-agua-2018-espana.pdf

SIEBRISTS, R. (2012): “Swimming pools and intra-city climates: Influences on residential water consumption in Cape Town”, *Water SA*, vol. 38, nº 1, enero, pp. 133-144.

SILVA, F. ET AL. (2021): “Improving Water Efficiency in a Municipal Indoor Swimming-Pool Complex: A Case Study”, *Applied Science*, 11, 10530.

SYDNEY WATER (2011): *Best Practice Guidelines for Water Management in Aquatic Leisure Centres*, Sydney Water Corporation.

UNITED NATIONS (2023): *Informe Mundial de las Naciones Unidas sobre el Desarrollo de los Recursos Hídricos 2023: Alianzas y cooperación por el agua*, UNESCO, Paris.

UNITED NATIONS (2022): “Country-owned official statistics as a source for water statistics”, report conducted for the Global Webinar on Geospatial and Other Data Sources for Environment Statistics: Assessing the Impact of the Economy on the Environment, Sección de Estadísticas Medioambientales, de la División Estadística de las Naciones Unidas (UNSD).

VIDAL ET AL. (2011): “Changing geographies of water-related consumption: residential swimming pools in suburban Barcelona”, *Area*, vol. 43, nº1, pp. 67-75.

WATER COMMISSION (2023): *Turning the Tide. A Call to Collective Action*, March 2023, OECD, Environment Directorate, available at: https://watercommission.org/wp-content/uploads/2023/03/Turning-the-Tide-Report-Web.pdf

WATER RESEARCH FOUNDATION (2016): Residential Uses of Water. Executive Report, version 2. Abril, available at: https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf

WORLD RESOURCE INSTITUTE (2024): “Aqueduct. Water Risk Atlas”, available at: https://www.wri.org/applications/aqueduct/water-risk-atlas/

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