



Water Economy



**Fondazione
Barilla**

il tuo cibo, la tua terra

www.barillacfn.com
info@barillacfn.com

Advisory Board

Barbara Buchner, Claude Fischler, Mario Monti, John Reilly
Gabriele Riccardi, Camillo Ricordi, Umberto Veronesi

In collaboration with
Carlo Alberto Pratesi – Università Roma Tre
Life Cycle Engineering
The European House-Ambrosetti

Publishing and editorial coordination
Codice Edizioni

Art direction and layout
adfarmandchicas

Images
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THE VISION OF THE BARILLA CENTER FOR FOOD & NUTRITION

TO OFFER A VARIETY OF HIGHLY SCIENTIFIC CONTRIBUTIONS AND BECOME A VALUABLE SERVICE TO THE INSTITUTIONS, THE SCIENTIFIC COMMUNITY, THE MEDIA AND CIVIL SOCIETY OVER TIME; A MEETING POINT FOR ANYONE WHO CARES ABOUT FOOD, THE ENVIRONMENT, SUSTAINABLE DEVELOPMENT AND ITS IMPLICATIONS UPON PEOPLE'S LIVES.



THE BARILLA CENTER FOR FOOD & NUTRITION

The Barilla Center for Food & Nutrition (BCFN) is a center of multidisciplinary analysis and proposals which aims to explore the major issues related to food and nutrition on a global scale.

Created in 2009, the BCFN intends to listen to the demands emerging from society today by gathering experience and qualified expertise on a worldwide level and promoting a continuous and open dialogue.

The complexity of the phenomena under investigation has made it necessary to adopt a methodology that goes beyond the boundaries of different disciplines: hence, the breakdown of the topics under study into four broad areas: *Sustainable Growth for Food*, *Food for Health*, *Food for All* and *Food for Culture*.

The areas of analysis involve science, the environment, culture and the economy; within these areas, the BCFN explores topics of interest, suggesting proposals to meet the food challenges of the future.

In line with this approach, the activities of BCFN are guided by the Advisory Board, a body composed of experts from different but complementary sectors, which makes proposals, analyzes and develops the themes and then drafts concrete recommendations regarding them.

One or more advisors were then individuated for each specific area: Barbara Buchner (expert on energy, climate change and the environment) and John Reilly (economist) for the area *Food for Sustainable Growth*; Mario Monti (economist) for the area *Food For All*; Umberto Veronesi (oncologist), Gabriele Riccardi (nutritionist) and Camillo Ricordi (immunologist) for the area *Food for Health*; Claude Fischler (sociologist) for the area *Food for Culture*.

In its first two years of activity, the BCFN created and divulged a number of scientific publications. Driven by institutional deadlines and priorities found on the international economic and political agendas, in these first years of research it has reinforced its role as a collector and connector between science and research on the one hand, and policy decisions and other governmental actions on the other.

The BCFN has also organized events which are open to civil society, including the *International Forum on Food & Nutrition*, an important moment of confrontation with the greatest experts in the field, now in its second edition. The BCFN continues its path of analysis and sharing for the third year, making its content accessible to as many interlocutors as possible and acting as a reference point on issues of food and nutrition.

In particular, in the *Food for Sustainable Growth* area, the Barilla Center for Food & Nutrition has examined the issue of the use of natural resources within the food chain,

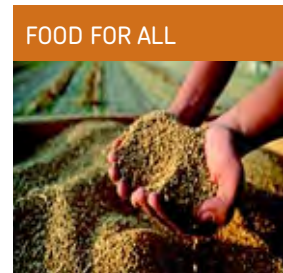
pointing out the weaknesses and drafting proposals to improve and assess the impact on the environment by the production and consumption of food.

The document that we present is part of that sphere of activity, seeking to investigate how to manage, govern and sustainably use the resource-water so as to tackle one of the biggest challenges that society faces today on a global scale: the reduction in water supplies and the decrease of freshwater available for the living beings on our Planet.

Study areas




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A high-angle, close-up photograph of a person's legs and feet on dry, rocky ground. The person is wearing a red garment. Their right foot is visible, and they are holding a dark, shallow bowl filled with water. A thick, light-colored rope lies on the ground, looping around the person's foot. The ground is composed of small, dark stones and dry earth.

WATER ECONOMY

"NOWADAYS PEOPLE KNOW THE PRICE OF EVERYTHING
AND THE VALUE OF NOTHING."

Oscar Wilde, *The Picture of Dorian Gray*

EXECUTIVE SUMMARY

Introduction

We only realize that water is a value when it is scarce. So far, the problem seemed limited to the most unfortunate countries, but things could change because the water of “quality” – that is to say, fresh and unpolluted – represents only a tiny percentage of our reserves.

And we always use more: both because the population of the Earth is increasing and because of the greater wellbeing achieved by many countries that drives people to consume (and waste) more water. Consumption should be considered not only in terms of “real” (by calculating the quantities that are used to care for themselves, for cooking or cleaning the house), but also “virtual” (in terms of a water footprint), estimating all the water that was used throughout the life cycle of any product or service purchased. Suffice it to say that if you change your eating style – for example by switching to a diet rich in fruits, vegetables and whole grains, limiting the amount of animal protein – this can also significantly reduce “virtual” water consumption.

So, while on the one hand the demand grows and the resources shrink, on the other – even if pollution and climate change are to blame – there is no doubt that the economic value of water will grow, as will the inequalities, that already exist today, between those who have water and those who have much less and which will bring new frictions. We know very well how much interest and dramatic litigation the control of oil fields can generate: the conflicts over water could be even more severe. Also because, ultimately, you can survive without oil, but not without water.

So we need a concerted effort to adopt a more rational use of water, especially in agriculture (which represents the “scooping” industry par excellence) and on a personal level (for example, diets with water saving). There is also the need to formulate new legislation that will truly ensure the “right to water” and define the boundaries of privatization which, on the one hand, could lead to benefits in terms of greater efficiency in the management of the sources, and on the other, must be carefully controlled to avoid undue increases in prices and less accessibility for the most vulnerable population.

For this reason, we decided to be the first to speak about water economy, and it is in this spirit that the Barilla Center for Food & Nutrition aims, with this document, to provide the community with the main scientific, legal, economic and social evidence that will allow everyone to take part in the discussion.

Because the challenge of water economy starts now: to win it, we need the cooperation of everyone.

Executive Summary

In the near future, partly because of global warming and pollution, the amount of freshwater available to humanity may not be sufficient to meet the growing demand. If the trend of demographic and economic development should be confirmed, and if we do not adopt new systems to avoid waste and reduce consumption, the value of water resources will eventually increase enough to seriously affect the global economy and geopolitical balance.

This is why managing and governing the resource of water and its use represent one of the biggest challenges that society faces today on a global scale.

1. Availability of water: from abundance to scarcity

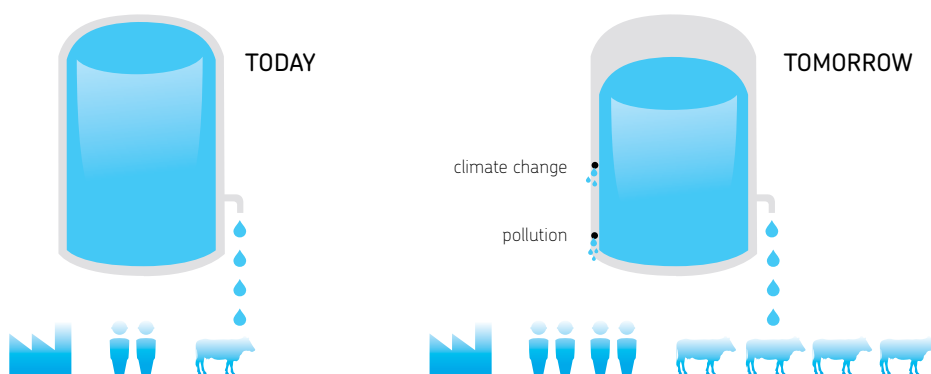
The issue of the current and future availability of water was introduced through a photograph of the current scenario of water resources, both considering its agricultural, industrial and domestic use and the greater consumption which is expected in the future.

In this regard, the major global phenomena were identified which have a significant impact on water consumption (population growth, increasing prosperity of the population resulting in changes in lifestyles and dietary habits, urbanization and expansion of economic activities, production of biofuels) and on the reduction of available water resources (climate change and pollution).

Overall, our planet has approximately 1.4 billion km³ of water. However, it is estimated that only a little less than 45,000 km³ of water (equal to 0.003% of the total) are theoretically accessible and only 9 to 14,000 (representing approximately 0.001% of the total) are actually available for use by mankind, being of sufficient quality, accessible and affordable.

FRESHWATER
REPRESENTS ONLY
0.001% OF
THE TOTAL WATER.

The current and future scenario referring to water resources



The causes of water consumption



Source: Barilla Center for Food & Nutrition, 2011

13 COUNTRIES HAVE
64.4% OF THE GLOBAL
WATER RESOURCES.

AGRICULTURE USES 70%
OF THE FRESHWATER.

ONE PERSON IN SIX
DOES NOT HAVE
ENOUGH WATER.

IT IS ESTIMATED THAT
WATER WITHDRAWALS
WILL HAVE INCREASED
BY 50% IN 2025 .

By analyzing the location of water, you can see that the freshwater resources are unevenly distributed among the regions of the planet: 64.4% of global water resources is located in just 13 countries.

The allocation of water resources is tilted towards the agricultural sector, with a 70% consumption of freshwater, while 22% is for industry and the remaining 8% is used for domestic purposes.

It should be stressed that more than one in six people in the world will not meet the minimum standards, set by the UN at 20-50 liters of freshwater per capita per day, which are necessary to ensure the basic needs related to nutrition and hygiene.

Along with emerging technologies for water management, an important role is played by modern irrigation techniques which, in agriculture, provide adequate resources to 20% of the cultivated area in the world, while the remaining 80% is based instead on rainwater.

The current water demand, which is already very high, will grow steadily in the future, leading to a situation of progressive scarcity, particularly in certain areas of the globe.

From an environmental perspective, water is considered “scarce” when more than 75% of river and groundwater resources are withdrawn to be used in agriculture, industry and households: in this case, the exploitation is approaching (or has already exceeded) the limit of sustainability.

The scenario expected by 2025 of the shortage of water is dramatically worse than at present. The areas with a high harvest rate of resources available (over 20%) will increase substantially, extending across the entire territory of the United States, continental Europe and Southern Asia and will worsen, in terms of percentage, in large areas of Africa and the Indian peninsula. It is estimated that somewhere between 15% and 35% of current water withdrawals for irrigation will not be sustainable in the future due to population growth, the persistence of inefficient irrigation practices and the increasing competition in act for use of water resources. Furthermore, it is estimated that with the growth of the population by 2025, water withdrawals necessary to meet the demand will increase by 50% in developing countries and 18% in developed countries.

2. Reality and prospects of the right to water

THE RIGHT TO WATER
WAS RECOGNIZED
BY THE UN ONLY IN 2010.

POSITIVE PROGRESS HAS
BEEN MADE TOWARDS
THE GOAL OF HALVING
THE POPULATION
WITHOUT ACCESS TO
CLEAN WATER.

The “right to water “ – which only recently was recognized for the first time in history as a universal and fundamental human right, through a UN Resolution on July 29, 2010 – is embodied in the recognition of each individual, without discrimination, to have the possibility of access to water.

Making drinking water available in sufficient quantity and quality to meet the basic needs of a person is a target (No. 10) of the Millennium Development Goals (MDG); it aims to “reduce by half by 2015, as compared to 1990, the proportion of people without sustainable access to safe water and basic sanitation.”

In 2008, about 884 million people were without access to sufficient and adequate water – of these, 84% lived in rural areas –, while 2.6 billion people lacked the possibility of receiving adequate sanitation systems.

The analysis conducted by the WHO/UNICEF on the progress made to achieve the accessibility of drinking water (target 10) shows that the current situation is only partly in line with its target.

In fact, if the current trend is maintained, by 2015 the percentage of the population with access to water in their homes will exceed their target of 90%, thus reducing to 672 million those people who will still be without.

Instead, it will not be possible to reach the goal of halving the number of people without access to adequate sanitation because the result would be less than 13 percentage points than what was expected. It is estimated that in 2015, approximately 2.7 billion people will have no access to basic sanitation.

A cost-benefit analysis conducted by the WHO about the real possibility of achieving number 7 of target #10 of the Development Goals and its plan of operations estimates that every U.S. dollar invested to improve access to water and sanitation would generate economic returns ranging between 3 and 34 U.S. dollars by 2015.

LATE FOR IMPROVING ACCESS TO ADEQUATE SANITATION.

3. Choices and attitudes for a sustainable consumption of water

The water footprint of a product (a commodity, good or service) is made up of the volume of freshwater consumed to produce it, adding up all the stages of its life cycle.

The comparison of the water footprint (in cubic meters per ton) of certain agricultural products in some countries of the world expresses considerable differences between different products, both in comparing them to one another and taking into account the place of production.

In particular, livestock products (meat, eggs, milk and dairy products) have a greater water footprint than those that are cultivated, since livestock consumes a large amount of crops as food, in some cases for several years, before being processed into food.

In addition, the water footprint of a product can vary greatly from place to place, depending on factors such as climate, the agricultural techniques adopted, the yield of crops, etc.. The different dietary habits, therefore, imply a greater or lesser consumption of water resources. In fact, a person uses an average of two to five gallons of water per day for drinking, while the consumption of virtual water daily to feed oneself ranges from about 1500-2600 liters in the case of a vegetarian diet to around 4000-5400 in the case of a diet rich in meat. So if everyone on the planet adopted the average diet of Western countries, which is characterized by a high consumption of meat, you would need an increase of 75% of the water currently being used to produce food.

By flanking the food pyramid with an environmental water pyramid, similar to the one proposed by the Barilla Center for Food & Nutrition in its previous work, *Double Pyramid: healthy food for people, sustainable for the planet*, you get a double pyramid which shows that most of the food we suggest be consumed more frequently is also the food with a smaller water footprint.

THE WATER FOOTPRINT OF PRODUCTS VARIES SIGNIFICANTLY.

THE BCFN WATER FOOTPRINT PYRAMID OF FOOD AND BEVERAGES.

4. The water footprint of a nation and the trade in virtual water

The water footprint can be calculated not only for each product or activity, but also for every well-defined group of consumers (an individual, a family, the inhabitants of a city, a nation) or producers (private companies, public organizations, economic sectors).

The global water footprint amounts to 7452 billion m³ of freshwater per year, equal to 1243 m³ per capita per year, i.e., more than twice the annual flow of the Mississippi River.

Considering the water footprint in absolute terms, the country that consumes the greatest volume of water is India (987 billion m³), followed by China (883) and the United States (696). Taking into account the values per capita, instead, the citizens of the United States have an average water footprint of 2483 m³ water per year, followed by Italians (2232) and Thailand (2223). The differences between countries depend on a number of factors. The main four are: the volume and model of consumption, climate and agricultural practices.

THE GLOBAL WATER FOOTPRINT IS MORE THAN DOUBLE THE FLOW OF THE MISSISSIPPI RIVER.





VIRTUAL WATER TRADE.

Trade between countries determines a transfer in the flow of virtual water (virtual water trade), since the raw materials, goods and services are characterized by a certain virtual water content.

The water footprint is then disassembled into two parts: the internal water footprint (i.e., the consumption of domestic water resources) and the external water footprint (consumption of outside water resources; that is, coming from other countries).

EUROPE IS A NET IMPORTER OF VIRTUAL WATER.

Europe is a net importer of virtual water and its water security depends heavily on external resources.

Globalization of water use appears to result in both opportunities and risks, in that the level of interdependence among countries in the exchange of virtual water is expected to grow, given the ongoing process of liberalization of international trade.

VIRTUAL WATER AS AN ALTERNATIVE WATER SOURCE.

One of the main opportunities is the fact that virtual water can be considered as an alternative source of water, allowing local resources to be preserved.

Moreover, globally, it is possible to save the volume of water consumed when a product is marketed by a country with high productivity of water resources (for that product) to another with low productivity.

The main hazards are represented by the fact that each country could experience an excessive dependency on the water resources of other nations, as well as the fact that importation of products with high virtual water content implies the outsourcing of indirect effects involving the exploitation of this resource by the importing country to the exporting country. This phenomenon is referred to as “water-colonialism,” i.e., a new form of domination by rich countries to the detriment of poorer ones which, driven by demand for goods from abroad, are likely to dry up their water reserves.

WATER COLONIALISM.**CONFLICTS OVER WATER.**

Water as a strategic objective is more and more often the source of conflict between States, generated by the competition for different water uses (domestic, industrial, agricultural) within a State, or the use of a common body of water that crosses borders. Suffice it to say that the watersheds shared by several countries account for almost half the Earth's surface and are shared by 145 countries.

5. The privatization of water: between public and private

OWNERSHIP OF WATER RESOURCES.

The term “water privatization” can refer to three different areas.

The first is that of *private property rights on water resources*, while allowing its free trade: this kind, found in some developing countries, is far from the European experience, where water is safely in the hands of the community. Our institutional system is, in fact, not always based on the public ownership of resources, but on the regulation of the use of a common property resource and, as such, an inalienable right. The user, therefore, does not “buy the water” but acquires the right to use it.

PRIVATE SECTOR INVOLVEMENT IN MANAGEMENT.

The second area is the *involvement of private sector in the management of water services*, according to three different management models:

- *Territorial monopoly* : annuity that is privatized and regulated, applied in the United Kingdom, and which is based on the actual transfer of ownership of the entire infrastructure and the control of water into the hands of private operators;
- *Public ownership*, with private individuals entrusted with temporary custody through the procurement system, as in France;
- *Public ownership* and governance, such as in Italy and Germany, with the acquisition from the market of the resources necessary for service delivery.

The third area is the *involvement of the private sector in financing infrastructure and services*,

because traditional channels of public finance are no longer sufficient to guarantee the necessary capital and distribute it appropriately and in a timely manner.

The “privatization” of water brings both benefits and risks with it

Among the main benefits is the alleged belief that the private sector is more efficient than the public sector in optimizing the management of water distribution, as well as streamlining costs in order to reduce the rates for users. In addition, the awarding of these contracts allows private enterprises to share the cost of network maintenance of the aqueduct, against the sale profits.

But the privatization of water resources can also bring some risks, such as very substantial increases in rates instead of the planned reduction of the same, or the breach of private operators towards their obligations to the development of water supply, especially to the poorest neighborhoods.

But if water is a good for everyone, only an effective system of democratic control can provide adequate security to address risks arising from a model of ineffective management of water resources, be it public or “privatized.”

PRIVATE SECTOR
INVOLVEMENT
IN FINANCING
INFRASTRUCTURES.

THE NEED FOR A
DEMOCRATIC DEBATE.

6. Recommendations: the areas of intervention

The priority areas, in our judgment, are eight:

- 1 *Models and tools to aid a real “integrated” management of water:* to develop policies, models and integrated management tools in view of water economy, in order to effectively address issues related to water resources.
- 2 *Practices, know-how and technology for increasing water productivity (more crop per drop) and waste minimization:* to break the correlation, which is very strong today, between economic development, population growth and the consequent increase in the levels of water consumption.
- 3 *The water footprint as a simple, communicable, objective indicator:* to use the water footprint as a tool for comprehensive assessment of environmental impacts of individuals, enterprises (production and distribution, within each sector) and States.
- 4 *Dietary habits and a lower consumption of water content:* to orient individual behavior and consumption patterns towards lifestyles that involve a more careful use of water.
- 5 *Efficient locations of cultivation and virtual water trade for a savings on a global scale of water consumed:* to rethink the locations on a global scale of the activities of the production of goods with higher rates of water consumption according to criteria of efficiency.
- 6 *Commitment and accountability of institutions to ensure access to water:* to improve access to drinking water and sanitation for the populations that are now the most disadvantaged in this respect, promoting the necessary investments and removing any technical and policy constraints.
- 7 *Economic evaluation of water resources and the internationalization of the cost of water in the price:* to rethink the functioning of markets in view of water economy through the development of economic models that can accurately define the economic value associated with the use of water.
- 8 *Management of water resources between privatization and democratic supervision:* to consider privatization as starting from the interests of the people, obligating the private management companies to comply with social and ethical principles and introducing an effective system of democratic control that provides adequate security to address risks arising from an inefficient model of water resource management, whether it be public or “privatized.”



1. AVAILABILITY OF WATER: FROM ABUNDANCE TO SCARCITY

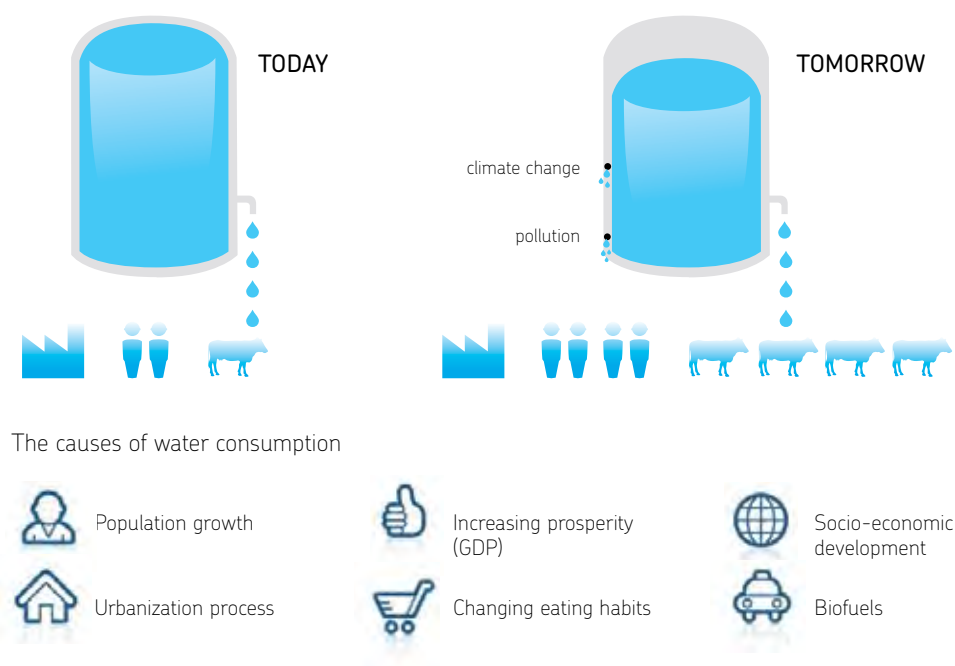
OUR PLANET HAS ABOUT 1.4 BILLION CUBIC KILOMETERS:
LESS THAN 0.003% OF THE TOTAL IS THEORETICALLY USABLE.



This chapter provides a picture of the current scenario of water resources, taking into consideration its availability and its agricultural, industrial and domestic uses. It also offers a hypothesis about its future development, taking into account the likely scarcity of water resources in the light of the increased consumption that is expected.

In this regard, the major global phenomena have been identified that have a significant impact on water consumption (population growth, the increasing prosperity of the population and a consequent change in lifestyle and eating habits, urbanization and expansion of economic activities, production of biofuels) and on the reduction of available water resources (climate change and pollution in particular).

Figure 1.1. The current and future scenario referring to water resources



1.1 HOW MUCH WATER IS THERE?

Water, an essential element for life and for the terrestrial ecosystem, has always been relatively abundant; thus, mankind tends to take its perennial availability for granted. Certainly on a global level, large enough sources of water are still available, but on the regional level, needs do not always coincide with the actual availability.

Overall, our planet has about 1.4 billion cubic kilometers of water (volume is a constant), of which only 2.5% is composed of freshwater, mostly collected in glaciers, the ice caps in the Arctic or at great depths underground.

The difficulties associated with the use of this resource are obvious: less than 45,000 cubic kilometers of water (equal to 0.003% of the total) are theoretically usable (these are the so-called “freshwater resources”). And only 9 -14,000 cubic kilometers of water (equivalent to approximately 0.001% of the total) are actually available for human use, being of sufficient quality, accessible and affordable.

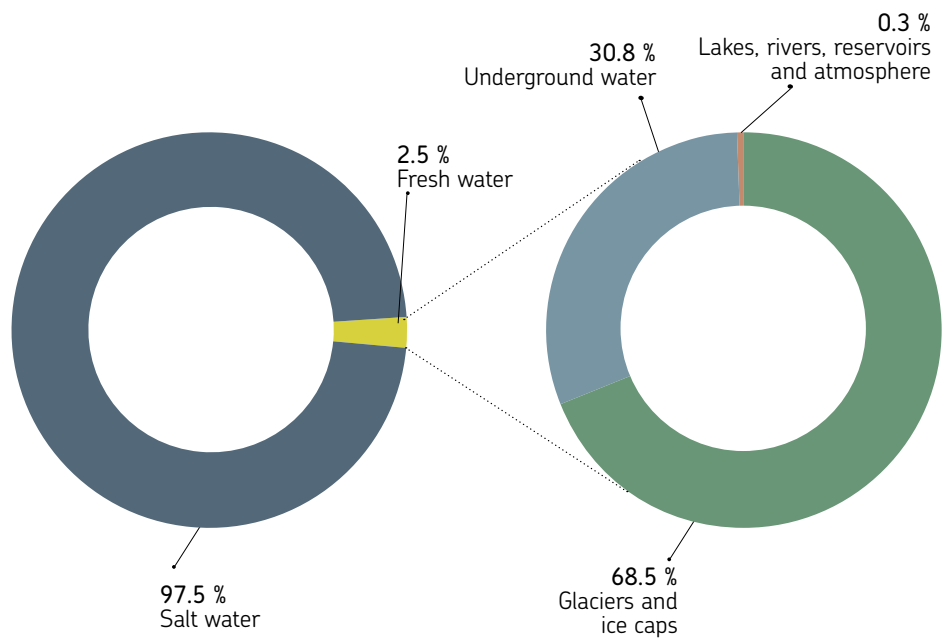
Brazil alone contains almost 15% of the overall water. It is followed by Russia (8.2%), Canada (6%), the United States (5.6%), Indonesia (5.2%) and China (5.1%). However, a growing number of countries have a serious shortage of water, with a per capita availability of less than 1000 cubic meters per year.



World Business Council for Sustainable Development (WBCSD). *Facts and Trends - Water*, 2009.

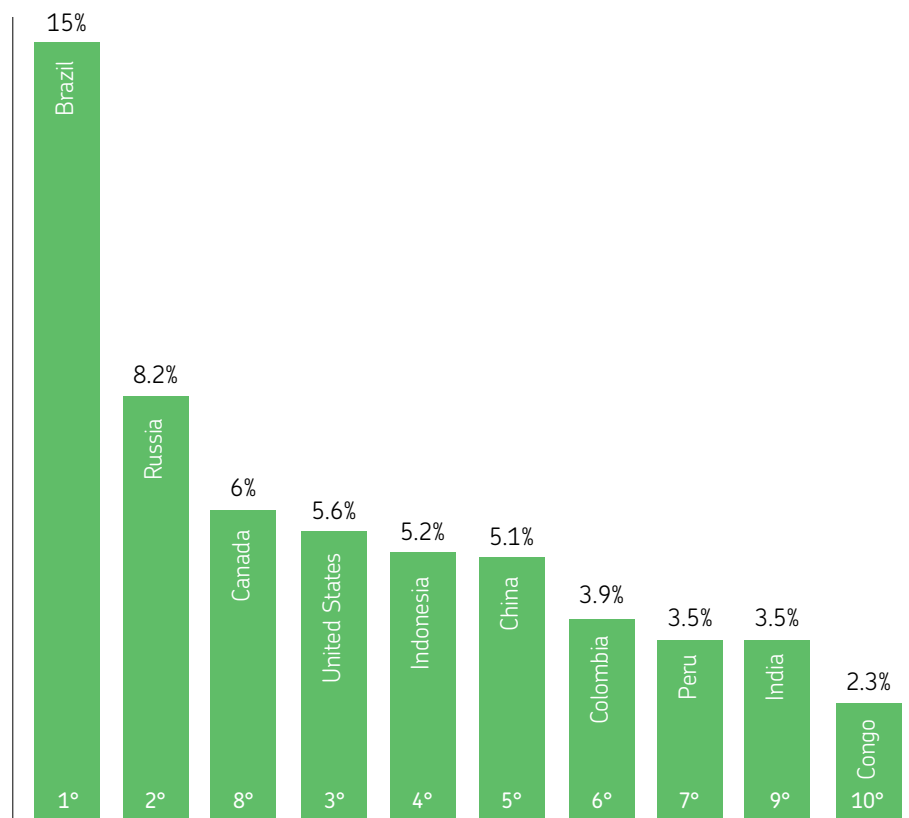
**64.4% OF THE
GLOBAL WATER
RESOURCES ARE
LOCATED IN JUST
13 COUNTRIES.**

Figure 1.2. The distribution of global water resources



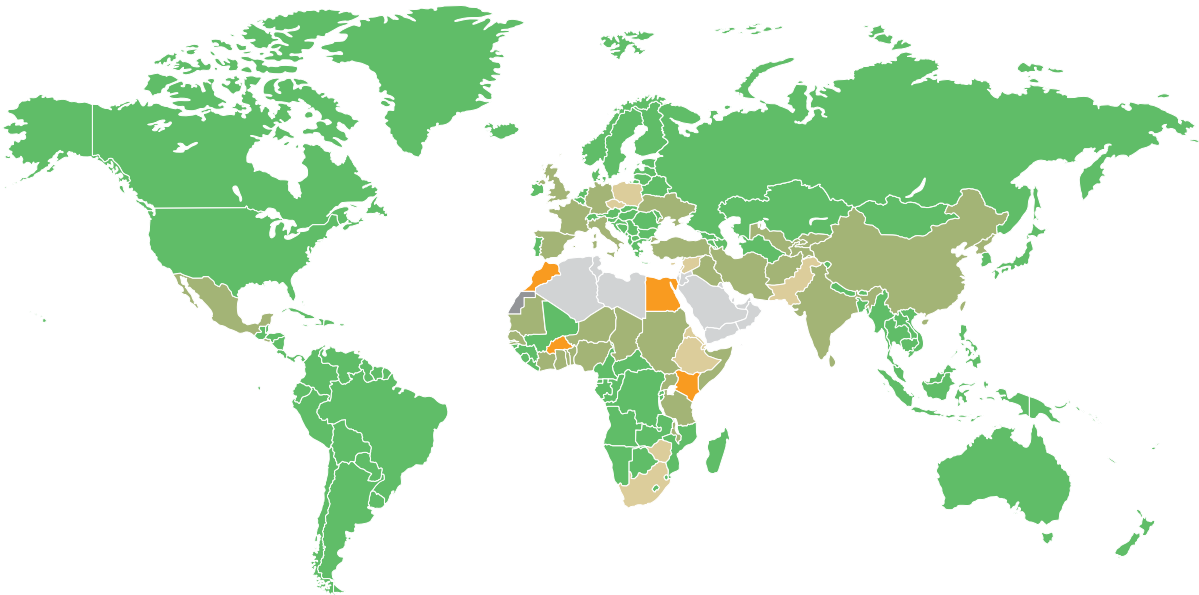
Source: revised by The European-House Ambrosetti from WBCSD, *Facts and Trends - Water*.

Figure 1.3. Top 10 countries for availability of fresh water (in %)



Source: revised by The European-House Ambrosetti from FAO, AQUASTAT Database, 2008

Figure 1.4. Availability of freshwater



- > 5000
- 1700-5000
- 1000-1700
- 500-1000
- < 500
- No data

Oceania



54,800

Latin America



26,700

North America



19,300

Europe



9100

Africa



4600

Asia



3000

The Caribbean



2400

Source: revised by The European-House Ambrosetti from FAO, AQUASTAT Database, 2008

Where does the rainfall end up?

Every year, about 110,000 cubic kilometers of rainwater fall on the land all over the world.

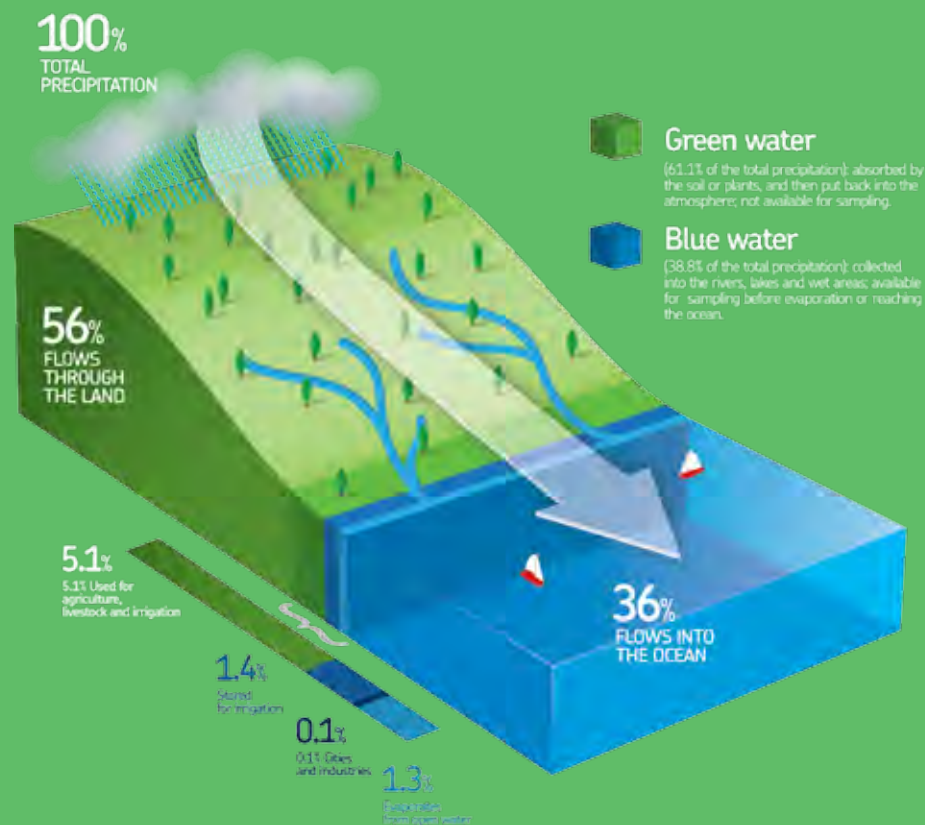
More than half of that fallen rainwater is not available for cultivation because it immediately evaporates or transpires from plants.

This portion of water is the “green water,” while the remaining portion of water is called “blue water” (rivers, lakes, wetlands and underground water) and

indicates the amount of water available for withdrawal before “evapotranspiration.” This enormous amount of water would be more than sufficient to meet the water needs of all the inhabitants of the Earth, if only it were accessible in the right place at the right time.

Unfortunately, as shown in Figure 1.5, most of it cannot be captured, in that it is distributed unevenly as it flows to the sea.¹

Figure 1.5. Destination of precipitation



Source: Rogers, P., *Facing the water crisis*, in “Le Scienze” (Science), # 482, October 2008

1.2 HOW WE USE WATER: AGRICULTURE, INDUSTRY AND HOUSEHOLDS

In order to analyze the efficient use of available water resources, its destination must also be taken into consideration.

In this sense, the data clearly shows that allocation is strongly biased towards the agricultural sector, which alone employs about 70% of the world consumption of fresh water. This figure is even higher in countries with middle or low incomes (reaching 95% in some developing countries), while in those that are developed, the industrial weight of the total consumption is largely predominant (59%).

In particular, if we consider the geographical areas, the weight of industry is particularly evident in Europe and North America, where it counts for – in terms of water consumption – 52.4% and 48%, respectively. While in South America and Asia, where water consumption for industrial use is 10.3% and 5.5%, respectively, there is a net imbalance in favor of agriculture (70.7% and 87.6%, respectively).

The analysis of samples of water resources for agricultural use in some countries confirms this data. Figure 1.8 shows the obvious differences between water use in agriculture in countries such as India or Greece, for example, and in France or Germany, characterized by a withdrawal for agricultural use amounting to 90-88%, respectively, and to 12-3% of the total consumption of fresh water.

Industry is the second largest sector globally for the withdrawal of water (after agriculture) and employs about 22% of the consumption of freshwater (see Figure 1.6).

Depending on the productive sectors, there is great variability in the quantity of water withdrawn. Almost all productions are based on water usage, both directly (as an ingredient in products for human use, as in the case of food, beverages, pharmaceuticals, etc.) and indirectly (within the production cycles).

As noted previously (Figure 1.7), the analysis of samples of water for industrial use in the period of 1987-2003 shows that the main countries responsible for the most consumption of water resources are located in North America and in Eastern and Western (see Figures 1.9 and 1.12).

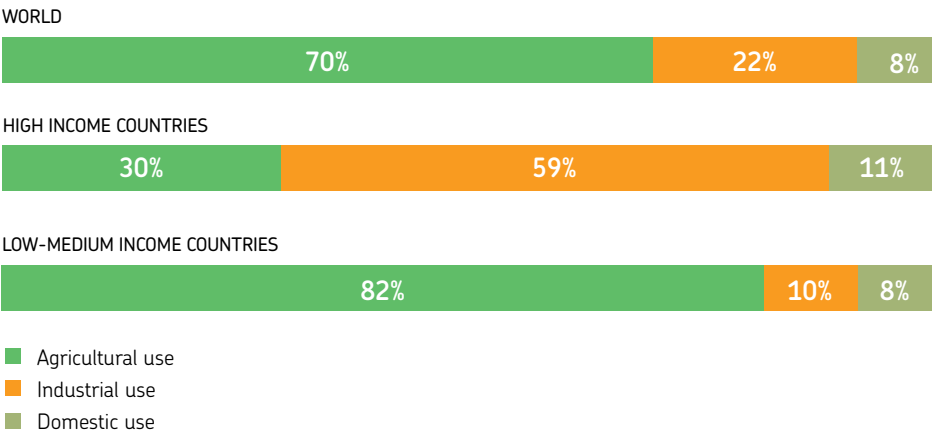
The extremely limited extraction of water for industrial use in African, Asian and Central American countries such as Mali, Cambodia and Haiti, instead, emphasizes the marked prevailing of agriculture over industry in predominantly rural economies which are also characterized by extreme poverty.

Finally, with regard to the availability of water for domestic use, the UN indicates 20-50 gallons of freshwater per capita daily to be the minimum requirement necessary to ensure basic needs related to nutrition and hygiene. Worldwide, more than one out of six people do not reach these standards. The consequences of such inequality are significant, not only

THE AGRICULTURAL
SECTOR ALONE EMPLOYS
ABOUT 70% OF THE
WORLD CONSUMPTION
OF FRESH WATER.

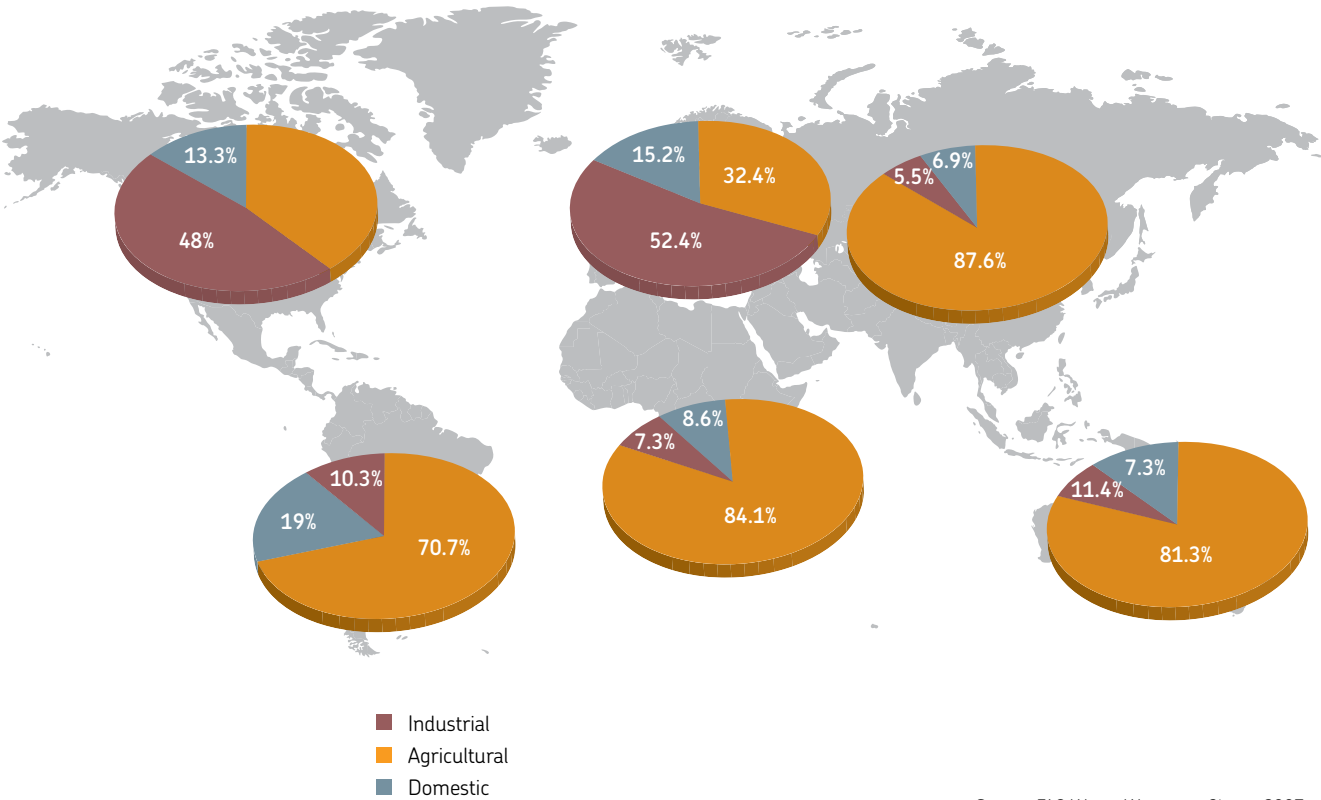
from the standpoint of economic efficiency, but also in humanitarian and health terms. In terms of the average daily use per capita, UN data² indicates how world consumption varies considerably from country to country, especially between that of developed and developing countries: for example, it ranges from 575 liters in the United States to 385 in Italy and 285 in France, and from 180 in Brazil to 135 in India and 85 in China.

Figure 1.6. Sampling of the water resources by type of sector and income level: the current state



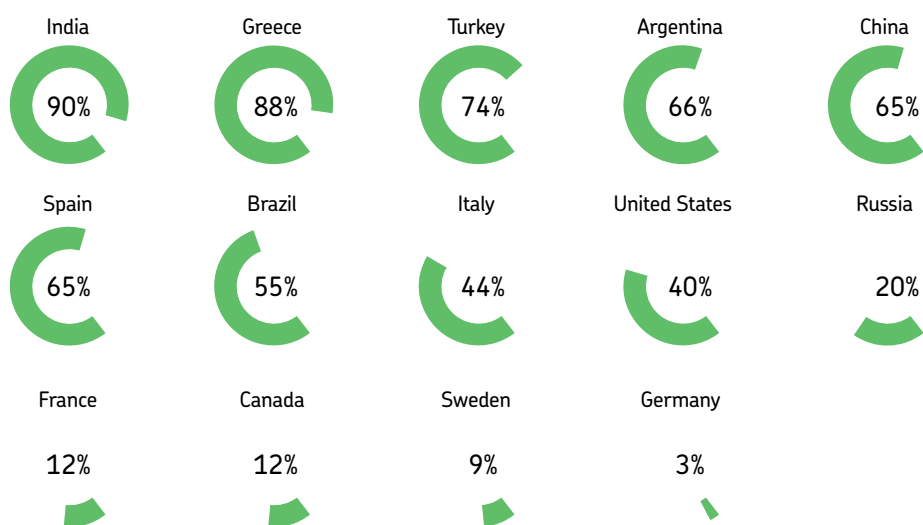
Source: WBCSD, *Facts and Trends – Water*

Figure 1.7. Sampling of the water resources by type of sector and geographic area: the current state



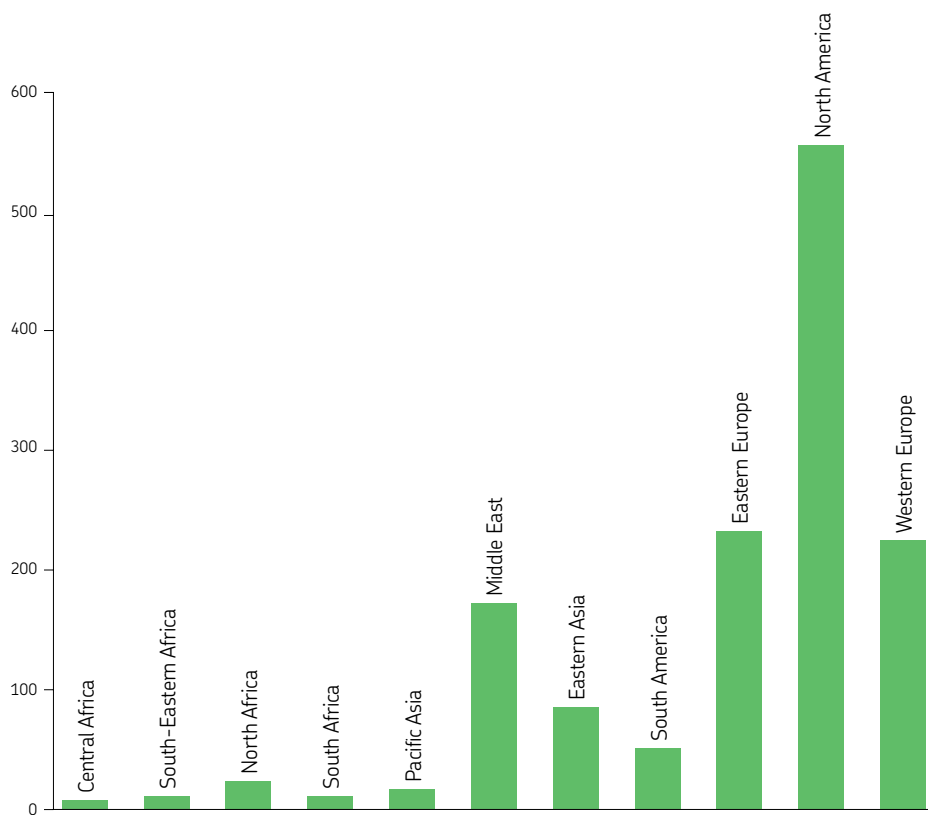
Source: FAO Water, *Water at a Glance*, 2007

Figure 1.8. Use of water for agriculture in some countries
(as a percentage of the total use)



Source: revised by The European House-Ambrosetti from FAO, AQUASTAT Database, 2010 (latest available data)

Figure 1.9. Use of water for industrial purposes by geographic area, 1987-2003



Source: revised by The European House-Ambrosetti from www.worldmapper.org

The irrigation systems in India, Pakistan and Bangladesh: from canals to wells

Over the last century, Southern Asia has seen a profound change in its irrigation systems.

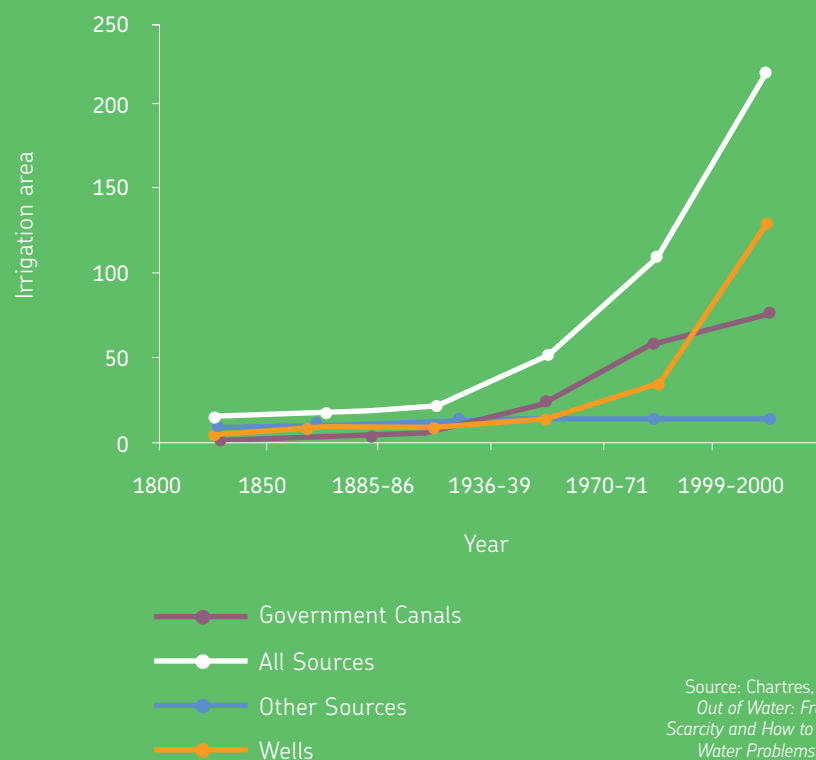
The British colonial dominion has left the world's largest centralized infrastructure of irrigation canals to such countries as India, Pakistan and Bangladesh.

However, as shown in Figure 1.10, these surface irrigation systems have now been replaced by the use of underground water taken from millions of unregulated wells. Although this transformation has significantly increased the opportunity for small

farmers to access water for agricultural use (as shown by the increase in irrigated areas), the proliferation of such a large number of wells requires a reflection by the governments of the countries involved regarding the pressure exerted on the groundwater resources.

It is estimated that in the next 20 years, one quarter of the food grown in India will be at risk if the country does not tackle the problem of the management of groundwater withdrawn for agriculture.

Figure 1.10. Trasformation of the irrigation systems in India, Pakistan and Bangladesh, 1800-2000



Unsustainable use of water in agriculture

The Aral Sea

The Aral Sea is the victim of one of the worst manmade environmental disasters.³ With an original area of 68,000 square kilometers, since 1950 the lake has been reduced by about 85% due to a plan for intensive cultivation desired by the Soviet regime in the immediate postwar period. The water from the two tributary rivers – the Amu Darya and Syr Darya – was withdrawn through the use of canals to irrigate the vast cotton fields of the surrounding areas. The plan to exploit the use of river water for agricultural purposes had the express aim of “making the Aral Sea die peacefully.” The need for water was so abundant, in fact, that the Soviet regime declared



Figure 1.11. The Aral Sea 1989–2008

Source: UNEP/GRID-Arendal, *Vital Water Graphics 2*, 2008 (maps.grida.no/go/graphic/thedisappearanceofthe-aral-sea).

that the lake was considered a huge waste of water which otherwise was useful for agriculture, as well as “a mistake of nature” that needed to be corrected. For this reason, it was necessary

to reduce the lake to a large marshy swamp, so that it could be easily used for growing rice, making way for plantations and, to this end, using herbicides and pesticides that have contaminated the surrounding soil.

As shown in Figure 1.11, already in the late eighties, the lake had lost about 60% of its original volume, its depth had diminished by about 16 meters and the shoreline had receded in some points up to 150 km, leaving a desert lake of salty sand instead. In addition, fishing activities, which in 1950 had guaranteed 44,000 tons of fish per year and thus supported more than 60,000 jobs, had literally disappeared by 1989.

Today, most of the area is uninhabitable because of the wind that constantly blows, transporting salty toxic sand, and respiratory and kidney diseases have had a huge impact on the local population.

The Colorado River and Powell Lake and Mead Lake

Even in developed countries, water shortages are becoming more frequent due to the construction of hydroelectric plants and an indiscriminate use in agriculture. For example, recently in the U.S., drought has affected many cities in northern Georgia and vast areas in the southwest of the nation.

The case of the artificial lakes Mead and Powell is emblematic; both are fed by the now exhausted Colorado River, whose total capacity ranges from 113 m³/sec. during drought to 28,000 m³/sec during periods of maximum flooding.

Today, an amount of over 2000 m³/sec. is rare, due to the stabilization brought about by the construction of large reservoirs for hydroelectric power plants in the lower reaches.

Over the years, the white marks left along the canyon walls by the lakes at their fullest have been lowering more and more, thus attesting to the gradual decline of these two basins.

Even the "The New York Times Magazine" in its October 2007 issue, in an article entitled "The future is drying up," highlighted the non-sustainability of the situation that the Colorado River

and the lakes feeding it are in: "About 30 million people depend on this water. An exhausted river could unleash chaos in seven states: Colorado, Utah, Wyoming, New Mexico, Arizona, Nevada and California. Furthermore, the reduced flow of the Colorado River would almost certainly create considerable economic chaos, threatening the future utilization of water for agricultural and industrial use and for the growing municipalities. [...] If the largest reserves of water in the southwestern United States are emptied, in the future the region will be living out an apocalypse, an Armageddon.»⁴



Mead Lake



Powell Lake

Figure 1.12. Main countries for use of water for industrial use
(cubic meters)

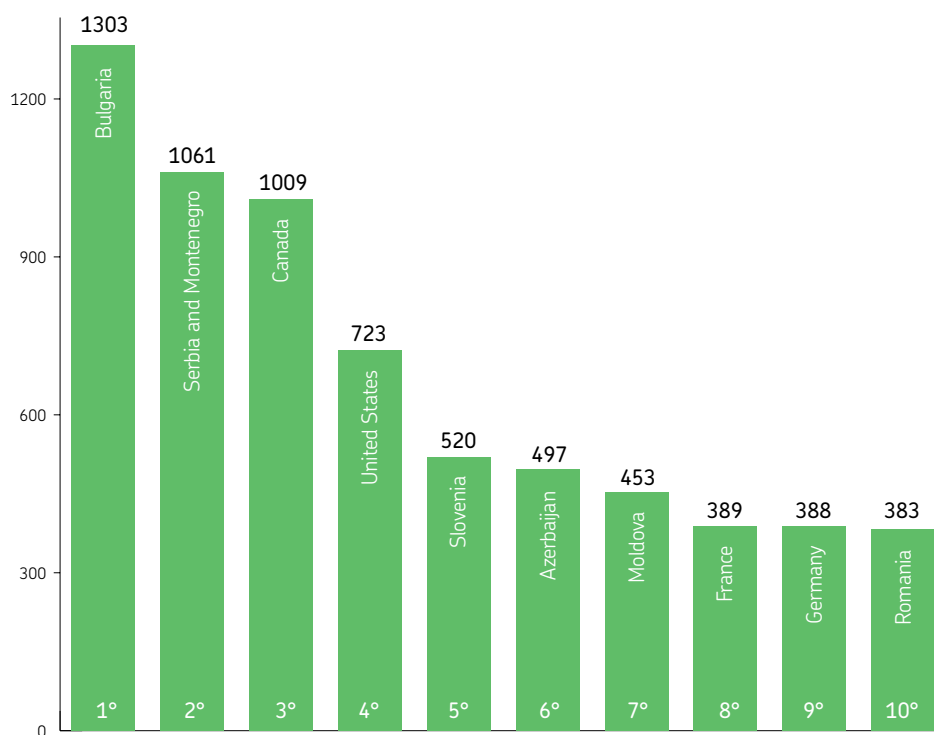
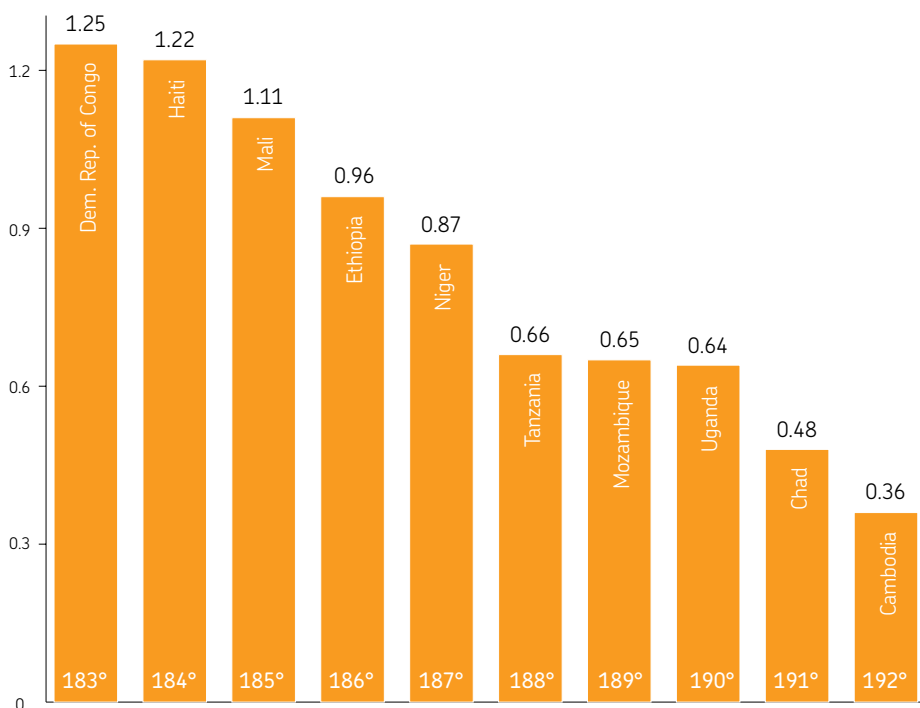
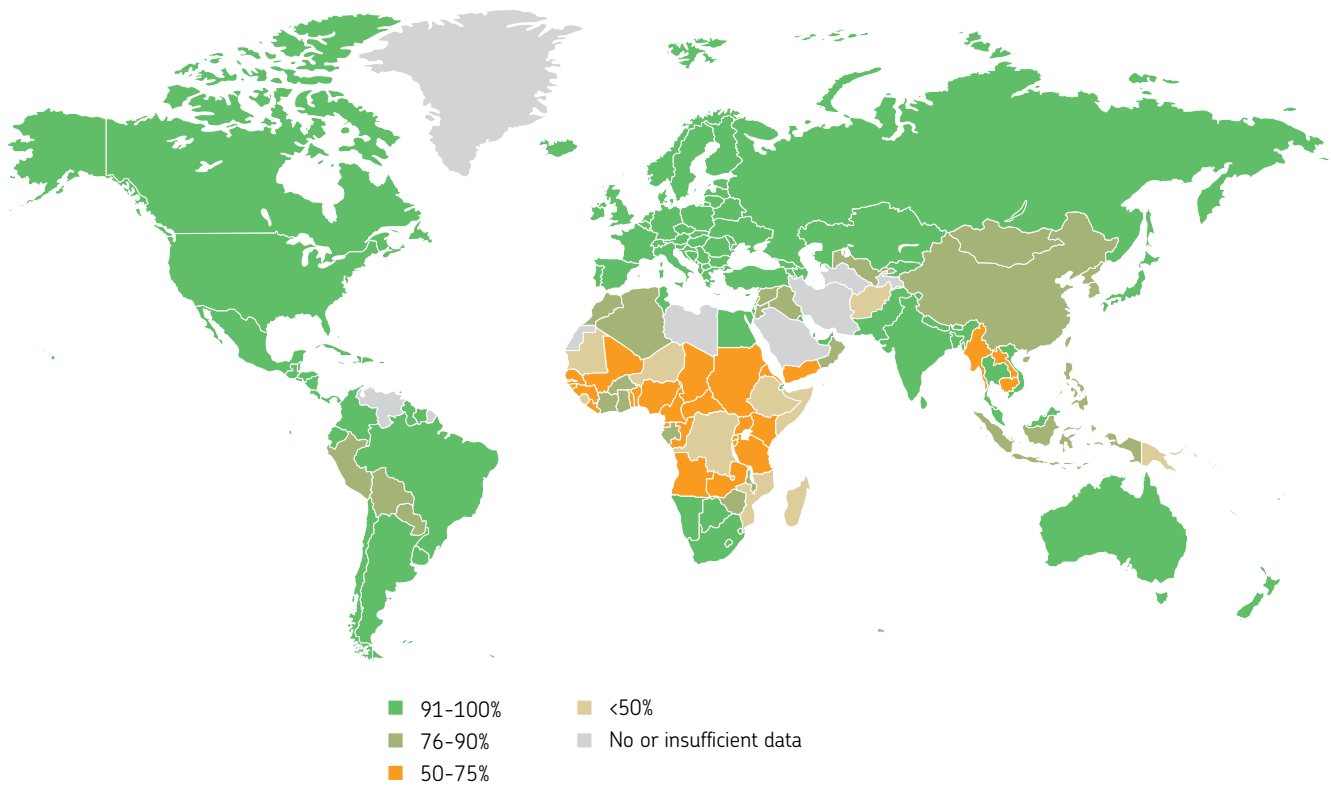


Figure 1.13. The last countries for use of water for industrial use
(cubic meters)



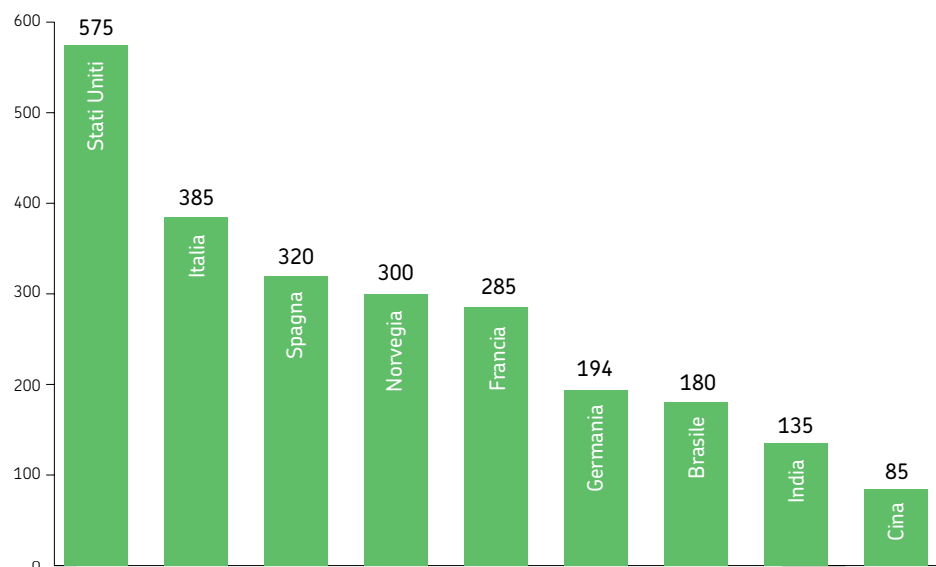
Source: revised by The European House-Ambrosetti from www.worldmapper.org.

Figure 1.14. Populations with access to safe drinking water in 2008



Source: WHO/UNICEF, *Progress on Drinking Water and Sanitation*, update 2010.

Figure 1.15. Average daily use of water per capita (liters per capita per day)



Source: revised by The European House-Ambrosetti from Chartres and Varma, *Out of Water*, 2010.



1.3 WATER SCARCITY TODAY

FROM AN ENVIRONMENTAL PERSPECTIVE, WATER IS CONSIDERED “SCARCE” WHEN MORE THAN 75% OF RIVER AND GROUNDWATER RESOURCES ARE WITHDRAWN FOR AGRICULTURAL, INDUSTRIAL AND DOMESTIC USE: IN THIS CASE, THE EXPLOITATION IS APPROACHING (OR HAS ALREADY EXCEEDED) THE LIMIT OF SUSTAINABILITY.

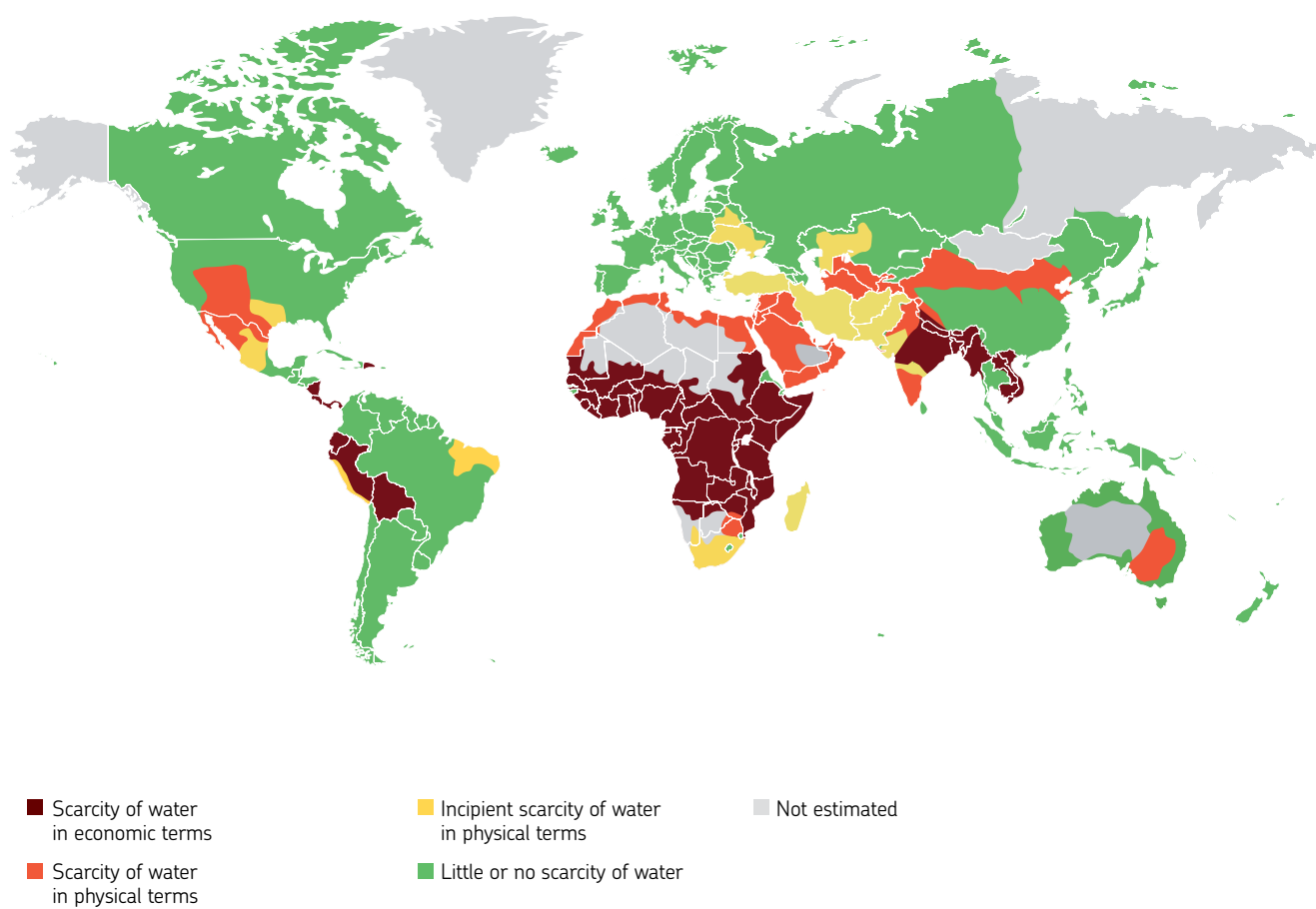
The current demand for water, which is already very high, will grow steadily in the future (as shown in the following paragraphs), causing a situation of progressive scarcity, especially in some areas of the planet. Theoretically, we are talking about “water scarcity” when the demand for water by humans and the ecosystem is greater than the available resources. There is a distinction between environmental scarcity and economic scarcity.

From an environmental perspective, water is considered “scarce” when more than 75% of river and groundwater resources are withdrawn for agricultural, industrial and domestic use: in this case, the exploitation is approaching (or has already exceeded) the limit of sustainability.

Instead, one speaks of “incipient shortage” of water from the environmental point of view when more than 60% of the river water is removed, leaving an insufficient amount of water in the near future. In technical terms, however, economic scarcity occurs when obstacles related to human, institutional and financial capital prevent access to water, even if the water would be available locally and could meet human needs. In particular, we speak of economic scarcity when less than 25% of the river water can be taken to meet human needs.

Based on environmental criteria, on a global level the areas with water shortages are mainly in North Africa, some inland areas of southern Asia, part of Australia and the southeastern United States. When analyzing the shortage of water from the economic point of view, one can see that the areas most affected are those in central Africa and part of the Indian peninsula.

Figure 1.16. Areas with shortages of water in environmental and economic terms



Source: *Comprehensive Assessment of Water Management in Agriculture*, 2007.



The global water scenario in small doses

Good and bad news:

There is a lot of water in the world...but it is not always where it is needed.

In nature, water is free... but the infrastructures for its distribution are extremely expensive.

In many areas of the Earth, water is easily accessible at low cost... but people assume that it will always be available.

Nature constantly recycles and purifies the water of rivers and lakes... but mankind is polluting water faster than Nature can recycle it.

There is a large amount of water underground... but mankind is using it faster than Nature can replace it.

5.7 billion people have access to clean

water... but 800 million do not.

Four billion people have basic sanitation... but 2.5 billion do not.

Millions of people are trying to overcome their poverty ... while the richest are using more water than necessary.

The pace of industrialization is growing... even though industries require more freshwater.

Industries are becoming more and more efficient in their use of water... but many companies are still using water unsustainably and inefficiently.

Awareness of the problem of water is increasing... but translating such awareness into action is a slow process.

1.4 WHY THE DEMAND FOR WATER IS INCREASING

Starting from the availability and utilization of water resources, it is interesting to outline a summary of the main causes which, within the context of reference, will have an impact on the future worldwide demand for water:

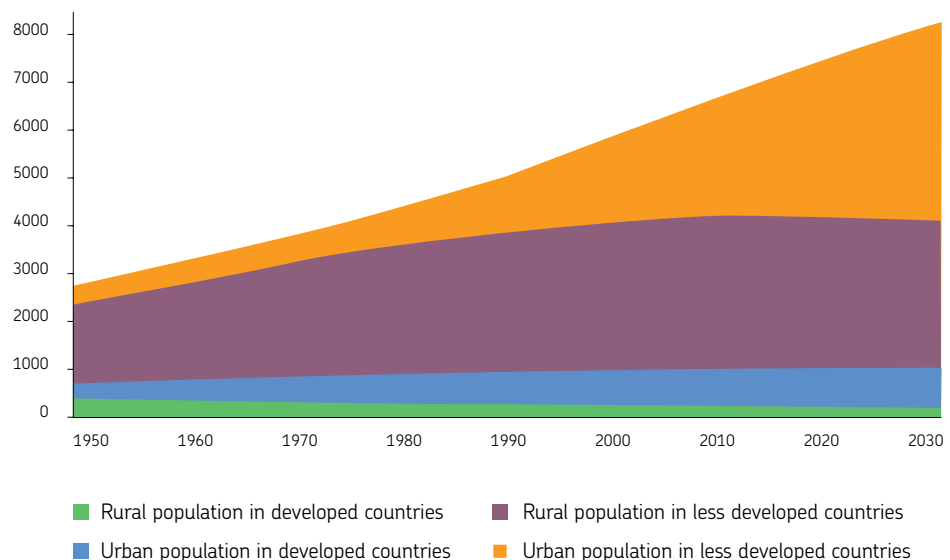
- population growth and urbanization;
- the increase in the welfare of the population and the resulting change in eating habits;
- socio-economic development and the production of biofuels.

1.4.1 Population growth and the urbanization process

Among the causes that will have an impact on the future worldwide demand for water, a particularly important role is played by demographic trends and increasing urbanization. Estimates relating to population growth indicate that the global population will increase to over 8 billion people by 2030 and reach 9 billion by 2050.

IT IS ESTIMATED THAT BY 2025, THE WITHDRAWAL OF WATER NECESSARY TO MEET THE NEEDS OF THE POPULATION WILL INCREASE BY 50% IN DEVELOPING COUNTRIES AND 18% IN DEVELOPED COUNTRIES.

Figure 1.17. Population growth and urbanization



The world population is already using 54% of the water resources of freshwater contained in rivers, lakes and accessible aquifers. With the population increasing, it is estimated that by 2025, the withdrawal of water necessary to meet the needs will increase by 50% in developing countries and 18% in developed countries.

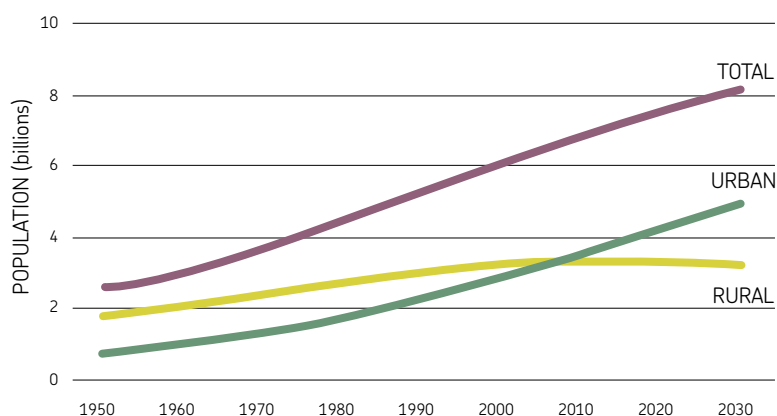
In particular, the world's food needs in 2025 will have risen by 55% compared to the 1998 figures, resulting in an increased demand for water for irrigation of at least 14%. At the same time, the water demand to meet the primary needs for sanitation, power generation and industrial development will also increase.

Within this undoubtedly complex picture, an element of optimism is represented by estimates by UNESCO,⁵ according to which, the increase in the volume of water required for irrigation (+14%) will be lower than the increase in irrigated areas (+34%), thanks to the adoption of more efficient techniques. In parallel, there is the strong acceleration of the urbanization process (as can be observed from Figure 1.17, which clearly shows how the component that has – and in the future, will still have – the highest growth rates, is that of the urban population in LDCs – less developed countries).

For the first time in history, in 2007 the urban population exceeded the rural one, with direct consequences in terms of infrastructures for access to water⁶ (Figure 1.18).

In fact, the investments needed to ensure a water supply to a growing number of citizens and for the associated treatment and purification of the wastewater arising from domestic and industrial uses are increasing.

Figure 1.18. An increasingly urbanized population



Source: UNDESA, *World Urbanization Prospects*, 2007.

1.4.2 Increasing welfare of the population and changing eating habits

The increasing world population and the increased spending power of the population of developing countries are accompanied by changes in eating habits and an increase in the calories consumed (for example, in the last 20 years, meat consumption in China has more than doubled and will double again by 2030).

This causes an increase in the water which is withdrawn, given that the production of meat, milk, sugar and vegetable oils requires, on average, the use of a greater quantity of water than grain production (for further study regarding this, see chapter 3).

On average, the production of one calorie of food requires a liter of evapotranspiration water. For a vegetarian diet therefore, an average of 2000 liters of water per day is required, compared to 5000 liters per day for a diet rich in beef. The water consumption would be less, however, if the beef produced from cattle were fed by means of irrigated pastures and not with cereals.

According to FAO, the average per capita consumption of meat in major developed countries is about 90 pounds per year,⁷ against a consumption of 40 pounds in sub-Saharan Africa and 6 in eastern Asia. It is estimated that developing countries will see an annual 2-4% increase in meat consumption in the next 10 years.

To feed a population of 9 billion people in 2050, considering an average daily calorie intake of 3000 calories, a further 2500-3000 cubic kilometers of freshwater will be required, an estimate likely to default with respect to the real one, in that it is based on a low-protein diet with a low consumption of water drawn. This data, combined with forecasts of population growth, emphasize the need to use existing water more efficiently and productively in order to minimize the total consumption.



Des & Jen Bartlett/National Geographic Image Collection

1.4.3 Socio-economic development and the production of biofuels

Among the causes of the growth of future demand for water, economic development also has a significant impact. The improvement in economic conditions and in the lives of people living in developing countries, as well as the expansion of economic activities – from industries to services and tourism – result in increasing pressure on the available water resources and on the natural ecosystem.

Above all, it is the growing global demand for energy⁸ that exerts extreme pressure on the demand for water resources. In particular, the production of biofuels has increased exponentially in recent years⁹ (ethanol production has tripled since 2000, amounting to 77 billion gallons produced in 2008, and is estimated to reach 127 billion liters by 2017¹⁰), mainly due to the instability of oil prices and of the support of international and national environmental policies.

Biofuels, while being a potentially valuable tool for reducing dependence on fossil energy sources, are exerting pressure on the balance of water and biodiversity in some countries. This is due to the large amounts of water (and fertilizer) needed for the cultivation of corn, sugar cane and other crops from which biofuels are derived.

In China and India, for example, the production of corn and sugar cane is based on a consistent use of irrigation, unlike Brazil and the United States, which, for the production of ethanol, cultivate the same crops using primarily a supply of rainwater.

To produce a liter of biofuel, it takes an average about 2500 liters of water¹¹ (with significant variations between different geographical areas due to the use of higher or lower irrigation fields), which is equivalent to the volume of water needed to produce enough food for the daily caloric needs of a person.

In this regard, the following tables show the water footprint of the main biofuels in comparison with the main sources of energy, emphasizing the strong pressure of biofuels on water consumption.

Figure 1.19. Comparison between the average water footprints of the primary sources of energy

	Average water footprint (m ³ /Gj)
<i>Primary energy carriers (excluding biomass and hydropower)</i>	
Wind energy	0.0
Nuclear energy	0.1
Natural gas	0.1
Coal	0.2
Solar thermal energy	0.3
Crude oil	1.1
<i>Primary energy carriers: hydropower and biomass</i>	
Hydropower	22
Biomass the Netherlands (average)	24
Biomass US (average)	58
Biomass Brazil (average)	61

Source: Gerbens-Leenesa, W., A.Y. Hoekstra and T.H. van der Meerb.
The Water Footprint of Bioenergy. University of Twente, 2008.

Figure 1.20. Average Water Footprint of 10 crops used to produce ethanol and 3 to produce biodiesel

Crop	Total WF	Blue WF	Green WF
Ethanol		m ³ per Gj ethanol	
Sugar beet	59	35	24
Potato	103	46	56
Sugar cane	108	58	49
Maize	110	43	67
Cassava	125	18	107
Barley	159	89	70
Rye	171	79	92
Paddy rice	191	70	121
Wheat	211	123	89
Sorghum	419	182	238
Biodiesel		m ³ per Gj biodiesel	
Soybean	394	217	177
Rapeseed	409	245	165
Jatropha	574	335	239

Source: Gerbens-Leenesa, Hoekstra and van der Meerb, *The Water Footprint of Bioenergy*, 2008.

Compared to the “first generation biofuels” obtained indirectly from biomass (wheat, corn, beet, cane sugar, etc.), some studies are underway on the development of techniques for the production of biofuels in order to avoid the occurrence of problems such as the reduction of available agricultural land for food production or changing its agricultural use.

The so-called “second-generation biofuels” are, in fact, obtained through the cultivation of *Miscanthus* (a grass plant common in the East), algae or the processing of lignocellulosic material. The latter is obtained through the technique of pyrolysis, which transforms the biomass collected directly on the site into a special oil, which is then sent to a central facility for the synthesis of the fuels themselves, thus considerably reducing transport costs.

1.5 WHY IT REDUCES THE AVAILABILITY OF WATER

Similar to the existence of factors that will influence the future demand for water in the world, we should also delineate those cases which, within the context of reference, will affect the reduction in the availability of water: increased pollution and climate change.

1.5.1 Pollution

Among the main causes of reduced water availability are the problems caused by pollution, which threatens the quality of available water resources. In particular, the economic growth in the markets and the appearance of large numbers of people previously excluded from mass consumption create very serious problems, particularly in the area of waste management. Some data¹² strikingly clarifies the size of the problem. It is estimated that every day, two million tons of waste generated by human activities are discharged into waterways.

The contribution of food to the production of organic substances polluting the water is 40% in developed countries and 54% in developing countries.

In the latter case, 70% of the industrial waste is discharged into waterways without undergoing any sewage treatment, partly polluting the water resources of the available freshwater.

EVERY DAY, TWO MILLION TONS OF WASTE GENERATED BY HUMAN ACTIVITIES ARE DISCHARGED INTO WATERWAYS.



The case of China's water crisis

"China is on the brink of the most serious water crisis in the world, bringing into question its economic development in recent years. The problem is serious and must be resolved before it is too late."

These are the words of Qiu Baoxing, Vice Minister of Construction in China, referring to the challenge posed by water scarcity and pollution in his country, fourth in the world in absolute availability of water resources but with a population of 1.3 billion people, making the Chinese annual availability per capita¹³ among the lowest on Earth (2,138 m³/year against 10,231 in the U.S.).

The country's situation is very serious. Despite hosting some of the largest river basins in the world, five of the seven¹⁴ major rivers of the country are, in fact, deeply polluted, as is 90% of the groundwater, causing 700 million Chinese to drink contaminated water every day. Moreover, the distribution of water resources in the country is quite uneven, a trend that will increase, considering the demand for water in the future: some areas are already naturally dry today, others (especially in

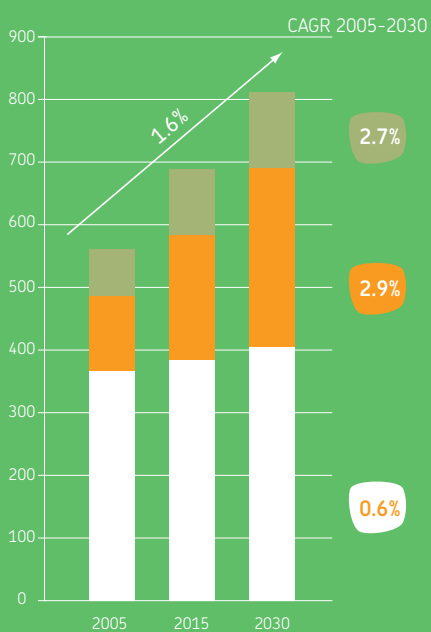
mainland China and in major cities) will suffer a real shortage of water in 2030 because of the shortsightedness of the government in managing the water problem. Less than half of the country's sewage is purified and recycled, while in 660 cities, the poor conditions of the pipes cause average losses of approximately 20% of the total supply of water.

In the capital, Beijing, residents have access to a per capita amount of water equal to one third of that which is available to the inhabitants of western cities; in rural China, it is estimated that over 500 million people have no access to drinking water. The situation is also deteriorating because of frequent droughts, the movement of millions of residents from rural to urban realities, defective or obsolete systems of water purification and treatment, as well as the acceleration of desertification which, together with the projected population growth, exacerbates the water crisis facing the entire country and which, according to an estimate by the World Bank, could result in some 30 million environmental refugees by 2020.

Figure 1.21. Gap between the current availability of water resources and the expected water demand in China in 2030



Figure 1.22. Water withdrawals per sector (billions of m³)



■ Agricultural use ■ Industrial use ■ Domestic use

Source: China Environment Situation Factbook: China Agriculture Annual Book; 2030 Water Resources Group.

1.5.2 Climate Change

Another important factor that will affect the future availability of water resources is climate change. There is now broad consensus about its effects on water and its availability:¹⁵

- a massive contraction of the land and sea covered by ice (according to some projections, a substantial part of the Arctic ice could disappear completely by the end of the 21st century);
- a substantial increase in the average level of the sea, which, in the second half of the twentieth century, has increased by 1.75 mm per year;
- a gradual shift towards the poles of non-tropical storms, resulting in significant effects on winds, precipitation and temperature;
- a significant increase in the frequency of “extreme” phenomena such as intense heavy rain or heat waves. The expectation is that there will be an increase in river flows and the overall availability of water in the northern hemisphere, while tropical areas and those of semi-arid areas (mainly the Mediterranean, eastern USA, South Africa and northeastern Brazil) will face a significant decline in water resources, increasing the risk of droughts.

In Africa, where there are higher temperatures, increased evaporation and reduced rainfall have contributed to reducing the flow of water of many major rivers by 40%, leading to recurrent drought in the Horn of Africa.

Because of the profound changes caused by climate change, some terrestrial and marine ecosystems (including the Mediterranean) will suffer severe consequences, especially because of the significant reduction in rainfall. The impact of climate change on the Mediterranean ecosystem (and all across Southern Europe, in general) will be made manifest mainly through a significant reduction of the water supply and crop productivity. Agriculture in general and some crops in particular (including all cereals) will be significantly affected by rising temperatures and lower rainfall, while the negative effect on the soil will mainly be due to accentuated erosion.

More generally, two macro-trends have been identified in the world that could impact heavily on both marine and terrestrial ecosystems:

- the sharp increase in the atmospheric concentration of CO₂, that generates the progressive increase of the acidification of the oceans and water with negative consequences, both on the very existence of marine ecosystems themselves and in relation to the availability (and related costs) of water used for human purposes;
- the gradual slowdown expected in the southern current of the Atlantic (MOC - Meridional Overturning Circulation) during the twenty-first century: though difficult to estimate, the effects of the structural changes of this current will have a huge impact on marine ecosystems, the concentration of CO₂ and oxygen and, in general, the terrestrial vegetation.

The IPCC¹⁶ predicts a possible significant reduction in the quality of water in soil, both at the ground level and the underground level, with significant implications for health. In addition, one of the most critical effects of climate change and related phenomena is the significant increase in the pressure borne by the urban and rural infrastructures related to water, which is potentially critical not only as to allocation and distribution, but also with regard to a high level of conflict between states, especially in cases of access to common water bodies (trans-boundary waters).

As predicted, the impact of climate change mainly afflicts those developing countries that are particularly vulnerable, not only because of their geographical position but

also for their financial and institutional weakness.

These factors, combined with an economy based on the need for substantial water withdrawals for agricultural use, undermine the ability of these countries to cope with a significant future reduction of available water resources.



Paul Nicklen/National Geographic Image Collection





THE IMPACT OF CLIMATE CHANGE
ON THE MEDITERRANEAN
ECOSYSTEM WILL BE MADE MANIFEST
MAINLY THROUGH A SIGNIFICANT
REDUCTION OF THE WATER SUPPLY
AND CROP PRODUCTIVITY.

The impact of climate change in Australia

Following the disastrous effects caused by the drought in southeastern Australia, the National Water Commission funded a study in 2005 to investigate the situation of water resources in the Murray-Darling Basin, which is named after the homonymous rivers running through the area.

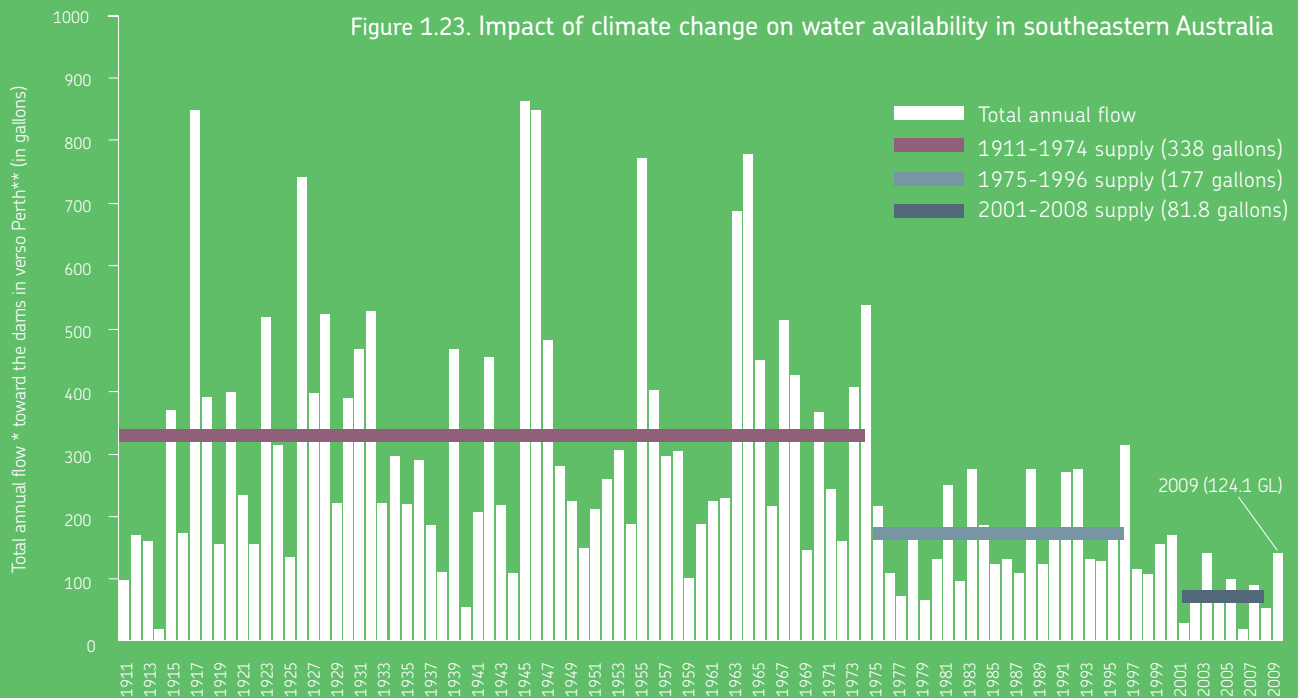
The study aimed to estimate the current and future (2030) water availability of the basin and aquifers in the area being analyzed, as well as the impact demographic development, climate change and the interaction between surface water and groundwater will have on water resources. Among the main findings, it was found that by 2030, the availability of water in the the Murray-Darling basin will decrease by 9-11% in the northern area and 13% in the

south, while the Murray River will reduce its water flow by 61%.

The study also shows that in 2030, due to the effects of climate change, the area will undergo a drought equal to that experienced between 1997 and 2006 in southeastern Australia, partly because of a sharp decrease in precipitation, as shown in the following figure.

Faced with this future situation that many countries have in common, the study then stressed the importance and urgency of finding clear answers to address a key issue for future development: to produce “more food” to feed more and more people in the presence of increasingly scarce water resources.

Figure 1.23. Impact of climate change on water availability in southeastern Australia



Notes: *A year is taken as May to April / **2009/10 inflow to October 21, 2009

Source: Water Corporation, Perth.

1.6 THE ROLE OF TECHNIQUES

1.6.1 Irrigation Techniques

Along with emerging technologies for water management, an important role is also played by modern irrigation techniques. In the agricultural sector, in fact, the rain water supply ensures appropriate resources to 80% of the cultivated areas in the world, while the remaining 20% is based on irrigation instead.

Irrigation techniques, accounting for 40% of the total agricultural output, however, result in higher returns, as they lead to an increased productivity of agricultural land by a greater amount of water made available for crops.

It is estimated that the maximum yield that can be obtained from irrigation is more than double that which can be achieved through the rainwater supply.

Modern irrigation techniques also promote water conservation, thus confirming the importance of irrigation especially for developing countries which in many cases have a limited amount of rain. Drip irrigation (see box below), in particular, is spreading quickly in areas where water resources are limited, because water can be saved by reducing evapotranspiration and deep drainage, since water can be administered with greater precision to the roots of plants than is the case with spray or sliding irrigation systems.

Irrigation remains a key element, especially for enabling a country with a great shortage of water to feed its population in an efficient way – combined with fertilizers and seed varieties – the practice of irrigation is the best way to increase productivity and food security.

THE SUPPLY OF RAINWATER ENSURES APPROPRIATE RESOURCES TO 80% OF THE CULTIVATED AREAS IN THE WORLD, WHILE THE REMAINING 20% IS BASED ON IRRIGATION.



Source: FAO Water, *Water at a Glance*, 2007.

Drip Irrigation

The first experiments that combined the irrigation of the roots with the use of underground terracotta drainage pipes were conducted in Germany in 1860; once again in Germany, between the '20s and '30s, the first attempts were made to irrigate crops using perforated pipes.

The modern technology of drip irrigation, facilitated by the advent of plastics, was introduced in the late fifties by the agronomist and engineer, Simcha Blass – a Polish Jew by birth who moved to Palestine in 1930 – who patented it and in 1965 conceded the license of its production to the Hatzerim kibbutz.

That agreement marked the birth of Ne-

tafim, a company for the production of drip irrigation systems which originally arose in the middle of the kibbutz fields.

Within a few years, the company established itself as a worldwide leader in micro-irrigation systems and has come to cover more than one third of the market, developing other products for agriculture and, in recent years, environmentally friendly technologies for biofuel production. Today, Netafim is jointly held by three kibbutzim – Hatzerim, Magal and Yiftach – and has 30 subsidiary offices in 110 countries.

With 2000 employees and 11 production facilities, it achieved a turnover of 400 million dollars in 2006.



J. Baylor Roberts/National Geographic Image Collection

1.6.2 Emerging technologies

In the report *Water in a Changing World*¹⁷ (which we recommend for further study on this issue), the United Nations identified some key areas of technological development relevant to the future management of water resources, including:

- research and development on environmental issues;
- renewable energy and bio-energy;
- nanotechnology;
- ICT (Information and Communication Technology).

The first point is a general one that covers various environmental issues, including that of water management. In recent years, many developed countries have witnessed an increase in spending on research and development in the environmental field, in order to promote innovative technologies that help improve the quality of the environment.

This trend is not observable, at least not with the same intensity, in developing countries. Therefore, the transfer of technology from developed countries should be oriented to the developing countries to ensure sustainable growth in the latter, also from an environmental perspective.

As for research related to renewable energy, it has benefited recently from the decisive political orientation towards the reduction of harmful emissions to the atmosphere. Thanks to these efforts, at this stage important technological innovations are being made that will foster a growing use of renewable sources; for example, in solar energy, energy produced by exploiting the ocean tides, new generation geo-thermal systems and those based on the integration of various bio-energy sources.

However, in the near future, only a fraction of the energy demand will be achieved by means of renewable sources, and traditional sources (fossil fuels and nuclear energy) will still be predominant. These sources also have a significant impact in terms of water consumption. Just think, in fact, that to generate a megawatt of electricity using coal, 2 cubic meters of water are required, 2.5 cubic meters when using nuclear energy and 4 cubic meters when oil is used as a source.

A growing trend, which recently is also at the heart of scientific and economic debate, is that of research and applications related to bio-energy. While these energy sources appear to have less impact on pollution, causing fewer harmful emissions into the atmosphere, nevertheless they appear to have the effect of increased use of water resources, requiring a massive use of water for their cultivation.

Nanotechnology seems to have great potential in the techniques of desalination and water purification of metal pollutants, allowing the prospect of recovering a quantity of water for domestic use, health and irrigation at a low cost.

In particular, desalination devices permit the exploitation of the huge resource represented by the sea, in view of the fact that 97% of the water on the Earth is salt water.

Recently, a substantial reduction of cost has been obtained for one of the most efficient desalination technologies (the reverse osmosis membrane) by applying a series of improvements, including membranes that require less pressure, and therefore less energy, and a modular system which simplifies the construction of the plant. Many coastal cities may soon have new sources of drinking water by adopting this technology, which is already used in desalination plants built in Singapore and Tampa, Florida. Finally, among all current and future technological innovations, the dissemination of related information and communication technologies (ICT) must be

taken into consideration. This is extremely necessary in order to generate knowledge of the phenomena and their possible applications, providing a fundamental contribution in terms of monitoring the state of exploitation and pollution of worldwide water resources.



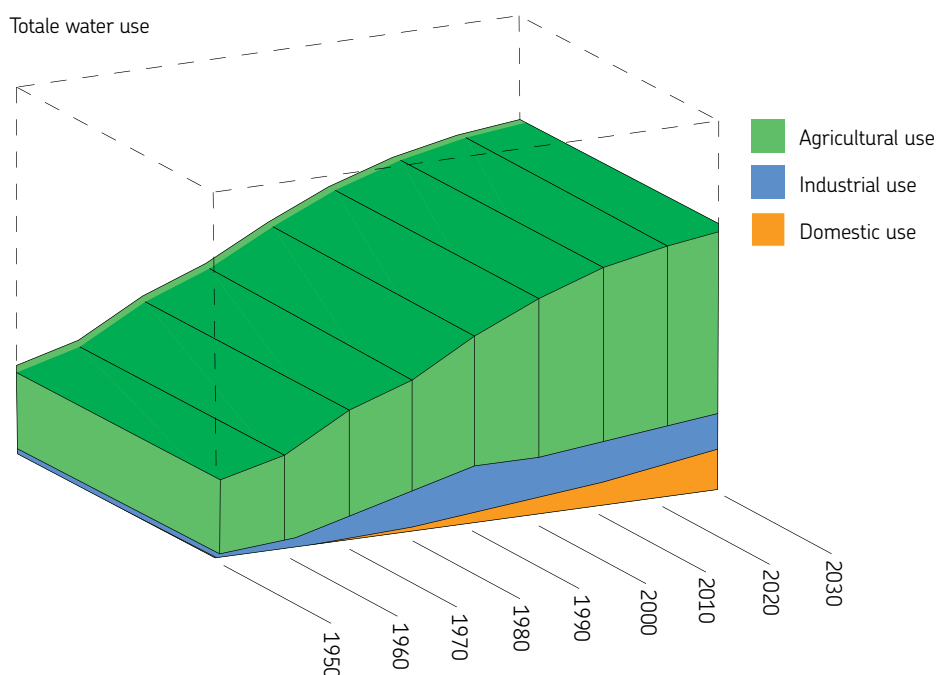
Bobby Haas/National Geographic Image Collection

1.7 FUTURE SCENARIOS

If the current picture of the availability and use of water resources is the one represented in the previous sections, future projections do not suggest a very different situation: it is estimated that in 2030, agriculture will still be the sector with the highest absorption of global water resources,¹⁸ while the weight of industry will remain stable, or at most decrease slightly, mainly due to the increase of efficiency that characterizes the production processes. Instead, the withdrawal of water for domestic use (in line with sanitation requirements) will undergo a rapid increase, surpassing the industrial sector.

IN 2030, AGRICULTURE WILL STILL BE THE SECTOR WITH THE HIGHEST ABSORPTION OF GLOBAL WATER RESOURCES, WHILE THE WEIGHT OF INDUSTRY WILL REMAIN STABLE. INSTEAD, THE WITHDRAWAL OF WATER FOR DOMESTIC USE WILL UNDERGO A RAPID INCREASE, SURPASSING THE INDUSTRIAL SECTOR.

Figure 1.24. Removal of water resources by type of industry: the future outlook

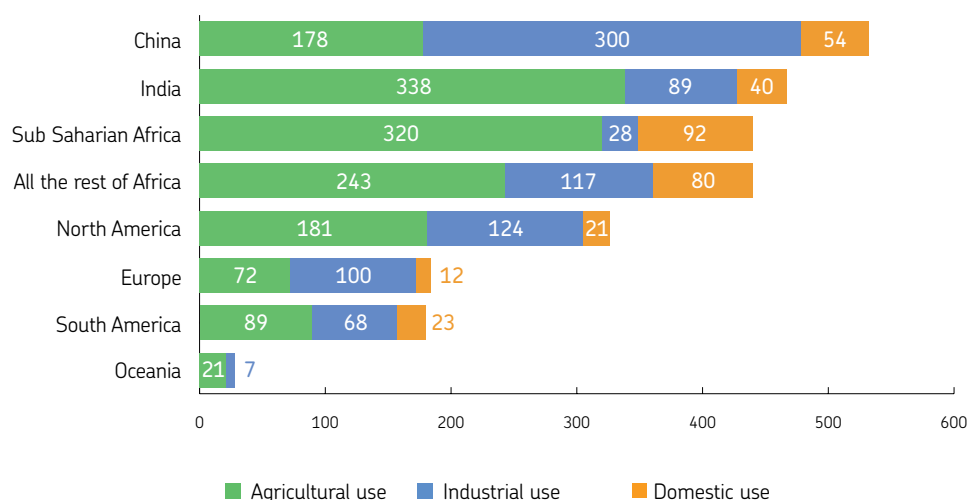


Source: WBCSD, *Facts and Trends - Water*, 2009.

IT IS ESTIMATED THAT
A SHARE OF BETWEEN 15%
AND 35% OF THE CURRENT
WATER WITHDRAWALS
FOR IRRIGATION WILL
NOT BE SUSTAINABLE
IN THE FUTURE

In particular, when analyzing the increase in the withdrawal of water resources in the years 2005-2030 by region, it can be seen that the greatest increase in the demand of water for agricultural use will mainly be in emerging countries like India – where the agricultural sector will account for more than 10% of the country's GDP in 2030 – and in sub-Saharan Africa, while the highest increase for industrial use will occur mainly in China.

Figure 1.25. Increase of the withdrawal of water resources by type of sector and by region, 2005-2030



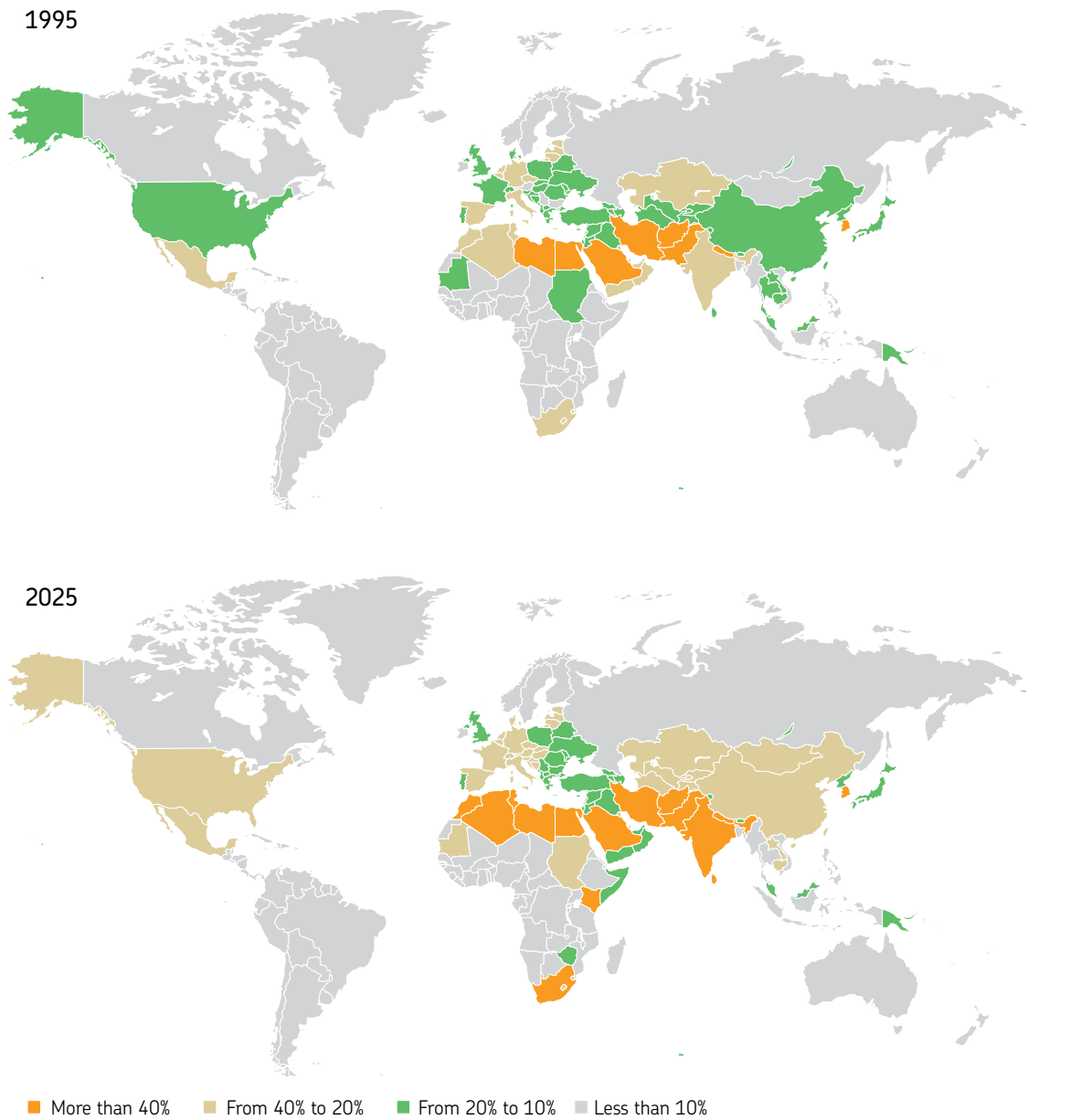
Source: revised by The European House-Ambrosetti from *2030 Water Resources Global Water Supply and Demand Model*, International Food Policy Research Institute.

The degree of water scarcity, on a prospective basis, can be estimated by analyzing the amount of water withdrawn in different geographical areas against the global resources. Because of population growth, the high cost of irrigation techniques, which often exceed the financial possibilities of small farmers in many developing countries, the persistence of inefficient irrigation practices and the increasing competition for water use, it is estimated that a share of between 15% and 35% of current water withdrawals for irrigation will not be sustainable in the future.¹⁹

In 1995, the areas with a high sampling rate (above 20%) were in fact located in the southern United States, North Africa, in parts of Western Europe, the Arabian Peninsula and parts of Southeast Asia. In the prospective scenario for 2025 (Figure 1.27), the situation is dramatically worse in terms of the relationship between resources used and those available. It is estimated that the global area characterized by a withdrawal rate higher than 20% will increase substantially with regard to that of 1995, extending to the whole of the United States and much of continental Europe and Southern Asia, with large areas located in Africa and in the Indian peninsula²⁰ registering rates above 40%.

The situation does not appear to be different if the perspective of water availability per capita in different regions of the world is considered: Africa will fall from nearly 16,000 cubic meters per capita in 1960 to less than 4000 in 2025, Asia from about 6000 to about 2000, the Middle East and North Africa from about 4000 in 1960 to less than 2000 in 2025.

Figure 1.26. Increase in the withdrawal of water resources by type of sector and geographical area 2005–2030



Source: WBCSD, *Business in the World of Water: WBCSD Water Scenarios to 2025*, 2006.

Thus, a particularly difficult future scenario is outlined, requiring wise and courageous choices that, as of now, can affect the trends. What is also clear is the need for a thorough analysis aimed at identifying a model of truly sustainable growth and ensuring access to food for a growing world population in the face of increasingly scarce water resources.

FOR 18 YEARS, EVERY MARCH 22ND HAS BEEN DESIGNATED AS WORLD WATER DAY.

Initiatives relating to water

March 22: World Water Day

The organization of an international day to celebrate water was recommended²¹ at the United Nations Conference on Environment and Development (UN-CED) in 1992 and subsequently adopted by the UN General Assembly, which organized the first World Water Day on March 22, 1993. This occasion was established within the guidelines of Agenda 21, the result of the conference which was held in Rio de Janeiro on 3-14 June, 1992 and is also remembered as the "Earth Summit."

This was the first world meeting on the environment involving heads of state, who debated on the issues of patterns of production, alternative energy resources to replace the use of fossil fuels which are held responsible for global climate change, public transportation systems for reducing vehicle emissions and lastly, the growing water shortages.

It was an unprecedented event in terms of media impact, both as to the political choices and the development that followed.

World Water Day 2011

The topic of focus of the World Water Day 2011, which was held in Cape Town on March 22nd, was *Water for Cities: Responding to the Urban Challenge*.

For the first time in human history, in fact, the majority of the world population (3.3

billion people) lives in urban environments that continue to grow at a faster rate than the sanitation infrastructures in urban areas are able to.

38% of that reality consists of slums in expansion, which are characterized by infrastructures for water treatment that are inadequate or even lacking.

The objective of the 2011 World Water Day, therefore, was to focus international attention on the impact of rapid urban population growth and water management systems, with the intent of encouraging governments, communities and individuals to take action to combat the challenge posed by urbanization in the management of water in cities.

Topics covered in past editions

With the aim of emphasizing the importance of freshwater and to encourage sustainability in the management of water resources, past initiatives devoted to water have awakened international attention regarding the following aspects:

2010 – Clean Water for a Healthy World

- The day in 2010 was dedicated to the theme of water quality, stressing the importance of interventions in the management of water resources, not only from the standpoint of quantity in dealing with its increasing scarcity, but also against the pollution of waterways in order to ensure the health of ecosystems and human welfare.

2009 – Shared Water Shared Opportuni-



ties - Particular attention was given to border waters with the intent of promoting the development of opportunities for cooperation between nations, to share this resource and at the same time promote the peace, security and growth of economic sustainability, also at the regional level.

2008 – *Sanitation* - As the International Year of Sanitation, thus declared by the General Assembly of the United Nations, 2008 led the World Water Day to address the issue of insufficient progress played in the field of sanitation on the global level, as well as to recognize that a shared political and community effort can ensure concrete results in the improvement of sanitation and the treatment of wastewater.

2007 – *Coping with Water Scarcity* - Coordinated by the FAO, the day highlighted the need for action to be integrated both globally and locally to address the issue of the sustainability of water resources in a context of increasing scarcity, inequitable distribution, degradation of surface water and conflicts.

2006 – *Water and Culture* - There was some discussion about how all people use and celebrate water, depending on their history and cultural tradition. Some give the water a sacred role in religious rites and ceremonies, others have represented it in art for centuries, while all recognize its central role for their survival.

2005 – *Water for Life 2005-2015* - The inauguration of the International Decade for Action, proclaimed by the UN General Assembly as the decade of 2005-2015, to ensure more effort and cooperation, including a greater participation by women, in order to achieve the development goals (Millennium Development Goals) established in the Millennium Declaration, which was signed in September 2000.

2004 – *Water and Disaster* - Natural disasters caused by climate change and weather (tornadoes, storms, cyclones and floods) constitute 75% of the environmental disasters that occur each year in the world, causing severe human and economic losses. For this reason, the need to predict these events and mitigate their consequences prompted the UN to spend the day on this issue in 2004.

2003 – *Water for the Future* - In order to guarantee a good quality and quantity of water to future generations, the number of people in the world living without safe drinking water and without adequate sanitation facilities must be halved by 2015; to reach this goal, special attention was also placed on the need to use and maintain the existing water more responsibly.

2002 – *Water for Development* - Coordinated by the International Atomic Energy Agency, the day addressed the issue of the need for integrated planning and management of global water resources which are increasingly scarce and at risk of deterioration.

2001 – *Water for Health* - Taking Charge. Coordinated by the World Health Organization, the day emphasized how water and health are closely linked, since they are both precious and vulnerable. Concrete efforts are therefore necessary to preserve both, so that everyone can benefit from cleaner and safer drinking water.

2000 – *Water for the 21st Century* - The first World Water Day of the 21st century dealt with the issue of the “water crisis” and how its availability and quality are profoundly and negatively influenced by a future scenario characterized by rapid population growth, especially in areas where the availability of water is already scarce today.

1999 – *Everyone Lives Downstream* – Following the inundations and flooding of many rivers in 1998 that caused thousands of deaths and serious economic losses in China, Bangladesh and India – areas where almost half of the world's population lives – the day was also dedicated to remembering how improper man-made interventions to the river basins, and not just excessive rains, can be the cause of these disasters.

1998 – *Groundwater – The Invisible Resource* – Emphasis was placed on the importance of groundwater in the survival of more than half of the world's population, who benefit from it to meet their water needs. This water must then be protected from the degradation to which it is subjected as a result of contamination by pollutants, as well as the implications arising from unresolved conflicts for its use.

1997 – *The World's Water – Is There Enough?* – The decision to address the issue of assessing the actual availability of water arose from an awareness of how it is a prerequisite for the birth and survival of life itself on Earth, facing an exploitation and ever-increasing competition for its use, which can affect its availability.

1996 – *Water for Thirsty Cities* – The issue under discussion was the growing crisis of water for major cities around the world, threatening the sustainability of their economic and social development.

1995 – *Women and Water* – The issue arises from awareness of how water is often a problem that is specific to women, because the responsibility

of providing water rests on them. In some places, in fact, women have to walk for up to 10 kilometers to reach water sources.

1994 – *Caring for Our Water Resources Is Everyone's Business* – Today, taking care of this vital resource is a must and a responsibility. Sustainable water management is a key to ensuring, both now and in the future, that everyone has access to and the usability of a resource which is not only vital to the survival of every single living being, but is also important for the development of all the social, economic and organizational processes of every population in the world.

The 2010 World Water Week: quality, prevention and containment

Since 1991, the Stockholm Water Institute International (SIWI) – a Swedish institute that supports the international fight against the current global water crisis – has organized an annual World Water Week in Stockholm, an event lasting one week that brings together more than 2400 political and economic decision-makers, opinion leaders, experts and international organizations to discuss and debate issues about water and its implications in economic, social, science and health terms.

While the 2011 edition, to be held August 21 to 27, will focus on water in a strongly urbanized world – *Water in an Urbanising World* – to explore one of the mega-trends behind the large increase expected in the consumption of water, the last edition, which was held September 5-11, 2010, explored the theme of its quality – *Responding to Global*



Changes: The Water Quality Challenge – Prevention, Wise Use and Abatement.

Climate change and population growth, urbanization, economic growth and the expansion of industrial activities all exert tremendous pressure on both the quantity and the quality of water resources by reducing their availability, increasing the pollution level and putting not only the health of the world population but also that of the natural ecosystems at risk.

For this reason, the World Water Week 2010, through eight seminars whose main contents were designed by a high-level scientific committee, dealt with the following themes of focus:

- Prevention and control of the pollution of water resources;
- breaking the “vicious cycle” of water pollution;
- the quality of water for human health;
- the management of groundwater;
- reduction of the pollution of water resources generated from farming;

- management of the resilience of social-ecological systems under uncertain conditions;
- the sources of water pollution in urban environments.

Besides the seminars described, numerous conferences and round tables also allowed the participants from 135 countries around the world to further explore, and therefore bring to international attention, the issue of the challenges relating to water quality, addressing not only the problems and the implications on the environment, the economy and health, but also emphasizing the progress of current scientific research and to work together for the formulation of concrete proposals and the individuation of effective solutions to ensure better prevention and a more economic use of the water resources that are available.

NOTES

1. Part of the water captured is often wasted due to inefficiency of water systems. In that regard, it is estimated that in 2008, 47% of drinking water was lost, largely to ensure the continuity of flow in pipes or due to real losses in the pipelines.
2. UNDP, *Human Development Report 2006*.
3. WBCSD, *Facts and Trends – Water*, 2009 and FAO Water, *Water at a Glance*.
4. Gertner, J., *The Future Is Drying Up*, in “The New York Times Magazine”, 21 October 2007.
5. UNESCO – World Water Assessment Program, 3rd *United Nations World Water Development Report: Water in a Changing World*, 2009.
6. UNDESA, *World Urbanization Prospects*, 2007.
7. 2001 data drawn from Chartres and Varma, *Out of Water*
8. It is estimated that the global energy demand will grow by 55% by 2030. Source: IEA 2008.
9. Currently representing a still modest market share (about 2%) of the global market for fuels used for transport.
10. IEA, 2008.
11. UNESCO – World Water Assessment Program, 3rd *United Nations World Water Development Report: Water in a Changing World*, 2009.
12. *Ibid.*
13. FAO, AQUASTAT Database, 2008.
14. Yangtze (6300 km), Yellow (5464 km), Amur (3420 km), Sungari (2308 km), Pearl (2210 km), Yarlung Zangbo (2057 km), Tarim (2046 km).
15. IPCC, *Climate Change 2007: Synthesis Report. Summary for Policymakers*, 2007.
16. *Ibid.*
17. UNESCO – World Water Assessment Program, 3rd *United Nations World Water Development Report: Water in a Changing World*, 2009.
18. According to more long-term estimates, in 2050 agriculture will consume 90% of the water used globally. Source: UNESCO – World Water Assessment Program, 3rd *United Nations World Water Development Report: Water in a Changing World*, 2009.
19. WBCSD, *Facts and Trends – Water*, 2009.
20. WBCSD, *Business in the World of Water. WCCSD Water Scenarios to 2025*, 2006.
21. UNDESA – Division for Sustainable Development, *Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management and Use of Water Resources*, Agenda 21, Chapter 18, 1992.





2. REALITY AND PROSPECTS OF THE RIGHT TO HAVE ACCESS TO WATER

"ACCESS TO SAFE WATER IS ESSENTIAL FOR LIFE AND, AS SUCH, IS A HUMAN RIGHT. THIS IS AN URGENT MATTER OF HUMAN DEVELOPMENT AND HUMAN DIGNITY. TOGETHER, WE CAN PROVIDE ACCESS TO SAFE, CLEAN WATER TO ALL THE WORLD'S PEOPLE. THE WORLD'S WATER RESOURCES ARE OUR LIFELINE FOR SURVIVAL, AND FOR SUSTAINABLE DEVELOPMENT IN THE TWENTY-FIRST CENTURY."

Kofi Annan, Secretary General of the United Nations, 2005¹



2.1 TOWARDS WATER SECURITY

Already in 2002, the United Nations Committee on economic, social and cultural rights² officially recognized³ water as a “limited natural resource, a public good and, above all, a human right.”

The importance of water as a resource that is essential for the welfare and dignity of people as well as for the economic and social development of countries and communities has also been underlined by the establishment of “Water for Life Decade 2005-2015,” an initiative spawned from the need to sensitize and channel efforts of the international community towards the goal of the accessibility and usability of water.

In fact, the “right to water” has been substantiated to guarantee all individuals, without discrimination, the possibility to obtain a quantity of water for themselves that is sufficient, safe and physically and economically accessible.

For the first time in history, the UN resolution on July 29, 2010 recognized this right as a fundamental and universal human right. The resolution emphasizes repeatedly that water for drinking and hygienic use “as well as being a right of every man, [...] concerns the dignity of the person more than the other human rights, it is essential to the full enjoyment of life and fundamental for all the other human rights.”

This resolution is not binding, but states a principle that still “recommends” (and thus does not require) nations to take initiatives to ensure drinking water of quality, that is accessible and at affordable prices for everyone. Making drinking water available in sufficient quantity and quality to meet the needs of a person (i.e. drinking, cooking, washing) is a priority shared worldwide, and one of the targets (#10) of the Millennium Development Goals (MDG) that 147 heads of state and government set when they signed the Millennium Declaration in September 2000.

In particular, the target to be reached, as compared to 1990, is “to halve the proportion of people without sustainable access to drinking water and basic sanitation systems by 2015.”⁴



THE “RIGHT TO WATER” IS SUBSTANTIATED TO GUARANTEE ALL INDIVIDUALS THE POSSIBILITY TO OBTAIN FOR THEMSELVES A QUANTITY OF WATER THAT IS SUFFICIENT, SAFE, AND PHYSICALLY AND ECONOMICALLY ACCESSIBLE.

THE TARGET TO BE REACHED, AS COMPARED TO 1990, IS “TO HALVE THE PROPORTION OF PEOPLE WITHOUT SUSTAINABLE ACCESS TO DRINKING WATER AND BASIC SANITATION SYSTEMS BY 2015.”

Figure 2.1. The path to water security



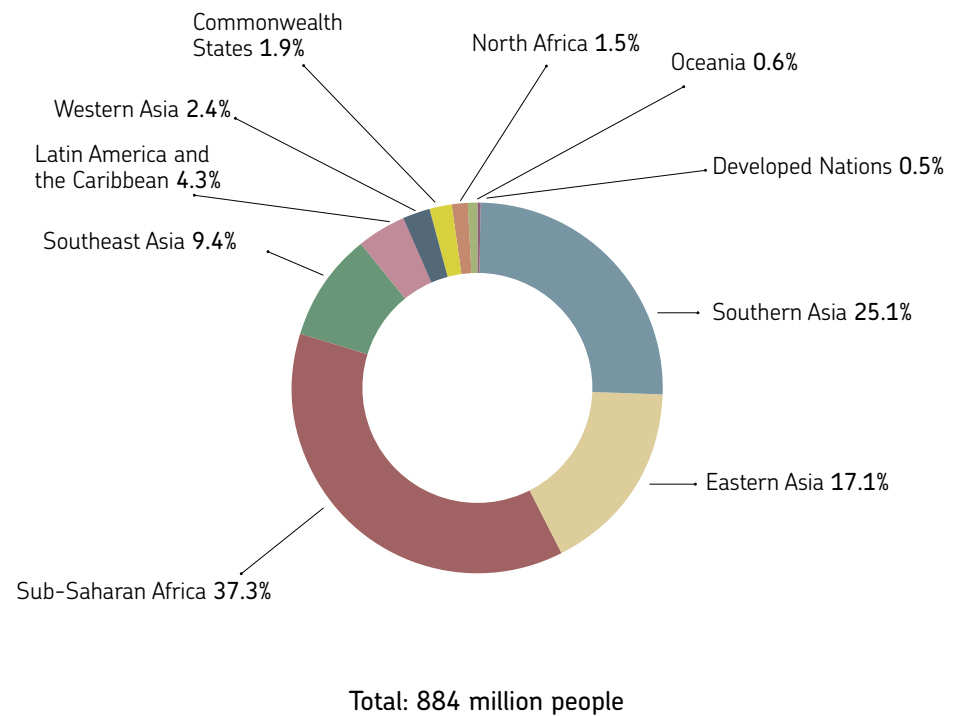
Source: revised by The European House-Ambrosetti



IN 2008 ABOUT 884 MILLION PEOPLE – 37% OF WHOM LIVING IN SUB-SAHARAN AFRICA – DID NOT HAVE ACCESS TO SUFFICIENT AND ADEQUATE WATER, WHILE 2.6 BILLION PEOPLE – 72% OF WHOM LIVING IN ASIA – DID NOT HAVE ADEQUATE SANITATION SYSTEMS.

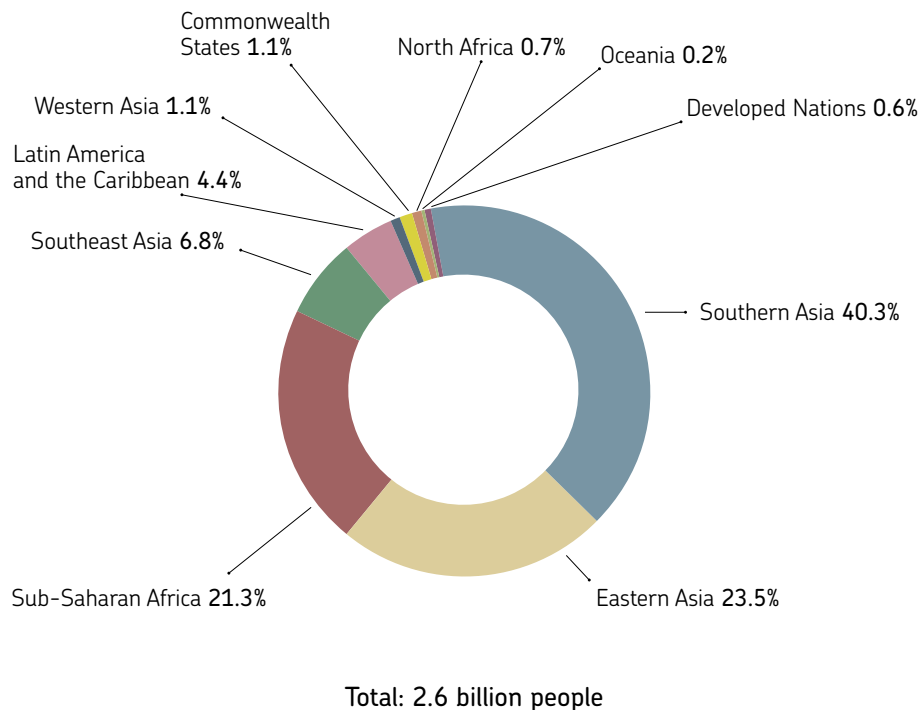
The progress made today towards the achievement of the targets proposed will be analyzed in detail in the following paragraphs, but to understand what the dimensions of the challenge are, it should be immediately pointed out that in 2008, about 884 million people – 37% of whom living in sub-Saharan Africa – did not have access to sufficient and adequate water, while 2.6 billion people – 72% of whom living in Asia – did not have adequate sanitation systems.

Figure 2.2. Distribution of the world population without access to water



Source: revised by The European House-Ambrosetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010

Figure 2.3. Distribution of the world population without access to sanitary systems



Source: revised by The European House-Ambrosetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

The availability of uncontaminated water is critical for the prevention of hydro-transmittable diseases such as dysentery and typhus, which are the cause of approximately 1.5 million deaths every year, 90% of which are children under 5 years of age.⁵

According to the World Health Organization and UNICEF, in areas most affected by these problems, improved access to safe drinking water and sanitation and hygiene services would cause:

- a drastic reduction in the mortality rate from diseases associated with the factors (it is estimated that it would save about 1.6 million lives each year);
- a reduction in the working hours lost by adults because of their disease and therefore a greater involvement on their part in economic and productive activities;
- a decrease in school absenteeism, which is to say, an increased participation of children in school activities and education, the prime mover of future economic development.

Millennium Development Goals



On September 6–8, 2000, the heads of state and government of all the UN state members who met in New York City at the “Millennium Summit” put their signature on the “Millennium Declaration.” On that occasion, world leaders affirmed their responsibility not only in relation to their own people but to the entire human race, defining a series of ambitious intentions to be achieved by 2015 (articles 19 and 20 of the Declaration). From these affirmations, and through

successive diplomatic meetings with the participation of the main agencies of the United Nations, the Millennium Development Goals (MDG) took shape: eight measurable and unambiguous goals, binding for the entire international community, which entrusted the UN with a central role in managing the process of globalization.

One or more concrete actions for achieving a number of targets are connected to each one of the targets.

Figure 2.4. Millennium Development Goals and concrete actions

	Goal	Concrete Actions
MDG 1	Eliminate hunger and extreme poverty	Target 1: To halve the number of people living on less than one dollar a day by 2015. Target 2: To halve the number of people suffering from hunger by 2015.
MDG 2	Basic education for everyone	Target 3: To ensure that by 2015 all boys and girls complete the primary school cycle.
MDG 3	Equal opportunities between the sexes	Target 4: To eliminate gender disparities in primary and secondary schools by 2015.
MDG 4	Reduce the infant mortality rate	Target 5: To reduce the infant mortality rate by two thirds, with respect to 1990, by 2015.
MDG 5	Improve maternal health	Target 6: To reduce the maternal mortality rate by three fourths, with respect to 1990, by 2015.

	Goal	Concrete Actions
MDG 6	Combat AIDS and malaria	<p>Target 7: To arrest and begin to reduce the spread of AIDS by 2015.</p> <p>Target 8: To arrest and begin to reduce the spread of malaria and other serious infectious diseases by 2015.</p>
MDG 7	Ensure environmental sustainability	<p>Target 9: To integrate sustainable development principles in the countries' policies and programs; to reverse the current trend of loss of environmental resources.</p> <p>Target 10: To halve the number of people without access to drinking water and sanitation systems by 2015.</p> <p>Target 11: To achieve a significant improvement in the lives of at least 100 million people living in slums by the year 2020.</p>
MDG 8	Develop a global alliance for development	<p>Target 12: To maximize a trading and financial system based on predictable and non-discriminatory rules.</p> <p>Target 13: To take into account the special needs of the least developed countries. This includes admission without duties and restrictions on the export sales of these countries, the enhancement of debt relief programs for highly indebted poor countries and cancellation of official bilateral debt, and a more generous official development assistance for those countries committed to poverty reduction.</p> <p>Target 14: To address the special needs of landlocked states and small developing island states.</p> <p>Target 15: To deal comprehensively with the problem of debt in developing countries through national and international measures likely to make the debt sustainable in the long term.</p> <p>Target 16: In cooperation with developing countries, to develop and implement strategies to provide work for young people.</p> <p>Target 17: In cooperation with pharmaceutical companies, to make essential medicines available and affordable in developing countries.</p> <p>Target 18: In cooperation with the private sector, to make the benefits of new technologies available, especially those related to information and communication.</p>

2.2 ACCESS TO WATER IN THE MILLENNIUM DEVELOPMENT GOALS

2.2.1 Measurement criteria

The United Nations have established the following criteria that meet the need for full accessibility to water. These must be:

- constant availability and sufficient quantity;
- accessible physically and economically;
- safe.

The first of the criteria, the availability of a sufficient quantity, is strongly influenced by the distance of the “water source” from the home. The minimum level of accessibility is that which is required to meet basic physiological needs. This is a quantity of water equal to about 20 liters per person per day, which generally means a water source within a mile (or a moving time within 30 minutes).

A better access to drinking water allows for meeting the physiological, food and hygiene needs of individuals and encourages greater attention to personal hygiene.

It is believed that when water is made available within the confines of the dwelling, the amount used is theoretically about 50 liters per capita daily. This means that hygiene practices can be put in place more easily. For example, it is estimated that a family which has access to water in their home uses an amount for the hygiene of a child that is 30 times higher than what they would consume if they were to obtain a supply from outside sources.

The second criterion is accessibility, which requires that each individual be guaranteed a safe and convenient access to the water resources and infrastructures. It also specifies that access must be ensured “near each person’s home, school and workplace.”

Water – in addition to being physically accessible – must also be accessible from an economic point of view. Ensuring accessibility thus implies that the cost of the resource should meet the economic possibilities of the individuals.

And lastly, the third criterion refers to the quality of the water for human consumption. In fact, the water must be healthy, clean and not contain micro-organisms, parasites or other substances in any quantity or concentration that could represent a potential hazard for human health. Furthermore, in terms of adherence to the organoleptic parameters, the water for human consumption must be colorless (transparent), odorless and tasteless. The parameters of safety and quality of the water are normally established by local or national regulations. The WHO has drawn up a set of guidelines that can be used as a ref-

Figure 2.5. Levels of accessibility to drinking water

Level of accessibility	Distance/Time	Potential volume of water gathered	Needs met	Priorities for action
No access	More than 1 km/ More than 30 minutes	Very little (usually less than 5 liters per day)	Consumption: not guaranteed. Hygiene practices: compromised	Very high - Providing a basic level
Minimu, Access	Within one mile/ Within 30 minutes	About 20 liters	Consumption: should be ensured, Hygiene practices: potentially compromised	High - Teaching of hygiene practices - ensure availability of a minimum quantity
Intermediate Access	Water available near the home by means of at least one tap	About 50 liters	Consumption: ensured, Hygiene practices: basic personal and food needs not compromised, theoretically	Low - Promotion of hygiene practices to obtain benefits in terms of health; encourage better use of the resource
Optimum Access	Water available inside the home by means of taps	About 100-200 liters	Consumption: all needs met Hygiene practices: all needs should be met	Very low - Promotion of hygiene practices to benefit in terms of health

Source: Howard, G. and J. Bartram, *Domestic Water Quantity, Service Level and Health*, World Health Organization, 2003.

erence for the development of national standards and which, if implemented adequately, guarantee the safety of the drinking water.⁵

2.2.2 Progress made on the accessibility of drinking water

In order to understand and assess the availability and quality of access globally to water resources, the international organizations use the so-called drinking water ladder. This methodology distinguishes the population based on the type of water system (distribution structure) to which it has access.

The three categories identified are:

- A** Direct access in the dwelling through pipes
- B** Indirect access through public facilities and/or wells.
- C** “Compromised” access through structures that are not adequate to protect the resource from potential contamination and/or by using inadequate tools for its collection.⁷

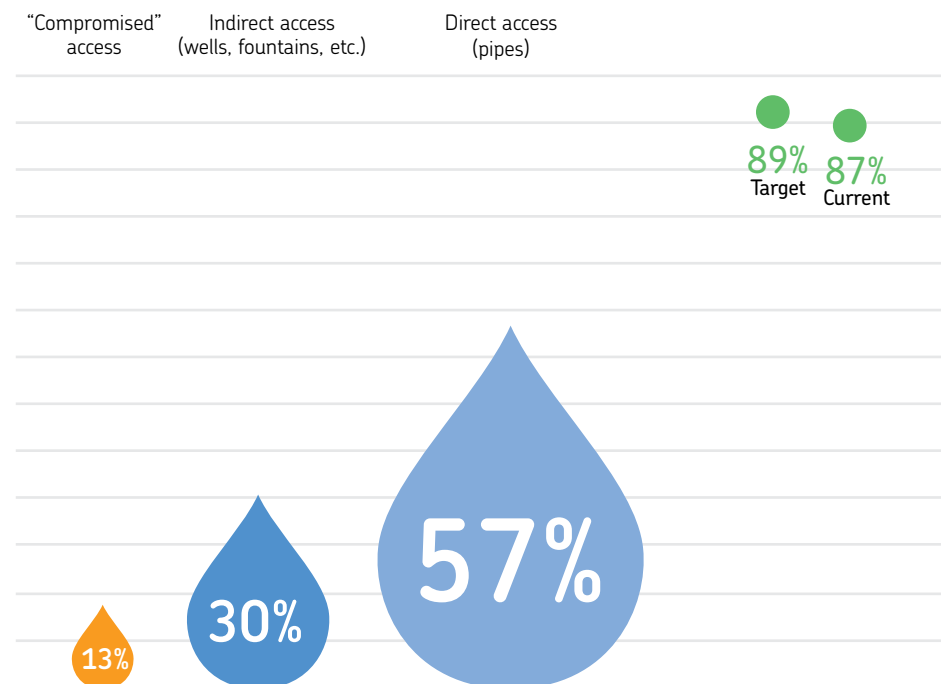
In 2008, 87% of the world population had access to drinking water through pipes (57%) and/or shared facilities, such as wells and public taps (30%). These facilities are considered adequate to ensure safe access to the resource.

Compared to 1990, about 1.8 billion more people have gained access to these types of structures.



WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

Figure 2.6. Percentage of the global population with access to drinking water according to the types of available water systems



Source: revised by The European House-Ambrosetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

MAINTAINING THE CURRENT TRENDS, BY 2015 THE PERCENTAGE OF THE POPULATION WITH ACCESS TO WATER IN THEIR HOMES WILL BE MORE THAN 90%.

By analyzing this issue at the regional level, it is clear that countries in sub-Saharan Africa are facing major challenges regarding access to drinking water: approximately one third of the 884 million people who do not qualify for a safe and constant water supply, in fact, live in these areas. Instead, in the developed regions, it is estimated that there are about 35 million people living in such conditions.

In sub-Saharan African countries, the availability of adequate structures (type A and B) is significantly lower than in other countries. However, noting the progress made since the nineties, we note that the proportion of people who benefit from direct or indirect access to water rose from 49% in 1990 to 60% in 2008 (+11%). This means that an additional 256 million Africans have access to safe water.

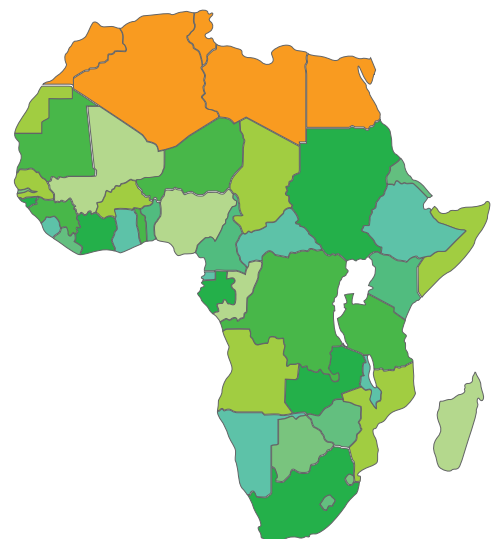
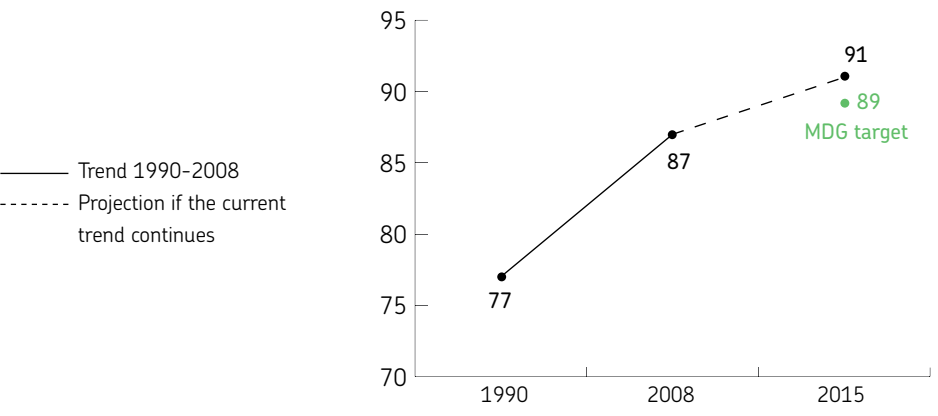
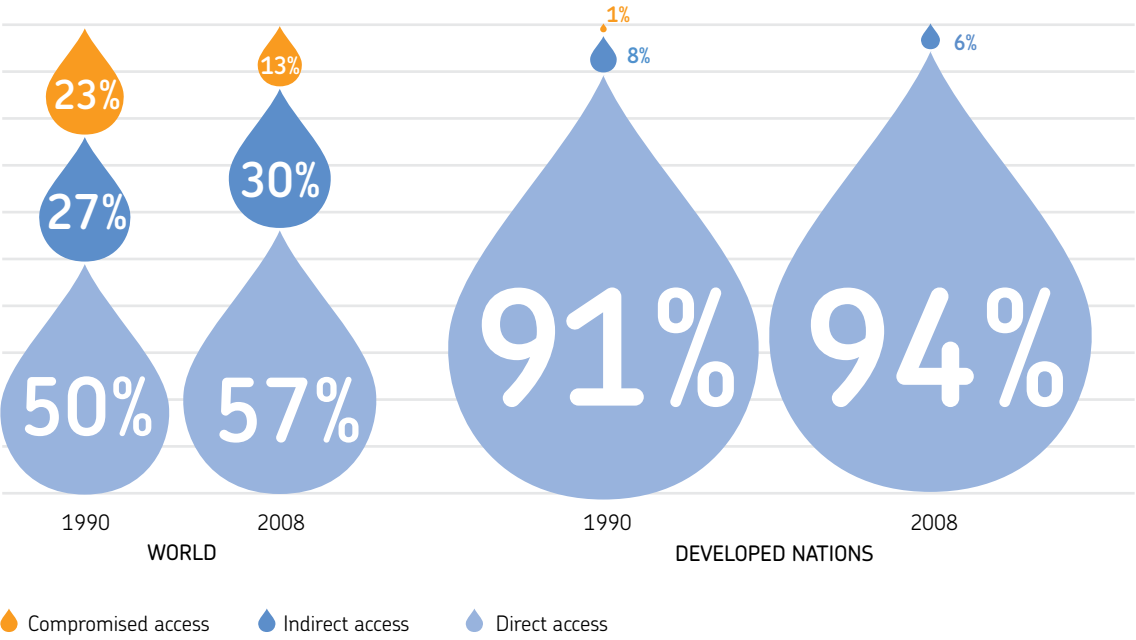


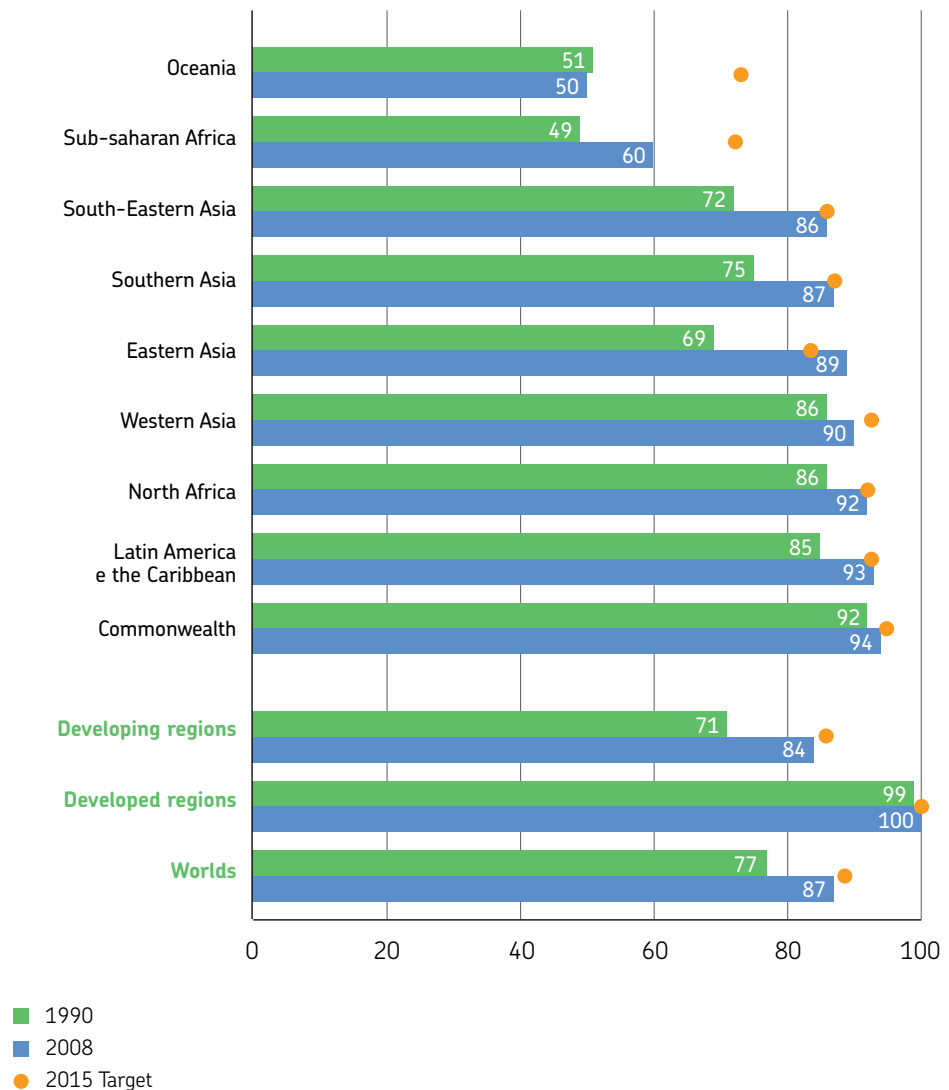
Figure 2.7. Percentage of the global population with access to drinking water by type of available water system, 1990-2008 and trend 1990-2015



Source: revised by The European House-Ambrossetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

Analyses carried out by WHO/UNICEF clearly show, therefore, that the current situation is in line with the objective that the United Nations has set. Maintaining the current trends, by 2015 the percentage of the population with access to water in their homes will be more than 90%, thus reducing the number to 672 million people still lacking it.

Figure 2.8. Percentage of the population with access to drinking water, 1990-2008 and the 2015 target



Source: revised by The European House-Ambrosetti from United Nations, *The Millenium Development Goals Report*, 2010.

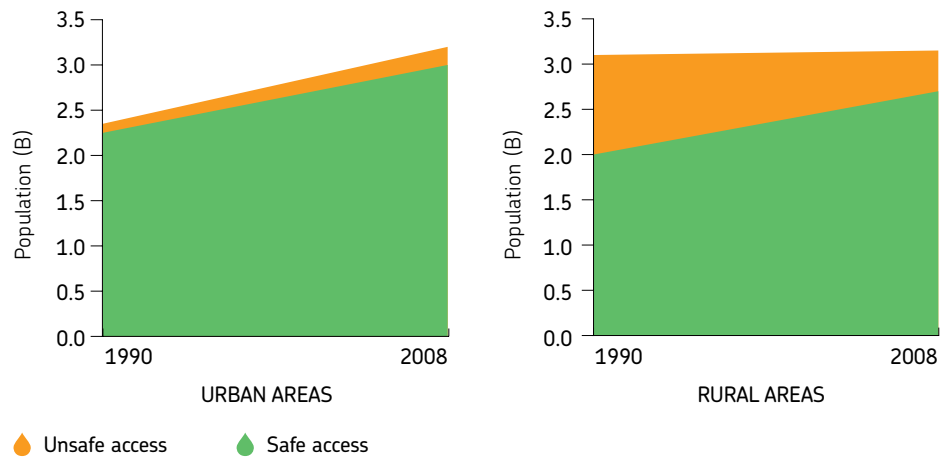
84% OF THE WORLD'S POPULATION WHICH OBTAINS ITS SUPPLIES FROM UNSAFE WATER SOURCES LIVES IN RURAL AREAS.

To highlight the most crucial areas of intervention, it is important to also analyze the situation from the point of view of the type of human settlement. In fact, one of the deepest disparities in the field of water and sanitation is that between urban and rural areas. This occurs not only because the average income tends to be lower in rural areas, but also because it is more difficult and often more expensive (on a per capita level) to provide these services to a spread-out rural population with respect to a more concentrated urban population.

As can be seen from the figure below, there are still huge disparities between urban and rural areas: at least 743 million people located in rural areas lack access to safe water supplies, as compared to 141 million people located in urban areas. 84% of the world's population which obtains its supplies from unsafe water sources lives in rural areas.



Figure 2.9. Population with access to water sources: comparison between rural and urban areas, 1990-2008



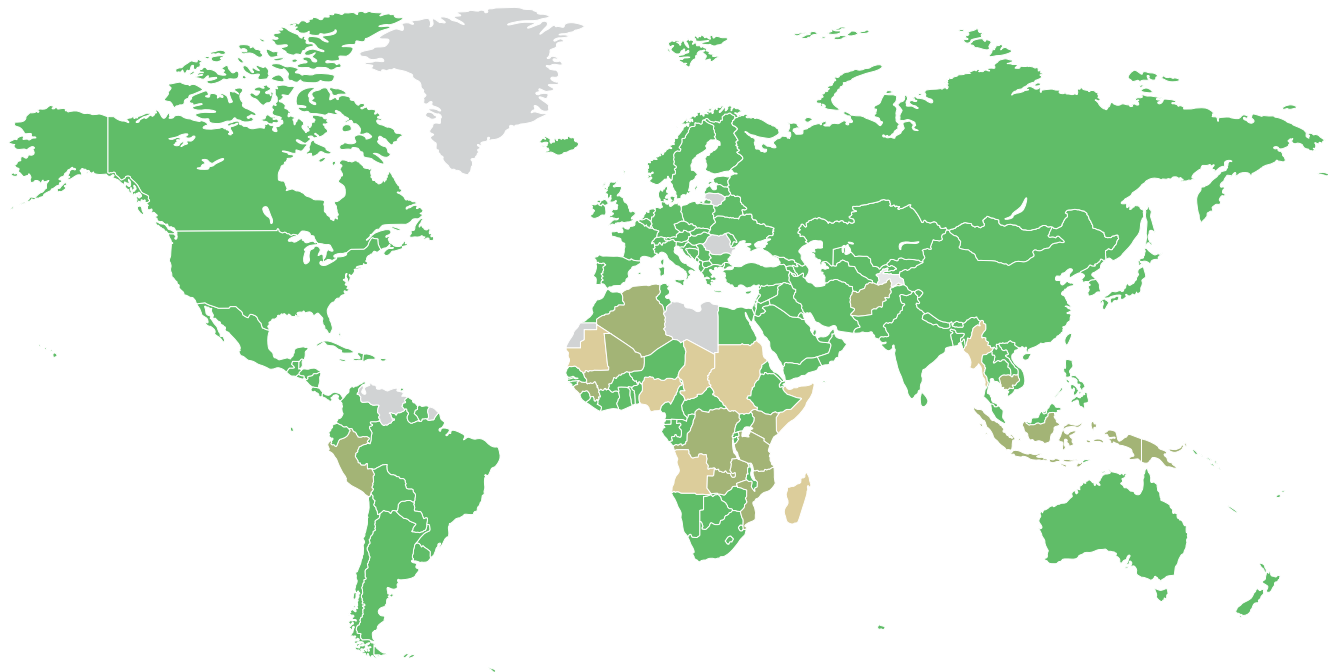
People without access to water sources (2008):
Urban areas 141 mill vs. Rural areas 743 mill

Source: revised by The European House-Ambrosetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

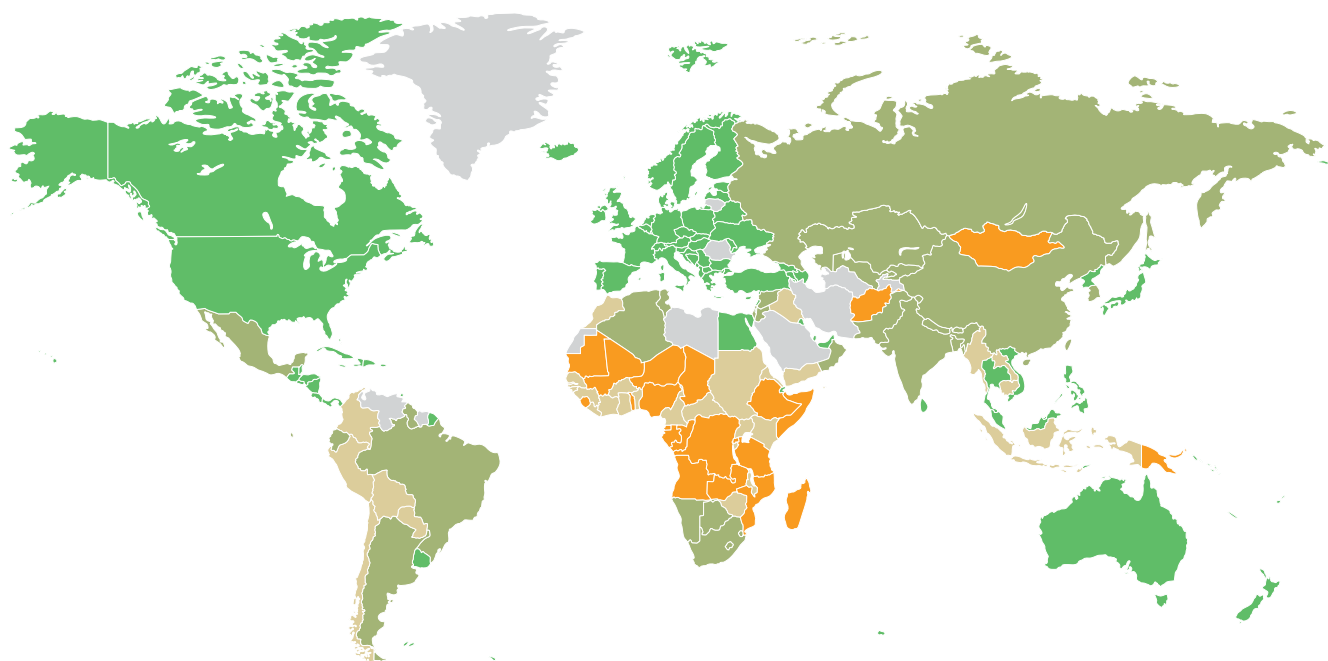
Moreover, since 1990, the urban population has grown by about 1.089 billion people: of these, only 1.052 billion people have gained access to adequate services. As a result, the sector of urban population without adequate access has grown from 104 to 141 million. Thus, meeting the growing needs of urban areas is another challenge to be reckoned with. Disparities in access between urban and rural areas is most marked in Latin America (91-100% versus 50-75%) and in regions of sub-Saharan Africa, especially in Mauritania, Liberia, Nigeria, Niger, Angola, Mozambique and Somalia, where the availability of safe water is between 50% and 75% for the population living in urban areas, compared to values lower than 50% found in rural areas.

Figure 2.10. Access to water availability from water systems of direct or indirect access: comparison between urban and rural areas, 1990–2008

URBAN AREAS



RURAL AREAS



Use of improved drinking-water sources

91–100% 76–90% 50–75% <50% No or insufficient data

Source: WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

2.2.3 Progress made in access to sanitation facilities

The Development Goal (target 10) does not refer only to water supply, but also makes explicit reference to accessibility to basic facilities of hygiene (health care facilities in housing, sewer systems, promotion of better hygiene practices, etc.)

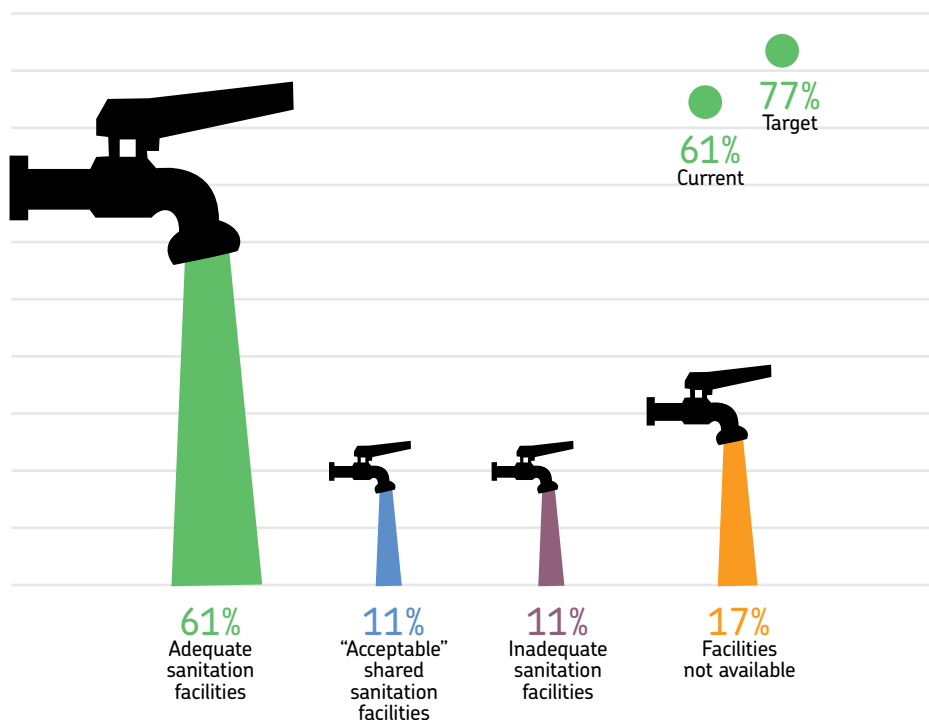
The need for health facilities and sewer systems is closely linked with the protection of water quality from contamination deriving from human and animal waste.

In order to measure the current availability and the progress made in this area, international organizations use the so-called sanitation ladder, an analysis method that divides the population according to the type of sanitary facility available. This methodology distinguishes between:

- A** Adequate sanitation facilities⁸ (61% of the world population).
- B** “Acceptable” shared sanitation facilities (11% of the world population).
- C** Inadequate facilities (11% of the world population).
- D** Facilities not available (17% of the world population)⁹.

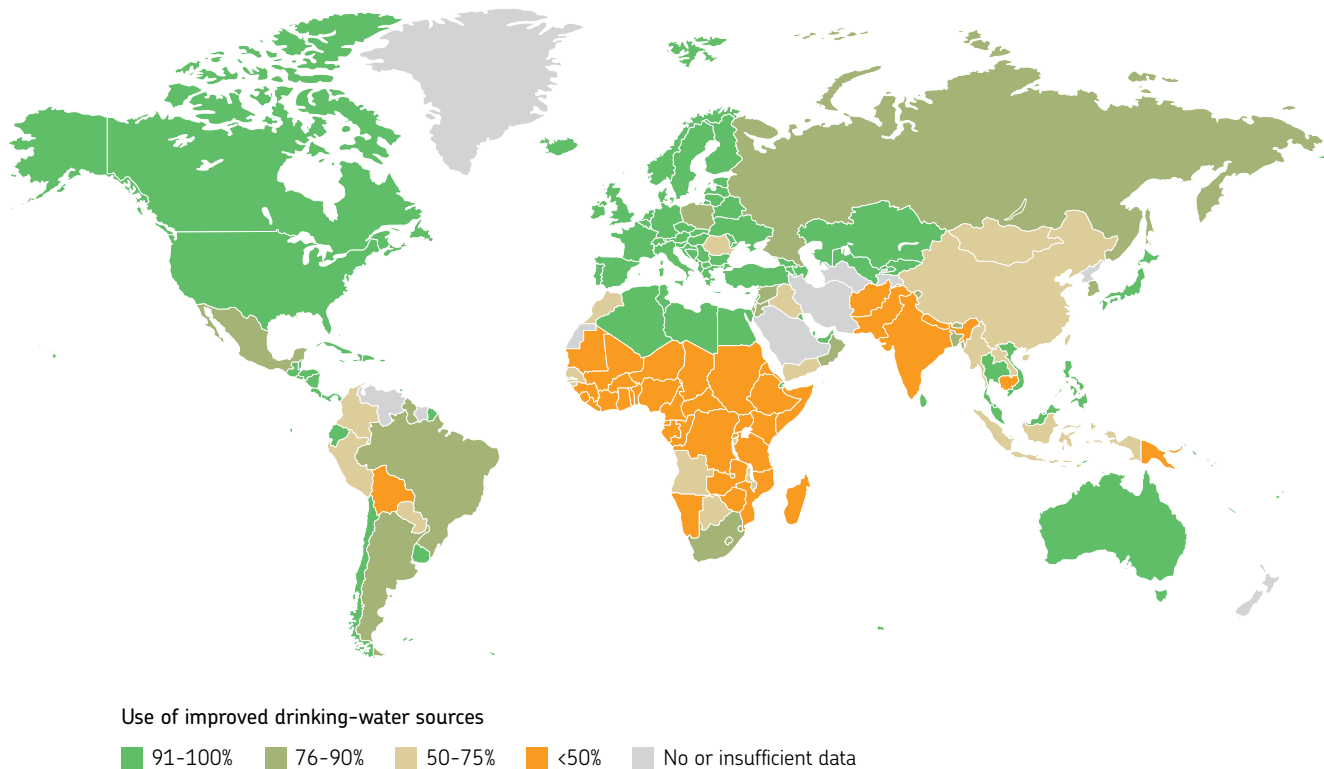
In 2008, 2.6 billion people lacked adequate sanitation. 73% (1.9 billion people) live in Asia, 22.5% in Africa (583 million), while in the developed regions, the estimation is that of 0.6% (about 15 million).

Figure 2.11. Percentages of global population by type of sanitation facility available, 2008



Source: revised by The European House-Ambrosetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

Figure 2.12. Percentage of population with availability of adequate sanitation facilities, 2008



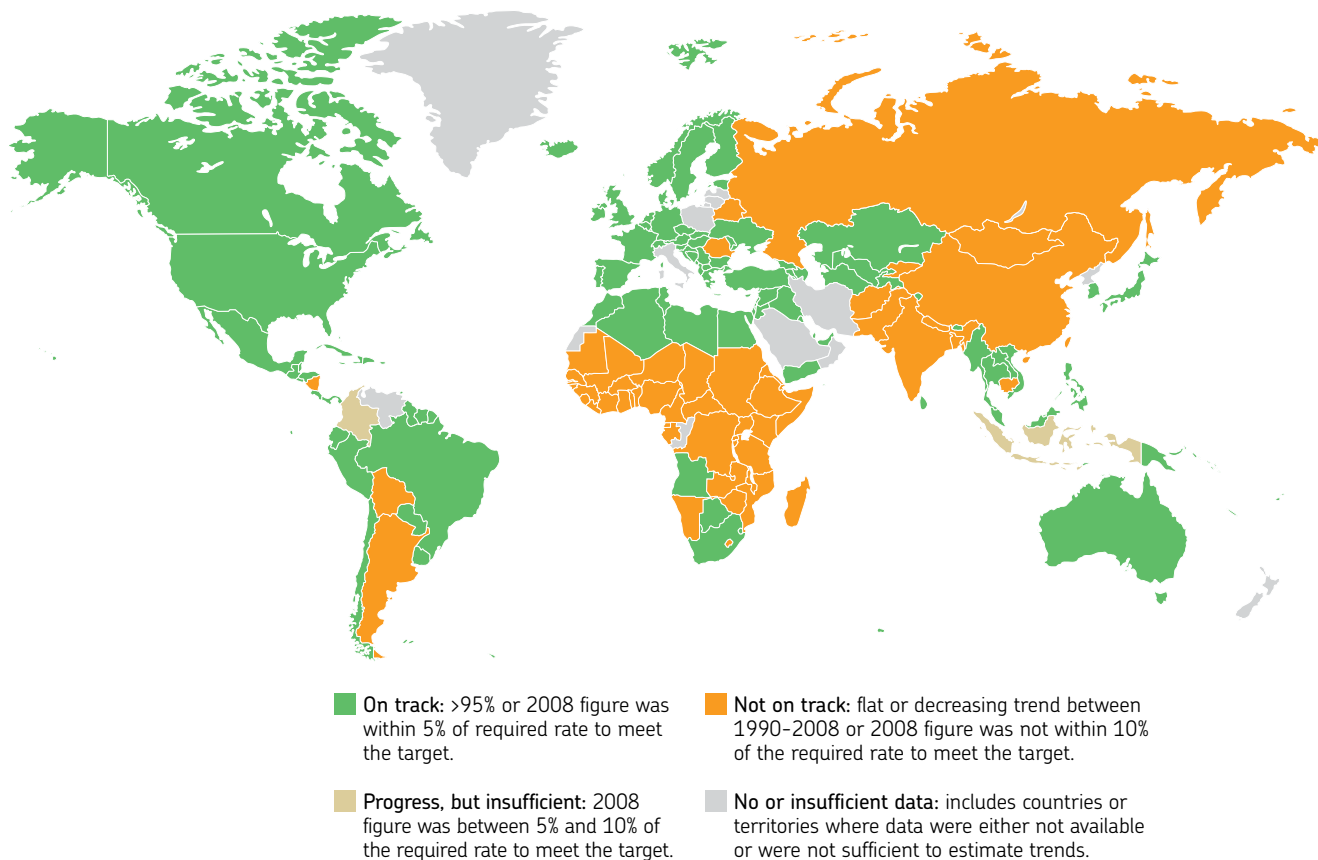
Source: WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

From 1990 to 2008, globally, about 980 million more people (+7%) have received adequate sanitation facilities. This means that the percentage of the world's population that has been satisfied is about 61% of the total (the data refers to the latest available data, relative to 2008).

Although in 2006, this percentage of the population corresponded to 62% of the total, an overall improvement in availability has nevertheless been recorded due to an increase – from 8% in 2006 to 11% in 2008 – of the population which is able to benefit from “shared” sanitation facilities.

However, this improvement is not sufficient if we consider target 10 of the Millennium Development Goals. It clearly emerges that many countries – especially those located in sub-Saharan Africa and Southern Asia – are not in line with the achievement of this goal.

Figure 2.13. Degree of achievement of the Development Goal (target 10) per country in 2008

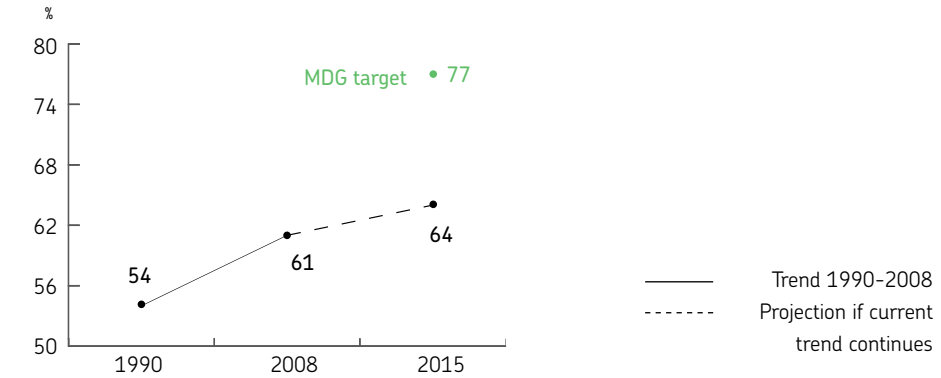
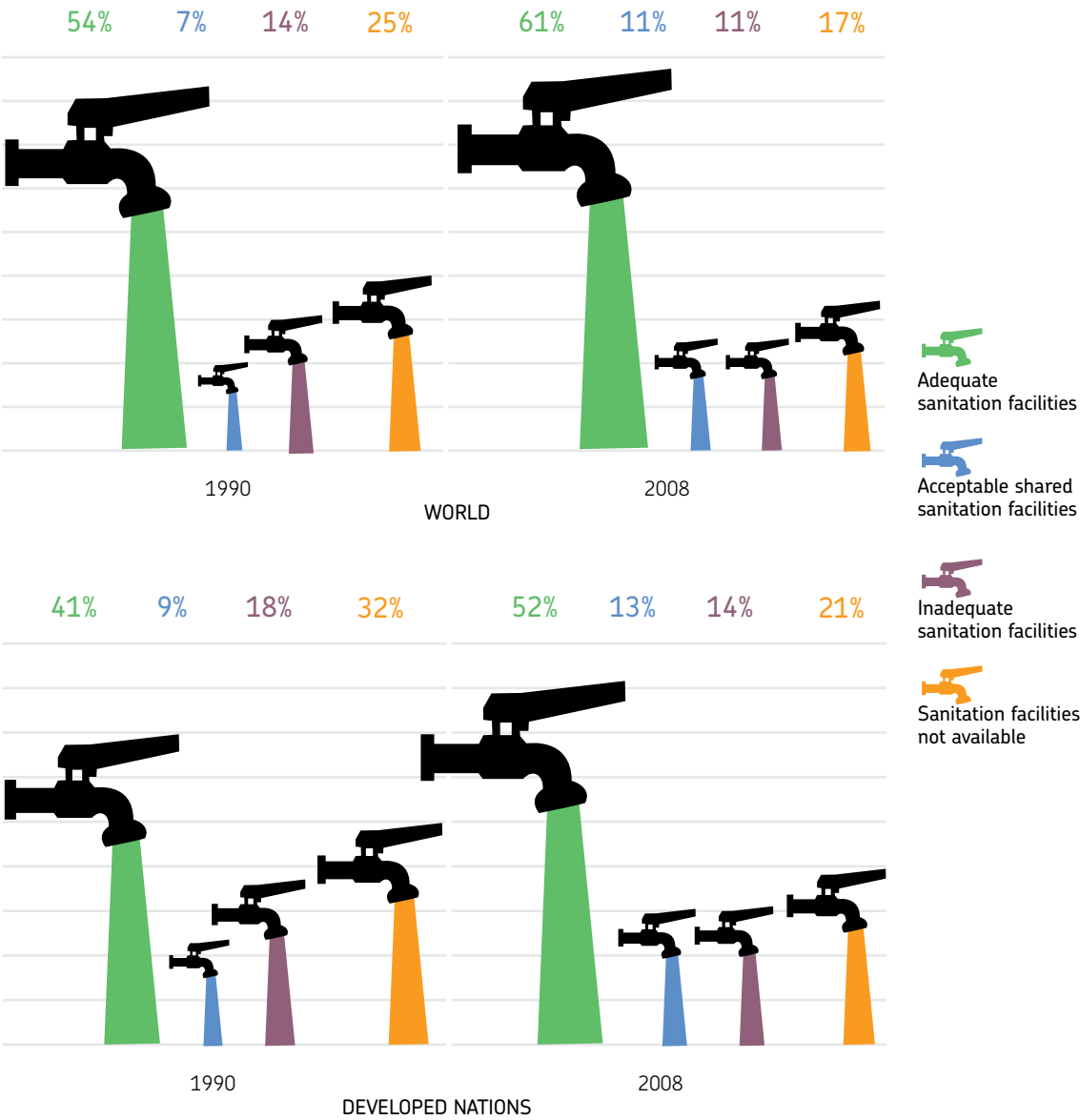


Source: WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

Unfortunately, in this regard, if current trends are maintained, it will not be possible to achieve the goal because the result would be less than 13 percentage points. It is estimated that in 2015, approximately 2.7 billion people will still have no access to basic sanitation facilities.

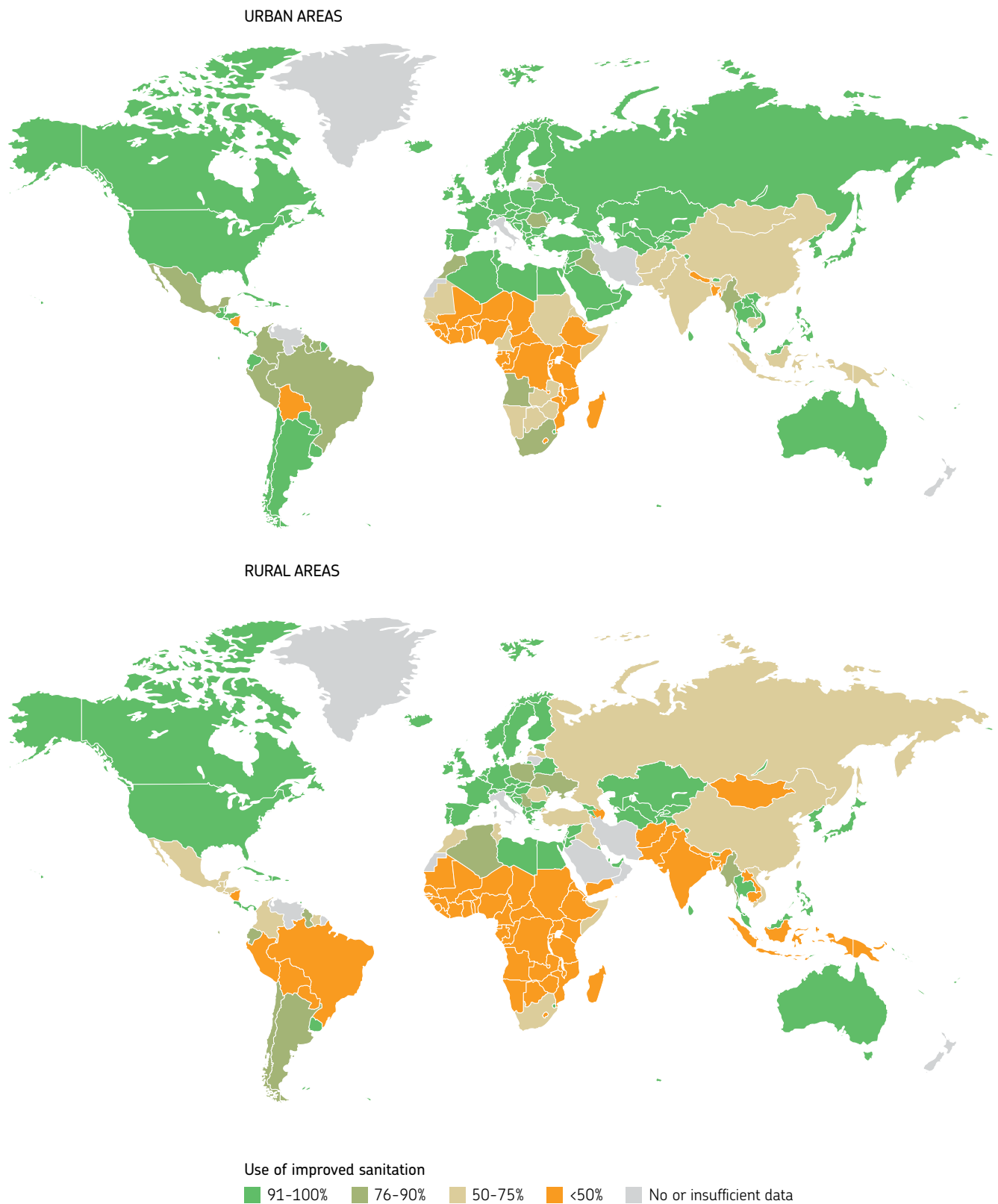
Recognizing the importance of sanitation facilities as to health, environment, poverty reduction and economic and social development, and considering the insufficient results, the United Nations also declared 2008 “International Year of Sanitation,” with the aim of addressing the problem through a greater deployment of resources and funding and to achieve a better balance. Even in this case, as already noted for water supply, there are huge disparities between urban and rural areas, especially in developing countries (Latin America and southern Africa).

Figure 2.14. Percentage of population by types of sanitation facilities available, 1990-2008 and 1990-2015 trends



Source: revised by The European House-Ambrossetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

Figure 2.15. Availability of sanitation facilities: comparison between urban and rural areas, 1990-2008

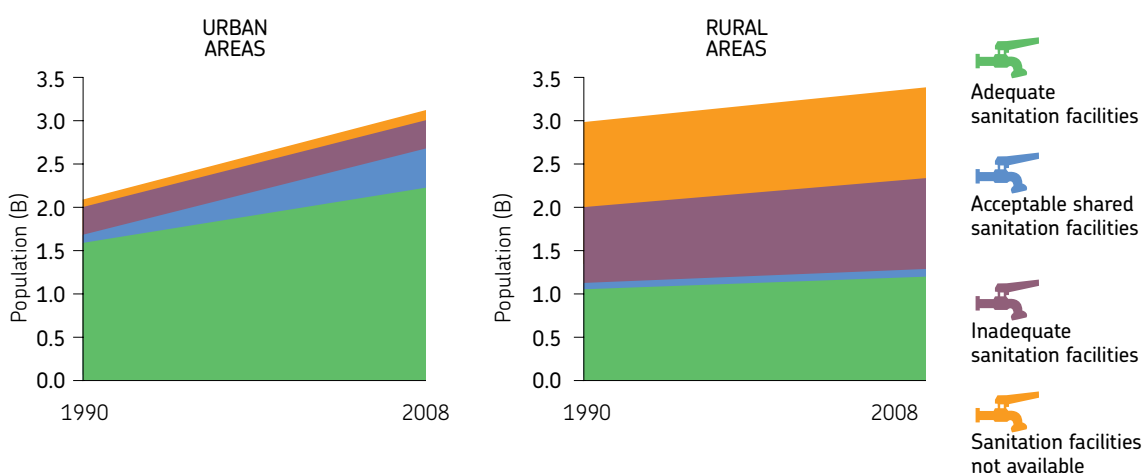


Source: WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

The percentage of people with access to adequate services in urban areas has reached 76%, compared to 45% in rural areas. This means that more than 7 out of 10 people without health care facilities live in rural areas.

The growing urbanization process taking place is an increasingly critical challenge. In fact, since 1990, although 813 million people have obtained access to proper sanitation facilities (type A), an additional 276 million have not been able to benefit from it. The offer of this service, therefore, is not able to maintain the same growth rate as the urban population (+1089 million people in 2008 compared to 1990).

Figure 2.16. Percentage of population as to type of sanitation facilities available: comparison between urban and rural areas, 1990–2008



Percentage of population with access to adequate sanitation facilities (2008):
Urban areas 76% vs. Rural areas 45%

Source: revised by The European House-Ambrosetti from WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010.

If current trends are maintained, it will not be possible to achieve the goal because the result would be less than 13 percentage points. It is estimated that in 2015, approximately 2.7 billion people will still have no access to basic sanitation facilities.

Actions to improve the water supply and sanitation system of a community should not be undertaken in isolation, but should subscribe to a coherent and cross-sector development strategy, including infrastructures, education and governance skills.

Indeed, achieving a sustainable and effective functioning of the structures over time requires periodic maintenance, as well as education and the creation of adequate professional figures. In addition, the spreading of information on the collection/preservation of water resources at households is critical for maintaining the water's organoleptic qualities and to prevent the creation of a potential habitat for disease-carrying pests.

Achieving the objectives that the UN has set calls for a joint involvement of all local and international actors, whether they be in public or private sectors.

IF CURRENT TRENDS ARE MAINTAINED, IT WILL NOT BE POSSIBLE TO ACHIEVE THE GOAL BECAUSE THE RESULT WOULD BE LESS THAN 13 PERCENTAGE POINTS. IT IS ESTIMATED THAT IN 2015, APPROXIMATELY 2.7 BILLION PEOPLE WILL STILL HAVE NO ACCESS TO BASIC SANITATION FACILITIES.

China and India: great progress made in the accessibility to drinking water and sanitation facilities

Even though China and India host more than a third of the world's population, since 1990 until today, both countries have made considerable progress in improving the access of their populations to safe water and basic sanitation.

In 2008, in fact, as much as 89% of China's population (about 1.2 billion people out of a total of 1.3) and 88% of the Indian population (about 1.1 billion people out of a total of 1.2) had access to drinking water, against 67% and 72%, respectively, in 1990.

As shown in Figure 2.17, the people of China and India account for almost half (47%) of the people worldwide who were denied access to adequate water systems between 1990 and 2008, thus highlighting the importance of these two countries regarding the global situation of the availability of drinking water for the population.

The achievement of the Millennium Development Goals is, therefore, highly dependent on the results of these countries.

Upon analyzing the availability of basic sanitation structures, it is evident that 38% of the global population living in China and India had access to improved basic sanitation systems between 1990 and 2008. In other words, during this period, 4 out of 10 people who had access to such facilities were living in these two countries.

Nevertheless, although between 1990 and 2008, the proportion of people with access to such services increased both in China (from 41% to 55%) and in India (from 18% to 31%), on a global level the achievement of the sanitation development goal appears to be compromised (-13% in 2015, as compared to the set target).

Figure 2.17. Distribution of the population with direct and indirect access to drinking water

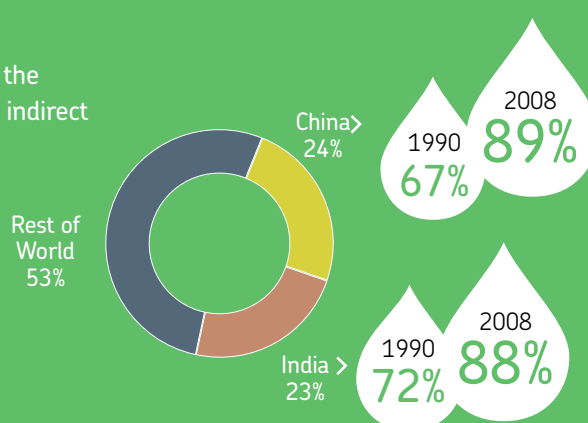
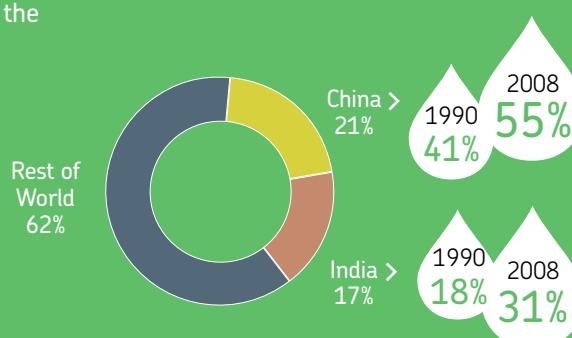


Figure 2.18. Distribution of the population with access to adequate sanitation



2.2.4 Cost-benefit Analysis

A cost-benefit analysis conducted by the WHO¹⁰ on the real possibility of achieving target #10 of the Development Goal number 7 by 2015 and its related plan of actions, estimated that every U.S. dollar invested in improving access to water and sanitation would generate economic returns ranging from 3 to 34 U.S. dollars.¹¹ Obviously, this amount varies depending on the starting conditions of the area which is the object of intervention and the technologies utilized.

In particular, achieving this goal would mean:¹²

- an annual reduction of \$7.3 billion in public health expenditure and, in parallel, a yearly reduction of \$340 million in private health spending;
- an annual gain of 1.5 billion days for the health of children under 5 years of age, 272 million days of school, 320 million working days (for the population between 15 and 59 years of age), with a value of approximately \$9.9 billion;
- time savings generated by an easier water supply, for a total of about \$63 billion a year.

Against these benefits, it is estimated that the total amount needed for the realization of the target for developing countries is:

- about \$42 billion, for the portion of the goal related to the creation of infrastructures to allow safe access to water;
- about \$142 billion for the portion of the goal related to meeting the sanitation needs.

This translates into a per capita expenditure of \$8 for the first sub-goal and \$28 for the second.¹³ The estimated total annual investment from 2005 until 2015, is therefore about 18 billion dollars¹⁴ (\$4 billion for water and \$14 billion for the health and hygiene portion) compared with around 84 billion dollars a year in total benefits.

EVERY U.S. DOLLAR
INVESTED IN IMPROVING
ACCESS TO WATER AND
SANITATION WOULD
GENERATE ECONOMIC
RETURNS RANGING FROM
3 TO 34 U.S. DOLLARS.

NOTES

1. This is what the Secretary of the United Nations at the time said in his inaugural address “Water for Life Decade 2005–2015.” Source: United Nations, *Access to Safe water priority as UN Marks Beginning of International Decade*, New York, March 17, 2005.
2. The United Nations Committee on economic, social and cultural rights (UN CESCR) is the body charged with monitoring the implementation by the member States of the International Covenant on economic, social and cultural rights and is therefore in compliance with the principles enunciated by the *Universal Declaration of the Rights of Man*.
3. UN CESCR, *General Comment No. 15*, 2002 (the document that enumerates a series of guidelines addressed to the Member States of the United Nations concerning the interpretation of specific aspects of the human rights treaty, under the jurisdiction of the issuing body).
4. United Nations, *United Nations Millennium Declaration*, New York, September 2000.
5. WHO/UNICEF, Joint Monitoring Programme for Water Supply and Sanitation (JMP), *Progress on Drinking Water and Sanitation*, 2008.
6. World Health Organization, *Guidelines for Drinking-water Quality*, third edition, 2008.
7. The World Health Organization has classified such structures as these following types: “improved,” “other improved,” “unimproved” (WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010).
8. Sanitation structures avoiding contact between humans and their excrements. These include: flush toilets, related sewer systems, cesspools, etc. The WHO classifies these facilities in the following categories: “improved sanitation facilities,” “shared sanitation facilities,” “unimproved sanitation facilities,” “open defecation” (WHO/UNICEF, *Progress on Drinking Water and Sanitation*, 2010).
10. WHO, *Safer Water, Better Health: Cost, Benefits and Sustainability of Interventions to Protect and Promote Health*, 2008. Hutton, G. and J. Bartram, *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level*, WHO, 2008.
11. According to a study by the United Nations, the economic return (always measured in terms of reducing health care costs, and increased profitability and time savings) is \$8 for every dollar invested in achieving the goal. (UNDP, *Human Development Report 2006*, 2006).
12. Estimate on a global level.
13. Hutton, G. and J. Bartram, *Regional and Global Costs of Attaining the Water Supply and Sanitation Target (Target 10) of the Millennium Development Goals*, WHO, 2008.
14. According to the authors, this data is in line with estimates published in previous studies, the last of which, in 2004, predicted a total annual expenditure of \$11.3 billion. The latest estimates emphasize the need to not focus the scope of analysis only on new structures, but also to consider the existing ones and therefore the maintenance costs associated with them. In fact, it has been estimated that the cost of maintenance needed to maintain an optimal state in existing plants is about 54 billion dollars a year.





3. CHOICES AND PRACTICES FOR SUSTAINABLE WATER CONSUMPTION



3.1 THE WATER FOOTPRINT

THE WATER FOOTPRINT IS A COMPLEX, MULTI-DIMENSIONAL INDICATOR THAT SHOWS THE VOLUME OF WATER CONSUMED PER SOURCE AND THOSE THAT ARE CONTAMINATED AS TO TYPE OF CONTAMINANT; ALL COMPONENTS OF THE WATER FOOTPRINT ARE SPECIFIC IN BOTH GEOGRAPHICAL AND TEMPORAL TERMS.

Water content – or more accurately, the water footprint or the virtual water content – of a product (commodity, good or service) is the volume of fresh water consumed directly or indirectly to achieve it, calculated by adding up all stages of the production chain. The term “virtual” refers to the fact that most of this water is not physically contained in the product, but is relevant to the direct and indirect consumption required for its production throughout its life cycle.

The water footprint¹ is a complex, multi-dimensional indicator that shows the volume of water consumed per source and those that are contaminated as to type of contaminant; all components of the water footprint are specific in both geographical and temporal terms.

As an indicator of “water consumption,” the water footprint differs from merely “taking a water sample” with regard to three parameters:

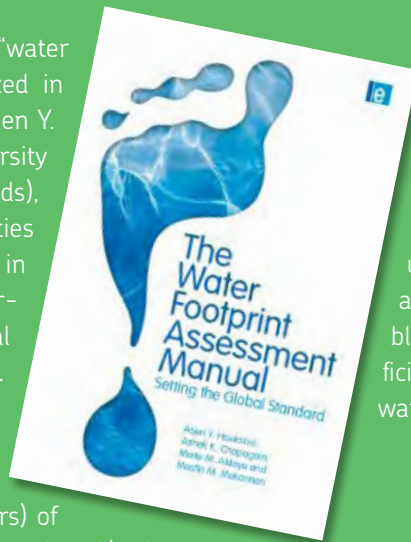
- it does not consider the volume of water that is withdrawn, but that which does not return
 - to the same source from which it has been taken;
 - it is not the mere consumption of water, but it also takes into consideration the volumes that are “absorbed” by the product and those which are polluted by production process;
- it does not just take into consideration the direct consumption of water, but also that which is indirect.

The water footprint, therefore, offers a broader and deeper insight into water use by a consumer or producer;² however, it does *not* measure how large the consumption of water is nor its pollution at the local level. The local environmental impact due to a given consumption and subsequent pollution of water is a function of the vulnerability of the local water system, namely the number of users of the water resource that is used and then polluted. The water footprint calculates the information on water use by humans for different purposes and activities explicitly in space-time terms. It is, therefore, necessary to bear in mind that a proper allocation and a sustainable and equitable use of water certainly contribute to creating a solid basis for the analysis of social, economic and environmental impacts at the local level.

This analysis has been conducted using the study of the life cycle, which permits the objective assessment of all the energy and environmental impacts related to a process.

The Water Footprint Network and its history

The concept of the “water footprint” was theorized in 2002 by Professor Arjen Y. Hoekstra of the University of Twente (Netherlands), as part of the activities promoted by UNESCO in the search for an alternative to the traditional indicators of water use. The water footprint measures the use of resources in terms of volume (in cubic meters) of water that has evaporated and/or been polluted during the entire chain, from production to direct consumption, which can be calculated not only for every product or activity, but also for every well-defined group of consumers (an individual, a family, the inhabitants of a city, a nation) or producers (private companies, public organizations, economic sectors). The water footprint is related to the concept of virtual water theorized by Professor John Anthony Allan of King’s College London, School of Oriental and African Studies in 1993, which shows the volume of the fresh water consumed to produce a product (commodities, goods or services) by adding together all the phases of the production chain. The Water Footprint Network (of which Hoekstra is the scientific director) is a non-profit organization founded in 2008, fruit of the major organizations involved in the issue of water resources, (including the University of Twente, WWF, UNESCO, the Water Neutral Foundation, the World Business Council for Sustainable De-



velopment, etc.), in order to coordinate activities in this field, to raise awareness of the water footprint, of the methods and tools used for its calculation, and to promote equitable, sustainable and efficient use of the global water resources.

The analysis of the life cycle of a product

The estimate of the environmental impact associated with any single food or product can be conducted with the analysis of the life cycle (Life Cycle Assessment – LCA), a method of objective assessment of energy and environmental impacts related to a process (whether it be an activity or service). This estimate includes the analysis of the entire supply chain, including the extraction or cultivation and the processing of raw materials, manufacturing, packaging, transportation, distribution, use, reuse, recycling and final disposal.

The LCA analysis method is regulated by ISO 14040 and 14044 of the international standards, which define its particular characteristics.

The LCA studies are tools of scientific analysis that, on the one hand, have the advantage of allowing an assessment of the system that is as objective and complete as possible, and on the other, the disadvantage that the results are sometimes difficult to communicate. To make it easier to understand the results of a study, summary indicators are normally used, defined so as to preserve the scientific analysis as much as possible. These indicators are typically selected based on the type of system being analyzed and they should be chosen to represent the interactions with the major environmental sectors in the most complete and easiest way.

To be more specific, focusing on the agricultural industries, the analysis of the processes leads us to underline that the main

environmental impacts are represented by the generation of greenhouse gases, the use of water resources and the occupation of territory.

The indicator chosen and reported in this document is the water footprint, which quantifies the consumption and ways to use water resources, and is measured in volumes of water consumed or polluted per unit of product.

Two other very important indicators used in conjunction with the water footprint³ are the carbon footprint and the ecological footprint. The first is the emission of greenhouse gases responsible for climate change and is measured in the equivalent CO₂ mass. The second measures the amount of biologically productive land (or sea) necessary to provide resources and absorb the emissions associated with a production system and is estimated in square meters or global hectares.

This publication deals with the issue of water and its attention, therefore, is directed chiefly at the water consumption for products, goods and services in common use, using the water footprint as the sole indicator of reference. However, it is important to remember that in order to have a clear overall vision of the environmental impact of a product, it is always necessary to also take into account the other indicators, in order to provide a sufficiently complementary view of the impacts, avoiding those that are piecemeal and, in some cases, misleading.

Figure 3.1. The life cycle of a product





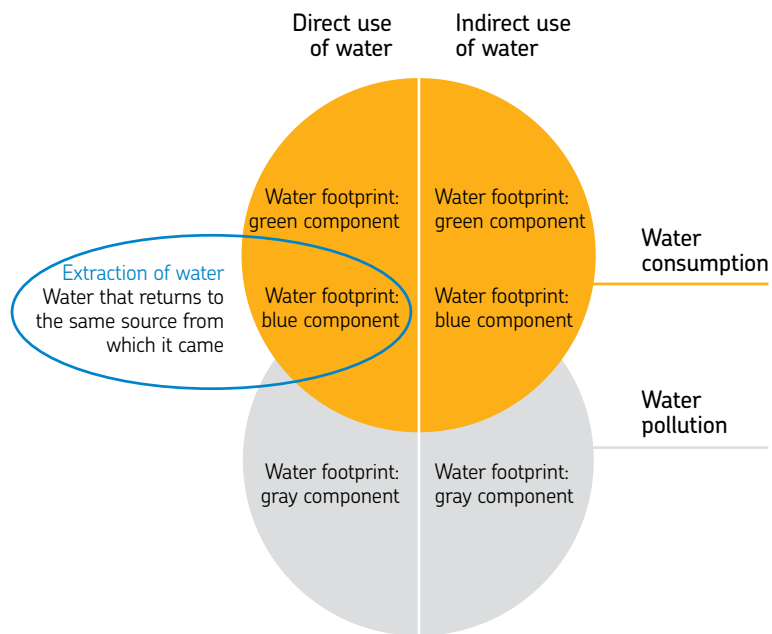


3.2 Calculation of the green, blue and gray water footprint

The water footprint has three components:

- the *green water footprint* is the volume of rainwater that evaporates during the production process;
- the *blue water footprint* is the volume of water used in the production process that does not return to the water source from which it came;
- the *gray water footprint* is the volume of polluted water, which can be quantified by calculating the volume of water needed to dilute the pollutants released into the water system during the production process.⁴

Figure 3.2. Schematic representation of the components of the water footprint of a consumer or producer



Source: Hoekstra et al., *The Water Footprint Assessment Manual*, 2011.

The figure shows the different components of the water footprint and helps to understand how the portion of water withdrawn and not consumed (which returns to the source from which it was extracted) is not counted in the calculation. Moreover, it explains – in contrast to what is done to measure a mere sampling of water – how this is included in the green and gray water footprint, as well as the components related to the indirect use of water.

The water footprint, in fact, does not just take the direct use of water into account, (i.e. to produce a good or service or supporting activities), but also the indirect content (i.e. consumption relating to the entire production chain).

For example, the water footprint of an activity is defined as the total volume of water used directly and indirectly by the activity itself and, therefore, is the total amount that can be associated to the outputs of the system. The direct use of water is equal to the volume used in the production or support activities, while the indirect use is the volume used at

the inception of the process or activity under consideration which includes, for example, water consumption for the production of raw materials.

The use of the three components of virtual water affects the hydrogeological cycle differently. For example, the consumption of green water has a less invasive impact on the environmental balance than that of blue water, which, however, is the most strategic and important water resource.

The component that is relatively simpler to calculate is the blue water footprint of a product, which can be traced to the accounting of the water consumption by a more or less complex industrial system.

Therefore, the volume of water that is diverted from its course must be considered to be that which evaporates during the production process. In the case of agricultural crops, it is the amount of irrigation water that evaporates from the soil and the evaporation from irrigation canals and artificial reserves. In the case of industrial and domestic purposes, it means the amount of water drawn from water sources or reservoirs that has evaporated, and thus is not re-entered into the water system from which it came.

In the case of food production chains, for example, it takes into account both the water which evaporated as a result of its use during the industrial production and of that which evaporated as a result of irrigation in the agricultural phase.

In the latter case, for simplicity, it can be assumed that all water used for irrigation has evaporated or not returned to the same body of water from which it came, and thus, comes to be a part of the component of impact. This hypothesis is, in fact, a precaution because if the water of the upper aquifer is used to irrigate, part of what goes onto the ground might actually fall in the water table, immediately replenishing the reserve from which it was taken (this is true if the water has been taken from the same aquifer that it goes to replenish). The estimation of the gray water component must be made by taking into account both the characteristics of the water released from the system and the natural conditions of the receiving body into which it is released.

The volume of gray water, in fact, is calculated as the amount of water (theoretically) required to lower the level of the pollutant to the legal limits and which is then discharged at the end of the production processes upon (presumably) reaching the levels of natural concentration for the receiving water body in question. For example, if it is a matter of calculation of the gray water footprint for cultivation, it is necessary to take into account such factors as the amount of fertilizer used, the fraction that actually leaches into the soil and the yield of the crop, in addition to the maximum concentration legally admissible and the natural concentration that in some cases may be set at zero.

The most characteristic and complex feature to consider is certainly the part of the green water used specifically for agricultural production and biomass, in that it depends on the local climate and the type of crop species. In essence, this component represents rainwater evapotranspiration.

The green water footprint is an especially relevant component for agricultural crops (including the transpiration from plants and other forms of evaporation).

Again, the operational difficulties of the calculation are simplified by the availability of tools and public data provided by the FAO, which measure the green water footprint of a product taking into consideration the influence generated by the species and the area of the world where it is grown.

The following table lists some examples of the average global water footprint of some of the most common cereals (with details of the division into the green, blue and gray components) in the study by Hoekstra⁵ published in 2011.

THE USE OF THE
THREE COMPONENTS
OF VIRTUAL WATER
AFFECTS THE
HYDROGEOLOGICAL
CYCLE DIFFERENTLY.

Figure 3.3. Comparison of the average global water footprint of some cereals

Agricultural Product	Green Water Footprint	Blue Water Footprint	Gray Water Footprint	Total Water Footprint
Wheat	1277	342	207	1827
Wheat (Italy)*	1200	16	189	1405
Rice (paddy fields)	1146	341	187	1673
Barley	1213	79	131	1423
Corn	947	81	194	1222
Rye	1419	25	99	1544
Oats	1479	181	128	1788

Sources: Mekonnen, M. and A.Y. Hoekstra, *The Green, Blue and Grey Water Footprint of Crops and Derived Crop Products*, Hydrology and Earth System Sciences Discussions Editor, n. 8, pp. 763-809, Copernicus Publications, Göttingen, Germany, 2011. *The data relates to the grain produced in Italy and comes from the study by Mekonnen, M. and A.Y. Hoekstra, *A Global and High-Resolution Assessment of the Green, Blue and Grey Water Footprint of Wheat*, Water Research Report Series, n. 42, UNESCO-IHE Institute for Water Education Editor, Delft, The Netherlands, 2011.

TO CALCULATE THE GREEN WATER FOOTPRINT OF A SIMPLE FOOD SUCH AS TOMATOES, YOU NEED TO KNOW THE AREA OF ORIGIN, THE CHARACTERISTICS OF WEATHER AND CLIMATE AND THE CULTIVATION PERIOD.

For example, to calculate the green water footprint of a simple food such as tomatoes, one needs to know the area of origin, the characteristics of weather and climate and the cultivation period. Depending on these characteristics and the place where the product is grown, it can also be inferred whether or not irrigation is necessary, and then the blue water footprint can be calculated. Finally, depending on the type and amount of fertilizer used, an estimate must be made of the amount of virtual water required to dilute these contaminants up to the return of that used for irrigation back to the natural concentration, i.e., the gray water footprint.

Evapotranspiration

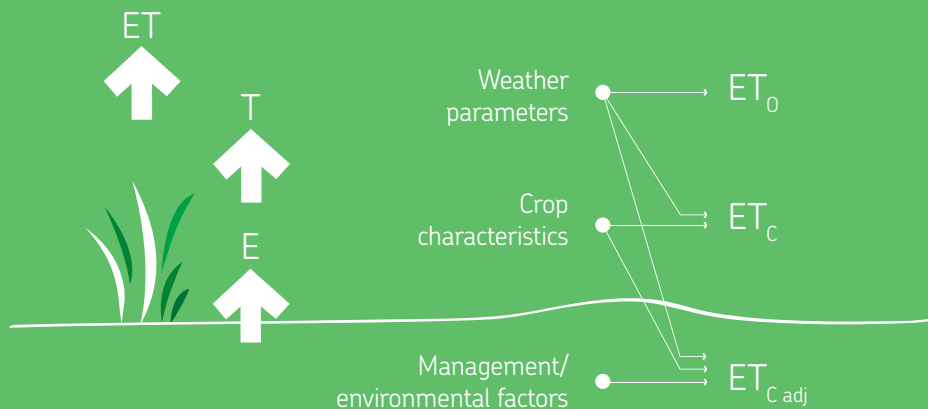
Evapotranspiration (ET) is a variable or physical quantity that is the amount of water (per unit of time) that goes from the ground into the air to become vapor due to the combined effect of transpiration (T), through plants, and evaporation (E), directly from the soil.

The concept encompasses two distinctly different processes (since, strictly speaking, the evaporation goes beyond that of the cultivation); however, one cannot separate the two phenomena and treat them separately. On the other hand, for all practical purposes, it is the actual consumption, both by evaporation and by

transpiration, that is of concern. The unit of measurement is the millimeter, defined as the height of the mass of evaporated and transpired water. Although it is a climatic phenomenon which is the opposite of rainfall, conventionally the millimeter is used to make the size directly comparable with the precipitation.

Evapotranspiration is the result of the coming together of several factors depending on the nature of the terrain, climate, agricultural species and cultivation technique. These factors cannot be distinguished because the evapotranspiration is the result of their interrelationships.

Figure 3.4. The evapotranspiration process



3.3 THE VIRTUAL WATER CONTENT OF SOME PRODUCTS AND FOOD

FARM PRODUCTS (MEAT, EGGS, MILK AND DAIRY PRODUCTS) HAVE A HIGHER VIRTUAL WATER CONTENT THAN THOSE WHICH ARE CULTIVATED BECAUSE LIVESTOCK CONSUME A LARGE AMOUNT OF CEREALS AS FOOD FOR SEVERAL YEARS.

The water footprint concept can also be applied to products of common use to make manifest the direct and indirect use of water to produce what is consumed daily, such as agricultural products (from the cultivation of plants and breeding animals), which account for about 70% of the water that is used by humans globally.

In particular, farm products (meat, eggs, milk and dairy products) have a higher virtual water content than those which are cultivated because livestock consume a large amount of crops as food for several years, before being processed into food products (in addition to the direct consumption of water for drinking and other operations).

The table below shows the value of virtual water for some types of agricultural products in amounts of product easily found in the everyday lives of consumers and in finished industrial products (such as a T-shirt, a sheet of A4 paper, etc.).⁶

In the end, it should be stressed that the water footprint of a product does not always have the same value everywhere in the world, but varies depending on its origin. For example, if you look at an agricultural product in terms of water consumption, it has a different impact depending on the area where it was produced, the characteristics of the local climate and weather, water availability and whether it needs to be watered.

In this regard, compare the water footprint of wheat in Italy (2421), which is equal to four times that of China (690), or maize in India (1937), and also equal to four times that in the United States (489).

Figure 3.5. Water footprint of some agricultural products (m³/ton) in some countries

	World average	USA	China	India	Russia	Brazil	Italy
Rice	3419	1903	1972	4254	3584	4600	2506
Wheat	1334	849	690	1654	2375	1616	2421
Maize/Corn	909	489	801	1937	1397	1180	530
Soy	1789	1869	2617	4124	3933	1076	1506
Beef	15,497	13,193	12,560	16,482	21,028	16,961	21,167
Pork	4856	3946	2211	4397	6947	4818	6377
Goat	4043	3082	3994	5187	5290	4175	4180
Sheep	6143	5977	5202	6692	7621	6267	7572
Chicken	3918	2389	3652	7736	5763	3913	2198
Eggs	3340	1510	3550	7531	4919	3337	1389
Milk	990	695	1000	1369	1345	1001	861
Cheese	4914	3457	4963	6793	6671	4969	4278

Source: revised by The European House-Ambrosetti from Hoekstra, A.Y. and A.K. Chapagain, *Water Footprints of Nations: Water Use by People as a Function of Their Consumption Pattern*, in Craswell, E., M. Bonnell, D. Bossio, S. Demuth and N. Van De Giesen (edited by), *Integrated Assessment of Water Resources and Global Change – A North-South Analysis*, Springer, 2007.

Figure 3.6. Global average water footprint of some types of commonly used products (liters).

<div>Sheet of A4 paper (80 g/m²)</div> <div><div>10</div></div>	<div>Tomato (70 g)</div> <div><div>13</div></div>	<div>Potato (100 g)</div> <div><div>25</div></div>
<div>Slice of bread (30 g)</div> <div><div>40</div></div>	<div>Orange (100 g)</div> <div><div>50</div></div>	<div>Apple (100 g)</div> <div><div>70</div></div>
<div>Egg (40 g)</div> <div><div>135</div></div>	<div>Bag of potato chips (200 g)</div> <div><div>185</div></div>	<div>Slice of cake (80 g)</div> <div><div>250</div></div>
<div>Piece of cheese (100 g)</div> <div><div>500</div></div>	<div>Piece of chocolate (50 g)</div> <div><div>860</div></div>	<div>T-shirt (250 g)</div> <div><div>2000</div></div>
<div>Hamburger (150 g)</div> <div><div>2400</div></div>	<div>Pair of a leather shoes</div> <div><div>8000</div></div>	

Good practices for saving water

Daily behavior and habits can lead to the wasting of more or less water: a commodity that is fundamental to life. But it is also a good that is in short supply, especially in some parts of the world, as well as being an economic good; therefore, it is important to follow a few simple gestures to help respect and conserve water. Some of these, such as those listed below,⁷ can be a good way to reduce the wastage of water in everyday behavior:

- use an air mixer in taps and showers: this helps reduce water consumption without changing one's habits and saves almost half of that which is used;
- use a dual-flush button in toilets (each jet flushing consumes about 10 liters of water, but this amount is not always necessary);
- collect and channel rainwater to the garden or harvesting cisterns, for later use;
- water plants on the balcony with the water used to wash fruit and vegetables;
- make periodic checks of the water system of the house to repair any leaks;
- choose a shower over a bath (to fill a bathtub, 100 liters of water are needed, whereas for a shower, the consumption is about half);
- always close the tap when not in use (while brushing your teeth or while lathering in the shower or massaging your skin, or even while washing your hands);
- wash the dishes using a pan in which to soap them and a small jet of water for rinsing them only at the very end.

These are simple gestures which, however, together with other responsible choices, can lead to reducing the wastage of water.



3.4 THE WATER FOOTPRINT OF THE FOOD PYRAMID OF THE BARILLA CENTER FOR FOOD & NUTRITION

The food pyramid allows the principles of proper nutrition to be communicated concisely and effectively in order to educate the population as to more balanced eating habits and is based on the model of the Mediterranean diet.

The Barilla Center for Food and Nutrition has proposed the food pyramid in two versions, by placing the food not only according to what nutritional science has long been suggesting for our health, but also according to their impact on the environment. The result is a “Double Pyramid”: the traditional food pyramid and an environmental pyramid.⁸ The latter is represented upside down: the foods with the most environmental impact are on top and those with reduced impact are on the bottom.

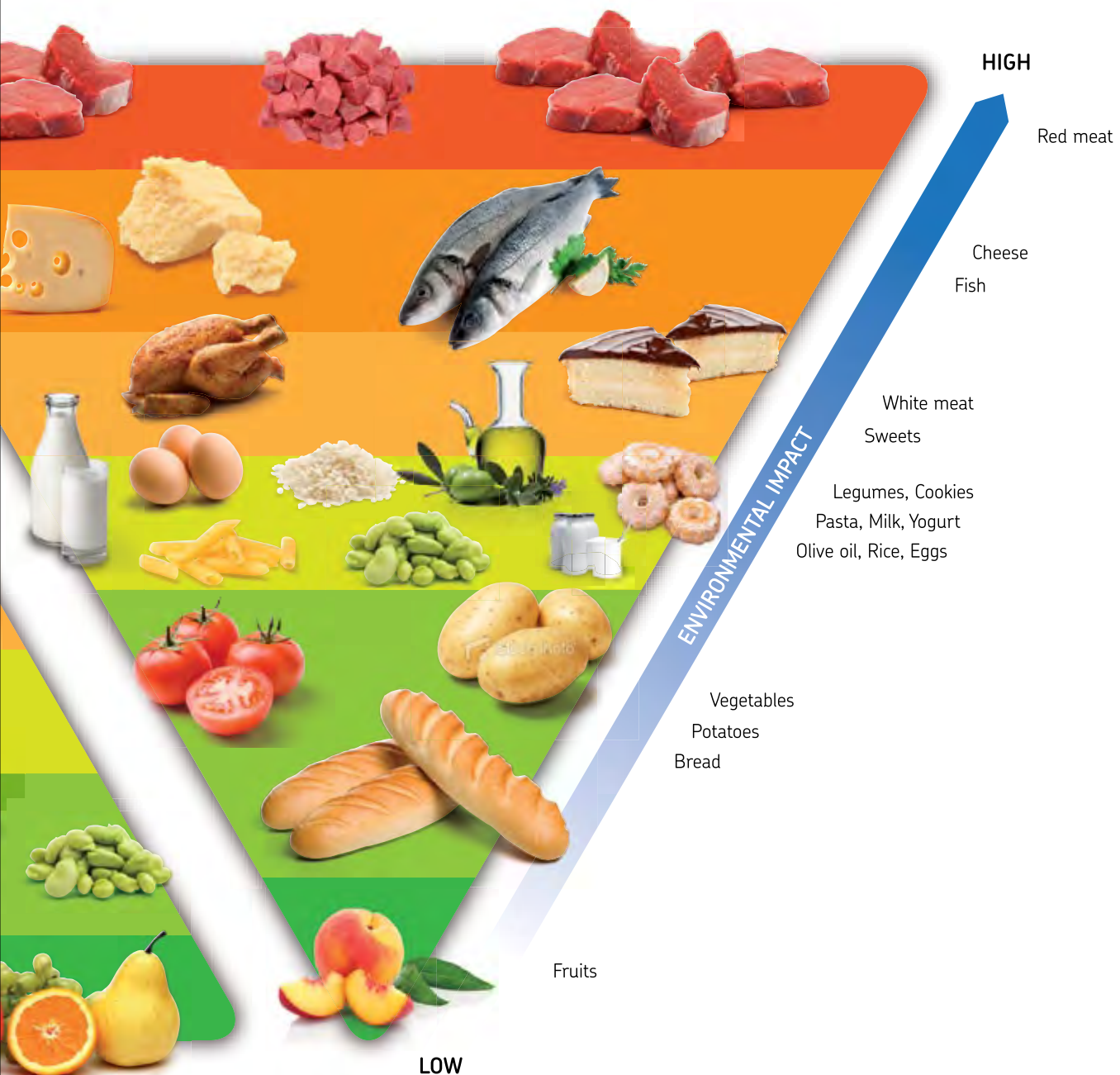


Figure 3.7. The food and environmental “Double Pyramid” prepared by the Barilla Center for Food & Nutrition



Source: Barilla Center for Food & Nutrition, 2010

ENVIRONMENTAL PYRAMID



THE ENVIRONMENTAL PYRAMID OF WATER, ALONGSIDE THE KNOWN FOOD PYRAMID, LINKING TO THE ENVIRONMENTAL IMPACT – AND THEREFORE IN THIS CASE – OF DIFFERENT TYPES OF FOOD.

MOST OF THE FOODS FOR WHICH A MORE FREQUENT CONSUMPTION IS RECOMMENDED ARE ALSO THOSE WITH MINOR ENVIRONMENTAL IMPACT IN TERMS OF WATER USE.

The food pyramid shows the different food groups in ascending order. At the base of the pyramid are the foods of plant origin (characteristic of the Mediterranean diet), rich in terms of nutrients (vitamins, minerals, water) and protective compounds (fiber and bio-active compounds of plant origin) and with reduced energy density. Ascending gradually are the foods of growing energy density (many of which are found in the American diet) that should be eaten less frequently.

The environmental pyramid was made based on the estimate of the environmental impact associated with each individual food considering the whole life cycle and using data available in literature.

Although the representation of the environmental pyramid prepared by the Barilla Center for Food & Nutrition in the previous paper *Double Pyramid: healthy food for people that is sustainable for the planet* was made using the ecological footprint as the single indicator of reference, it is possible to make the environmental pyramid with reference to the water footprint indicator.⁹

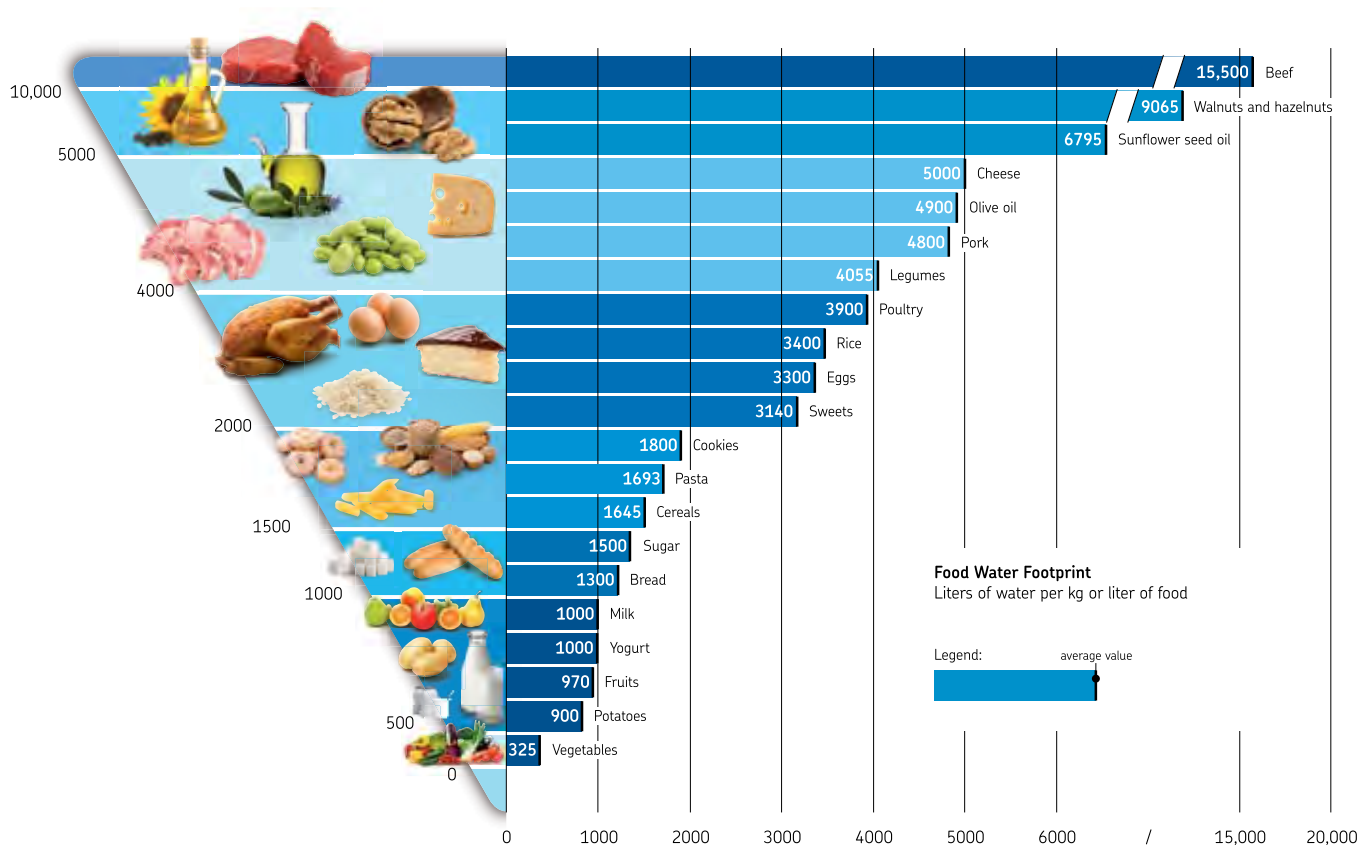
Through the use of this indicator, it is, therefore, possible to create an environmental pyramid of water, alongside the known food pyramid, linking to the environmental impact – and therefore, in this case, the water consumption – of different types of food.

An inverted pyramid is thus obtained, in which the different food groups are arranged in ascending order on the basis of their environmental impact in terms of their water footprint¹⁰: up above are foods with the most impact, while down below are those that have a lower impact.

In particular, we found that even in the environmental pyramid of water, as well as for that obtained using the ecological footprint, red meat is the food that has the greatest impact, whereas vegetables, potatoes and fruit are characterized by effects that are significantly lower.

Therefore, placing the environmental pyramid of water drawn alongside that of the food, you can see how most of the foods for which a more frequent consumption is recommended are also those with minor environmental impact in terms of water use.

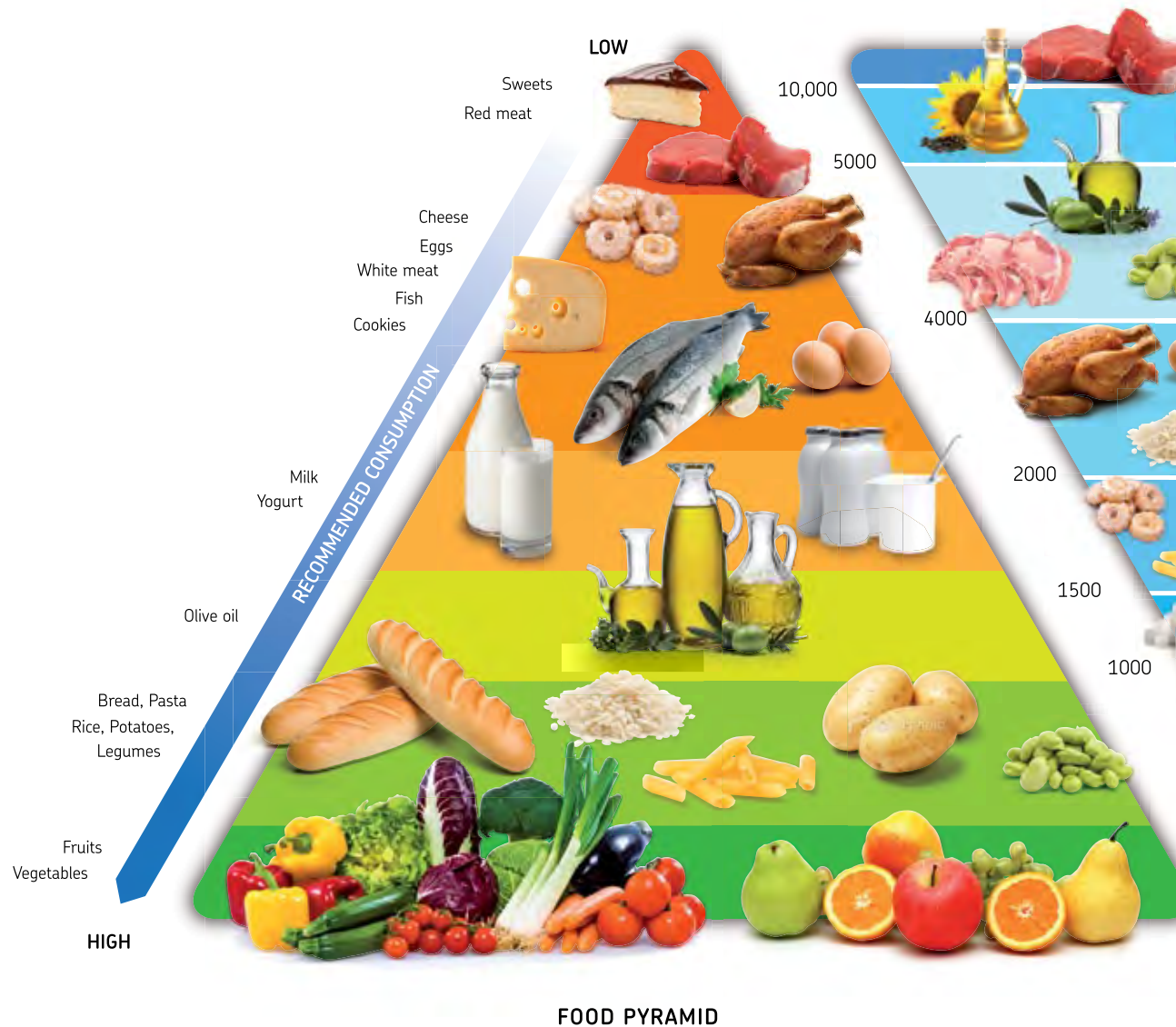
Figure 3.8. Food Water Footprint

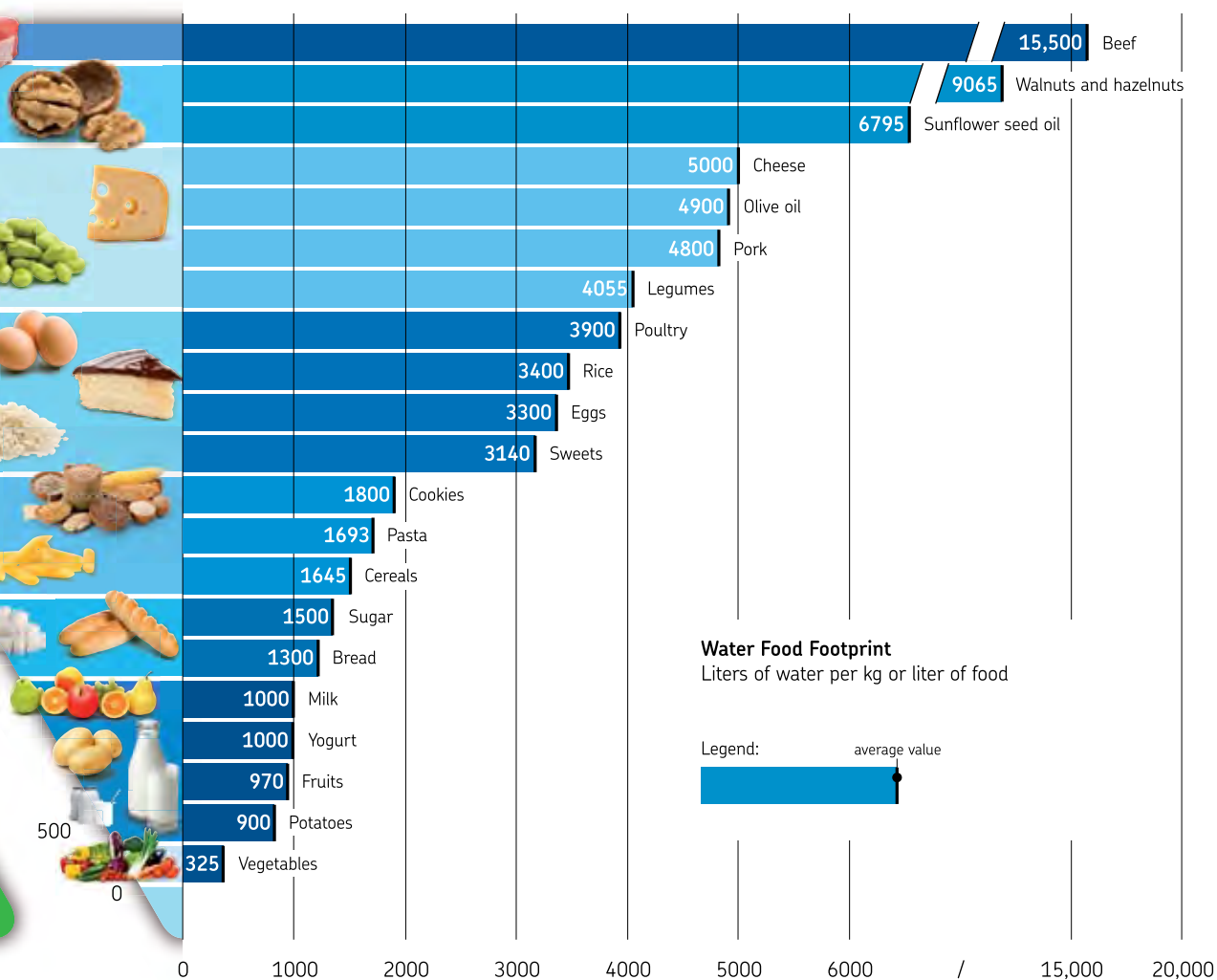


WATER FOOTPRINT OF FOOD

Conversely, most of the foods for which a less frequent consumption is recommended are those having a greater impact on the environment also from the point of view of the consumption of water resources.

Figure 3.9. Water Footprint of the Food Pyramid





In other words, even from this new elaboration of the Double Pyramid in a single model, the coincidence is shown of two different but equally important goals: health and environmental protection.

WATER FOOTPRINT OF BEVERAGES

Finally, by analyzing the water footprint of the most popular beverages and their daily consumption, another pyramid can be made which shows the water consumption necessary for the preparation of each of them.

All data contained in the pyramid of beverages derives from the site of the Water Footprint Network or from scientific publications on the water footprint.

Figure 3.10. Water Footprint of beverages (per glass or cup of the beverage)

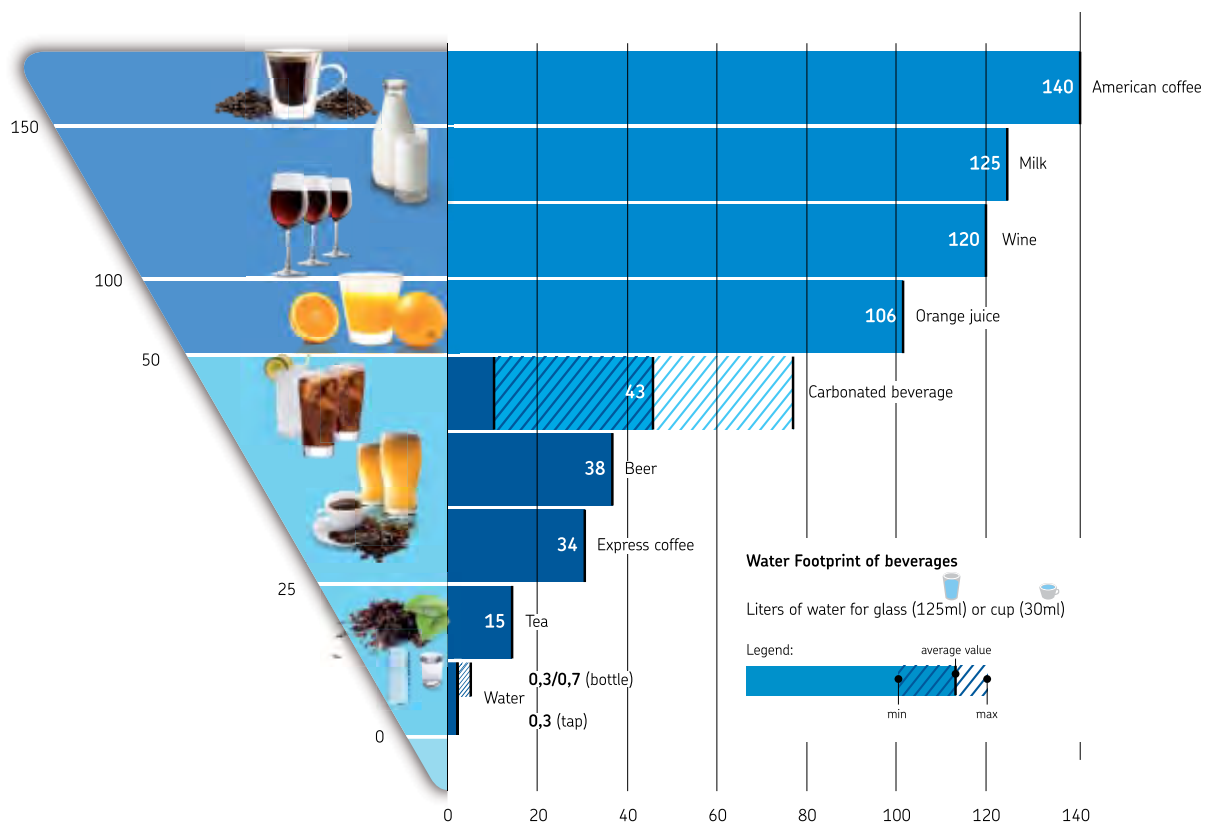
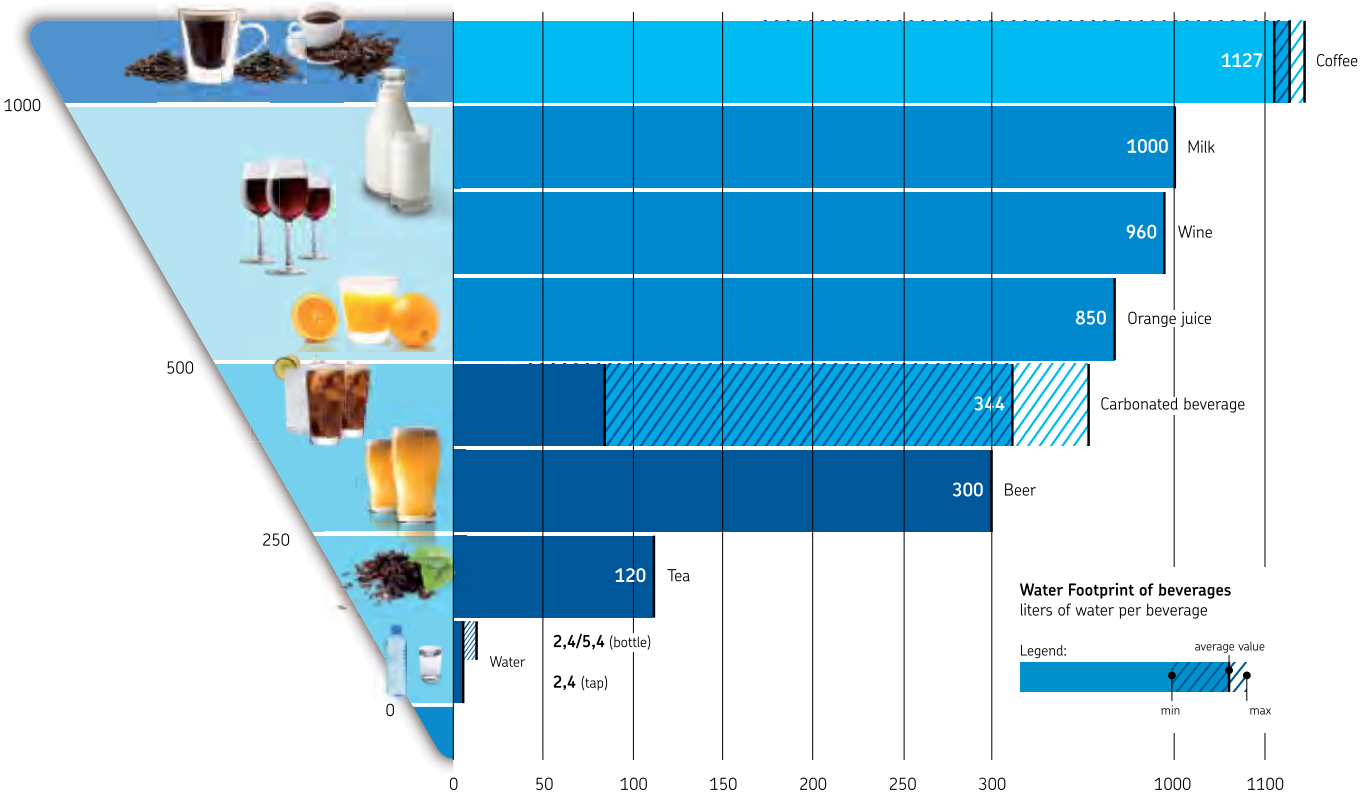


Figure 3.11. Water Footprint of beverages (per liter of beverage)





3.5 THE IMPACT OF DIETARY HABITS ON THE CONSUMPTION OF WATER

It is generally accepted that there is a drastic need today for the improvement of water use, especially in agriculture, and for limiting waste.

According to the study, *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*,¹¹ long-term maintenance of the current practices of the production and consumption of food will determine severe food crises in different parts of the world.

Therefore, we can start with the food, taking into account that an individual uses an average of two to five gallons of water per day for drinking, while the consumption of virtual water daily to feed oneself ranges from about 1500-2600 liters in the case of a vegetarian diet to about 4000-5400 liters in the case of a meat-rich diet.¹²

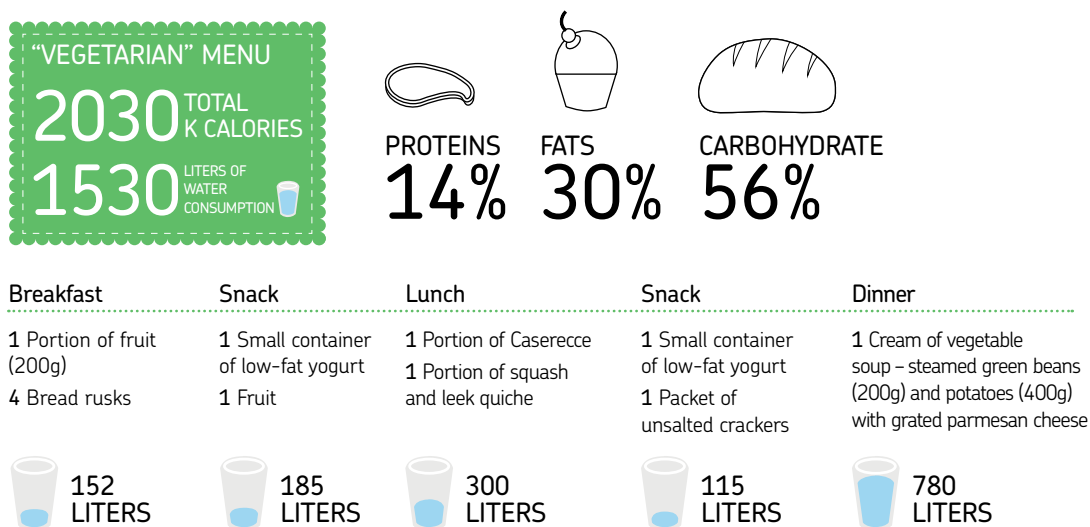
From the above, it is evident that eating habits, in addition to nutritional effects of nature, also involve significant environmental effects.

To understand the differences, two daily menus have been prepared, both balanced from a nutritional standpoint, and their impact in terms of water consumption have been calculated.

The first daily menu includes a diet rich in vegetable protein and low in animal fat; instead, the second is based on a consumption, albeit modest, of red meat.

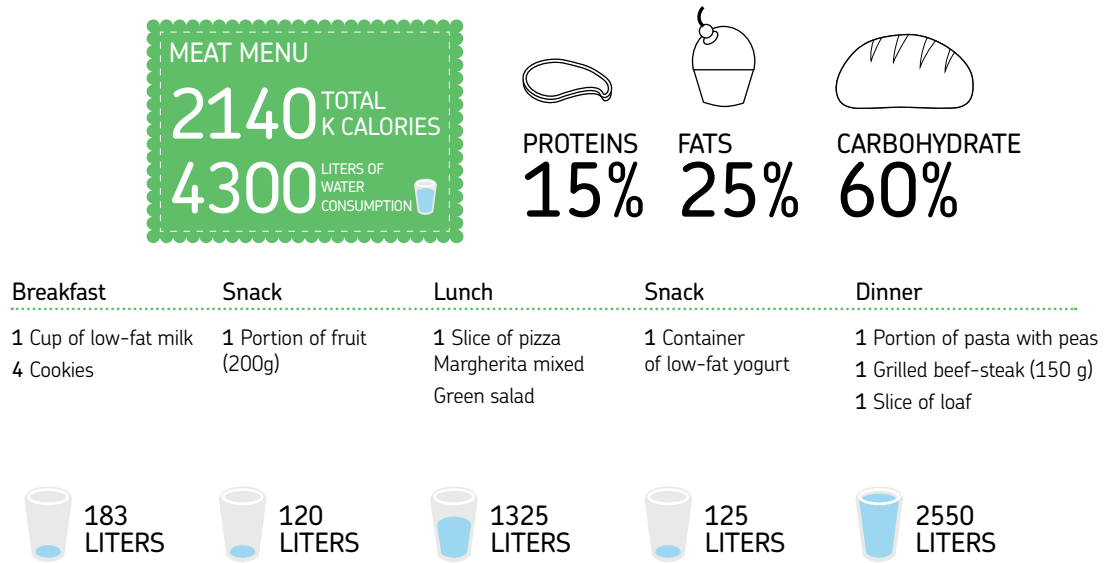
THE CONSUMPTION OF VIRTUAL WATER DAILY TO FEED ONESELF RANGES FROM ABOUT 1500-2600 LITERS IN THE CASE OF A VEGETARIAN DIET TO ABOUT 4000-5400 LITERS IN THE CASE OF A MEAT-RICH DIET.

Figure 3.12. "Vegetarian" Menu



Source: Barilla Center for Food and Nutrition, 2011

Figure 3.13. Menu with more meat



Source: Barilla Center for Food and Nutrition, 2011

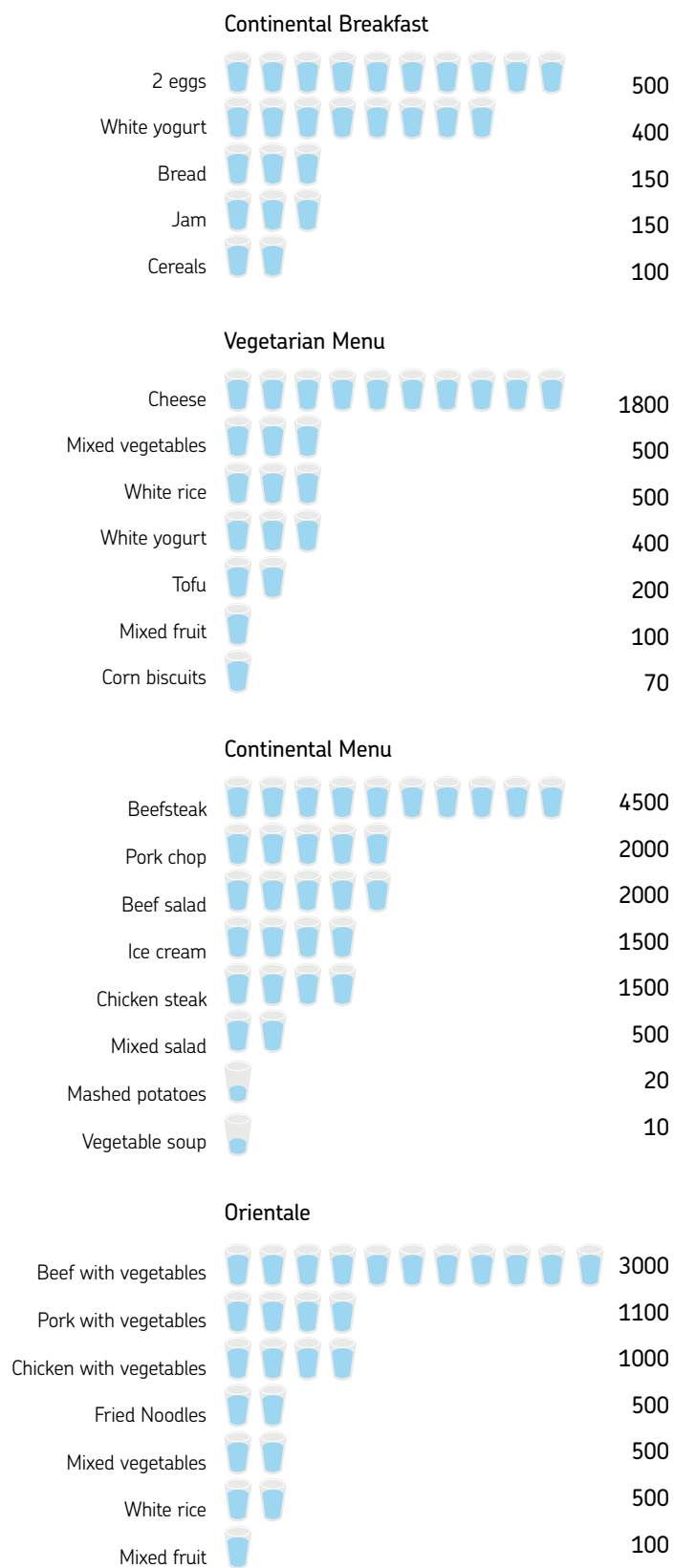
THE INCLUSION OF LIVESTOCK PRODUCTS RESULTS IN AN INCREASE OF ABOUT THREE TIMES THE CONSUMPTION OF WATER RESOURCES.

By comparing the impact in terms of the water footprint of the two menus proposed, it is clear that the inclusion, however modest, of livestock products in the menu such as milk and meat results in an increase of about three times the consumption of water resources.

Milk and meat, in fact, have a greater virtual water content than cultivated products such as fruits and vegetables due to the significant consumption of agricultural products used to feed farm animals in order to turn them into food resources, resulting in a less “sustainable” menu, characterized by the elevated presence of livestock products.

The following figure shows the water footprint of some courses.

Figure 3.14. Water footprint of some courses of a hypothetical international menu

Source: World Water Council, 3rd World Water Forum, 2003

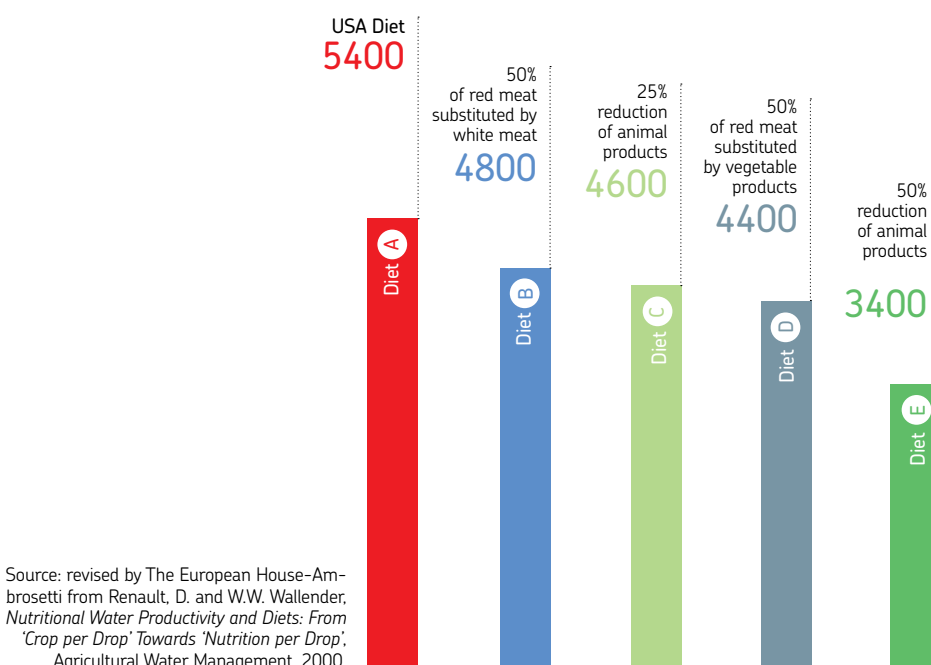
IF ALL THE INHABITANTS OF THE PLANET WERE TO ADOPT THE AVERAGE DIET OF WESTERN COUNTRIES, A 75% INCREASE OF THE WATER CURRENTLY USED TO PRODUCE FOOD WOULD BE NEEDED.

From these examples, it is clear that the evolution of the dietary habits of individuals can have a very significant impact on the availability of water resources.

Suffice it to say that if all the inhabitants of the planet were to adopt the average diet of Western countries characterized by a high consumption of meat, a 75% increase of the water currently used to produce food would be needed.¹³

The following figure shows the effects of certain food choices – leading to changes in the typical American diet (rich in red meat) – on the volume of water needed (water footprint) to produce the food items in the diet.

Figure 3.15. Effects of changes in the way of eating on the virtual contents of the average American diet (liters per person per day)



If, in fact, fifty years ago the number of inhabitants on our planet and their way of life required less water, today the competition for water resources, which are increasingly scarce, is intense: many basins are not able to meet the demand for water and some have dried up completely. Looking ahead, the lack of water will be a constraint to food production for hundreds of millions of people.

In this context, which requires a clear yet drastic turnaround, the accountability of institutions and enterprises (both agricultural and industrial) and the personal commitment of all citizens to contribute to the progressive reduction of consumption and waste must be added. This can be done simply by improving their eating habits, adopting diets that, in addition to being healthier for themselves, help to significantly reduce their water footprint.

NOTES

1. Hoekstra, A.Y., A.K. Chapagain, M.M. Aldaya and M.M. Mekonnen, *The Water Footprint Assessment Manual: Setting the Global Standard*, Earthscan, London 2011.
2. Updates about the rules for calculating the water footprint can be found in Hoekstra *et al.*, *The Water Footprint Assessment Manual*, 2011. Further discussion is contained in Chapter 4 of this position paper.
3. See section 3.3 and Barilla Center for Food & Nutrition, *Double Pyramid: Healthy Food for People, Sustainable for the Planet*, 2010.
4. This volume is obtained by dividing the pollutant load by the difference between the environmental quality standards of a certain contaminant (C-max, which is the maximum acceptable concentration) and its natural concentration in the receiving water body (C-nat).
5. Mekonnen, M. and A.Y. Hoekstra, *The Green, Blue and Grey Water Footprint of Crops*, Hydrology and Earth System Sciences Discussions Editor, USA, 2011.
6. For the examples, world average data was collected based on what is available; relating to agricultural products, a rather long time span (1996–2005) was taken into consideration for collecting all the rainfall and climate data of the main areas of the world in which each product is grown.
7. See www.ecoage.it/risparmiare-acqua.htm.
8. An examination of the theme of the food pyramid and the Double Pyramid is contained in the position paper *Double Pyramid: Healthy Food for People, Sustainable for the Planet*, by the Barilla Center for Food & Nutrition in 2010.
9. As mentioned in Section 3.1, the water footprint is a direct indicator of the use of fresh water made to express both the quantity of water resources actually used and the way in which the resource is used.
10. The water pyramid has been made for each category of product to obtain an average figure from data found in literature, disregarding those that are clearly abnormal. In particular, we used the database of the website and publications of the Water Footprint Network, which provided several examples relating to foods of animal or agricultural origin.
11. Comprehensive Assessment of Water Management in Agriculture, *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture – Summary Book*, Earthscan and Colombo, International Water Management Institute, London 2007.
12. World Water Council, 2008.
13. Zimmer, D. and D. Renault, *Virtual Water in Food Production and Global Trade: Review of Methodological Issues and Preliminary Results*, in Hoekstra, A.Y. (ed.), *Virtual Water Trade: Proceedings of the International Expert Meeting on Virtual Water Trade*, Value of Water Research Report Series No. 12, Delft (The Netherlands), UNESCO-IHE, Institute for Water Education, 2003.

The main sources of data

VALUES DERIVING EXCLUSIVELY FROM PUBLIC DATABASES AND SCIENTIFIC STUDIES

The information used to build the water footprint of food pyramids was grouped according to the following classification: foods and beverages.

The values of water footprints deriving exclusively from public databases and scientific studies have been shown for each category analyzed.

The decision to use only data and information of a “public” nature is due to the fact that a decision was made to organize the presentation of the results so that they could be re-constructed by any reader who wants to deal with the analysis more thoroughly and analytically.

If there were several scientific studies for the same product, or when there were multiple values within the same study, the minimum, maximum and average values were taken. Otherwise, the only available value is shown.

The information used to complete this work derives from the published literature or other databases typically consulted in the study of life cycle analysis. In the bibliographical references, every single source found in the scientific literature was cited, and in particular:

- the database of the Water Footprint Network (<http://www.waterfootprint.org>);
- the Environmental Product Declaration EPD; <http://www.environdec.com>);
- scientific reports and publications.

Far from being conclusive, this work is

meant to be a stimulus for the publication of further studies on measuring the water footprint of food, which will be considered in the next editions of this document. This way, readers can increase the coverage of statistical data and examine the influence that some factors, such as geographical origin, for example, can have.

The following tables show, in detail, the bibliographical sources selected for the construction of the water footprint of the food pyramids. The first column shows the product, followed by the unit of reference of study and the main system boundaries taken into consideration. The last column shows the data used.



Beverages

PRODUCT	VALUE IN LITERS PER FU	FUNCTIONAL UNIT (FU)	SYSTEM BOUNDARIES	BIBLIOGRAPHIC REFERENCE	VALUE QUOTED IN PYRAMIDS [LITERS OF WATER PER BEVERAGE]
WATER	3.61-8.14	1.5 liters of mineral water in PET bottles	Water extraction and production of raw materials, production of the pre-forms for PET bottles and transport to the bottling plant, bottling and packaging, distribution to super-markets and from there to the final consumer	Botto, S., <i>Tap Water Vs Bottled Water in a Footprint Integrated Approach</i> , Department of Environmental Sciences, University of Siena, 2009 (http://precedings.nature.com/documents/3407/version/1/files/npre20093407-1.pdf).	Minimum value: 2.4 Maximum value: 5.4 Average value: 4
	3.63-3.65	1.5 liters of tap water	Extraction of water, water supply pipelines, water storage and distribution through a water network to the end user		Minimum value: 2.42 Maximum value: 2.43 Average value: 2.4
TEA	30	0.250 liters	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=tea	120
BEER	75	0.250 liters	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=beer	300
CARBONATED BEVERAGES	169-309	0.5 liters of beverage bottled in PET bottles	Creation (from the resin to the blow-molding) and cleaning (air) of the PET bottle, preparation of the syrup and ingredients, mixing of ingredients, filling of bottles, labeling	Ercin, A.E., M.M. Aldaya and A.Y. Hoekstra, <i>The Water Footprint of a Sugar-containing Carbonated Beverage</i> , Value of Water Research Report Series n° 39, UNESCO-IHE Institute for Water Education Editor, Geneva 2009.	Minimum value: 70 Maximum value: 618 Average value: 344
	35	0.5 liters of Cola bottled in PET bottles	Creation (from the resin to the blow-molding) and cleaning (air) of the PET bottle, preparation of the syrup and ingredients, mixing of ingredients, filling of bottles, labeling	The Coca-Cola Company, <i>Product Water Footprint Assessment – Practical Application in Corporate Water Stewardship</i> , The Nature Conservancy, 2010.	
ORANGE JUICE	170	0,200 liters	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=orange	850
WINE	120	0.125 liters	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=wine	960
MILK	1000	1 liters	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=milk	1000
COFFEE	140	0.125 liters	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=coffee	Minimum value: 1120 (american coffee) Maximum value: 1133 (express coffee) Average value: 1127

Food

PRODUCT	VALUE IN LITERS PER FU	FUNCTIONAL UNIT (FU)	SYSTEM BOUNDARIES	BIBLIOGRAPHIC REFERENCE	VALUE QUOTED IN PYRAMIDS [LITERS OF WATER PER BEVERAGE]
VEGETABLES	325	1 kg di vegetables	Cultivation of the product until harvest – includes the three water footprints (blue, green and gray water)	Mekonnen, M. and A.Y. Hoekstra, <i>The Green, Blue and Grey Water Footprint of Crops</i> , Hydrology and Earth System Sciences Discussions editor, USA, 2011.	325
POTATOES	900	1 kg of potatoes	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=potato	900
FRUIT	970	1 kg of fruit	Cultivation of the product until harvest – includes the three water footprints (blue, green and gray water)	Mekonnen, M. and A.Y. Hoekstra, <i>The Green, Blue and Grey Water Footprint of Crops</i> , Hydrology and Earth System Sciences Discussions editor, USA, 2011.	970
MILK	1000	1 liter of milk	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=milk	1000
YOGURT	1000	1 liter of yogurt	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=milk	1000
BREAD	1300	1 kg of bread	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=bread	1300
SUGAR	1500	1 kg of brown sugar	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=sugar	1500
PASTA	1532-2232	1 kg of dried pasta made of durum wheat	Cultivation of the wheat, production of flour, production of pasta, transport of raw materials and the products to the distribution platforms	Barilla EPD applied to dried pasta made of durum wheat produced in Italy and packaged in cardboard boxes, Revision 2 – valid for 3 years after the approval, registration number SP-00217, approval date 10/03/2011.	Minimum value: 1532 Maximum value: 2232 Average value (global): 1693
CEREALS	1645	1 kg of cereals	Cultivation of the product until harvest – includes the three water footprints (blue, green and gray water)	Mekonnen, M. and A.Y. Hoekstra, <i>The Green, Blue and Grey Water Footprint of Crops</i> , Hydrology and Earth System Sciences Discussions editor, USA, 2011.	1645
BISCUITS	1800	1 kg of biscuits	Field Phase (for the raw materials), preparation of the dough and baking	Barilla Center for Food & Nutrition, <i>Double Pyramid: healthy food for people, sustainable for the planet</i> , 2010.	1800
SWEETS	3140	1 kg of sweeties	Field Phase (for the raw materials), preparation of the dough and baking (home-made)	Barilla Center for Food & Nutrition, <i>Double Pyramid: healthy food for people, sustainable for the planet</i> , 2010.	3140
EGGS	3300	1 kg of eggs	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=eggs	3300
RICE	3400	1 kg of rice	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=rice	3400
POULTRY MEAT	3900	1 kg of poultry meat	Information not available	http://www.waterfoot-print.org/?page=files/productgallery&product=chicken	3900

PRODUCT	VALUE IN LITERS PER FU	FUNCTIONAL UNIT (FU)	SYSTEM BOUNDARIES	BIBLIOGRAPHIC REFERENCE	VALUE QUOTED IN PYRAMIDS [LITERS OF WATER PER BEVERAGE]
LEGUMES	4055	1 kg of legumes	Cultivation of the product until harvests – includes the three water footprints (blue, green and gray water)	Mekonnen, M. and A.Y. Hoekstra, <i>The Green, Blue and Grey Water Footprint of Crops</i> , Hydrology and Earth System Sciences Discussions editor, USA, 2011.	4055
PORK	4800	1 kg of pork	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=pork	4900
OLIVE OIL	4900	1 liter of olive oil	Cultivation of olives and the production of oil	Barilla Center for Food & Nutrition, <i>Double Pyramid. Healthy food for people, sustainable for the planet</i> , 2010.	4900
CHEESE	5000	1 kg of cheese	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=cheese	5000
SUNFLOWER SEED OIL	6795	1 kg refined oil	Cultivation of product until harvest and further processing and refining – includes the three water footprints (blue, green and gray water)	Mekonnen, M. and A.Y. Hoekstra, <i>The Green, Blue and Grey Water Footprint of Crops</i> , Hydrology and Earth System Sciences Discussions editor, USA, 2011.	6795
WALNUTS AND HAZELNUTS	9065	1 kg of walnuts and hazelnuts	Cultivation of the product until harvests – includes the three water footprints (blue, green and gray water)	Mekonnen, M. and A.Y. Hoekstra, <i>The Green, Blue and Grey Water Footprint of Crops</i> , Hydrology and Earth System Sciences Discussions editor, USA, 2011.	9065
BEEF	15,500	1 kg of beef	Information not available	http://www.waterfootprint.org/?page=files/productgallery&product=beef	15,500



4. THE WATER FOOTPRINT OF A NATION AND VIRTUAL WATER TRADE



4.1 THE WATER FOOTPRINT OF AN INDIVIDUAL, A NATION, A PRODUCT AND A COMPANY

The water footprint does not simply measure the amount of water used but also the type of water consumed (green, blue and gray footprints).

This indicator can be calculated for every product or business and also for any well-defined group of consumers (an individual, a family, the inhabitants of a city, a nation) or producers (private companies, public organizations, economic sectors).

In particular:

- the water footprint of a product (physical good or service) is the total volume of the freshwater consumed to produce it, taking all the different stages of production into consideration (this coincides with the concept of “virtual water” described in the previous chapter);
- the water footprint of an individual, a community or a nation is the total volume of freshwater consumed directly or indirectly (therefore, including the power required to produce the goods and the services used);
- the water footprint of an enterprise consists of the volume of freshwater consumed in the normal course of business, together with that consumed by the various components of its supply chain.

4.1.1 The water footprint of a country

MANY COUNTRIES HAVE MASSIVELY OUTSOURCED THEIR WATER FOOTPRINT, IMPORTING FROM OTHER PLACES THOSE GOODS THAT REQUIRE A LARGE AMOUNT OF WATER TO BE PRODUCED.

“Problems related to water are often closely linked to the structure of the global economy. Many countries have massively outsourced their water footprint, importing those goods that require a large amount of water to be produced from other places. This puts pressure on the water resources of exporting countries, where all too often there is a shortage of mechanisms aimed at wise management and the conservation of resources. Not just governments, but also consumers, businesses and every civilized community can make a difference, so that we can achieve better water management.”¹

Trade between countries is not determined merely by a transfer of goods from one place to another but also by the virtual water trade pertaining to the raw materials, goods and services.

In order to measure the share of the global water used by a country, it is not sufficient to count what is consumed in its territory; the water used to produce its imported goods and services must also be taken into consideration.

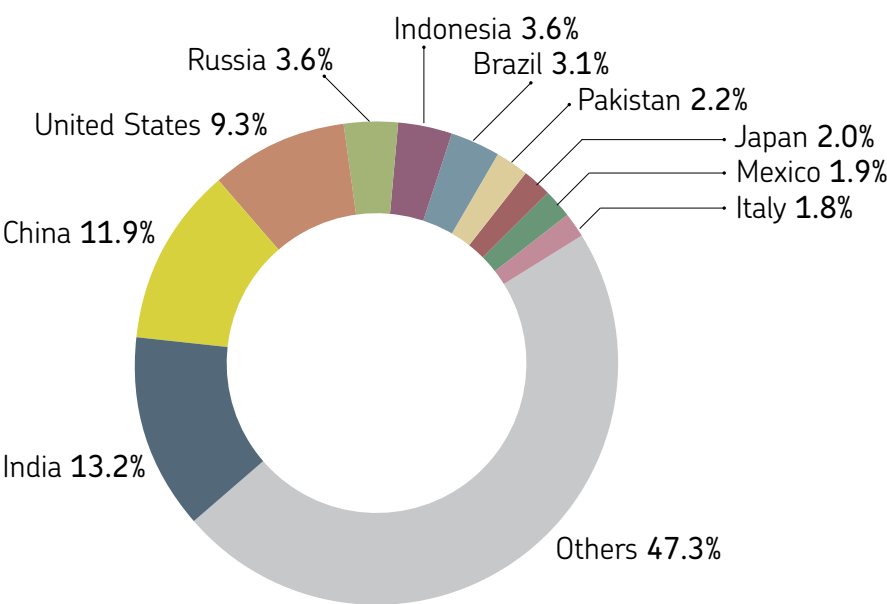
The water footprint of a country is made up of two parts:

- internal water footprint, or the consumption of domestic water resources;
- external water footprint, or the consumption of water resources from other countries.

Therefore, to assess the water footprint of a country, the total consumption of internal resources should be calculated, then the virtual water trade that leaves the country through exports is subtracted and the virtual water trade entering it through imports is added. The global water footprint amounts to 7452 billion m³ of freshwater per year, equal to 1243 m³ per capita per year (i.e. more than twice the annual flow of the Mississippi River). Considering the water footprint in absolute terms, the country that consumes the most water is India (987 billion m³), followed by China (883) and the United States (696). The top 10 countries account for 52.7% of the global water footprint (Figure 4.1).

THE GLOBAL WATER FOOTPRINT AMOUNTS TO 7452 BILLION M³ OF FRESHWATER PER YEAR, MORE THAN TWICE THE ANNUAL FLOW OF THE MISSISSIPPI RIVER.

Figure 4.1. Breakdown by country of the global water footprint

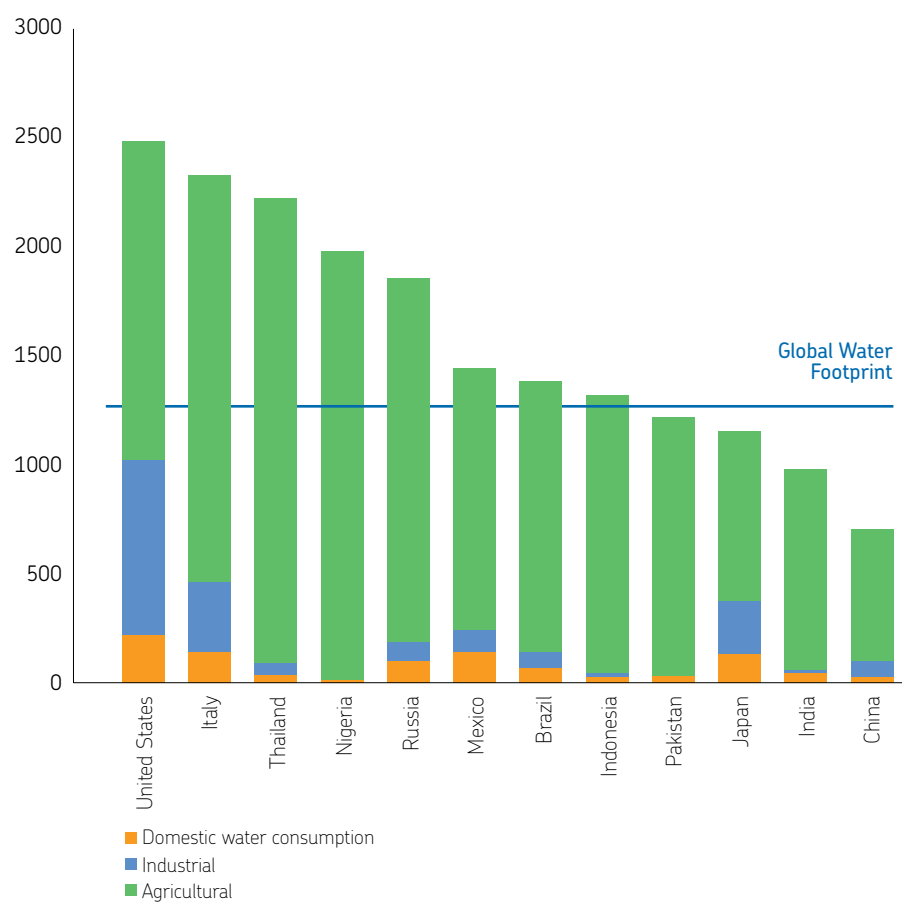


Source: revised by The European House-Ambrosetti from Hoekstra and Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, 2008.

On the other hand, taking into account the per capita values, the citizens of the United States have an average water footprint of 2483 m³ of water per year, followed by the Italians and the Thai.

As can be seen from the figure below, the citizens of countries such as China, Bangladesh, South Africa and India record values that are significantly lower than those of the more developed countries.

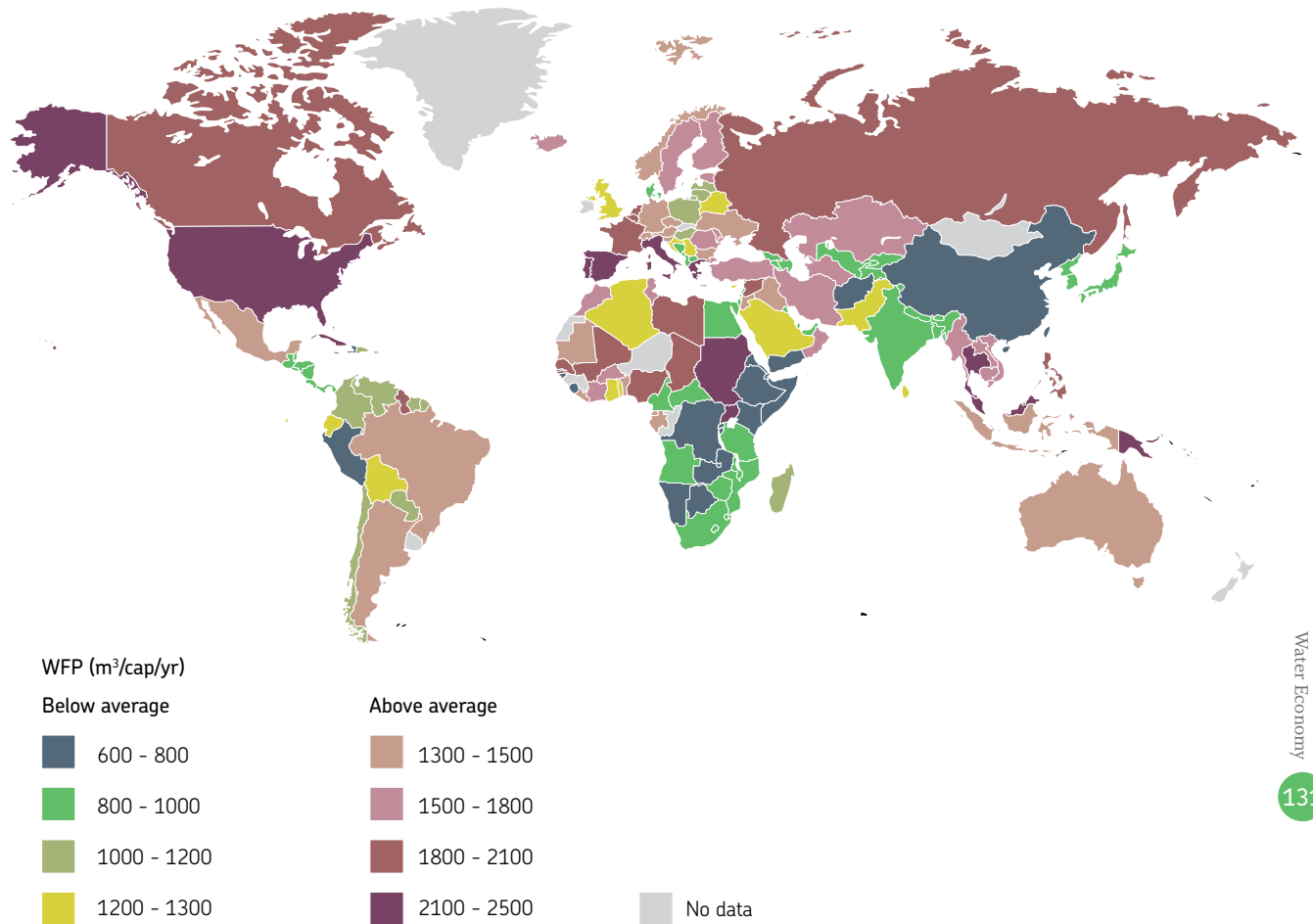
Figure 4.2. Contribution to the global water footprint of the largest consumers (m³ per capita/year)



Source: Hoekstra, A.Y. and A.K. Chapagain, *Globalization of Water: Sharing the Planet's Freshwater Resources*, Blackwell Publishing, Oxford, UK, 2008.

Also in the next figure, which indicates those countries with a lower water footprint per capita than the world average in shades of green and those whose footprint is higher than average in shades of red, sharp differences appear in the consumption of global water resources by the different countries.

Figure 4.3. Water footprint per country (m³/year)



Source: Hoekstra and Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, 2008.

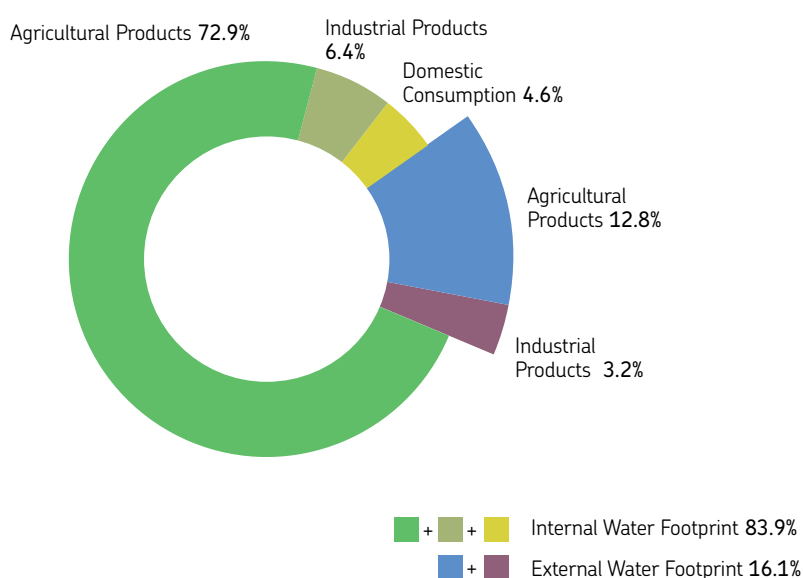
These differences depend on a number of factors. In particular, we can identify four main ones:²

- A** the volume of consumption, usually related to the gross national product (wealth) of a country;
- B** the pattern of consumption, especially with regard to dietary habits, which may be oriented to more or less meat consumption (e.g., the average consumption of meat, per capita, in the U.S. is 120 pounds per year, more than three times the world average) and the use of industrial goods. The pattern of consumption is also generally related to the wealth of the country;
- C** climate, which mainly has effects on the rainfall, the transpiration of plants and the amount of water needed for the crops;
- D** agricultural practices, particularly with regard to the efficiency of water use. For example, in Thailand the yield of rice crops is around 2.5 tons per hectare, compared to a world average of 3.9.

The global water footprint is largely determined by the production of agricultural products and food, followed by the production of industrial goods and the use of water for domestic purposes. In addition to the sector responsible for water consumption, figure 47 also shows the proportion consumed due to exports: 16% of the global water footprint comes from making products for export.

The breakdown of the water footprint varies considerably from country to country, especially with reference to the external footprint. For example, Italy imports 51% of the virtual water it consumes, whereas India imports just 1.5%.

Figure 4.4. Global water footprint contribution from the different categories of consumption and the distinction between internal and external footprints



Source: Hoekstra and Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, 2008.

EUROPE IS A NET IMPORTER OF VIRTUAL WATER AND ITS WATER SECURITY DEPENDS HEAVILY ON EXTERNAL RESOURCES.

India – as well as China (see “virtual water trade in China” in the following pages) – is, therefore, still largely self-sufficient in terms of water, but with the growing demand for food and the scarcity of water within these two large developing countries, an increase in food imports is expected, and thus, a growing demand for water from other countries. This could lead to problematic situations in terms of water supply problems.

In Europe, however, France is the only net exporter of virtual water. All the other countries are importers. This means that, overall, Europe is a net importer of virtual water and its water security depends heavily on external resources.



4.2 VIRTUAL WATER TRADE

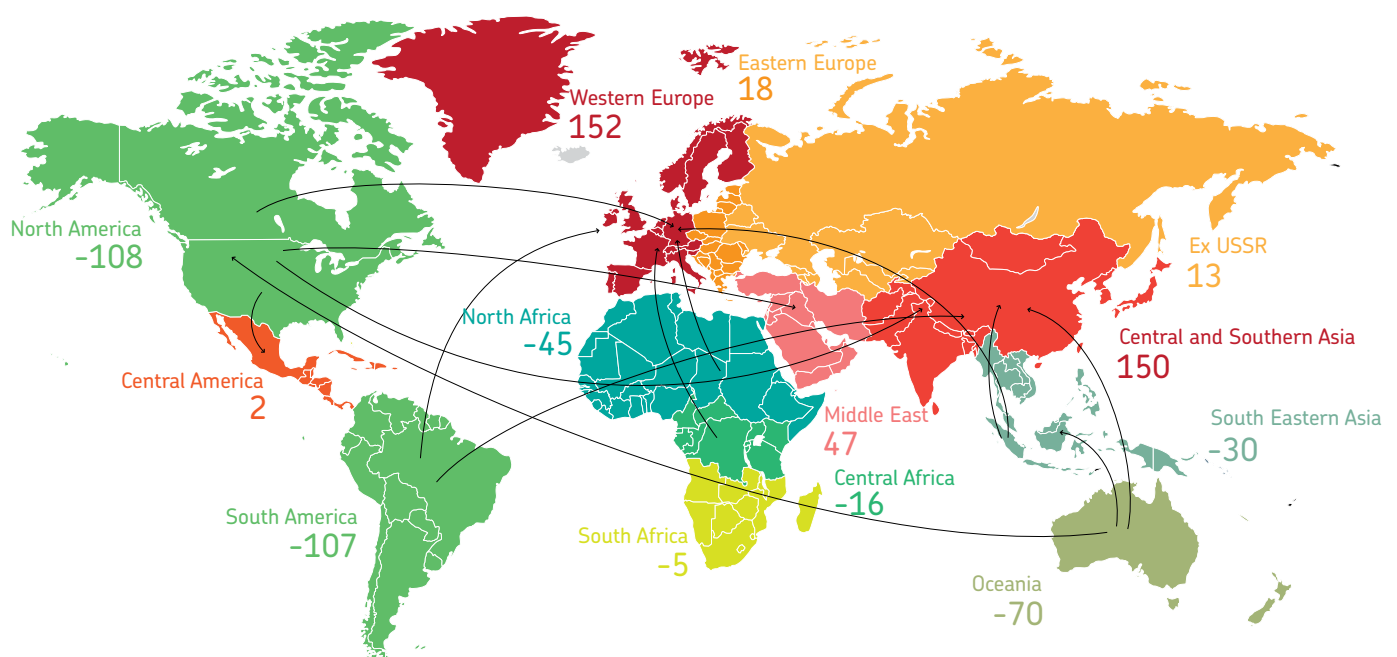
Today, the international trade in agricultural products does not take the water component included in the exchange into consideration in any way. Suffice it to say that of the top 10 exporters of wheat, three are characterized by severe water shortages, while of the top 10 importing countries, three have high water availability.³ The level of interdependence among countries in the exchange of virtual water is rather critical and is bound to increase in the future, given the ongoing process of the liberalization of international trade.

In this regard, the following figure shows the complexity of the virtual water flows related to trade in agricultural products between countries and identifies the amounts (shades of red) and net exporters (shades of green) of virtual water.

The “globalization of water use” creates both economic and environmental benefits and risks.

THE LEVEL OF INTERDEPENDENCE AMONG COUNTRIES IS BOUND TO INCREASE IN THE FUTURE, GIVEN THE ONGOING PROCESS OF THE LIBERALIZATION OF INTERNATIONAL TRADE.

Figure 4.5. The virtual water flows between countries related to trade in agricultural products (Gm³/yr)



Source: Hoekstra and Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, 2008.

The virtual water flows in China

Since 1980, rapid economic development and population growth in China has led to a sharp increase in the demand for water, which presumably could affect the food security of the country and limit its economic and social development in the future.

In the period 1997-2001, the average water footprint of China was about 700 cubic meters per person per year, of which only 7% was virtual water imported from abroad, thus highlighting how the country still possesses a relatively high availability of water for self-sufficiency.

The situation, however is very different within China itself.

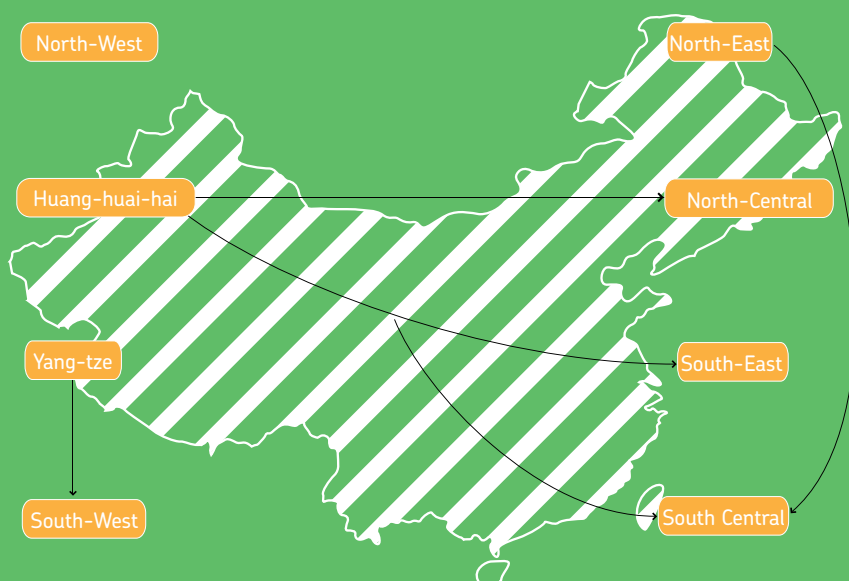
In particular, the North faces a serious problem of water scarcity, as more than 40% of the annual renewable water re-

sources are used for domestic use, while nearly 10% of the water used in agriculture is utilized for the production of food exported to the South.

For this reason, in 1999, southern China was a net importer of agricultural products from the North, amounting to 52 billion cubic meters of virtual water.

To compensate for this “flow of virtual water” from the North to the South of the country and to reduce the water scarcity in the northern part, a project to transfer water from the South to the North has been implemented (the South-North Water Transfer Project), thus creating flows consisting of huge volumes of water transferred from the rich South to the arid North, resulting in considerable volumes of food being moved in the opposite direction.

Figure 4.6. Virtual water trade in China in 1999







WATER COLONIALISM: A NEW
FORM OF DOMINATION
BY RICH COUNTRIES
TO THE DETRIMENT OF
POORER ONES WHICH,
DRIVEN BY THE DEMAND FOR
GOODS FROM ABROAD, ARE
LIKELY TO EXHAUST THEIR
WATER RESERVES.

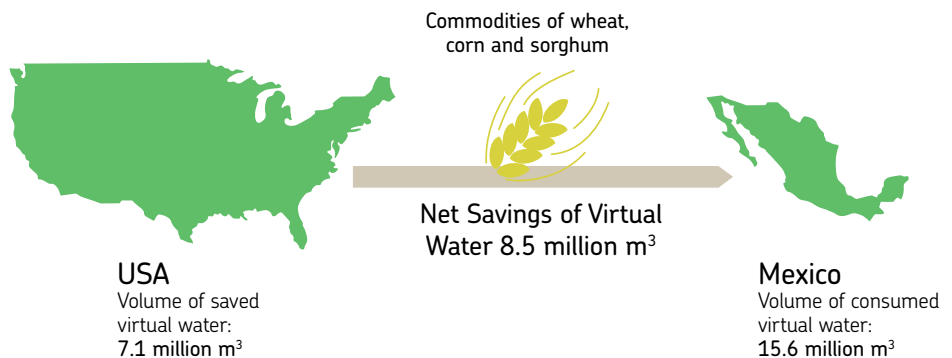
4.2.1 Economic and environmental benefits

One benefit deriving from the growing liberalization of international trade is the possibility of considering virtual water as an alternative water source. It is, therefore, a true instrument of government as to the availability of water resources from each country. In fact, in an economy that is increasingly open to trade, the countries suffering from scarcity of water resources in their territory may reduce that pressure by importing goods with a high virtual water content from countries where this resource is more abundant, and exporting products with a lower virtual water content.

International trade of virtual water also allows for savings in the volume of water consumed when a product is exported from a country with high productivity of water resources (for that particular product) to another with a low productivity. For example, in the case of import-export relations between the U.S. and Mexico (figure 4.7), there is an optimization of water use, thanks to greater efficiency in the production of wheat, corn and sorghum found in the U.S., as compared to Mexico.

The commodities produced in the U.S. and exported to Mexico, in fact, have a much lower virtual water content (7.1 million cubic meters) than that which Mexico would consume by cultivating this product directly in its territory (15.6 million cubic meters). In the interests of global water resources, the net savings amounted to 8.5 million cubic meters.

Figure 4.7. Global Virtual Water Savings in the trade of wheat, corn and sorghum between the U.S. and Mexico



Source: Chapagain, A.K. and A.Y. Hoekstra, *The Global Component of Freshwater Demand and Supply: An Assessment of Virtual Water Flows between Nations as a Result of Trade in Agricultural and Industrial Products*, in "Water International", vol. xxxiii, n. 1, March 2008, pp. 19-32.

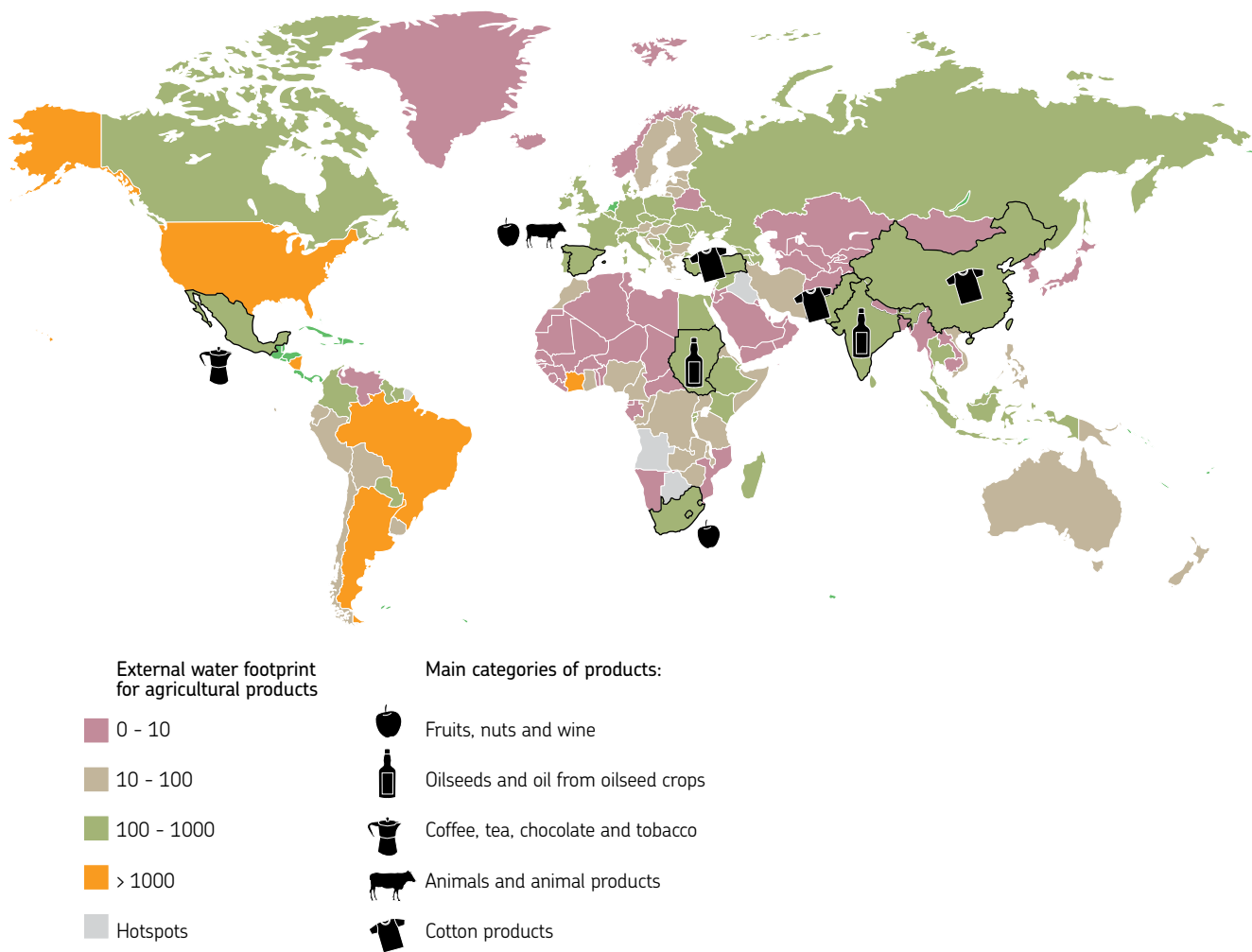
4.2.2 The risk of water "colonialism"

The greatest risk generated by the globalization of water use is the fact that the importation of products with high virtual water content implies the outsourcing of indirect effects of the exploitation of this resource by the importing country on that of the exporter. Since in many countries the water used in agriculture has a price that is far lower than its real value, the costs associated with the consumption of water by the exporting country are generally not fully reflected in the price of the products consumed in the importing country. This factor can lead to a situation of imbalance in terms of efficiency and equity

in trade and, more specifically, imbalances in the water system of the exporting countries. For example, the figure below represents a map of the impact of the external water footprint of Holland: in the figure it is shown the water consumption in different countries around the world relating to the consumption of agricultural products by the citizens of the Netherlands. It is highlighted so as to show the countries where the external water footprint of the Netherlands (and the products associated with it) generates a relatively high social and environmental impact.

THE COUNTRIES THAT IMPORT PRODUCTS WITH A HIGH VIRTUAL WATER CONTENT OUTSOURCE THE EFFECTS OF THE EXPLOITATION OF THIS RESOURCE OUTSIDE THEIR TERRITORY.

Figure 4.8. Map of the impact of the external water footprint of Holland



Source: Hoekstra and Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, 2008.

145 NATIONS HAVE
IN COMMON THE FACT
THAT THEY SHARE
RESERVOIRS WITH
SEVERAL COUNTRIES:
MORE AND MORE OFTEN,
WATER IS AT THE
ORIGIN OF CONFLICTS
BETWEEN STATES.

This suggests that the consumption of certain agricultural products from Holland poses a threat to the balance of the water systems of other countries (Mexico, South Africa, Sudan, Spain, Turkey, India, China, etc.) from which the Netherlands imports such products, due to the conditions of stress and water scarcity in these areas.

This phenomenon is referred to as “water colonialism” because it can be interpreted as a new form of domination by rich countries to the detriment of poorer ones which, driven by the demand for goods from abroad, are likely to exhaust their water reserves.

For some countries that import products with a high content of virtual water, a second element of risk is represented by an excessive dependence on the water resources of other nations.

For example, Jordan already imports a volume of virtual water which is five times greater than its internal renewable water resources. On the one hand, if this imbalance allows the country to protect its water resources and reduce the risk of unsustainable exploitation of the same, on the other, it exposes it to the risk of excessive dependence on countries abroad. Other countries in the area (such as Kuwait, Qatar, Bahrain, Oman and Israel), as well as some European countries (UK, Belgium, Holland, Germany, Switzerland, Denmark, Italy and Malta), are currently importing a volume of virtual water greater than that drawn from their own internal resources.

In the end, the risks mentioned imply other serious effects. Water as a strategic objective is, in fact, at the origin of conflicts between States, because in the absence of international legislation regulating the management of shared waters, the conflicts between countries are more and more often resolved through the use of force, especially in areas with scarce water resources.

Reservoirs shared by several countries account for almost half of the Earth’s surface, and involve 145 nations. At least 19 reservoirs are shared by more than five of these nations. There are currently 263 river basins that are shared and two-fifths of the world’s population lives near them.

The major shared river basins

Some of the major river basins that are shared and fought over in the world include:

- Nile (6671 km), where the catchment area affects ten countries of East Africa;
- Mekong (4880 km) and Volga (3530 km), crossing five and eight States, respectively;
- Indus (3180 km), crossing through India and Pakistan;
- Danube (2858 km), which affects as many as 17 countries, including Hungary, the Czech Republic and Slovakia;
- Tigris (1900 km) and Euphrates (2760

km), both of which have their source in Turkey, cross through Syrian territory and join in Iraq before emptying into the Persian Gulf under the name of the Shat-el-Arab;

- Colorado (2339 km), crossing the United States and Mexico;
- Okavango (1600 km), passing through Namibia and Botswana;
- Jordan (320 km), running through Lebanon, Syria, Israel and the Palestinian territories.



Nile



Mekong



Indus



Danube

Rivalry in the sharing of water may arise both due to the competition for the various uses of water (domestic, industrial, agricultural) and among countries for the use of a common body of water that crosses the borders.

The countries that share the same water source are deeply interconnected since they face the division of a limited resource that is often crucial to sustaining their livelihood, their economic growth and their environment.

This implies the need to individuate sharing strategies and the partition of a common resource and, where possible, to promote an approach of integrated water resources management.

The various countries involved should facilitate the exchange of resources and services in a way that is beneficial to all of them, such as exchanging hydro-electric power (economically more profitable in the higher mountainous and steep regions) with agricultural products (since irrigation produces the best results in the plains and valleys).

The creation of synergies for the benefit of all countries involved is included in the recommendations of the United Nations Development Programme (UNDP), which in the 2006 *Human Development Report*⁴ affirmed that the management of shared water can be regarded as an asset for either peace or for conflict, even if it is up to the politicians to decide which of these two paths is to be taken.



UNDP, *Human Development Report – Beyond Scarcity: Power, Poverty and the Global Water Crisis*, 2006.

Water as a source of conflict

Israel, the Palestinian territories and the Jordan river

To further fuel the harshness of the Israeli-Palestinian conflict, in an area suffering from a severe water scarcity, a “water war” is being fought for the management of available resources.

The situation is most serious in the Gaza Strip, where water availability is only 320 cubic meters per person per year (considerably below the water scarcity threshold of 1000 cubic meters per person per year). In addition to the problem of the shortage of rainfall, there are the effects of the unequal sharing of water resources between the State of Israel and the occupied territories, confirmed by the fact that, even though the Israeli population is less than twice that of the Palestinian population, their water consumption is equal to seven times the amount consumed by the Palestinians.

The issue of water management played a significant role in the Middle East conflict, interwoven with competition for control of the territory. One of the motives that triggered the 1967 Six-Day War was, in fact, an attempt by Jordan to divert the flow of the Jordan river.

The outcome of the war, with the occupation of the West Bank and the Golan Heights, has allowed the Israelis to control the groundwater resources of the area – which are critical to the agricultural and economic development of the region – and to receive two-thirds of their water from the territories they conquered in that conflict.

The water control strategy implemented by the Israelis is not just based on the physical occupation of the territories, but also on

a limitation of the Palestinians’ consumption: restrictions were decided by orders of the military, prohibiting Palestinians from building or owning a water system without permission from the Israeli military. Limits have been placed, such as the one requiring that wells dug by Palestinians not exceed 140 feet in depth, as opposed to the 800 meters of Israeli wells; water quotas were set; and the wells and water sources of absent Palestinians were expropriated.



Blue Gold: World Water Wars (documentary film by Sam Bozzo, 90', USA, 2008).



Figure 4.9. Israel and the Palestinian territories

Turkey, Iran, Iraq and Syria and the basins of the Tigris and Euphrates rivers

For many years, there has been great tension – between Turkey, on the one hand and Iran, Iraq and Syria on the other – regarding the basins of the Tigris and Euphrates rivers. The tension was triggered by Turkey's decision to promote the "Great Anatolian Project," a regional development plan of southeastern Anatolia, which involves the construction of a system of dams to improve irrigation and produce electricity. In particular, it consists of 13 integrated projects (6 on the Tigris and 7 on the Euphrates) focusing on the construction of 22 reservoirs capable of gathering 60 cubic km of water, 19 power plants and the irrigation of 1.7 million hectares.

Through these interventions, Turkey will be able to control the outflow of the two Mesopotamian rivers in Syria and Iraq, placing these two countries in a situation of dependency.

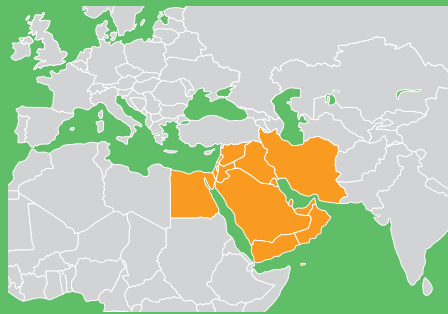


Figure 4.10. The Tigris and Euphrates water basin

The area is also inhabited by Kurds, who will see part of their land flooded.

The project was strongly opposed by both Iraq and Syria, and despite the fact that the Turkish government has guaranteed them a certain amount of water, the water issue remains a matter of political tension between the three countries.

India: internal conflicts between its regions

Conflicts over water resources may also regard regions within the same country.

Looking at India, for example, we can see how the major rivers (Ganges, Narmada, Yamuna, Sutlej, Mahanadi, Krishna and Kaveri) have long been the subject of violent demonstrations in cities and rural villages, as well as legal disputes between regions and the central government in order to reach an agreement on the allocation of water availability for the regions involved.

Ever since the independence of India, the Kaveri river, in particular, has become a major reason for conflict between the regions of Tamil Nadu and Karnataka. When the extension expired for the irrigation generated by the dam which had been built by mutual agreement in 1974, these regions became the protagonists of fierce clashes which also involved the respective associations of farmers.

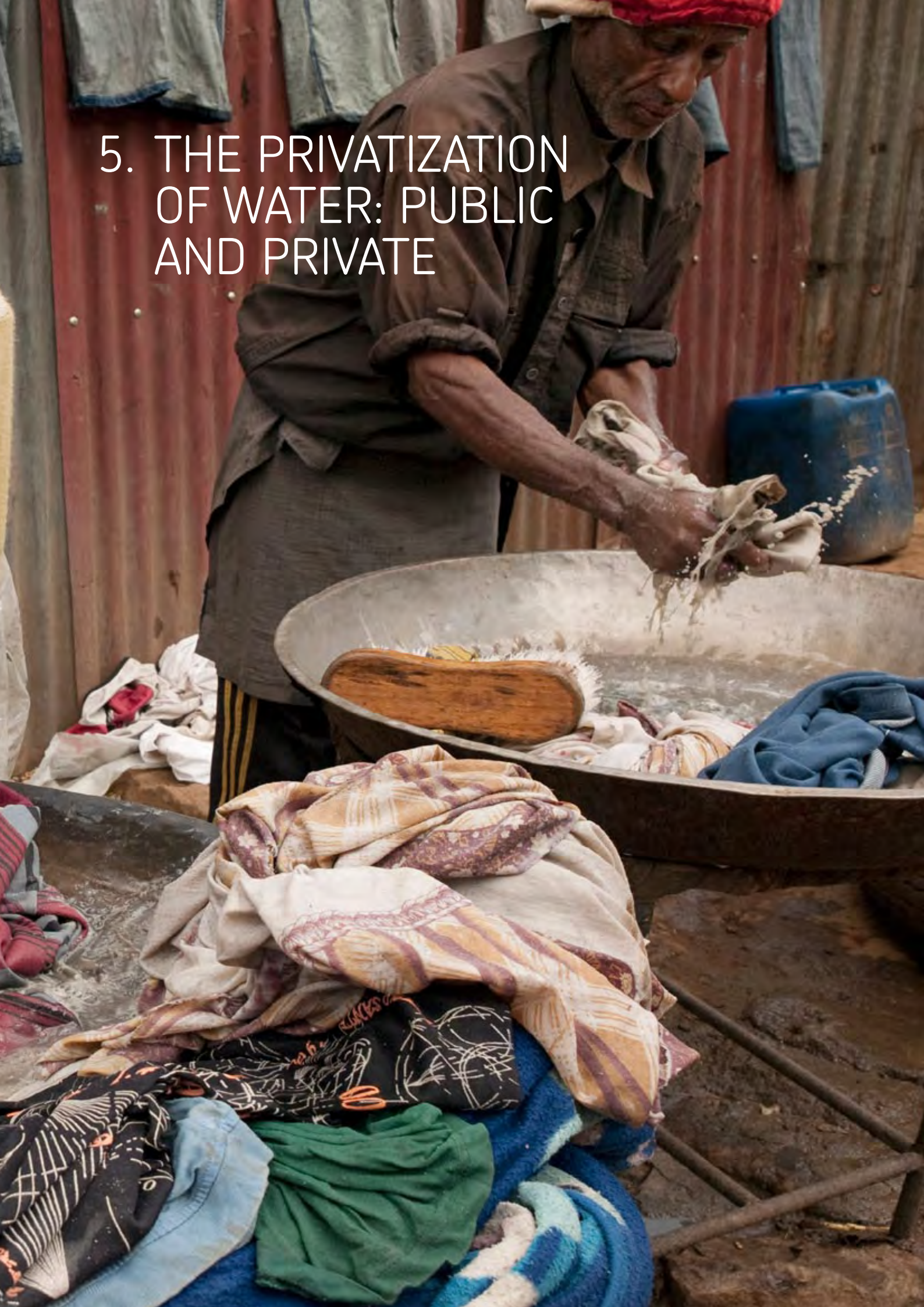
After several appeals to the Supreme Court, in 1991, the final outcome, which focused on the region of Tamil Nadu, generated such rage and discontent that unrest broke out in Karnataka's capital, resulting in assaults, looting and arson against families and triggering, within a few days, retaliation in the region of Tamil Nadu.

NOTES

1. Hoekstra, A.Y. and A.K. Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, Value of Water – Research Report Series No. 28, UNESCO-IHE, Delft, The Netherlands, 2008.
2. Hoekstra and Chapagain, *Water Footprints of Nations: Water Use by People as a Function of Their Consumption Pattern*, 2006.
3. The World Economic Forum Water Initiative, *Water Security: The Water-Food-Energy-Climate Nexus*, 2011.
4. UNDP, *Human Development Report – Beyond Scarcity: Power, Poverty and the Global Water Crisis*, 2006.



5. THE PRIVATIZATION OF WATER: PUBLIC AND PRIVATE



5.1 THE PRIVATIZATION OF WATER

The expression “privatization of water” can be referred to three different areas:

- private property rights on water resources, while allowing its free sale;
- private sector involvement in the management of water services;
- the involvement of the private sector in financing infrastructures and services.

5.1.1 Private property rights on water resources

The first meaning that the term “privatization” may take on in reference to water resources is that of the definition of private property rights on these resources, while allowing the free sale of water.

This situation, although present in some developing countries, is far from the European experience. In particular, our institutional system has always been based, not on the public ownership of the resources, but on the regulation of the use of a common property resource and, as such, an inalienable right. The user, therefore, does not “buy the water,” but acquires the right to use it.

The State, rather than the owner, is the guarantor of the general interest: it cannot sell an asset that it does not own; rather, it can only regulate by whom and how that asset can be used, and resolve any disputes.

In Europe, therefore, water is safely in the hands of the community. What has been under discussion is the introduction of an economic logic in planning interventions and allocation of rights to its use, so that the public money needed to fund major water works is destined elsewhere.

Thus, the notion of “whoever uses pays” is not a way to privatize the water resource, but to more strongly assert that it is of a public nature, ensuring that whoever uses it then returns to the community the value of what has been appropriated for their specific interests.

Equally indisputable is also the fact that water is an essential public service which corresponds to the right of citizens to receive it, and it is the State’s duty to ensure that everyone can use it in an appropriate manner, paying a fair price.

This principle has not always been formalized, especially where the public actors were focused on water services, but it remains valid everywhere and particularly in countries where significant advances have been made towards involving the private sector: for example, in England, France and, more generally, the European Union, where water services have been given the status of services of general economic interest.

WATER IS AN ESSENTIAL
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Water and oil: points in common and differences

Its growing value as a scarce resource and concerns about quality, quantity and accessibility have turned water into a vital strategic asset: a good as rare and precious as oil. However, there are profound differences between the two resources;

- Water and oil are both critical resources for global economic development and sources of potential competitive advantages, as well as conflicts.
- Oil is a consumable and non-recyclable resource; water is a consumable resource, but it is renewable.
- Oil is a private good; water is often

considered a public good.

- Oil is a commodity, whereas the UN has declared that access to water is a human right.
- Oil has a system of protection of well-defined property rights; instead, property rights regarding water, where present, are legally variable.
- The price of oil is defined by expectations on the supply and demand; the price of water is established artificially.
- Oil is a source of energy for which alternatives exist; but there are no substitutes for water.



5.1.2 The involvement of the private sector in water services management

INVOLVEMENT OF THE PRIVATE SECTOR IN THE MANAGEMENT OF WATER IS CONSTRAINED BY THE FACT THAT WATER BELONGS TO THE COMMUNITY AND ACCESS TO BASIC WATER SERVICES IS A PRIMARY PUBLIC INTEREST.

The second meaning of privatization of water refers to the involvement of the private sector, through various contractual arrangements and in different forms, in the management of water services, notwithstanding the fact that water belongs to the community and access to basic services is a primary public interest.

There are three different management models:

- *Territorial monopoly*: annuity that is privatized and regulated, applied in the United Kingdom, and which is based on the actual transfer of ownership of the entire infrastructure and the control of water into the hands of private operators.
- In this model, an enterprise has a monopoly on the water service in a specific area and the properties of networks, while the appropriate authority regulates the environmental and quality standards, the obligations of public service and any penalties and fees.
- *Public ownership* is with private individuals who are entrusted with temporary custody through the procurement system, as in France.
- In this model, the responsibility for service provision and ownership of the plant is held by the public entity that entrusts the concession to private companies, which do not become the owners of the network but only are responsible for its management and the distribution of water. In return, they collect all the bills, determine the price and eventually make a profit.
- *Public ownership and governance*, such as in Italy and Germany, with the acquisition from the market of the resources necessary for service delivery.
- This model provides for the procurement of network management and the distribution of water to a private company that is paid directly by the State under the terms of a contract establishing the rates. The private company can take many forms, from a joint-stock company with public shareholders, to municipal companies and institutions of public law.

5.1.2.1 Management models of private sector involvement in Europe

Before 1980, in Europe – with the exception of France and some private water supply in Britain and Spain – water was primarily owned and operated by public bodies.

Even today, 70% of Europeans are drinking water distributed by public operators or those with a majority of public shareholding, thus highlighting the presence of a very large potential market for private companies to manage water resources.

Thatcher's privatization

THATCHER'S PRIVATIZATION

In Britain, starting in 1989, the government of Margaret Thatcher decided to sell the country's water infrastructures to the private sector, thereby giving a strong impetus to privatization.

Before the sale (on extremely favorable terms) to the private sector – including Suez – of the 10 regional bodies that dealt with water, the government extinguished all debts of the water bodies, totaling more than five billion pounds, giving them an incentive payment of 1.6 billion pounds.

Although, according to the Prime Minister, this assignment was meant to help consumers, in early 1994, two million British families could not pay their bills, which had become too expensive; at the same time, company profits had grown by 147%.

In an attempt to bring order to an open market by now without any rules, it was necessary to establish a supervisory authority (Office of Water Services – Ofwat), which is mainly responsible for the regulation of tariffs for access to water resources.

80% of the French market¹ of water is held, instead, by the “oligopoly” of only three companies (Veolia Water, Suez Lyonnaise des Eaux and Saur), which provides water to half of the French towns and, specifically, 70% of the inhabitants of the country. The remaining 20% of the market, still in public hands, involves various large municipalities (including Amiens, Limoges, Nancy, Nantes, Reims, Strasbourg, Tours) and “water agencies,” authorities on water at the regional level, branched out over the territory.

THE FRENCH OLIGOPOLY



Veolia Water, serving more than 23 million people in France, covers 40% of the privatized world market, and together with Suez Lyonnaise des Eaux, “quenches” the thirst of 240 million people spread across all the continents.

Instead, Saur has won over the French countryside and 7000 towns – France has 36,000 –, totaling about six million inhabitants.

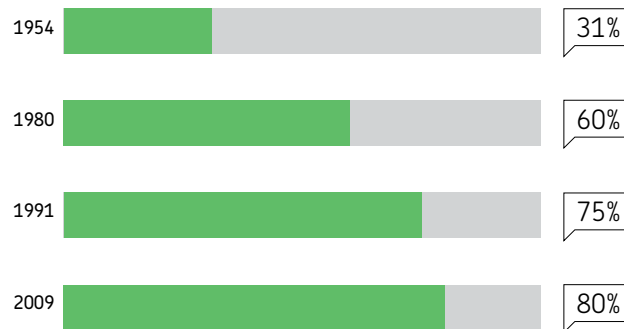
A 1999 survey conducted in France showed that the water distributed by private operators under the concession contract in use cost an average of 13% more than the water managed by the municipal service.

Having saturated the internal market over the past ten years, the three French companies mentioned have focused on winning the international market, where drinking water is still almost entirely in public hands.

The French Alpine town of Grenoble is the only case of re-municipalization of the management company in France. After over 12 years of management delegated to a private company, with embezzlement, illegal financing and strong price increases, in 2001 a campaign by a local civil movement led to a change in the city majority and the re-municipalization of the company in a legal form that would guarantee a certain autonomy from the City Council. The prices of water supplied were stabilized, despite a significant increase in the investments.

THE CASE OF GRENOBLE

Figure 5.1. The increasing quotas of Veolia Water, Suez Lyonnaise des Eaux and Saur in the French water market



Source: Casarano, V., *L'acqua come il petrolio? Ovvero: sarà anch'essa fonte di conflitti?*, Schena Editore, Fasano 2009.

THE GERMAN MARKET

In most of Germany, the management of drinking water is entrusted to municipal limited companies (*Stadtwerke*).

In particular, in Munich the drinking water is distributed by the *Stadtwerke München* (SWM), a municipal company responsible not only for water but also for natural gas, electricity, swimming pools and public transportation. This has enabled it to develop mechanisms for financing the different services it manages. The efficiency of the company is considered exemplary: the quality of the drinking water is high and the prices are among the lowest in Germany. This company enjoys autonomy from the city council, which exercises control only indirectly.

Instead, in Berlin, where the water service has been entirely entrusted to Veolia Water, the cost of one cubic meter of water is more than four Euros, among the highest in Germany.

In other countries, however, governance is enshrined in law.

COUNTRIES WHERE GOVERNANCE IS ENSHRINED IN LAW

In Switzerland, the Constitution expressly provides that water management is the sole responsibility of public companies, declaring that water resources are a “monopoly” of the State.

Belgium adopted a law under which all the taps are operated by an in-house S.p.A., or a company whose shares are all in the hands of the municipalities. In particular, in Brussels, the water service is managed by the public company Vivaqua.

In the Netherlands, in 2005 a law came into force under which only corporations with public capital are allowed to provide services related to drinking water. Consequently, the privatization of water is not possible and all the drinking water companies in the country are controlled by regional and local administrations.

Nevertheless, large public corporations such as Vitens and Evides are for the most part structured and operated as successful private companies, with their focus on profits, a system of delegated management and outsourcing.

The cost of water in the world

Considering the cost of water in different European cities, it is easy to identify an inverse relationship between the cost of water resources and their consumption.

In fact, Italy is the country with rates for the use of water resources that are among the lowest in Europe (fig. 5.2), but with the highest consumption.

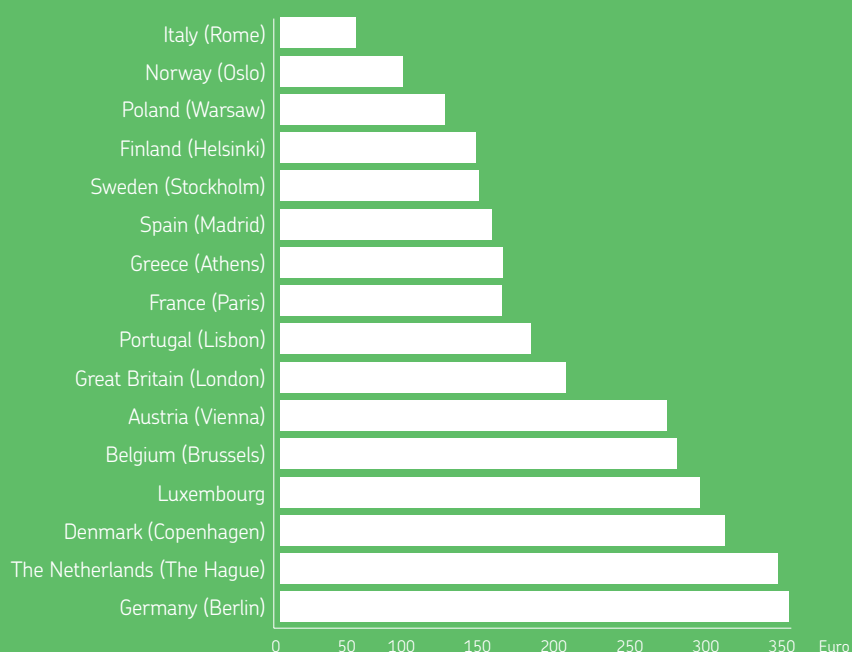
In fact, Italians have little knowledge of the value of water resources and end up wasting water, unlike the Germans, who, since they spend seven times more for water, adopt more sustainable consumption habits, such as watering the garden and washing the car with non-drinkable water. Going into detail, in Berlin (where water costs euro 4.30 per 1000 liters) citizens have a per capita consumption of 117 liters per day, while in Rome or in Turin (where the rate varies between 0.78 and

0.81 Euros to the m^3) they will exceed 220 liters per person per day.

At the international level, even outside Europe, there are few cities where the price of water is below the Italian national average.

Only Buenos Aires (0.17 Euro/ m^3), San Paolo (0.68 Euro/ m^3), Athens, Hong Kong, Miami and a few other big cities have recorded rates of integrated water services (drinking water, sewer and water treatment) comparable with the Italian ones. Differences are not lacking among Italian cities, in which, according to the geographical characteristics of the land and investments, there are deviations from the average rate, starting from a minimum of 0.49 per m^3 in Lombardy up to a maximum of euro 1.37 per m^3 in Tuscany (with a further polarization within each region).

Figure 5.2. The cost of water in different European cities



Source: European Environmental Agency

5.1.3 The involvement of the private sector in financing infrastructures and services

The third meaning of privatization of water refers to the involvement of the private sector in financing infrastructures and services.

Especially in recent decades, the traditional channels of public finance are no longer sufficient to guarantee the necessary capital or are too influenced by policy choices to meet the criteria of economic rationality. For this reason, all operators, whether public or private, have sought access to financial markets.

The involvement of private capital in financing infrastructures and water services also involves the identification of procedures for reimbursement and remuneration, with criteria that may be in line with their risk profiles and the profitability expected by the investor. In this case, the value of the charge applied becomes the factor of evaluation. Thus, developed countries have gone from financial intervention aimed at the creation and development of basic infrastructures that are exclusively public to gradually opening up to private capital.

In developing countries, private capital has entered in many cases, including the financing for the development of these same basic infrastructures.

From this point of view, the role of the World Bank and the International Monetary Fund is important: on the basis of some important reports such as the “Camdessus Report” (World Water Council, *Financing Water for All*, 2003), these international bodies have been increasingly promoting the liberalization and privatization of water services, supporting the conclusion of partnership agreements between public and private bodies (management models that are known as PPP – Public Private Partnership).



Michael & Patricia Fogden/ Minden Pictures/National Geographic Image Collection

5.2 RISKS AND BENEFITS

The privatization of water, in all the forms mentioned, brings both benefits and risks with it, as evidenced by several incidents over time, in which private companies have been the protagonists.

Often, behind the granting by some municipalities of water management contracts to private companies there is the belief that the private sector is more efficient than the public sector in optimizing the management of water distribution. In addition, the awarding of these private contracts allows for a sharing of the cost of the aqueduct network maintenance, against the sale of the profits.

The anticipated better management guaranteed by private companies can potentially rationalize costs and result in a consequent reduction in charges to users.

Often, however, against the benefits, the privatization of water resources can pose risks.

Some episodes have shown that privatization of water resources, instead of the planned reduction, has led to very substantial increases in charges.

For example, in France in 1999, the water distributed by private operators under concession contract of use was on average 13% more expensive than water managed by the municipal service.

Instead, in Bolivia, privatizing the management of the network has led to increases in the price of water, equal to 600%, which in poorer neighborhoods resulted in an increase in the monthly bill (from 5 to 17 U.S. dollars) of about 20% of the average salary (in this regard, see the in-depth box).

Added to this is the fact that the rationalization of costs in some cases is implemented by resorting to the dismissal of some staff (even if qualified), leading to malfunctions in the network management.

In some cases, the granting of water management to private operators has concerned the breach of the same of its obligations towards the development of the water supply, especially to the poorer neighborhoods.

For example, in Argentina, the privatization of the water supply and disposal of wastewater has not been accompanied by low-income families' connection to the water supply on the part of the private management enterprises. This has forced the Argentine government, despite the privatization, to subsidize the cost of that connection with public funds.

Often, the privatization of water is the result of pressure from financial institutions (e.g., the World Bank), which promote water management by the private sector as likely to be able to introduce efficiency, growth and greater value for society, with respect to the public sector.

However, the fact that private companies should be accountable for their choices before their shareholders, whose criteria for evaluating policies is their share revenues, requires a

THE OPPOSING VIEWS ABOUT WATER ON THE WORLD STAGE TODAY, AND WHICH REFLECT THE MANAGEMENT MODELS OF WATER RESOURCES, CAN BE TRACED TO TWO PRINCIPLES: THE APPROACH TO WATER AS A "COMMON GOOD" AND AN INCREASINGLY RARE RESOURCE AND THAT OF IT AS AN ECONOMIC GOOD.

reflection on the validity of this instrument for the management of water resources, especially in relation to the lack of an incisive and effective control by the public.

If on the one hand, the public bodies may not be able to properly handle a privatized service in which capital investments are very important, on the other, there have been many cases of inefficient management of public companies.

If the water is a good for all, only an efficient system of democratic control can provide adequate warranty to address risks arising from an ineffective management of water resources, be it public or “privatized.”

Privatization and the mobilization of civil society

The occurrence of the risks and the consequences that the privatization of water resources brings with it (for example, increased tariffs, reduced accessibility to safe drinking water, etc.), has on many occasions been accompanied by major episodes of the mobilization of consumers, who have protested against this water management tool.

From Bolivia to Germany to Italy, albeit with different forms, citizens have raised their voices against the privatization.

The struggle for water in Cochabamba (Bolivia)

In January of 2000 in Cochabamba, Bolivia, there arose the greatest movement in history against the privatization of water which, with the support of institutions like the World Bank and International Monetary Fund, intended to facilitate the entry of major multinationals in the management of water services.



The protagonist of this privatization process was the U.S. multinational Bechtel Corporation, in collaboration with the Italian company Edison, under the supervision of the World Bank.

The project, which included privatization and the provision of all water in the city by the company Aguas de Tunari, owned by Bechtel, brought the tariffs for drinking water to levels that caused about 50% of the population to be effectively excluded from access to water services.

When the population found that even the chance to collect rainwater was denied, it rose in a vigorous protest movement against the government measures and multinational water companies.

Organized into a “coordinated defense of water and life,” the movement managed to bring together profoundly different social sectors, historically in conflict – farmers and laborers of the province joined the inhabitants of the city – showing how the battle for water had become more important than the internal differences.

In 2001, during the “water revolution” in Cochabamba, hundreds of people were injured and five children were killed during a bloody crackdown by the army, which was called in to quell protests by demonstrators.

After six days of protests and battles, the government had to cancel the management contract and repeal the provision that privatized the distribution of water services, while Bechtel was forced to leave the country, renouncing the compensation asked of the State for a loss of a \$25 million profit.

Berlin's "no" to the privatization of water resources

At the referendum on February 13, 2011, 665,713 inhabitants of Berlin representing 27% of the voters, approved a bill that required all agreements relating to the partial privatization of water to be published, agreements that since 1999, have guaranteed high profits to RWE and Veolia, the holders of 49.9% of the municipal water services (Berliner Wasserbetriebe).

In this way, the citizens of Berlin have clearly expressed their desire to return to a public management of their water service, since after 1999, water prices have increased by 35%, ranking among the highest of any German city.

In order for the referendum to succeed, the regional regulation required that at least one quarter of the electorate voted – thus, 615,571 people had to be convinced – but the supporters of the proposal were 50,000 more than that figure, and therefore numerous enough for it to be confirmed for the first time in a national referendum in Berlin. The result achieved, thus, contradicted the initial expectations, as well as the media and political parties, which had greatly underestimated the outcome of the referendum.

The mobilization of Italian civil society

In Italy, the management of the water supply is regulated by the Galli Law (Law # 36/1994, "Regulations on water"), which in the text of the law refers to an "integrated" water service, which includes sewer and water purification.

The aim of the law was to reduce the excessive fragmentation of managerial subjects (7826 in the mid-nineties, including waterworks, sewers and treatment plants).

More than 15 years after the adoption of the law, the commitment of the single operators has been completed in 57 Opti-

mal Territorial Areas (91 have been identified by the Italian regions): 44 have chosen joint venture Public Private Partnerships or those of totally private capital; instead, only 13 have decided to entrust management directly, without bidding, to a public limited company wholly controlled by local authorities.

Since 2000, Italian civil society has mobilized against the Galli Law.

Between 2005 and 2006, fifty subjects (associations, unions, committees) gave rise, instead, to the Italian Forum of Water Movements, which has collected over 400,000 signatures for a popular law in favor of making the water service public again.

Aprilia, a town of 70,000 inhabitants in the Lazio region, has become the symbol of the struggle against the privatization of water resources in Italy. Over 5000 people chose to send their water bills back to the sender, i.e. Acqualatina, which has managed the integrated water service since 2002, tripling its rates but without making the necessary investments to improve service and reduce losses.

The law of popular initiative, which began debate in parliament on January 22, 2009, provides that operators of water services are only public bodies (companies and special groups) and disciplines the modalities of participation of the workers and local communities in decision-making. The text drafted by the Italian Forum of Water Movements states that investments need also be covered by the State, using general taxation, and not only by the companies, that they be financed by the bills paid by the citizens (the Galli Law provides that "the tariff is determined to ensure full coverage of investment and operating costs").

On March 26, 2011, the Committee for Two Yes for public water and the Italian Forum of Water Movements launched a national demonstration in Rome, which brought together more than 300,000 people, urging citizens to vote in the referendums against water privatization on June 12-13.



World Water Contract



To defend water as an inalienable right of man, in 1998 a group of intellectuals from different countries³, under the initiative of Riccardo Petrella (President of the IERPE - Institut Européen de Recherche sur la Politique de l'Eau), established the International Committee for the Promotion of a "World Water Contract."

This committee, chaired by Mario Soares (former President of the Republic of Portugal) and composed of 20 experts, drafted an "International Water Manifesto," aiming the Committee's work toward the recognition of water as a human and social right (a goal reached in July 2010) and a common good of humanity.

In order to further reinforce its measures, the committee launched a "network strategy," establishing national committees in many countries. Italy has one, too - as does France, Belgium, Switzerland, Canada, Brazil and the U.S. -, that is based in Milan.

-In the absence of a "world water policy" and facing the prevalence of strongly nationalistic policies and practices of the delegation of water management to private parties, the water contract, therefore, proposes the following priorities:

- the creation of a "World Water Law," as well as a "global treaty" to legalize water as a vital asset, common to all mankind;
- the promotion of policies to avoid conflicts over access to and the use of water;

-the promotion of democratic forms of local community management of water, resisting privatization.

The World Water Contract, in addition, poses three specific objectives:

- guarantee access to water for the 600 cities in the South of the world, which in 2020, will have more than one million inhabitants;
- reduce the number of people without water, and prevent that number from reaching 3.2 billion by 2020;
- avoid the destruction and deterioration of water, which is essential for life in the eco-system on Earth.



NOTES

1. The quota held by Veolia Water, Suez Lyonnaise des Eaux and Saur in the French water market was 31% in 1954, 60% in 1980 and 75% in 1991.

2. Data from the Supervisory Board on Water and Waste.

3. Including: Mikhail Gorbachev (president of the World Political Forum and Green Cross International), Mario Soares (former President of the Republic of Portugal), Guy Laliberté (founder of Cirque du Soleil and the Canadian foundation One Drop), Marinò da Silva (senator, former Minister for the Environment for the government of Brazil), Riccardo Petrella (president of the IERPE - Institut Européen de Recherche sur la Politique de l'Eau), Danielle Mitterrand (president of the France and Freedom Foundation), Vandana Shiva (president of the Indian Research Foundation for Science, Technology and Natural Resources).



6. RECOMMENDATIONS: AREAS OF INTERVENTION



6. RECOMMENDATIONS: AREAS OF INTERVENTION

This document has set itself the goal of increasing the level of attention and awareness regarding water, highlighting the main problems associated with its use. This last chapter features a compilation of the main recommendations that the Barilla Center for Food & Nutrition deems relevant.

6.1 Models and tools to help a real “integrated” management of water

IT REQUIRES THAT THE GOVERNMENTS BE AWARE OF THE BREADTH OF THE CHALLENGE AND WORK IN REFERENCE TO MANAGEMENT MODELS THAT TAKE INTO ACCOUNT ALL THE ELEMENTS THAT MAKE UP THE COMPLEX SYSTEM OF WATER ECONOMY.

Implement an integrated approach – a view of water economy – which takes into account all the variables that affect the availability and quality of water resources.

The measures put in place that are outside the boundaries traditionally assigned to the management of water resources are now able to significantly influence how water is used and allocated. The recent UNESCO report (*Water in a Changing World*, 2009) points out that the decisions taken by actors outside the water sector have a lot of weight in the conservation of global water resources.

This does not mean that the objectives of increasing the volume of water supplied, reducing losses and increasing overall efficiency of water management systems are any less relevant. It requires that the governments of the countries be aware of the breadth of the challenge and work in reference to management models that take into account all the elements that make up the complex system of water economy.

6.2 Practices, know-how and technology for increasing water productivity (more crop per drop) and the reduction of waste

BREAK THE CORRELATION (NOW VERY STRONG) BETWEEN ECONOMIC DEVELOPMENT, POPULATION GROWTH AND THE CONSEQUENT INCREASE IN THE LEVELS OF WATER CONSUMPTION.

Break the correlation (now very strong) between economic development, population growth and the consequent increase in the levels of water consumption.

Without action to reduce the use of water resources relating to production processes and cultivation, the risk of environmental imbalance in the near future is high, with catastrophic consequences for the planet and people.

This means reducing waste (and there is still much to do) and the use of technology to make water resources more productive (and thereby obtain quantitatively the most significant output for the same input: the so-called more crop per drop).

The introduction of forms of incentives to invest in technologies which are already available can lead to significant savings in the volume of water used in production processes

in a reasonably short time. With regard to the uses in agriculture – covering 70% of global water consumption –, there is ample room for the recovery of productivity of the water used. An example is the adoption of advanced techniques to collect rainwater to use for irrigation. Moreover, the diffusion of technologies and management tools designed to maximize agricultural irrigation efficiency does not always translate into huge investments in technology, but often, more simply, in the dissemination of knowledge and know-how.

6.3 The water footprint as a simple, communicable, objective indicator

Promote an increased awareness of the impact of the use of water on the ecosystem and support the emergence of virtuous behavior through the use of the water footprint indicator.

The logic of the Life Cycle Assessment of products, for example, is headed exactly in the desired direction, taking into account what happens at each stage of cultivation or extraction, production, transport and consumption, according to a systemic and integrated logic.

In particular, we believe it is essential to adopt a systematic use of the water footprint as a tool for the comprehensive assessment of the environmental impact of individuals, enterprises (of production and distribution, within each sector) and States.

6.4 Dietary habits and a lower water consumption

Orient individual behavior and consumption patterns towards lifestyles that involve a more careful use of water.

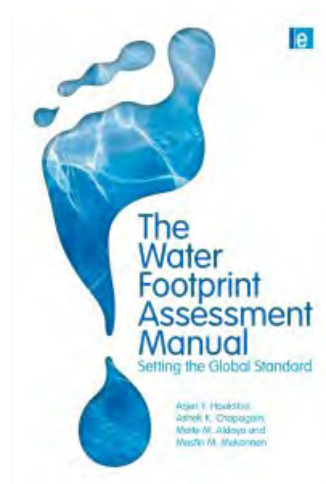
Interventions of awareness aimed at affecting lifestyles have not only the task of encouraging a more rational use of water in daily activities, but also that of introducing a more caring attitude on the whole towards the issues of the conservation of water resources.

Consumption habits should be oriented towards the use of goods and services with a lower water content (water footprint):

- increasing consumer awareness of the water footprint of products, by explicitly stating the amount of water consumed to produce those goods and services (*water footprint of the product*) on the labels, for example;
- introducing incentive schemes to purchase products and services of a lower water content within each category, even correlating the virtual content to the price.

The dietary styles adopted play an important role. In the past, the Barilla Center for Food & Nutrition developed the concept of the Double Pyramid, in which we can see that the foods that are recommended by nutritionists most often are those that have a lower environmental impact. This is especially true if you look at the double pyramid made with the water footprint of food.

The adoption of diets, such as the Mediterranean diet, characterized by a high consumption of fruits and vegetables but a moderate amount of meat, is a good example of healthy eating, but it is also more environmentally friendly, helping to safeguard water resources that we are making increasingly scarce.



IT IS ESSENTIAL TO ADOPT A SYSTEMATIC USE OF THE WATER FOOTPRINT AS A TOOL FOR THE COMPREHENSIVE ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF INDIVIDUALS, ENTERPRISES (OF PRODUCTION AND DISTRIBUTION, WITHIN EACH SECTOR) AND STATES.

ORIENT INDIVIDUAL BEHAVIOR AND CONSUMPTION PATTERNS TOWARDS LIFESTYLES THAT INVOLVE A MORE CAREFUL USE OF WATER.

6.5 Efficient crop location and virtual water trade for savings on a global level of water resources used

RETHINK ON A GLOBAL SCALE THE LOCATIONS OF ACTIVITIES THAT INVOLVE A HIGHER WATER CONSUMPTION. FROM THIS POINT OF VIEW, AGRICULTURAL PRODUCTS CONSTITUTE THE AREA OF GREATEST ATTENTION.

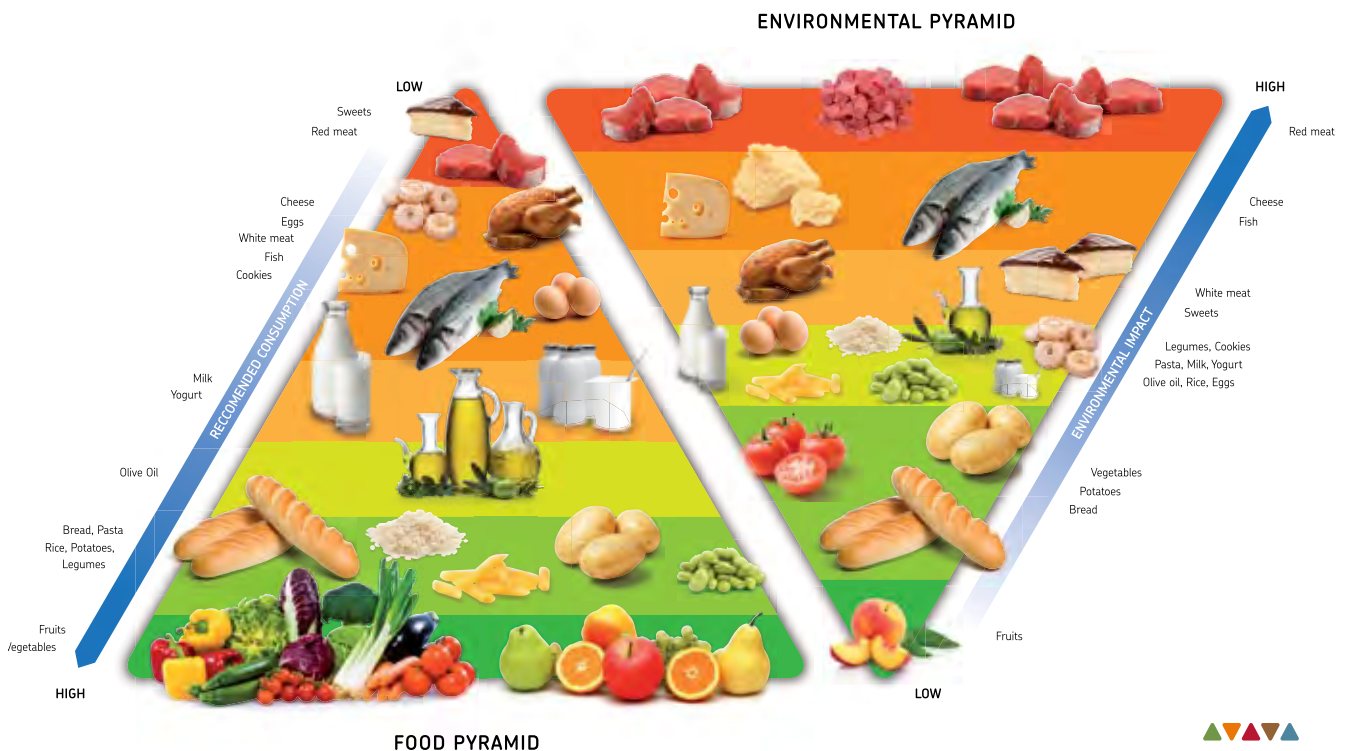
Rethink on a global scale the locations of activities that involve a higher water consumption. From this point of view, agricultural products constitute the area of greatest attention.

In particular, the proper location of agricultural crops is an issue that needs to be addressed with great caution. The nature of agriculture, in fact, has very strong local and territorial roots. Similarly, the consequences of climate change (e.g., changes in location and intensity of rainfall) must be kept in mind in the medium term.

What is suggested is a greater focus on the location of crops in relation to water efficiency. In particular, in the decisions about the location of certain crops, the opportunity could be seized to maximize the consumption of a green water footprint rather than that of blue water.

Not only that: it is possible to seize the opportunities offered by the growing liberalization of international trade by targeting the trading of goods with high virtual water content from the geographical areas that are richest in water resources to others of the poorest areas, by adopting the logic of virtual water trade.

Figure 6.1. The Food and Environmental Double Pyramid developed by Barilla Center for Food & Nutrition



La water neutrality per indurre alla riduzione del consumo d'acqua

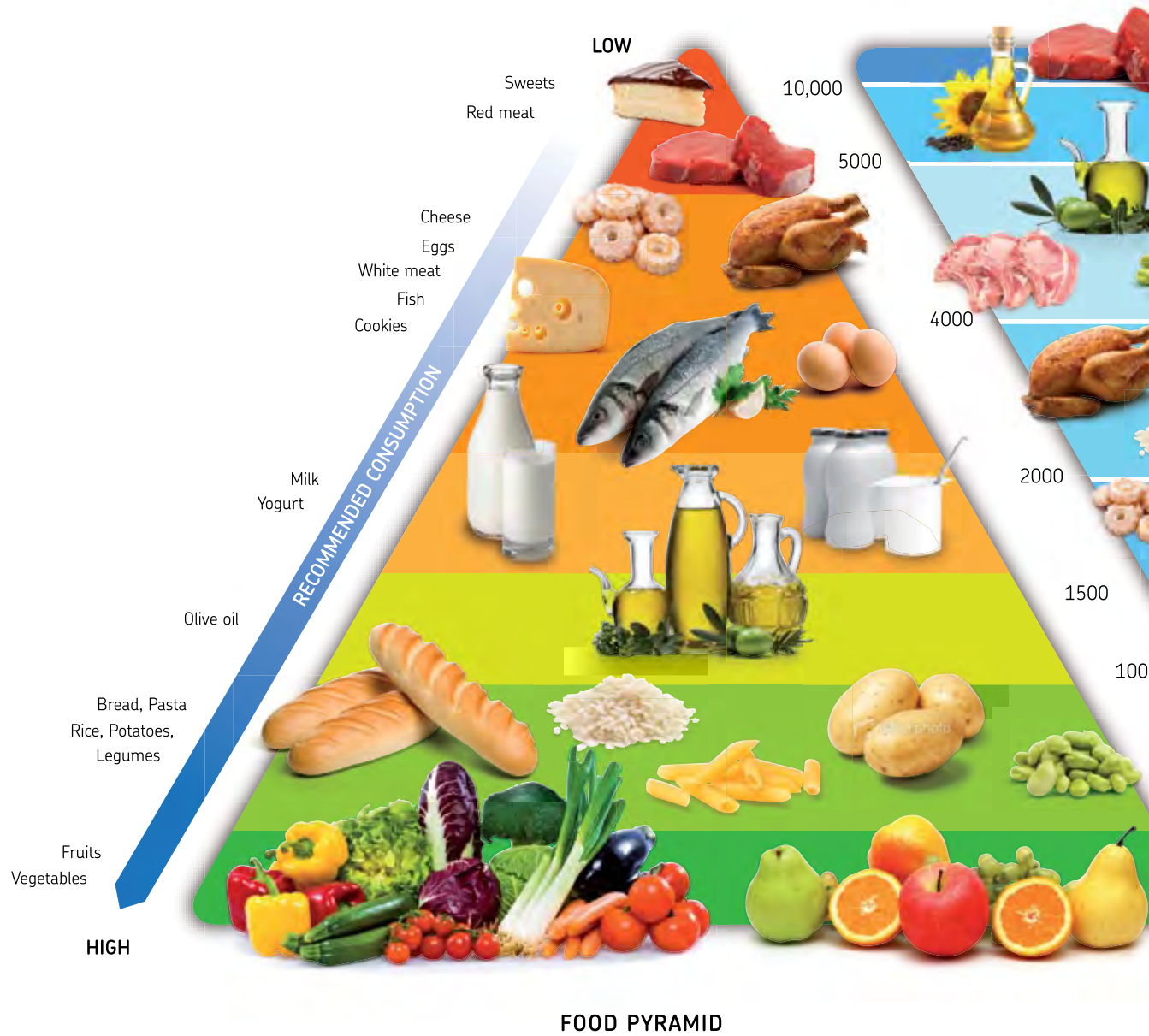
With reference to the issue of the reduction of the water, the concept of water neutrality was developed (see Hoekstra, A.Y. and A.K. Chapagain, *Water Neutral: Reducing and Offsetting the Impacts of Water Footprints*, Value of Water Research Report Series, # 28, UNESCO-IHE Institute for Water Education Editor, Delft, The Netherlands, 2008).

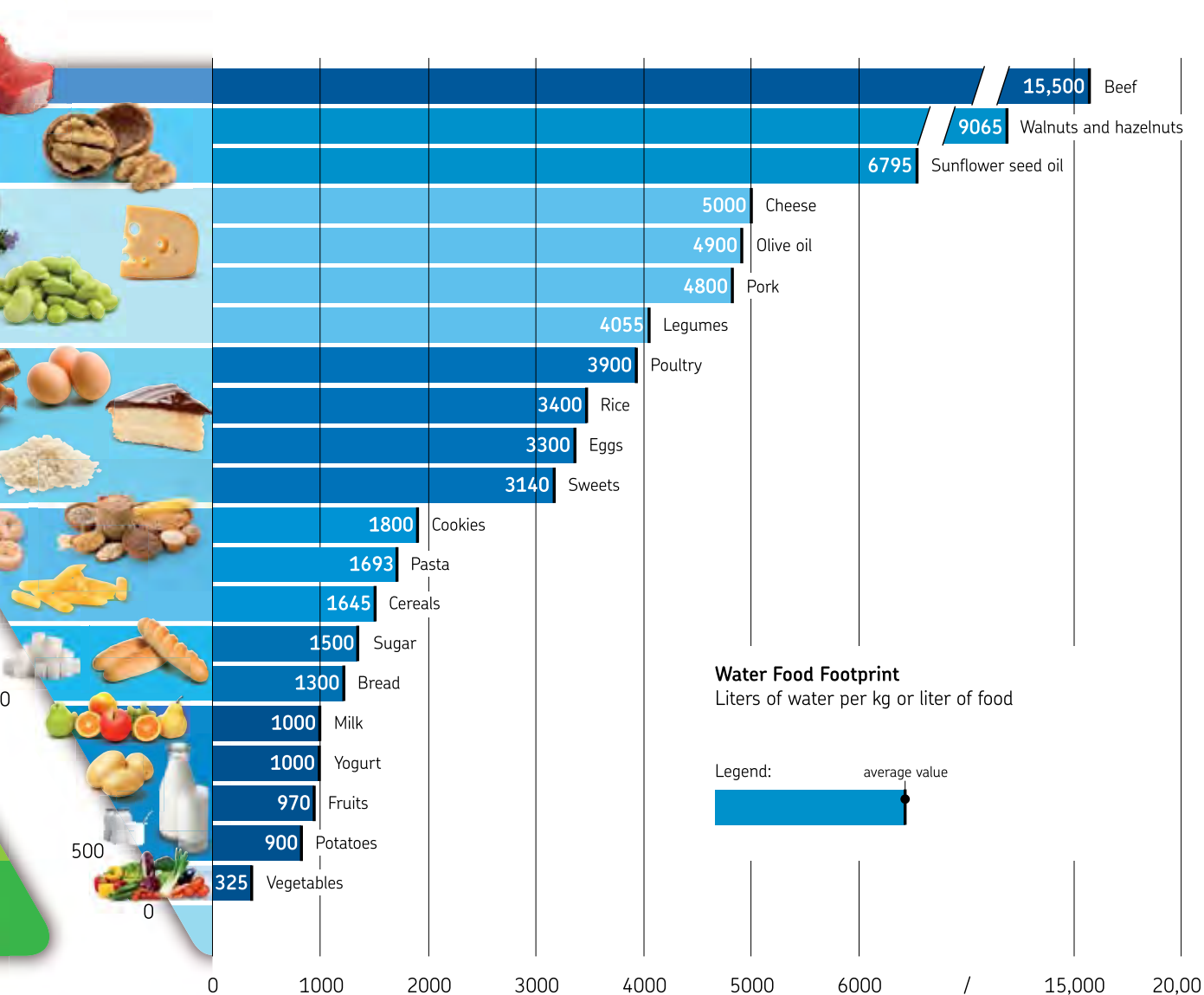
Making an activity water neutral, means reducing the water footprint (i.e., reducing the possible consumption and pollution of water used) as much as is reasonably possible, economically offsetting the negative externalities of the remaining water footprint (by investing in projects that promote sustainable and equitable use of water in the environment and the community involved). Generally, it is not a matter of zero consumption of water (because it is not pos-

sible, unlike carbon neutrality that provides for zero CO₂ emissions). The concept of water neutrality can be determined for a product, for a company (with reference to the reduction of the water and the financial compensation of the remaining water footprint of the entire supply chain) or for an individual or community.



Figure 6.2. Water Footprint of the Food Pyramid





6.6 Commitment and responsibility of institutions to ensure access to water

PROMOTE ACCESS TO WATER FOR THE MOST DISADVANTAGED POPULATIONS AS TO WATER TODAY, PROMOTING THE NECESSARY INVESTMENTS AND REMOVING TECHNICAL AND POLITICAL CONSTRAINTS.

Promote access to water for the most disadvantaged populations as to water today, promoting the necessary investments and removing technical and political constraints.

Much has been done in this context over the last decade and the results were encouraging. What needs to happen now, even in the face of different kinds of priorities arising from the global economic and financial crisis, is that the commitments be respected and that attention given to the issue continues to remain very high. European countries, in particular, can play an important role in this context.

The fact that the UN has ranked access to water among the Millennium Development Goals has created greater awareness, orienting the actors involved towards a single direction.

We simply emphasize the importance of inscribing the actions taken by these organizations into a coherent and cross-encompassing strategy that includes infrastructures, education and appropriate management skills.

6.7 Economic value of water resources and the internalization of the cost of water in the price

RETHINK THE FUNCTIONING OF MARKET IN VIEW OF WATER ECONOMY THROUGH THE DEVELOPMENT OF ECONOMIC MODELS THAT CAN ACCURATELY DEFINE THE ECONOMIC VALUE ASSOCIATED WITH THE USE OF WATER.

Rethink the functioning of markets in the optic of water economy through the development of economic models that can accurately define the economic value associated with the use of water.

The operation of the water market, both public and private, is one of the key issues to promote greater water efficiency. This debate is central to the identification of a mechanism for setting the correct value. Defining the “fair value” and, therefore, the “fair price” of water can reduce waste and increase the effectiveness of policies for environmental protection.

Pricing research requires a difficult balance: it must meet criteria of distributive equity and, at the same time, discourage excessive or improper use.

6.8 Management of water resources between privatization and democratic control

IF WATER IS A GOOD FOR EVERYONE, ONLY AN EFFECTIVE SYSTEM OF DEMOCRATIC CONTROL CAN PROVIDE ADEQUATE SECURITY IN THE FACE OF RISKS FROM A MODEL OF INEFFICIENT MANAGEMENT OF WATER RESOURCES, BE IT PUBLIC OR “PRIVATIZED.”

In recent decades, policy makers and development experts have seen privatization as an opportunity to reduce waste and provide efficient management of water resources agencies. This attitude – certainly supported by major studies commissioned by international institutions, but also by vested economic interests – has led to negative consequences, in many cases, for the community (reckless increase of rates, reduced availability, etc.). Looking ahead, the issue must be reconsidered starting from the interests of people, obligating the private management companies to comply with social and ethical principles.

If water is a good for everyone, only an effective system of democratic control can provide adequate security in the face of risks from a model of inefficient management of water resources, be it public or “privatized.”







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