WATER KNOWLEDGE

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Introduction

Water is the most important resource on Earth; it is able to change our planet in geological and landscape terms and it is thanks to its presence and abundance that it has been possible for life to emerge. Water is the most abundant chemical compound on Earth, it is found in all environments and is an integral part of all living organisms. Our planet is about 70% water, while only 30% is land. Seen from space, the Earth appears as a blue planet.
The bulk of it, 97%, is sea or salt water, unusable for drinking, but used for working, irrigating and for most industrial uses. Fresh water is also present on the planet in very large quantities, but is mostly retained by ice caps and glaciers (2.4%); only the remaining 0.6% is divided between lakes, rivers, groundwater and the atmosphere.

Water as a resource

A vital resource

Water is the most important resource on Earth; it is able to change our planet in geological and landscape terms and it is thanks to its presence and abundance that it has been possible for life to emerge. With its 10 trillion cubic metres, water covers more than 70% of the Earth's surface while only 30% is occupied by dry land. Seen from space, the Earth appears as a blue planet. The first cellular life forms appeared in the oceans some 3.5 billion years ago, only 1 billion years after the birth of our planet, and they have changed over time into more and more complex forms, colonising the land too, but still depending on water: there is no life without water. All living beings are made up of water in percentages ranging from 50% to over 95% (in some organisms such as jellyfish).
The vast majority of water on Earth, 97%, is sea water or salt water, unusable for drinking, but used for working, irrigating and most industrial uses. The remaining 3% is fresh water, and therefore potentially drinking water, a resource that is becoming increasingly precious to the point of being defined as 'blue gold'. Most of fresh water is found in glaciers and perennial snow (68.7%), and is not available for human consumption, while 30% is confined underground in groundwater aquifers, up to tens of metres deep, from which water of high purity and quality can be drawn, but only if pumps or other facilities are available. Only 0.3% is easily accessible in rivers and lakes.

Chemical properties of water

Water is an odourless, tasteless and colourless liquid. Each water molecule consists of two hydrogen atoms bonded to one oxygen atom (H_2O). Each hydrogen atom has only one electron that is shared with oxygen which, in turn, takes part in the bond with one electron. Since electrons and protons are present in equal numbers, each water molecule is therefore neutral as a whole. Water molecules are said to be 'polar' because they have a weakly positive pole near oxygen and a weakly negative pole near hydrogen; in fact, oxygen is able to hold electrons closer to itself than hydrogen can, and the water molecule is thus negatively charged at the oxygen atom and positively charged at the hydrogen atom. Since two opposite charges attract, water molecules tend to join together like magnets.

Water can melt many substances. Water is called the universal solvent since it can solve more substances than any other liquid. And we are very lucky it can: if it could not, we could not drink a cup of hot sugared tea, because the sugar would remain at the bottom of the cup. This is why the waters of rivers, streams, lakes, seas and oceans that may look pure at first sight contain in fact a huge number of solved elements and minerals released by rocks or by the atmosphere. Wherever it flows, above ground, underground or inside our body, water solves and carries an extremely high amount of substances. Water thus performs a precious task: that of carrying, sometimes to long distances, the substances it encounters along its way. Pure water, like distilled water, has a pH of 7 (neuter). Seawater is essentially alkaline, having a pH of around 8. Most fresh water has a pH between 6 and 8, apart from acid rains, of course, whose pH is below 7.

The physical properties of water

Water has a high specific heat, i.e. it needs a lot of heat to heat up and takes long to lose the stored heat and get cold. This is why it is used in cooling systems (for instance in car radiators or to cool industrial equipment). And this is also why in coastal (or lake) regions the temperature of the air is milder: in these areas, as seasons change, the temperature of the water 'mitigates' the temperature of the air, since it decreases or increases more slowly than that of the air. Water has a high surface tension: that means that, once poured on a smooth surface, it tends to form spherical drops instead of expanding into a thin film. Without gravity, a drop of water would be perfectly spherical. Surface tension allows plants to absorb the water contained in the soil through their roots. And it is surface tension, again, that makes blood, which is largely composed of water molecules, flow through the blood system of our body.

Only liquid water? In addition, water can normally be found in a liquid state, but can easily become solid or gaseous. Pure water goes from liquid to solid, i.e. freezes, at 0 degrees centigrade, while at sea level it boils at 100°C (the higher the level, the lower the temperature at which water starts boiling). The water boiling and freezing values are taken as a reference point to calibrate thermometers: in centigrade scales, 0° on the centigrade scale is the freezing point and 100° is the boiling point.

When freezing, water expands, i.e. its density decreases while its volume remains the same: this is why ice floats on the water or a bottle filled with water and placed in a freezer breaks up.

Water is a special natural resource since it is the only one on earth to be found in all of the three physical states depending on the surrounding temperature: liquid, solid (ice) and gaseous (water vapour). The whole of the processes that make water leave the oceans, get into the atmosphere, reach the emerged lands and flow back to the oceans later on is called hydrological cycle and is fuelled by the energy of the Sun.

Water cycle

In the oceans, water is in the liquid state. Solar heating causes a portion of surface water to evaporate and turn into steam, go up into the atmosphere and be carried by the wind. When a mass of water, that is already rich in water vapour, receives more water and saturates, or when it encounters a colder mass of air, water vapour condenses in the atmosphere, i.e. vapour turns into water again (or snow and ice, depending on how cold it is). This is how precipitations originate, through which liquid or solid water (rain, snow or hail) partly reaches the continents and partly gets straight back to the oceans. The water fallen through precipitations on the emerged land still has to go a long, often winding way before going back to the oceans and close the cycle. Some of this water seeps through the soil, and part of it remains in the soil, part feeds the water-bearing stratum (deep flow) to resurface later in rivers or springs. Part of the water that had remained in the soil evaporates into the atmosphere, while part of it is absorbed by plant roots and carried through to the leaves to be released again into the atmosphere through transpiration. These two processes together are called evapo-transpiration. Finally, some of the water fallen through precipitations remains on the Earth's surface and originates lakes and rivers, through which it gets straight back to the seas and oceans (surface flow).

Hydrological cycle

The amounts of water that are moved through the hydrological cycle can also be estimated and evaluated in numerical terms. The tool we use is the global hydrogeological balance of the Earth. The total amount of water that evaporates from the surface of the oceans is more than the water that gets straight into them from precipitations. The difference is part of the amount of water that falls down on the continents. The total amount of water that falls on the continents actually consists of that which has evaporated, not only from the seas or oceans, but straight from the soil as well. The global hydrological balance differs according to climatic conditions – especially the extent of precipitations – and is different, therefore, in each region of our planet. If we take, for instance, the equatorial climate, we can see that there are no water shortages during the year: there is always plenty of water available since the precipitations can easily cover the losses. Conversely, in the hot desert climate, the high temperatures promote the evapo-transpiration that the few precipitations cannot make up for: in this case, there are serious shortages all through the year and little water available. The differences found between the hydrological balances of these two types of climates have immediate repercussions on the vegetal and animal species that live there, whose survival is closely linked to the amount of water that is available and usable.

Drought and desertification

Due to the extent of damages and the number of people involved, drought is the number one natural catastrophe. A dry period is marked by less frequent precipitations compared to the annual average of the area. Drought is considered as serious when the average farming production decreases by 10% and catastrophic when it decreases by over 30%.

Dry periods have become more frequent and more intense over the last few decades, involving almost all of the emerged areas.
This tendency to drought has not only affected the dry or half-dry areas of Africa and Asia, that have been the most seriously affected by the different dry spells of the last 30 years, but also the mild and northern countries.
More or less one half of the surface of the emerged lands can be defined as dry or half-dry. Both ecosystems are extremely fragile and vulnerable. If exposed to drought for long periods, they can be affected by desertification, i.e. they can turn into deserts.
According to the UNCCD (UN Convention to Combat Desertification), 25% of the world's land area is either highly degraded or undergoing high rates of degradation. It is estimated that two-thirds of African land is already degraded to some degree and that land degradation affects at least 485 million people – 65% of the entire African population. By the 2050s, 50% of agricultural land in Latin America will be subject to desertification. It is therefore absolutely important to protect these regions.
The causes. The history of the biosphere has been marked, during the different geological ages, by natural climatic fluctuations that have altered the width of deserts. Exceptionally dry periods have become more frequent and more intense over the last few decades: from 5 a year in the Seventies to 12 a year in the Eighties. There are many complex causes for such increase: it must however be borne in mind that man's pressure, through a bad or improper use of the land, can heavily alter the characteristics of the soil, of the vegetal covering and the low atmosphere, thus irretrievably affecting the delicate balance of the hydrological system.
The effects. Desertification reduces the ability of an ecosystem to survive when the climate changes, with dramatic consequences, such as:

- loss of productivity of the soil;
- degradation of the vegetal covering, through to its total disappearance;
- dispersion of solid particles in the atmosphere – sand storms, air pollution – with a negative impact on man's health and productive activities;
- reduction of farming and breeding production: malnutrition and hunger;
- migrations of people and wars.

Hydrosphere

What distinguishes the Earth from the other planets is the presence of the seas and oceans. Satellite pictures show the Earth as a "blue" planet, because two thirds of its surface are covered by huge masses of water. The whole of the earth's environments where water is present in its liquid, solid or gaseous state is called hydrosphere. Most water can be found in the oceans, underground waters and in its solid state as ice in polar hemispheres. Water contained in the atmosphere as water vapour is instead just a very small part of the total amount. But this small part is very important in order to maintain the climate and feed the underground layers. Generally speaking, the hydrosphere can be divided into two different environments: salty water basins (seas and oceans) and fresh water basins. The main feature that distinguishes salty water basins from fresh water basins is their high salt content (or salinity), which is generally 35 grams per litre. Fresh water basins (or continental waters) can be divided into surface waters (rivers, lakes, lagoons, marshes) and underground waters (deep layers, surface layers and springs).

Continental waters

Continental waters consist of water bodies like glaciers, rivers and lakes. Differently from seawaters, they are characterized by a low salinity and they move towards the sea because they are not too deep. See the different landscapes that we can encounter when we have a walk on the beach, on the mountains or on the hills.

- Glaciers form above the permanent snow line due to the accumulation of water at a solid state (snow that transforms into ice). The line varies according to the latitude on which continental glaciers (that uniformly cover wide areas) and mountain glaciers (that occupy mountain valleys) form. Below the permanent snow the ice melts and the water is present in a liquid state.

- Watercourses, streams and rivers collect the water that flows on the Earth's surface and that is in continuous contact with groundwater.

- The lakes are temporary deposits of water on continental depressions. They are supplied with water by watercourses called tributaries. The water flows into the out-flowing streams, streams or rivers that originate from the lake. Lake water has a low salinity, but has plenty of suspended material, and its temperature depends on local climate conditions. Also the water of big lakes can move and originate variations called seiches, due to differences in atmospheric pressure.

Not all the water that comes back to the mainland through precipitations is collected by the rivers, lakes or trapped in glaciers. A part of it filters on the soil and goes down into it due to the force of gravity until it reaches a layer of waterproof rocks that stop the passage of water: a water-bearing stratum is created. When this condition does not occur, in order to reach the water-bearing stratum artesian wells are built and the water can be extracted as it reaches the surface after being subject to a high pressure.
The continuous exploitation of underground water determines the emptying of water-bearing stratums and lowering of soils. This occurs in Venice as a consequence of the extraction of water used for industrial aims in Marghera port area. Instead, when the exploitation occurs near coastal regions, the seawater filters underground to occupy the free spaces left by fresh water: this generates serious damages to agriculture and vegetation, as it is happening along Ravenna coast, where wide pinewood areas are dying.

Seawater

The main characteristics of seawater are:

- salinity: it refers to the total salt content in 1000 grams of seawater and it has a value of around 35 grams. The percentage of the different substances that are present in the solution depends on the river contribution, on chemical reactions that occur in sea sediments, on volcanic activity and on the decomposition of organisms. In fact, the quantity of salt is stable only at a certain depth, while on the surface and coastal areas it is also subject to seasonal variations;
- melted gases: oxygen and carbon dioxide are necessary for the life of water organisms. Oxygen is largely present on the surface, since water is in contact with the atmosphere and where photosynthetic organisms live, and deep underwater, where water temperature is very low. Carbon dioxide is a very soluble gas that easily spreads from the atmosphere into sea water, transported by river water to the sea, and which derives from decomposing organic materials;
- the temperature: as well as mitigating the climate of coastal regions, temperature influences the chemical and physical characteristics that are responsible for the vertical movement of water masses. On the most superficial layer (50-200 meters) the temperature is similar to the superficial one; on the thermocline layer (200-1000 meters) the temperature rapidly diminishes; on the deep layers it keeps on diminishing, but very slowly. The thermocline is an important surface as far as the spreading of organisms in the oceans is concerned. It represents an obstacle for many animals, plants, and tropical algae that need a temperature of 15 – 20°C;
- brightness: it depends on the ability of the light to penetrate in the water and light up only the superficial part even though the water is clear. This area is called photic zone (0-200 meters of depth), and it is where most of marine life and phytoplancton are concentrated.

The wind and the waves. Wave motion is caused by the wind and its action on the sea surface. In the open sea a floating object is lifted and lowered when a wave passes, but it does not move laterally since during the wave motion only the shape of the wave is transmitted. Therefore the water keeps still: individual water particles move according in a circular direction without moving from their original position. The wave motion does not spread deep underwater; on the contrary a submarine at a certain depth can quietly move even if there is a storm on the surface.

The Beaufort Scale describes the wind force according to 12 levels: level 0 refers to calm conditions, when the sea has no waves at all; level 6 refers to a fresh wind that forms big waves with white foam crests; level 12 indicates the presence of a hurricane with the air full of foam and splashes, and the sea is totally white.

Near the coast the waves break because the water depth diminishes and the particles do not manage to keep their circular movement.

Often coasts are not straight and the waves break first on promontories and then on bays. This provokes water movements parallel to the coast that originate currents called coastal drift currents. If the seabed has sand mounds submerged under the water, suck currents might form, that drag off-shore also the most export swimmers.

Tides. Tides are periodical lowering and lifting of water. They are due to the gravitational attraction of the Moon and the Sun. In the Mediterranean sea the sea range varies from 20 to 50 centimetres, but there can be different ranges according to the seabed morphology.

The tide can create some particular phenomena. In some estuaries in the North Sea and in the English Channel the water manages to go upriver against the current, with repercussions on the river navigability. Instead, when the wind persistently and strongly blows towards the coast, it can make the sea level lift, even more than tides: “the high water” in Venice, “storm surges” in the North Sea that provoke damages on Dutch and German coasts, “raz de marée” on French coasts. In particular, the “high water” in Venice is due to various factors: sirocco wind that raises the water by up to 90 cm, tides that can have a maximum height of 60 cm, and seiches, the presence of low pressure and seasonal variations that can reach 20 cm.

Sea currents

Huge masses of water displace for long distances due to the wind action. The direction of the movement is determined by the earth rotation (Coriolis force), which creates circular movements. In the Atlantic Ocean, regular and constant winds, the trade winds, move superficial water masses towards the Equator where they are diverted to the west by the Coriolis force (North-Equatorial current); when they reach the American continent they are pushed to the north and accumulate in the Gulf of Mexico. The water continues to flow towards the Atlantic ocean and form the Gulf current along the coast of the United States, and then divide into two:

- one current goes towards the Canary islands and starts the tour again, as we have already described;
- the other current moves to the north-east, reaches the north-western coasts of Europe and mitigates their climate.

In polar areas the water cools down, becomes more dense, falls deep down and moves to the Equator. As it gets warmer, it becomes less dense and lighter and tends to rise to the surface. This movement, that forms deep sea-currents, is very slow: it takes even a thousand years to a water mass to go back to the surface. The Mediterranean Sea is very salty as compared to the Atlantic ocean, as a consequence its water is denser. Water masses in the Mediterranean go deep down and enter the Atlantic ocean through the Strait of Gibraltar. Ocean waters, which are lighter, enter the Mediterranean by moving on the surface. The Black sea is connected to the Aegean Sea through the Bosporus strait and the Dardanelles, that is crossed on the surface as its water is less dense and salty. The water that comes from the Aegean Sea is dense and moves deep underwater, but it does not manage to reach the Black sea because the Bosporus is not deep enough. As a consequence, the water exchange in the Black sea is poor and limited.

Uses of water

Water consumption

Water is vital and indispensable for humans and all living things. The importance of water for the human body is due to the fact that it makes up 60% of the body, a percentage that varies depending on age, body mass index and gender. Our heart and brain are about three quarters water while this proportion rises to 83% in our lungs. Even apparently 'dry' bones are made up of 31% H2O. Water in our bodies performs many functions, such as regulating temperature, lubricating joints and nourishing our brains. This is why, each day, every human being needs to drink enough water to maintain the water balance between inputs and outputs, avoiding dehydration which, when excessive, can even lead to death. In fact, we can go weeks without eating but survive only very few days without drinking. The minimum requirement of a human being to ensure survival is about 4.5 litres of water per day, taken either in liquid form (water or other drinks) or in food. However, for daily activities (such as, for example, personal hygiene and washing clothes) it is possible to consume more than 100 litres per day!

People are particularly interested in drinking water, which is becoming increasingly scarce in relation to the growing world population and due to pollution. In various parts of the world, installations that make seawater drinkable are in operation, especially along the coasts of arid regions, to make up for the lack of drinking water on the continents. The variability of climatic and hydrogeological conditions makes the availability of water vary considerably from one region to another. Even those countries with a high supply of fresh water run the risk of facing water scarcity. Lack of water, in fact, is a relative concept, as it can refer either to an absolute lack of water or to the difficulty of accessing safe water supplies. On all continents, water resources are being exploited to an increasing extent by the growing demand for irrigation for agricultural purposes, urbanisation and industrial use. Economic development and urban growth often cause damage to freshwater streams through increased pollution. This reduces the amount of good quality water available for primary uses such as drinking, feeding and personal hygiene.

During the last century, the world's consumption of fresh water has increased almost 10-fold, and about 70% of the water consumed on Earth is used for agricultural purposes. This is a decreasing percentage because consumption for industrial (22%) and domestic (8%) uses is increasing. In less developed regions, the percentage of water used for agriculture is higher, while in more developed regions the percentage of water used for industrial and domestic purposes is higher. The more we move towards low-income countries, the more the percentage devoted to crops increases to an average of 82%. High-income countries, on the other hand, allocate less water to agriculture (30% on average), but use more for industry and households, 59% and 11% on average.

Drinking water in the world

The availability of drinking water varies according to geographical area, with significant differences between the North and the South of the world. The World Health Organisation (WHO) has estimated the personal daily requirement to be at least 50 litres, and ensuring availability and sustainable management of water and sanitation for all is Goal 6 of the 2030 Agenda for Sustainable Development. Unfortunately, treatment and management of fresh water requires huge investments and appropriate policies and, often, in territories where fresh water is 'scarce', the problem regards not only availability but also economic and political issues. The consequence of all this is that, according to estimates, more than two billion people live with less than the amount of water indicated by the WHO, in towns or villages where water mains and sewage systems are absent or inefficient. These people are concentrated in certain areas of the world that are some of the poorest in terms of water resources: North Africa, particularly the Sahara region, Eastern and Southern Africa and the Middle East are the most water-poor countries.

The countries richest in water include South America, Oceania, North Asia and North America, particularly Canada, with a per capita availability of water ranging from 10,000 to 50,000 litres per person. The United States, on the other hand, has an average availability of 10,000 litres, as do the European countries richest in water, i.e. the Scandinavian countries, Iceland and Ireland. In Europe, there is a disparity between northern and central-southern territories. In particular, the availability varies between 5,000 and 8,000 litres in Great Britain, France, Italy, Spain, Portugal and Greece, and then drops to 5,000 litres for Germany, Poland and Romania. Italy is the richest country in the Mediterranean basin and southern Europe in terms of water resources due to the presence of the Alps, one of the main reservoirs of water resources in Europe. In Italy, however, there are great inequalities between the North, rich in drinking water, and the South, poor and at risk of water stress during hot weather.

The distribution of water resources around the world does not always reflect trends in water consumption. While there are places like North America and Canada that have a considerable water supply, averaging 30-40 thousand litres of water per person per year, some areas of Africa struggle to reach 3,000 thousand litres per year. In South America, where there is no shortage of water resources, there are areas where people live under constant water stress due to the lack of both potable water and water treatment plants and adequate management systems, which are essential to guarantee the population access to drinking water.

This situation is reflected in consumption: from 425 litres per day for an inhabitant of the United States to 10 litres for one in Madagascar. In particular, it has been estimated that on average a Canadian family consumes 350 litres of drinking water per day, a European 165 litres and an African only 20 litres. Italy, with 428 litres per inhabitant per day, ranks first in the EU in terms of water withdrawn for drinking, but the daily supply for drinking use is actually 220 litres per inhabitant, due to mains leakages.

Where does water go?

Here is how the different sectors of human activities have an impact on water consumption.

Agriculture: 70%. Only 17% of all farmed lands is irrigated yet the latter produce 40% of all food we consume and absorb up to 2,500 km^3 of water a year.
Industry: 20%. Improvements in current technology allow to save more water in comparison to technologies applied in past years. For example, in the Thirties, to produce a ton of steel occurred between 60 and 100 tons of water, today 6 are sufficient. Aluminium, which today is often used as a substitute for steel, requires even less. We shouldn't neglect the fact that, in powerhouses, cooling water is recycled.
Civil use: 10%. The amount of water we use for drinking or preparing food is only a small part: about 96% of the litres used each day is for personal hygiene, washing clothes, housework and other needs.
Let's look at some examples:
• Personal hygiene: up to 60 litres for a shower. If, on the other hand, you opt for the bathtub, you can use as much as 130 litres.
• Toilet flush: approx. 12 litres.
• Washing dishes: 12 litres if washing by hand, twice as much with a dishwasher.
• Car wash: from 140 to as much as 210 litres.
• Irrigation: approximately 18 litres per square metre of soil.

Water and agriculture

Agricultural use of water to irrigate fields represents the main form of consumption of global hydric resources and involves two thirds of global availability of fresh water. Water is not evenly distributed on our planet, hence, very often, human intervention is necessary to modify the natural flows of rivers and build artificial canals to bring water where it's needed. Hydric requirements in agriculture depend on numerous factors among which are climate, soil characteristics, crop practices, irrigation methods, type of farming and many others.
For example, intensive agriculture practised today in the world, which maximizes productivity of lands, requires much more water in comparison to traditional agriculture as also the amount of water required to irrigate fields in dry and semi-dry areas is substantially higher than the amount used in temperate areas.
Irrigation processes, especially in dry areas, can cause soil salinization, which means that they can elicit progressive increase of salts that over time prevent the use and destroy potential productivity of lands. This occurs when insufficient drainage of soil and strong evaporation of irrigated areas take place: this means that water which the soil isn't capable of absorbing evaporates immediately and leaves in the soil its mineral content. It's for this phenomenon that crops in dry or semi-dry areas of the planet have been suffering a productivity decrease in the last decades: it is estimated that 20-30 million hectares of the 270 million hectares of total irrigated areas are suffering salinization.
Crops that grow in salinized soils undergo nutritional imbalances and for this reason require the use of greater energy and substances to grow at the same pace of plants grown in normal conditions.
Only some cultivated species present high tolerance to salinity, among these, beetroot, barley, asparagus, spinach. For the main crops it's necessary to contain this phenomenon, which means

lowering the excess of water that penetrates in the soil and, hence, irrigating according to the actual need of crops, not in excess as, especially in areas where natural drainage is lacking, this could determine an increase in the level of groundwater that makes subterranean water rise to the surface.
Generally, it’s important to use crop and processing systems that don’t deplete organic substance from the soil (as this improves salt catching and increases soil permeability) and it’ s useful favouring crops that use at its best available water in the soil, maybe with roots capable of extracting water in excess in deeper layers. Perennial crops and fodder plants, especially alfalfa, are useful for this, even because they have a long growing season and remove, in comparison to annual crops, more water deeper in the soil. Fodder plants can also increase the content of organic substance and improve the structure of the soil. Also subterranean water coming from acquifers can face salinization, for example, due to excessive extractions undertaken by humans to satisfy the growing request of potable water for domestic uses.

Water employed for breeding

By 2025 more than 60% of the world population will live in water-stressed conditions.
The zootechnical sector substantially contributes to water consumption and its pollution both directly and indirectly: 8% of world hydric consumption concerns the zootechnical sector that employs water mainly to irrigate fields farmed to produce fodder.
Just think that 15 thousand litres of water are required to produce 1 k of beef! To produce 1 kg of chicken we need 3,500 litres of water whereas the production of cereals requires less water, that is 3,400 litres for rice, 2 thousand for soy, 1,400 for wheat, 900 for corn and 500 for potatoes.
Animal production represents, moreover, one of the major sources of pollution of waters that entails: eutrophication that alters the balance of acquatic ecosystems; pollution of aquifers by nitrogen and phosphorus, organic and antibiotic micro-polluting agents with consequent risks for human and environmental health.
Eutrophication is generated by zootechnical waste, chemical pollution of aquifers is caused by excessive use of fertilizers and pesticides in crops used to feed cattle.
Liquid and semi-liquid cattle shedding contain levels of phosphorus and nitrogen above the average because animals can absorb only a small part of the amount of these substances contained in their fodder, the rest is released through their faeces. When animal manure filters in water flows, nitrogen and phosphorus contained in it in excess, alter water quality and damage acquatic ecosystems in damp areas.
Just think that up to 70-80% of nitrogen provided to bovines, pigs and laying hens through nutrition and 60% of nitrogen given to broilers is eliminated through faeces and urine and ends in water flows and underground aquifers. Think that an adult pig produces 4 times as many faeces as a human being and that in an industrial plant can live about 50 thousand pigs with a very high production of daily shedding!
When agriculture and breeding are balanced (as occurred before intensive breeding and partly still takes place), a cycle is created in which agricultural production is limited by the amount of manure

needed to fertilize fields and manure in turn depends on how much fodder is available to feed animals.
The coming of chemical fertilizers has allowed to free agriculture from breeding and the rhythms of industrial production create so much manure that farmed fields aren't sufficient to absorb it all: for this reason, shedding in excess must be disposed as waste.
Finally, we shouldn't forget that zootechnology prevents water from playing its crucial role of penetrating into land and reuniting with underground waters (that are drawn by humans) as this activity compacts soil, reduces infiltration capacity, dries damp areas and deforests to introduce crops.

Water and industrial activities

Man uses water also for industrial activities. The amount of water used in industrial activities depends on many factors, such as the kind of activity and technology used. Generally speaking, the uses you can make of water can be grouped into three types: for production (used as a raw material in the production process: for instance, the water required to make pasta or fruit juices), to cool machinery (basically, just like the radiator of our cars) and finally to wash equipment.

Water and energy

In addition, water is a renewable source of energy: the production of energy in hydroelectric plants does not involve real water consumption, but reduces the availability of water in other sectors (such as farming or civil sectors).
Water is also used in thermoelectric plants, where it is not directly used to produce energy, but only to cool machinery. Water from industrial uses can also be polluted, even if now many industrialised countries have issued strict laws that limit the concentration of pollutants in waste water, obliging the companies to send it first to special depurators that remarkably reduce its pollutants and send it back to lakes, rivers and seas when they are compatible with.

Water, sea and fish

Oceans are important not only for the plentiful food they can offer to man through fishing. From an ecological point of view, they provide over one half of the goods and services required to maintain the vital balance of the planet and host more animal species than any other system on Earth. In addition, through their volume and density, they absorb, store and carry large amounts of heat, water and nutritional substances. Fishing covers on average 25% of the world's consumption of animal proteins.
Underwater deposits supply one fourth of the oil and gas requirement, and over one half of trade goes by sea. Over two billion people live within the 100 km of the coastal stretch, sometimes in heavily urbanised areas; not to mention the tourists that crowd the beaches every year. Our well-being also depends, therefore, on the well-being of the oceans and seas.

Water saving

Water is a vital resource for humankind and a precious commodity which must be safeguarded. According to the latest United Nations World Water Resources Development Report, the world could suffer from a 40 percent overall water scarcity in 2030. In fact, the availability of drinking water is gradually decreasing as a result of ongoing climate changes and global warming but also as a result of increased needs due to population growth and increasing consumption by industry and agriculture and as a result of its deterioration due to the negative impact of many human activities and our excessive use and waste of it.

It tends to be considered a renewable resource because, after being used, it returns to the water cycle entering seas, rivers and groundwater, but the quantity and quality of freshwater available on the planet is decreasing every year. From industry to agriculture, solutions are being sought to reduce consumption and prevent pollution through increasingly advanced purification systems.

Water saving in agriculture

Often a great part of water drawn for irrigation purposes doesn't reach crops due to leaks along the pipes that transport water from the withdrawal point to the fields. Only part of the water reaching fields is used to grow crops, the rest is lost due to evapotranspiration and infiltration in the soil. Different strategies exist to save water in agriculture which, when integrated among them, can increase water saving.

One of the most effective ways to avoid wasting water is irrigating crops according to real necessities of a plant and in the right moment. A precise evaluation of the water volumes and times of irrigation make the use of water more efficient as the volumes necessary to the achievement of the best productions decrease. The estimate of the water balance of crops is the most accurate, low-cost and simple method to evaluate the amount of water necessary to bridge the gap between water consumed by crops due to evapotranspiration and water reaching plants when it rains or from superficial groundwater or capillary resurgence through the soil. This method, even if it's accurate, is laborious and often difficult to apply, especially at the times of greatest work in an agricultural enterprise. For this reason have been invented softwares that show on a daily basis to farmers when and how much they should irrigate each crop.

Reusing waste water for irrigation is an opportunity offering great benefits, especially in tha face of growing urbanization. Urban waste water, conveniently treated, can be channelled towards agricultural areas for irrigation. Waste water, moreover, supplies crops with nitrogen and part of phosphorus and potassium needed for agricultural production. Reusing waste water limits withdrawal of superficial and subterranean water, reduces the impact of discharging in rivers and favours water saving.

Drip irrigation represents one of the most efficient and sustainable irrigation methods as it allows to direct water only where it's needed, that means on the base of the plant, close to the roots. It's a much more efficient system than common sprinkler systems, which spread water on the whole field, even where it's not necessary with consequent waste of the water resource. In places where

this technique has been introduced a decrease in water consumption between 30% and 60% has been registered.
The transition from a method characterised by high losses to a system capable of determining the greatest efficiency of use represents, hence, an indispensable strategy for agricultural water saving. Matching an irrigation system to the characteristics of crops and land is never accidental, infact, no irrigation system adapts perfectly to all situations as each requires special attention to identify the optimal irrigation system. In the reality of a field, hence, not all crops are, for example, practicably irrigable through sprinkling and for many others it's difficult or uneconomic passing to drip irrigation. Every system can and must be used in the correct manner, adopting all possible precautions to allow achievement of their best efficiency.

Industrial water saving

It is estimated that by 2050 the industrial sector will increase its water demand by 150%. Saving water not only means saving a precious resource at an environmental level but also entails a real costs saving. Besides specific technological measures for every type of industry, tactics as reuse and recycle can be put into practice. Reusing means using waste water after treating it, for example, municipal waste water which is treated for irrigation of green areas. Recycling, instead, means reusing water for the same application for which it was employed. Many water discharges could be used for: final rinsing of cisterns, soaking and rinsing water of containers and bottles, cold water flows, pastorized and sterilized water, final rinsing in washing cycles, adequate use of cooling and defrosting tools, adequate use of cleaning equipment for pavements and drainage channels.
Recycled water could be used for other industrial uses and irrigation of green areas, agricultural irrigation, fire-extinguishing purposes, etc.

Give your contribution to water saving

There are many things we can do to save water and give our contribution to save and preserve water resources. Here are some suggestions:
I drink tap water! Prefer tap water to bottled water. Tap water, infact, doesn't need packaging. Drinking it means reducing the use of petrol to produce plastic bottles. Water then reaches directly our houses without covering not even one metre on the roads: it's hence "zero kilometre", saving the environment from emissions of pollutants produced by transport of bottled water on trucks.
Wash, thinking it over! If you can, prefer showers to having a bath: every time we have a bath we consume up to 150 litres of water; when we have a shower we consume only 50. Use shampoos and soaps sparingly and, if you can, choose the less polluting.
Let's be clever: avoid wastes. Just one tap left open, as you're brushing your teeth, brings to a useless consume of about 2,500 litres/per year per person. It's better therefore to close the tap when you're brushing your teeth.
Moreover, applying "aerators" which mix air and water to taps you can save up to 6,000 litres per year. Controlling taps and pipes you can avoid dripping and water leaks. A hole of one millimeter in a pipe over 24 hours can entail the loss of 2000 litres of water!

Keep your drain under control! At home about a third of drinking water ends, litteraly, in the WC drain. At every flush about 6 litres of water are consumed, often, only to discharge a small piece of paper. Hence, use low-flush every time you can or reduce the capacity of the tank. Finally, don't use WCs as a waste basket for rubbish and avoid throwing cotton buds, paper tissues, absorbent cotton, etc. inside.

Watchword: don't pollute. Remember that any type of rubbish thrown in the sea, rivers or lakes can pollute. Don't throw in the WC polluting substances as medicines, varnishes, solvents or any other type of waste.

ECO: economy or ecology? In the kitchen we can save from 40 to 80 litres per day using dihswashers only at full load. The same principle can be applied to washing machines unless they have programmes tailored for different loads.

A green thumb for a light blue planet. At home to water flower and plants we can reuse the same water used to wash fruit and vegetables saving 6,000 litres of water per year. In summer it's better to water plants in the evening as in the hotter hours water would evaporate immediately.

Text updated to August 2022