

# Water



# Climate

RETURN WATER TO THE EARTH  
TO RESTORE THE CLIMATE



# Water and Climate

RETURN WATER TO THE EARTH TO RESTORE THE CLIMATE



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# Introduction

## The link between water and climate change is often poorly understood

Climate change has become a major concern for our societies and its adverse effects on the environment, people and the economy are now widely recognised. As such, we believe it is crucial to highlight the need to ensure there is a properly functioning water cycle to restore the climate.

Generally speaking, and in particular during official negotiations between states, climate change is always linked to greenhouse gas emissions. Thus, at the 21st United Nations Climate Change Conference (**COP21**) being held in Paris in December 2015, the aim will be to reach an agreement on reducing greenhouse gas emissions to **limit the global temperature increase to 2°C above pre-industrial levels by the end of this century.**

However, climate change is far from being triggered by greenhouse gas emissions alone. The Intergovernmental Panel on Climate Change (IPCC) clearly acknowledges that **human activities have been affecting the global water cycle** since the 1960s and **is a dominant cause of climate change.**

Climate change most notably manifests itself through water and related catastrophic events, such as storms, flooding and drought, etc. However, whilst these events are given prominent media attention, the **impacts on the climate of human-induced changes to the water cycle** receive much less coverage. Despite its key role in climate change, the vital link between the climate and the water cycle, which accounts for a significant amount of current climate disruption, is always missing from international climate agreements.

Through this booklet, the Danielle Mitterrand – France Libertés Foundation aims to achieve three objectives:

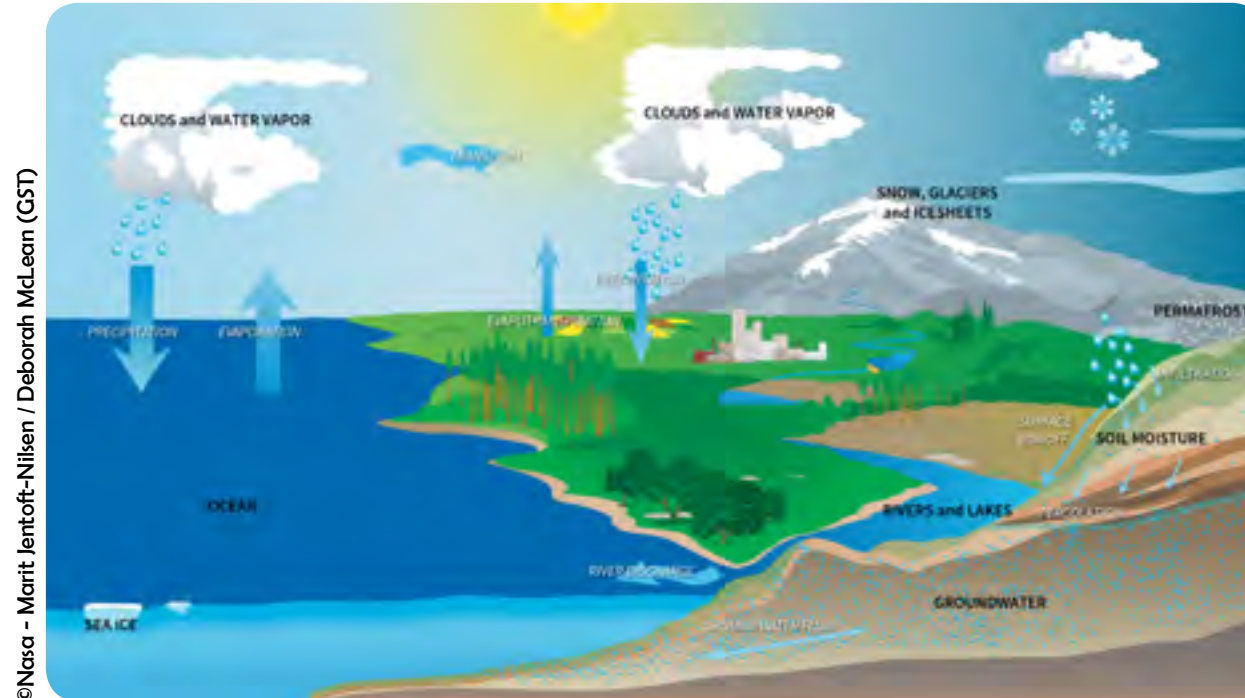
- ▶ to explain **how the water cycle and the climate are linked both globally and locally** by consciously focusing on water infiltration, evaporation and evapotranspiration;
- ▶ to present **alternatives from around the world** that prove that human activities do not always have to have an adverse effect on the water cycle and the climate;
- ▶ to show that it is possible for everyone **to take positive action and put management methods in place that respect the local water cycle** and help improve the balance of the climate.



# Water cycles

# The global water cycle

The global water cycle, also known as the hydrologic cycle, involves the continual exchange of water between the atmosphere, hydrosphere (all of the planet's water: seas and oceans, lakes and watercourses, groundwater, ice, water vapour) and the biosphere.



©Nasa - Marit Jentoft-Nilsen / Deborah McLean (GST)

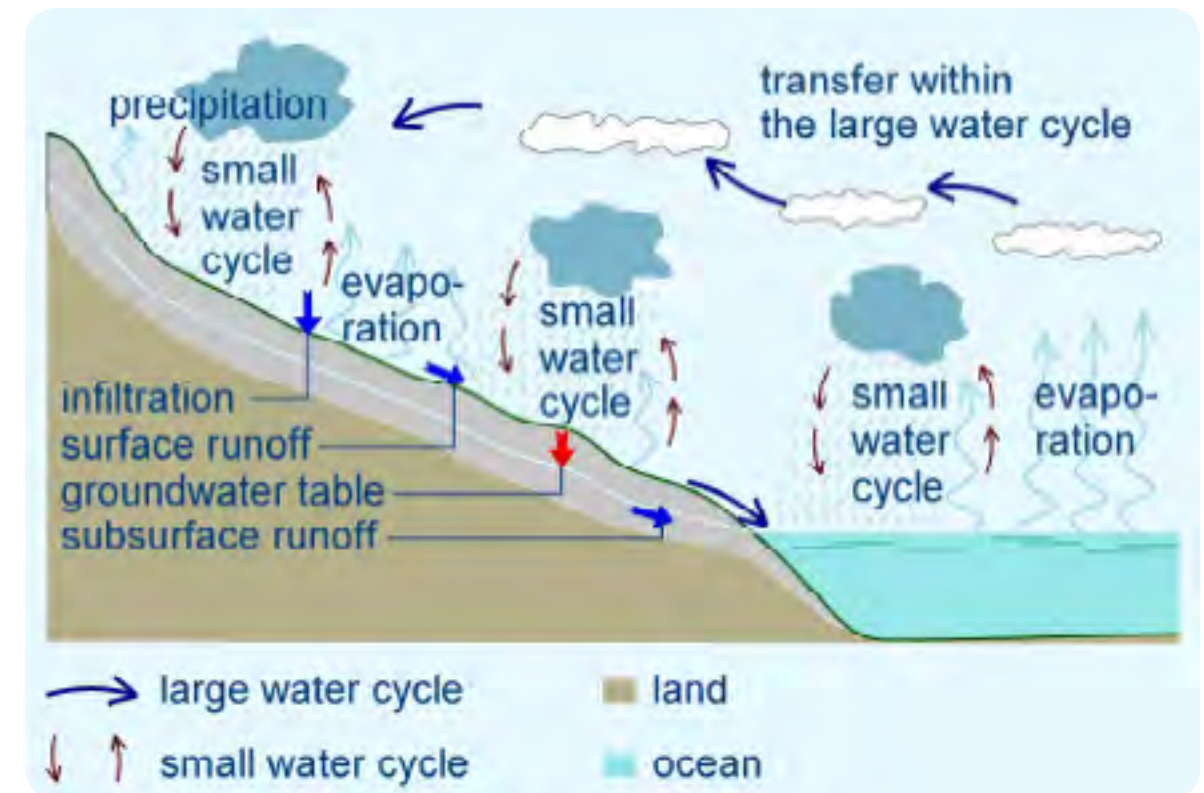
The sun, which drives the water cycle, activates and keeps water bodies\* moving at all times through the heat of its rays and the thermal energy released. Under the action of the sun's rays, water from the seas and oceans evaporates and is converted into clouds. These clouds are blown by the wind over land where they merge to form larger clouds. The evaporated water then falls as rain, snow or hail. As this precipitation falls to the ground, some of the water returns to the atmosphere, either directly through evaporation from surface water bodies (rivers, lakes, etc.) or through transpiration from plants and animals. Water from precipitation is vital to the functioning of numerous ecosystems (wetlands, forests, etc.), as well as agriculture. Some of the precipitated water also flows over the ground as runoff, back into the rivers and from there returns to the oceans. Only a small percentage of the water soaks into the ground as infiltration to replenish aquifers. After a long period of time, this groundwater also returns to the oceans through the watercourses fed by these aquifers.

The volume of water mobilised by the global water cycle varies from region to region: water is unequally distributed around the world. Some regions have an abundance of water (such as Europe and North America, for example) whereas, in other regions, water is scarce (the large hot desert areas of northern and southern Africa, Australia and the Middle East) [1].

# The local water cycle and microclimates

The local water cycle is a smaller scale version of the global water cycle. Here, however, evaporation and precipitation are directly linked to the environmental conditions of a specific region or river basin.

The water contained in the atmosphere and soil plays a key role in controlling the local temperature of our planet. Within the closed loop of a local water cycle, the water that evaporates from a given area falls locally as rain, infiltrates into the soil then evaporates once more after having contributed to plant growth. Two-thirds of the precipitation that falls on land comes from the local water cycle [2] !

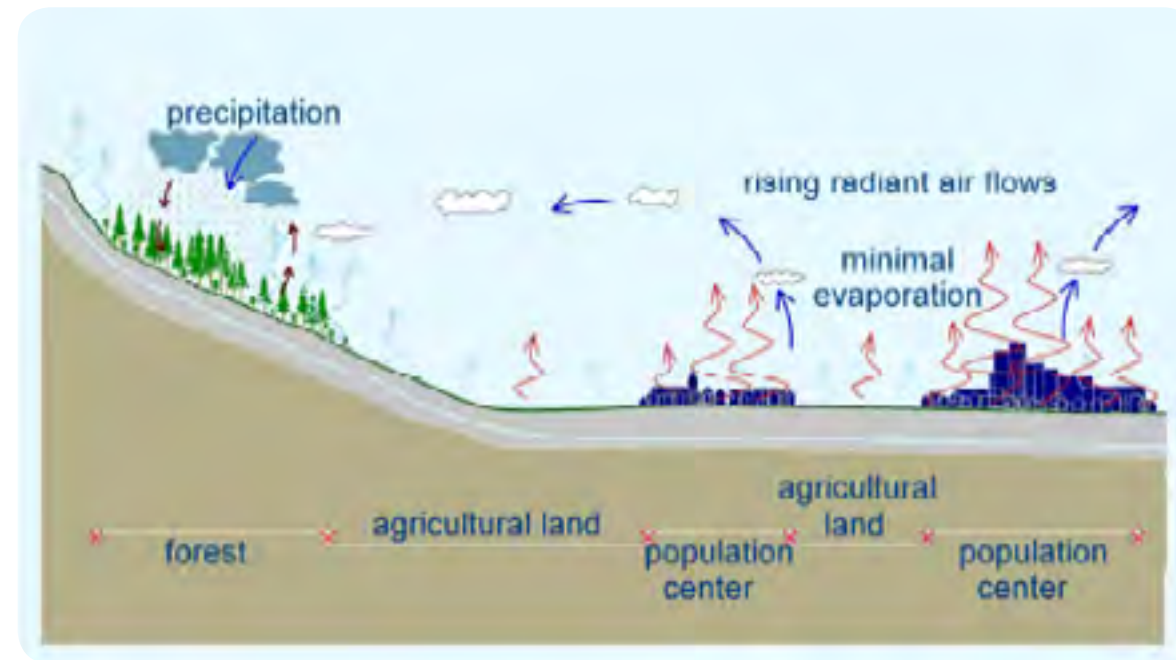


© The large and small water cycles (Kraucik et al. 2007)

The water cycle has a direct impact on the local climate or microclimate. The more water there is in the atmosphere, the stronger its moderating effect is on temperatures and microclimates; in addition, extreme weather events are likely to be less severe.

To ensure the water cycle and microclimates remain stable, we need to take steps now to preserve the balance of precipitation and related infiltration and evaporation processes, particularly in urban and peri-urban areas.

# The water cycle and climate disruption



© The impact of the transformation of land on the destruction of small water cycles (Kravcik et al. 2007)

The water cycle balance is easily disrupted. Changing the local water cycle upsets the microclimate, which, by extension, exacerbates climate change. In areas of bare, dry, «crusted» or, as found in cities, impermeable soil, water is no longer able to soak into the ground but instead runs off the surface. The increase in surface runoff, and resulting decrease in evaporation and infiltration, reduces groundwater recharge and watercourse levels. Thus, less water is supplied by the local water cycle.

Falling water levels in the soil and atmosphere are accompanied by extreme temperature conditions. Local temperatures increase and urban heat islands form over cities. The direction and intensity of the winds are affected by the changes in temperature and so they move differently, as do the clouds. This in turn has an influence on the frequency and intensity of precipitation and, as a result, the entire microclimate is altered. These small-scale climate changes all combine to culminate in and/or exacerbate global water cycle and climate disruption.

## FOCUS Tokyo, the largest urban heat island in the world

Urban heat islands are artificial microclimates that create a «thermal dome» over cities. As a result of urban development, towns and cities absorb more of the sun's heat than areas of vegetation, such as forests or fields. During the day, heat from the sun and traffic is absorbed and stored in the cities' concrete and tarmac surfaces and is then released at night. However, the built-up area acts like a greenhouse: once absorbed, the heat from the sun's rays is then emitted as infrared radiation, which warms the urban air and – as there is little wind – the entire city. This phenomenon is exacerbated during heatwaves, such as that recorded across Europe in 2003.

The city of Tokyo in Japan is one of the largest urban heat islands in the world. Urban development, soil sealing, the construction of skyscrapers that have altered the direction of the wind and the virtual disappearance of green spaces and bodies of water from the city have resulted in an annual average temperature increase of 3°C (the difference in temperature between the urban and surrounding rural area can sometimes be as high as 10°C [3]) since the start of the 20th century and there are more and more episodes of torrential rain [4].



© Tokyo Metropolitan Government

A number of solutions have thus been developed and put in place in Tokyo to tackle this phenomenon: buildings have been demolished to create 'wind paths'; grants have been set up to 're-green' the city (by increasing the number of green spaces and planting green roofs and walls, etc.); and a water retention pavement system and water-mist sprayers have been installed...

Developing our awareness of how the local water cycle works and how it affects the stability of microclimates is vital for improving our understanding of the causes of climate change and also provides **a great opportunity for us to act.**

**The balance between human activities,  
the climate and the water cycle  
is possible to find**



**Human activities (deforestation, agriculture, urban development, industry, etc.) are responsible for disrupting the local water cycle** as they upset the balance between precipitation and surface and groundwater recharge and the transpiration and evaporation processes that help cool the air and ensure cloud cover.

**Fortunately, this process is reversible.** By returning water to the earth, local initiatives, which are often easy to implement, can restore both the effective functioning of the water cycle and the microclimates.

## Human activity-induced disruptions to the water cycle

Overly high human water extraction\* or consumption\*, coupled with changes to the soil and vegetation, have a significant impact on the increasing effects of global climate change.

The Earth's surface water is now too polluted or in too short supply to meet the growing needs of human activity, which leads to numerous cases of water stress\*. In many places around the world, aquifers are being depleted faster than they are replenished. Following the emergence of increasingly sophisticated well-drilling technologies, and with many parts of the world lacking any clear groundwater legislation, the aquifer depletion rate more than doubled between 1960 and 2000 [5], and is continuing to rise.

This phenomenon is exacerbated by the fact that natural groundwater recharge through infiltration is being hampered by soil sealing caused by human activity.

As the Slovakian hydrologist Michal Kravčík explains, the green of our living world is created by the yellow of the sun combined with the blue of water. If we upset the balance by removing either the blue or the green from the earth, the heat of the sun will change everything [1].

As a result of deforestation, large-scale urbanisation and intensive agriculture, the soil's capacity to retain and infiltrate water is considerably reduced. Forests act as 'biological pumps', sucking up moisture from the air, transferring it to the soil then returning it to the air. Through evapotranspiration, water evaporates above plant cover to form clouds. If this plant cover disappears or if, in the case of intensive agriculture, the soil is overused and becomes impermeable, the biosphere's natural regulation system is impeded and the local water cycle disrupted. The soil dries out and is eroded, its organic content is reduced and agricultural output is thus adversely affected. Water runs off the land and out of the local water cycle area.

## FOCUS The damage caused by soil sealing and intensive irrigation in the United States

In the United States, intensive agriculture is responsible for causing considerable disruption to the water cycle and this severely impacts on the people and climate. Examples of this include the Dust Bowl and the severe droughts currently affecting California.

As a result of mechanisation and the introduction of large-scale single-crop farming, intensive agriculture has led to hedges being removed, soil rapidly drying out and sealing over and has increased surface runoff from precipitation. In the 1930s, these changes culminated in the Dust Bowl, a series of dust storms that affected the Great Plains area of the United States and the Canadian prairies. This phenomenon was caused by a combination of natural wind erosion (due to consecutive years of particularly hot and dry weather conditions) and anthropogenic changes (as the grassland of the prairies was replaced by erosive single-crops such as corn) and resulted in fields being destroyed, the soil being eroded and land and buildings being covered in dust. The Dust Bowl was a real ecological disaster that forced millions of families to abandon their farms and migrate west looking for work [6].

Lake Oroville, the second largest lake in the state of California, in July 2011 and January 2014



© California Department of Water Resources

Today, the state of California, the breadbasket and most densely populated area in the United States, is also experiencing unprecedented disruption of its water cycle. California is used to periods of drought, but the drought it has been suffering since 2011 is the most severe the state has experienced over the last 1,200 years. More than 80% of California is in extreme or exceptional drought and the pressure on groundwater is huge [7]. Farmers, who extract 80% of the water used in the state, are the first to be affected: lack of water means they are forced to leave their land lying fallow, but also to try to draw water from deeper underground. In California's Central Valley, groundwater is being pumped up so quickly that, in some areas, the land is sinking at a rate of over 30 centimetres a year [8].

The drought in California bears certain similarities to the well-known case of the Aral Sea, which was deprived of its main sources of water in the 1950s when the Soviet Union diverted the rivers to irrigate cotton, wheat and rice crops. The Aral Sea used to be the fourth largest lake in the world, but has now lost 60% of its original volume. As a result, plants and wildlife have been destroyed, water salinity has increased, chemical fertilisers have polluted the soil and aquifers, the microclimate has been severely altered (lower rainfall, more windstorms, etc.) and the impact on people's health and on the local economy has been disastrous [9].

In areas where the soil has sealed over, flooding has become increasingly common and weather events more and more extreme. Dry land, on which there is no vegetation and no life, traps the heat from the sun and causes local temperatures to rise; there is less cloud cover and less precipitation, but the little rainfall there is becomes more violent. In certain regions of the world, this situation can lead to desertification.

This disruption of the local water cycle through human activities is exacerbated by the fact that we divert large volumes of water away from its original water cycle area and into the oceans. In towns and cities, used water is immediately channelled into the sewer system, and from there into the rivers to eventually flow into the oceans, and so there is no opportunity for infiltration and evaporation to take place.



The « Kiev » and an unidentified boat,  
The abandoned fleet,  
Aral Sea, Kazakhstan

© Radek Skrivaneck, 2004

## FOCUS Water cycle disruption in the megacity of São Paulo (Brazil)

Large-scale deforestation in the Amazonian rainforest (primarily due to the expansion of soya bean cultivation and livestock breeding) has had a direct impact on the regional climate and water supply in São Paulo, the economic capital and most densely populated city in Brazil. 762,979km<sup>2</sup> of rainforest has been destroyed over the course of the last forty years, which is an area twice the size of Germany. Not only does the forest retain water, hold the soil in place and prevent erosion, but it also plays a key role in cloud formation as the soil and plants release billions of litres of water through evapotranspiration. Lack of rainfall is directly affecting water supply in São Paulo, which is suffering from unprecedented water shortages and service interruptions that can last for several hours a day. These water shortages are also affecting electricity supply in the region as 75% of Brazil's electricity is produced by hydroelectric power plants. In addition, the equivalent of nearly 112,000 billion litres of water is transferred abroad each year through the export of agricultural produce, thus further aggravating the situation [10].

The Paraibuna dam, supply system of Cantareira, Region of São Paulo



© Creofire



# How can we restore the local water cycle and microclimates?

A number of solutions for restoring the water cycle have been developed and already implemented around the world. Some of these are public or state-driven initiatives, whereas others have been launched by the local people themselves.

## Alternative solutions for agriculture

### • The facts

In 2014, 70% of global water extraction was used to irrigate crops. Unless changes are made to improve the efficiency of farming techniques, global water extraction for agricultural use is set to increase by around 20% by 2050 [11], dramatically affecting local water cycles and disrupting microclimates. This situation is further compounded by the fact that climate change is already adversely affecting the yields of most crops, such as wheat and corn, for example. Growing climate disruption means that grain prices are already expected to rise, with the price of corn estimated to increase by over 50% by 2050 [12]. The decline in productivity is also affecting the livestock and fisheries sectors. Thus, global food security depends on our capacity to tackle climate change and disruptions to the local water cycle.

### • The alternatives

Throughout the world, alternatives have been developed to improve the way in which we use and protect our water resources whilst ensuring that the agricultural sector continues to produce enough food to feed the population and create jobs.



A number of techniques have been developed to minimise surface runoff and soil erosion and improve the infiltration of water into the soil:

—> **planting new hedgerows and trees on farmland:** this technique of reintroducing plant cover also helps provide shelter for birds and small mammals that eat crop pests, thus reducing the need for pesticides;

—> **strip cropping, which involves growing different crops in alternate strips that follow the contours of the land, rather than planting a single crop over a large area.** Planting different crops ensures that there will be plant cover on at least part of the field at any given time, thus minimising soil erosion: should one strip of crops be particularly fragile, the cover provided by the neighbouring strip acts as a buffer when it rains and prevents surface runoff and soil erosion;



—> **reducing irrigation water demand and improving irrigation efficiency** by using techniques to reduce water losses through evaporation or consumption, such as drip irrigation (also referred to as micro-irrigation, this involves delivering just the right amount of water to the plants through a network of pipes and tubes) and underground root watering systems, rather than using surface irrigation (where water is distributed over the field) or spray irrigation (similar to natural rainfall) methods;

—> **creating water retention basins** to harvest rainwater to irrigate crops.



## FOCUS New farming techniques to tackle desertification in Burkina Faso

An article on resisting global warming in Burkina Faso appeared in the Le Monde newspaper on 30 May 2015 (entitled «Au Burkina Faso, les résistants au réchauffement climatique») [13] and describes how alternative farming techniques are being used to combat desertification and provide the population with food.

In this semi-arid country, expansion of the Sahel's climate towards the south is causing the large-scale desertification of agricultural land as it becomes covered in sand. This has an immediate impact on the population: fewer crops are produced and food stocks run out quicker year on year, pushing hundreds of thousands of people into food insecurity.

To tackle climate change and reverse the worsening living conditions of Burkina Faso's population, new farming techniques have steadily been introduced to improve crop yields. In the fields, farmers dig semi-circular, 'half-moon' basins in staggered rows to capture rainfall and surface runoff, enabling them to prepare the land for planting and grow crops in crusted soil.

The NGO Action Against Hunger (Action Contre la Faim) has launched a soil restoration and crop diversification action programme to increase food production and provide families with a complete and balanced diet.

« Half-moon » basins



© climate change

In addition to these techniques, there is also conservation agriculture, or ecologically intensive agriculture, which aims to combat soil erosion, improve soil fertility and increase crop yields, as well as prevent water loss through evaporation and considerably reduce the use of agricultural inputs, by:

- **introducing crop rotation and ensuring a variety of crops are planted on an alternate basis**, focusing on the crops best suited to the local climate, namely those that are resistant to drought, salt water infiltration and flooding and that need less water, etc.;
- **using the 'direct planting' system** that involves planting crops directly into the soil without tilling to minimise soil disturbance, which helps preserve the organic matter in the soil cover;
- **maintaining permanent soil cover** by ensuring the soil is not left exposed between crop harvests – good soil cover is made up of one or several crop types.

Conservation agriculture is widely used on the American continent (in the United States, Brazil and Argentina, etc.). In Argentina, over three-quarters of all arable land is farmed using conservation agriculture practices. In Brazil, conservation agriculture is predominantly found on the large farms that cover several thousand hectares of land. In Europe, its use is currently far less widespread, but is nevertheless on the rise [14].

## FOCUS The Bourguignons: using agronomy for sustainable agriculture

Claude and Lydia Bourguignon, agronomists and microbiologists, specialise in studying and analysing soil for wine producers and farmers. After having noted that 90% of soil microbiological activity had been stripped from overused farmland in France and elsewhere, they began advising farmers and other producers on how to improve and regenerate the soil. They recommend direct planting, crop rotation, limiting the use of fertiliser and not using weedkiller. Using these techniques, the soil once more becomes porous and can absorb water, insects return to the earth, the soil quality improves and the environment is preserved; at the same time, crop yields are the same or higher than when using traditional intensive farming methods. Claude and Lydia Bourguignon consider intensive agriculture to be a failure as it has not succeeded in eradicating hunger from the world; something that sustainable agriculture, which respects the soil and major ecosystems, would be able to do [18].

Conservation agriculture thus follows agroecology principles to ensure the integrated management of the soil and soil fertility. Agroecology «refers to i) a scientific discipline that uses ecological theory to study agricultural production, ii) farming practices, and iii) a political or social environmental protection movement» [15]. The aim of agroecology is to improve agricultural production systems by mimicking natural processes whilst at the same time preserving the environment and natural resources. In addition to conservation agriculture, agroecology also encompasses techniques such as agroforestry and integrated pest management. There are many documented examples of agroecology being used around the world. In France, Pierre Rabhi, the forefather of agroecology, has written numerous publications on agroecology techniques and launched the Colibris movement [16].

In Benin, each year, the Songhai centre trains hundreds of young African agricultural entrepreneurs to use organic farming techniques based on biomimicry (imitating natural ecosystems) that respect the environment [17].



**Family farming**, or small-scale farming, was highlighted by the General Assembly of the United Nations in 2014. Advocated by the FAO (the Food and Agriculture Organisation of the United Nations) [19], family farming pays a central role, not only in providing people with food security, but also in preserving the local water cycle as it uses less water than industrial agriculture, which is often accused of being the largest waster of water on the planet.

**Permaculture** combines a series of principles and practices to develop sustainable agricultural production by recreating the diversity and patterns observed in natural ecosystems. It is also based on a philosophy of working with and caring for the earth and living creatures. Permaculture encompasses a vast range of activities as its aim is to build sustainable and resilient human environments by using a range of good organic farming and agroecology techniques, as well as renewable energy and bio-construction methods [20].

**FOCUS** Permaculture in Tamera Ecovillage, Portugal

The ecovillage of Tamera, which means «near the essential source» in the traditional language, was founded in 1995 on 134 hectares of land. The greenery that grows around the large lake within this community is in sharp contrast to the barren landscape of the surrounding area.

Using permaculture techniques, lush vegetation has been reintroduced on soil that had been severely depleted by years of single-crop farming and a lack of water. A lake was created using ‘water retention landscaping’, which involves creating different sized, inter-connected retention basins that collect rainwater thanks to a small dam built from natural materials. The water is then able to soak into the soil, replenish the aquifer and provide the moisture required for plants to grow [21].

Other lakes have since been developed and Tamera’s inhabitants are now working to ensure that the winter rain that falls on the ecovillage all soaks into the soil or is stored in the lake so it can be used to irrigate crops and create springs and watercourses.



© Simon du Vinage/Tamera

**FOCUS** The district of Alwar (Rajasthan, India) - Using johads to restore the local water cycle

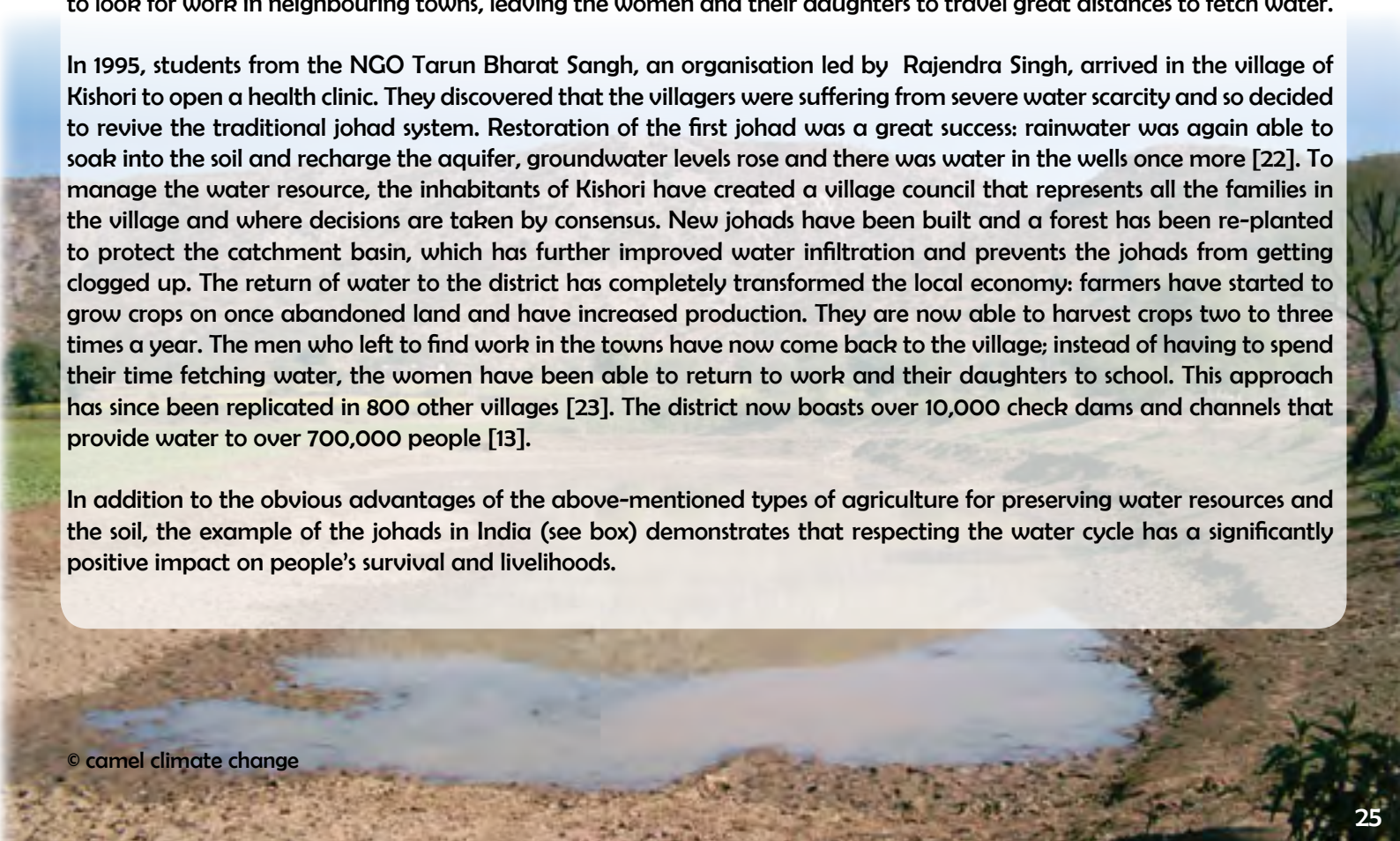
The district of Alwar in the Indian state of Rajasthan provides a textbook example of how to restore the local water cycle using a traditional agricultural technique, the johad. Johads, which were first used in the 13th century, are small earthen check dams used to collect and store rainwater during the monsoon season, leading to improved percolation and groundwater recharge.

From the 1950s onwards, the sale of the region’s forests to privately-owned groups led to large-scale deforestation, which not only increased soil erosion and silted up the johads, but also resulted in a shorter monsoon season. As there were fewer trees, less water evaporation and transpiration took place. In addition, less water soaked into the soil, causing groundwater levels to fall and wells to dry up. Boreholes then had to be dug to access this groundwater for both agricultural use and human consumption but this led to water levels dropping even further. In the meantime, having been replaced by this new borehole technology, all the johads fell into disuse. However, groundwater levels fell to such an extent that all the wells dried up and the remaining forest disappeared. Consequently, the local men left the district to look for work in neighbouring towns, leaving the women and their daughters to travel great distances to fetch water.

In 1995, students from the NGO Tarun Bharat Sangh, an organisation led by Rajendra Singh, arrived in the village of Kishori to open a health clinic. They discovered that the villagers were suffering from severe water scarcity and so decided to revive the traditional johad system. Restoration of the first johad was a great success: rainwater was again able to soak into the soil and recharge the aquifer, groundwater levels rose and there was water in the wells once more [22]. To manage the water resource, the inhabitants of Kishori have created a village council that represents all the families in the village and where decisions are taken by consensus. New johads have been built and a forest has been re-planted to protect the catchment basin, which has further improved water infiltration and prevents the johads from getting clogged up. The return of water to the district has completely transformed the local economy: farmers have started to grow crops on once abandoned land and have increased production. They are now able to harvest crops two to three times a year. The men who left to find work in the towns have now come back to the village; instead of having to spend their time fetching water, the women have been able to return to work and their daughters to school. This approach has since been replicated in 800 other villages [23]. The district now boasts over 10,000 check dams and channels that provide water to over 700,000 people [13].

In addition to the obvious advantages of the above-mentioned types of agriculture for preserving water resources and the soil, the example of the johads in India (see box) demonstrates that respecting the water cycle has a significantly positive impact on people’s survival and livelihoods.

© camel climate change





# Alternatives to large-scale deforestation

• **The facts**

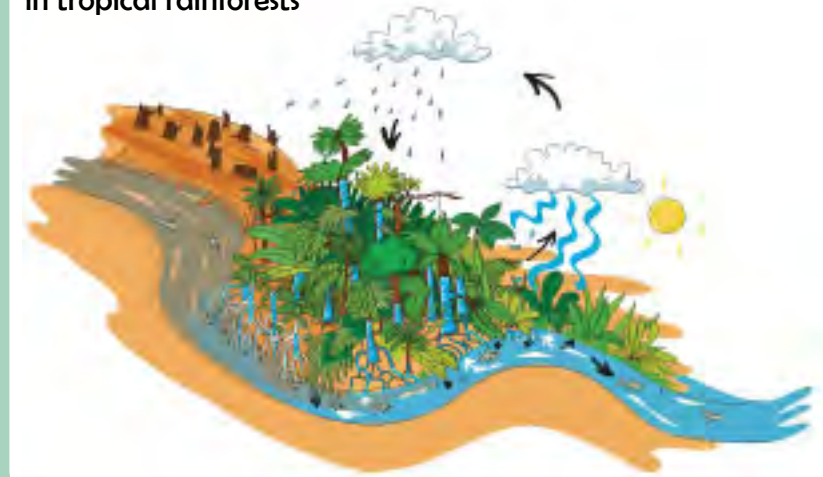
**Forests have a direct impact on atmospheric concentrations of greenhouse gases.** Forests absorb 2.6 billion tonnes of CO2 each year, which equates to nearly a third of the CO2 released from the burning of fossil fuels. As a result, deforestation accounts for nearly 20% of global greenhouse gas emissions as the CO2 stored in the trees is released when these are cut down, burnt or as they decompose. In addition, the loss of forest cover reduces CO2 absorption capacity and leads to soil degradation [24].

**Forests also play a key role in the water cycle.** Through their roots, trees considerably improve water infiltration into the soil and groundwater recharge whilst at the same time minimising surface runoff and erosion. Consequently, forests reduce local peak flows and flooding during rain episodes. Through transpiration, forests also help maintain a certain level of humidity in the air, enable clouds to form and thus rain to fall.

## FOCUS The water cycle in tropical rainforests

The water cycle in tropical rainforests works in the same way as the water cycle in Europe's temperate forests, but is much shorter and more intense. In tropical areas, ground cover helps generate a monsoon climate that leads to tropical rainstorms.

### The impact of deforestation on the water cycle in tropical rainforests



In the Amazonian rainforest, between 50 and 80% of the moisture released into the atmosphere through transpiration remains in the ecosystem's water cycle [25].

With deforestation, humidity levels fall and less moisture is released into the atmosphere. This has a dramatic impact on precipitation and microclimates, and even on the global climate, as these are the world's largest rainforests - the «green lungs» of the planet - that are being affected.

When examining the state of the world's forests, a distinction needs to be made between two very different situations: in Europe, forest area is increasing (forests now absorb and store 10% of the European Union's carbon emissions [26]); whereas on the other continents, the opposite is the case.

More than 13 million hectares of forest is lost around the world each year [27]. The Amazonian rainforest and the forests of the Congo Basin and south-east Asia are the most severely affected. This deforestation has a disastrous effect on the environment and population as it causes significant disruption to the climate. For instance, in Mozambique, in order to meet Chinese demand for precious woods, large-scale illegal deforestation is taking place in the primary forest that could alter rainfall patterns over the whole of Africa and cause temperatures in the region to increase by between 2 and 4°C [28] !

Mining industry and deforestation in the peruvian Amazon





In southern Chile, local forest cover has been replaced by fast-growing foreign tree species (pine and eucalyptus) to meet the demands of the lumber industry. Before being cut and exported from the region in which they are grown, these trees absorb a significant amount of rainwater, which would otherwise have soaked into the soil but is instead removed from the local water cycle. In addition, the logging techniques used destroy the land and seal the soil. This not only leads to soil erosion, but also changes the course of rivers and causes the estuaries to temporarily dry up in summer [29].



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However, it is not only the lumber industry that is responsible for the deforestation currently destroying the world's largest and oldest forests. Mining industries, the agro-food sector (particularly the single-crop farms growing palm oil in south-east Asia and soya in South America) and paper mills also all play a part, as do large dam construction projects.

Mining, for example, involves clearing the land and, for large mining operations, using bulldozers and diggers to extract the metals and minerals from the ground, permanently sealing the soil.

The world's largest bucket-wheel excavator (Bagger 288) in a german coal mine



© 350.org

- **The alternatives**

Given the devastating impact of deforestation on the climate, a number of countries have put alternative solutions in place to restore the local water cycle and combat climate change. For instance, the Slovakian NGO, People and Water, founded by Michal Kravčík, works to **restore watercourses in forests by creating retention basins** to slow surface runoff, increase infiltration and re-establish the local water cycle.



## FOCUS The Green Belt Movement tackling deforestation in Africa

In Kenya, the biologist Wangari Maathai launched the Green Belt Movement in 1977 to encourage women to plant trees to improve their standard of living and provide them with drinking water, wood for fuel and other resources. Through the work of this NGO, over 30 million trees have been planted in Africa to combat deforestation. The Green Belt Movement has also campaigned to protect forests, such as the urban Karura forest in Nairobi. Having been partially sold off by the government to private developers, who wanted to destroy this barrier against erosion to build blocks of flats, the Karura forest was protected by the women from the Green Belt Movement and their campaigning ultimately resulted in the development project being abandoned in 2003. Wangari Maathai received the Nobel Peace Prize in 2004 in recognition of her work within the Green Belt Movement [30].



© Green Belt Movement

In Brazil, in the Rio Doce valley, intensive agriculture has devastated the ancient Atlantic tropical rainforest. Through the **large-scale planting of trees**, the NGO Instituto Terra has helped restore the water cycle and replenish long dried up springs. This project is featured in the documentary film, 'The Salt of the Earth' directed by Wim Wenders and Juliano Salgado [31].



© Instituto Terra

Fazenda Bulcao in 2012

In Ecuador, where the rights of nature are recognised in the country's Constitution, the government has launched an extensive reforestation campaign to eradicate deforestation by 2017 and reclaim 50,000 hectares of forest. At the same time, the Socio Bosque programme offers economic incentives to smallholders who protect the forest and improve the quality of the soil using new practices [32].

In addition to reforestation, **it is possible to reasonably and sustainably manage forests by preserving their biodiversity and ensuring the ecological resilience of all forest ecosystems**. Various management techniques have been developed for this, such as ensuring forest regeneration times and maintaining the continuity of tree cover are included in logging programmes, prohibiting clear-cutting, logging fully mature trees rather than entire parcels by involving the local people.



## Alternatives in cities

### • The facts

**By creating artificial land cover and sealing the soil, urbanisation causes significant disruption to the water cycle and destroys all microclimates in its path.** It is estimated that, in France, artificial land cover expands to encompass an area the size of a département (or county) every seven years [33]. This phenomenon also produces high levels of greenhouse gas emissions and is estimated to be responsible for 20% of all greenhouse gas emissions in France. This equates to 100 million tonnes of CO<sub>2</sub> being released into the atmosphere each year [34].

In their standard form, sewer systems do not enable water, even once treated, to infiltrate the soil and rejoin the local water cycle. Runoff from roofs and sealed roads flows directly into the sewers and on to treatment plants before being discharged into rivers and oceans and so is removed from local water cycles. Cities tend to expel water rather than retain it.

Towns and cities also affect the water cycle by extracting large volumes of water from aquifers and rivers to meet their inhabitants' drinking water needs. After having exhausted their own available water resources, some towns and cities, such as Los Angeles [35] and Beijing [36], now find themselves having to import water from other areas. Urbanisation, which often involves deforestation and the destruction of plant cover, changes the microclimatic conditions of the local area and fosters the development of urban heat islands with dangerously high temperatures.

### • The alternatives

In order to restore microclimates and fully integrate cities and urban areas into a properly functioning water cycle, systems need to be put in place **to ensure that rainwater remains within the local water cycle and catchments and that wastewater is treated so it can be infiltrated back into the ground.**

To ensure precipitation continues to play a key role in the local water cycle, efforts need to be made to re-establish natural areas onto which rain can fall, run off and percolate into the soil. This involves **'unsealing' urban surfaces and restoring nature in our towns and cities.**

In Brussels, Belgium, a group of residents have joined together under the banner of a super-hero, Super-Désasphaltico, to campaign for a permeable city landscape. The group has carried out 'deasphalting' activities in areas covered with asphalt, tarmac or concrete slabs, clearing the sealed surfaces, which are once more able to provide the organic substrate required for plants to grow and help improve the local water cycle [37].

As highlighted by the French national landscapers union, UNEP, and the green cities observatory, Observatoire des Villes Vertes, in their manifesto «Gardens for the Climate», reintegrating **vegetation into urban areas** also helps adapt to climate change as the plants act as an urban air conditioner and form urban cool islands [38]. With this aim in mind, and also to improve water quality, the city of Adelaide in Australia launched the 'Million Trees Program', through which 3 million local native trees and shrubs were planted between 2006 and 2013.

## FOCUS Vancouver (Canada), the 'Greenest City in the World by 2020'

In Vancouver, the city council has set itself an ambitious target: to become the greenest city in the world by 2020. To achieve this, as well as focusing on transport, energy, the economy, architecture and air and water quality, part of the project is working on water conservation and integrating vegetation into urban areas. The city aims to reduce per capita water consumption by 33% over the 2006–2020 period. In addition, numerous trees have already been planted and parks created since the project was launched [39]; these trees and green spaces are helping to cool down buildings and promote evapotranspiration and water infiltration in the city.



© Politicsbc.ca

Adapting urban planning to climate change also involves **reintegrating the aquatic areas found within urban catchments**, as demonstrated by the 'New Urban Rivers' project being implemented by the Brussels water forum, EGEb.

## FOCUS The 'new urban rivers' in Brussels



© Valérie Malhaut

The 'new urban rivers' have been created to help offset the impact of urbanisation. The aim of the project is to review how water and its cycles are used within built-up areas and restore nature to the city. This project is being led by a group of people from the EGEb and involves creating a network of stormwater gardens. These are either green spaces, retention basins or slightly entrenched squares in which rainwater is collected in individual or community tanks set in the ground or plant cover and from whence the water either evaporates or soaks into the soil. Using this network of stormwater gardens, the rainwater flows away from private land (where it is collected through tanks, green roofs or private storm gardens) onto public land. This water then runs off the sealed urban surfaces, such as pavements and roads, and rejoins the new urban rivers [40].

This system is similar to a 'separate sewer system' in which rainwater and wastewater are carried in different sewers. The new urban rivers carry rainwater above ground, whereas wastewater is discharged through the sewers. These new urban rivers also help combat the creation of urban heat islands.



In France, government institutions and local authorities have also been exploring this issue. One such example is the Rhône-Méditerranée-Corse water agency, which put a climate change adaptation plan in place in 2014. Based on the 2011 national climate change adaptation plan, this plan advocates the ‘unsealing’ of soil in urban areas to promote water infiltration, reduce flooding and minimise the creation of urban heat islands [41]. In Strasbourg, Eurométropole is promoting ‘plot level’ stormwater management rather than channelling rainwater into the sewers [42].

**Watercourses flowing through cities** can help reduce urban heat concerns as the water absorbs a large part of the atmospheric heat. **Rainwater can even be collected** inside buildings to flow through small channels and provide natural air conditioning that uses less energy than traditional air conditioning systems. There are also numerous ways of reusing rainwater as, once harvested, it can be used to flush toilets, for instance (as can the greywater from showers, baths, washing machines and dishwashers).

The local water cycle in urban areas is closely linked to sanitation system management. **Phyto-purification** provides a good alternative to conventional sewer systems. This involves treating wastewater through an organic system of plants, soil and micro-organisms within an artificially created wetland area. Through phyto-purification, the wastewater is treated in an environmentally-friendly way and remains within the water cycle. An increasing number of cities and companies are now starting to use phyto-purification, such as the cities of Oberhausbergen and Nanterre in France, Wuhan in China, or Algiers in Algeria.



© Sabine Vanderlinden / Inter-Environnement Bruxelles

## FOCUS The Honfleur phyto-purification wastewater treatment park (France)

In 2004, the Honfleur inter-commune multi-purpose authority (Sivom) set up a phyto-purification plant to supplement the existing wastewater treatment plant. This phyto-purification plant is used to treat the wastewater from small businesses and domestic wastewater produced in Sivom’s 12 communes. The water is treated through the combined action of plants (reeds, aquatic plants, alder and willow) and micro-organisms, which notably reduces the organic load and removes harmful bacteria and nutrients. The phyto-purification plant has improved water infiltration and helped create public green spaces. Once treated, the water is discharged into the environment. The compost produced from the reeds is used as fertiliser in the area’s public parks and gardens [43].

A water treatment plant in Honfleur (France)



© Valérie Mahaut

In addition to treating and keeping wastewater within the local water cycle, phyto-purification techniques also meet IPCC climate change adaptation recommendations for the management of water resources, as they «provide universal sanitation with locally adapted technology and provide for proper disposal and reintegration of used water into the environment or for its reuse». There are also other environmentally-friendly wastewater treatment methods available, such as anaerobic\* digestion that, through the fermentation of organic matter, can be used to produce biogas (methane, carbon dioxide or hydrogen sulphide) for reuse as energy to provide electricity or heating, for example.



## Alternative solutions for industry

- **The facts**

Industry as a whole can seriously affect the local water cycle. One of the most damaging industrial practices involves the large-scale pumping and extraction of water from local resources. Industry also uses large quantities of chemicals and toxic products that, in the vast majority of countries, are discharged into watercourses without being properly treated. Water is not an expensive resource for industry, particularly when it is extracted directly from the local environment. The company pays for pumping rights but has no need to pay transport or treatment costs (and the groundwater is often of excellent quality). As in the agro-food sector, groundwater is overused by a significant number of companies and industries. The Coca-Cola plant in India is a case in point: located in the state of Kerala, it was forced to close in 2004 after having severely depleted groundwater levels [44].

The energy sector also impacts on the water cycle. The extraction of oil sands in the Canadian province of Alberta is just one of many examples of the way in which extractive industries disrupt the water cycle and the balance of nature. The oil sands contain a mixture of sand, water, clay and raw bitumen and are mined to extract this bitumen, which is a type of unconventional oil. This mining process uses millions of m3 of water each year; water that is extracted from the aquifer and diverted from nearby rivers. Once used, this water, by now extremely polluted as a result of the bitumen extraction process, is then either discharged without treatment into the environment or stored in huge tailing ponds, posing human health risks and a serious threat to the water cycle [45].

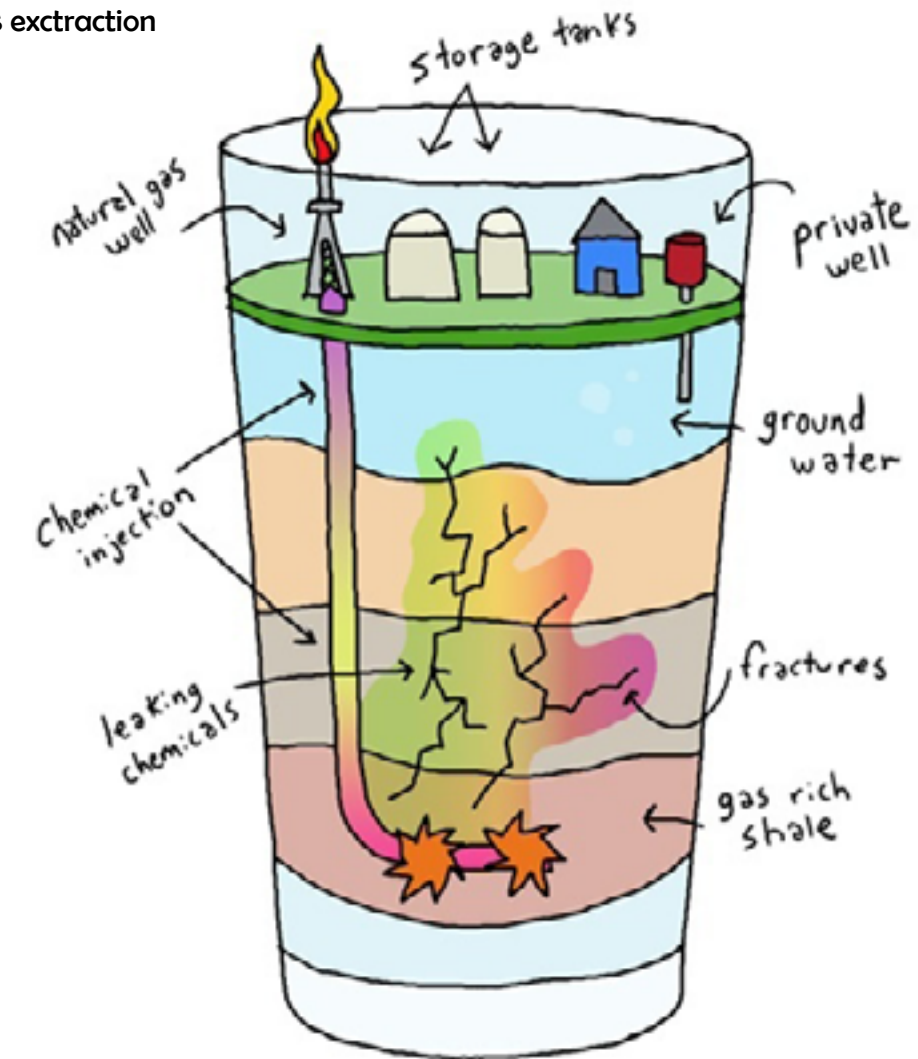
Aerial view of the Fort McMurray Region (Canada)



© Jiri Rezac / Greenpeace

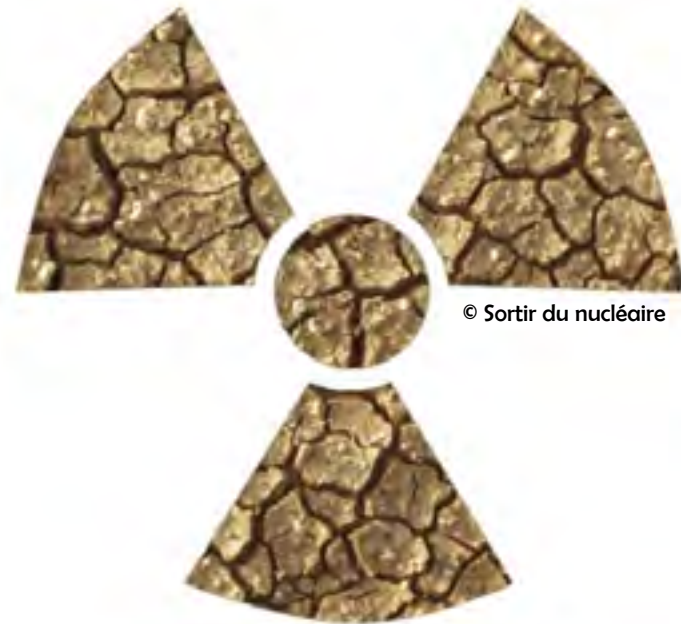
These same issues also apply to the shale oil and gas extraction process, which uses and pollutes vast quantities of water. The hydraulic fracturing technique used to extract shale gas involves pumping between 15 and 20 million litres of water into a wellbore to create a fracture. This water is heavily polluted by the chemical products added to it to create the fracturing fluid. 25% of these chemical additives are carcinogenic, 37% are endocrine disrupters, 40 to 50% can affect the nervous, immune and cardiovascular system and over 75% affect the sensory organs and respiratory system [46].

Hydraulic fracking  
for shale gas extraction



© stanechy

The nuclear energy sector also extracts large quantities of water from aquifers and watercourses, which it uses to cool the reactors: with climate change, this large-scale water use will have an increasingly negative impact on the environment [47].



- **The alternatives**

A number of alternative solutions need to be put in place to ensure water is no longer considered a simple resource for use by human activities but is recognised instead as a common good, the quality and cycle of which need to be nurtured.

Wastewater treatment could be significantly improved. Instead of discharging wastewater into the environment following chemical treatment (or sometimes without, as the legislation is often ignored even in developed countries), many industries could use phyto-purification to treat their wastewater, which could then be reintegrated into the local water cycle. A number of companies have already successfully implemented phyto-purification plants, such as Pocheco in France (see box), for instance. Phyto-remediation, which is a more extensive method that uses plants to decontaminate and clean the soil, water and air, can provide industry with an environmentally-friendly method of treating some of its wastewater whilst respecting local water resources.

More generally, wastewater reuse (ReUse) does not have to be limited to watering parks and gardens but can also extend to the agriculture and industrial sectors and even to replenishing the water bodies from where the water was originally extracted (aquifers, rivers and also wetlands). Reusing these high volumes of urban or industrial wastewater helps reduce water resource withdrawals and preserve the environment [48]. In southern California, treated wastewater reuse has helped cut down on water imports from neighbouring regions.

## FOCUS Reusing wastewater in Singapore to meet the needs of industry

To compensate for its virtual lack of water resources, the city-state of Singapore in south-east Asia has developed a system that combines seawater desalination, networks of drainage channels and dams to collect stormwater in reservoirs and which cover two-thirds of the city and a wastewater recycling system that is effective enough to supply water to the microelectronic and pharmaceutical industries. These are industries that require very pure, demineralised water for use in their manufacturing processes. Some of this water (around 5%) is 'remineralised' and returned to the reservoirs to rejoin the water supply network. These cutting-edge technologies, which make it possible to overlook geographic and climate conditions, nevertheless need to be used responsibly. Now there is virtually unlimited water available in Singapore and a multitude of users, the volume of water consumed within the city-state is expected to double from 2014 levels by 2060 [49].



It is possible for industry to reduce its water consumption requirements, not only for manufacturing, but also for operating its factories.



## FOCUS The Pocheco 'ecologic' factory in Nord-Pas-de-Calais, France

In France, the Pocheco factory, which specialises in making envelopes, has implemented 'ecologic' techniques to reduce its environmental impact and make cost-savings. It is thus self-sufficient in water. The company has installed a green roof to collect rainwater, which is used not only in the manufacturing process, but also for cleaning the floors and machines, watering plants and flushing the toilets. As a result, Pocheco is now self-sufficient in water and the green roof also helps insulate the factory. At the entrance to the site is a bamboo wastewater treatment plant. The dead bamboo and used palettes are composted and burnt to heat the factory in winter. Solar panels have also been installed to reduce energy consumption. In addition, the land around the factory has been made permeable to allow rainwater to soak into the soil. This also helps to stop flooding and prevents sewer and water supply networks from overflowing during periods of heavy rain [50].

Industry should also be encouraged to **replace fossil fuel with renewable energies**, such as solar, wind power or biogas, which are more water resource and environmentally-friendly. In the case of hydraulic power, the prospect of having a sustainable source of energy should not be allowed to obscure the fact that large dam construction projects have far-reaching consequences for the environment and a serious impact on local people. In addition to the billions of tonnes of concrete required to build them, these large dams flood forests and farmland causing the submerged organic matter to decompose and release huge quantities of greenhouse gases, such as methane and nitrous oxide, which are 25 and 300 times more harmful than CO<sub>2</sub> respectively. Large dams also cause disruption to watercourses and ecosystems and have led to the displacement of millions of people over the course of the last century [51].



© Greenpeace

However, more people and environmentally friendly alternatives do exist. In Nepal in the mid-1990s, a civil society-led campaign helped prevent the construction of the costly Arun III dam, save one of the Himalaya's last primary forests and protect the local people. At the same time, the campaign successfully ensured that the dam project was replaced by a network of mini hydroelectric power stations, some of which are managed by the community. These mini power plants now produce a third more electricity than the Arun III dam at twice the speed and for half the cost. This example proves that it is possible to obtain clean energy by constructing or reclassifying existing micro-dams on natural watercourses (known as «small-scale hydropower») whose small size is ideal for local, community-based management approaches.

In France, the ASCO des Arrosants de la Crau, an association based in the PACA region that manages the Arles branch of the Crau canal (constructed in the 16th century and used by farmers to irrigate their land), and the Société du Canal de Provence (the public company managing the Canal de Provence) have joined forces to build a micro-hydroelectric power plant on the Crau canal in order to produce and sell electricity [52].

**Another way to improve the management of water resources is by making water use more visible.** Calculating the water footprint of all consumer goods produced by industry would provide an effective means of raising consumer awareness and help make companies accountable for their water use in order to prevent overexploitation of the world's water resources.

## FOCUS The water footprint



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The water footprint is defined as the total volume of freshwater used to produce the goods and services consumed by an individual or community or produced by a business. It covers the amount of both direct and indirect water (technically known as 'virtual water') used, from the extraction of raw materials through to the end of the product's life. The water footprint makes it possible to measure the impact that human industrial, agricultural and domestic activities have on water. For example, 909 litres of water are required to produce 1kg of corn, 2,975 litres of water are needed for 1kg of rice and 15,497 litres of water for 1kg of beef. Due to international trade, virtual water is transferred over very long distances and between different regions of the world. Over 20% of the water used each day for human requirements has been removed from its original catchment [53]. The water footprint therefore provides a clear insight into water use. As such, it could be used in the same extensive way as the carbon footprint and serve as an indicator to determine the pressure being exerted on water consumption by industry (as well as other activities, such as agriculture) and highlight indirect water use. The water footprint could also be used to adapt water pricing strategies to types of use (essential use for individuals, for well-being, overuse, industrial purposes, agricultural use, etc.)

## The new water paradigm for changing global policy

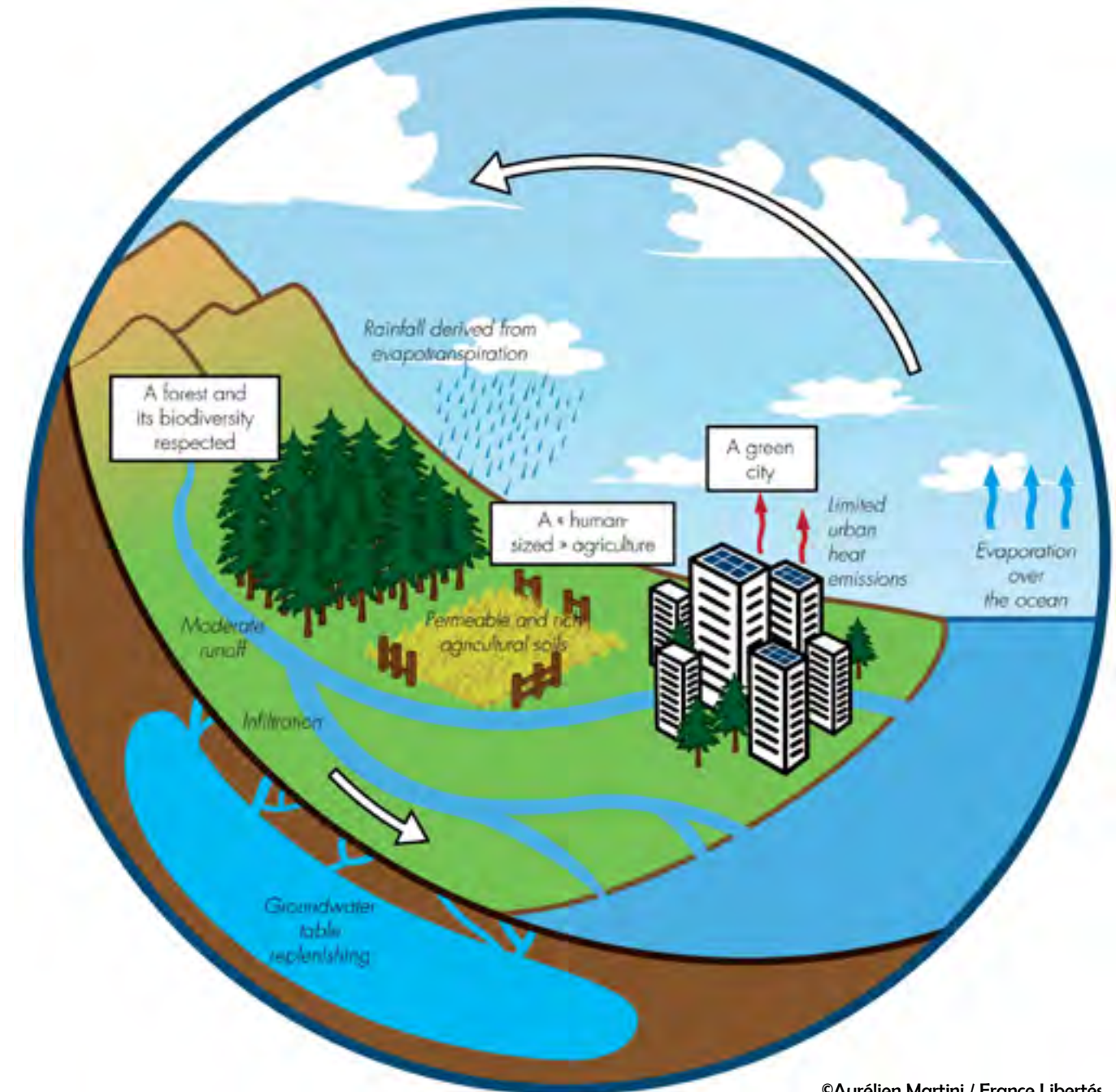
**The time has now come to take action to tackle climate change.** In addition to the damage caused by the growing number of extreme weather events and general increase in the earth's temperatures, climate change is also threatening to undermine much of the progress made over the last fifty years in development and public health around the world. Tackling climate change therefore needs to be a priority for our governments and policy-makers and the focus of public campaigns. Unless we rapidly resolve the numerous issues surrounding the local and global water cycles, even minimising increases in greenhouse gas emissions will not be enough to help us combat the effects of climate change.

There are numerous alternatives available that all focus on a **more integrated management of resources**, often using multi-level and multi-stakeholder approaches. The work of Elinor Ostrom, who was awarded the Nobel Prize in Economics, supports this principle. Managing the commons, such as water, at the community level helps protect it and ensure its survival. As Elinor Ostrom explained during her Nobel Prize acceptance speech, «what we have ignored is what citizens can do and the importance of real involvement of the people». The role of citizens and their representatives is thus vital for ensuring water resources are managed more effectively, the local water cycle is preserved and steps are taken to tackle climate change.

**People and elected representatives need to act now to protect the local water cycle and microclimates if we are to reverse climate change:**

**we need to restore the earth's capacity to store water and save this precious resource, the common resource of all humankind.**

## Properly integrating human activities into the local water cycle





# How to get involved

in protecting local and global water  
cycles and tackling climate change ?



© France Libertés

Workshop on water at the World Social Forum, Tunis (Tunisia), March 2015

But how do we go about this and where do we start? Here are a few suggestions ...

## For elected officials and policy-makers

### At the international level

It is time to establish international, ongoing and democratic dialogue on alternatives to the human activities that are severely damaging the water cycle and climate, on effective governance and, more generally, on underlying development models. In addition to this, the international community must now:

- **Ensure integrated water resources management is implemented worldwide** in order to minimise the impact of human activities on the water cycle and climate whilst ensuring everyone is able to effectively exercise their right to water;
- **Advocate for the creation of a representative, international water agency** that is empowered with real decision-making authority: there is currently no specific body with direct responsibility for water governance within the United Nations system.



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### At the national level

As highlighted by the COP21, national governments are key players in the fight against climate change. The same is true for elected members of parliament. Members of the parliament and senators have a key role to play as they can vote to build the capacities of local authorities and grant them funding. Governments and national elected officials now need to:

- **Include the climate in water-related policies and action plans and, conversely, include water in climate-related action plans and policies;**
- **Promote integrated water resources management principles** using a human rights-based approach. This approach consists of managing water in a participatory manner, ensuring all consumers within a given catchment are involved in the process, and fully respecting the human right to water and sanitation; the aim being to enable the ongoing development of the region whilst ensuring the sustainability of local ecosystems and ensuring the needs of future generations can be met;
- **Improve water-related legislation** to prioritise human needs and those of aquatic environments and ecosystems;
- **Further encourage research** to gain a better understanding of the impacts of water management on the climate and ensure that the required mitigation actions are more accurately targeted;
- **Strengthen the interface between science and politics** by firmly establishing water-related topics in discussions on the climate and by producing findings and recommendations, as well as by involving scientists in dialogue and in governance bodies;
- **Encourage effective citizen participation** and involve the whole of civil society in consultations and decision-making on the environment;
- **Opt for development models that respect water resources** and have a small water footprint.



## At the local level

Local elected officials from regional, county and local councils are also key players in the fight against climate change. To preserve the local water cycles and microclimates, they need to:

- **Ensure elected officials and local council departments are trained** on water management, environmental transitions and resource preservation to provide them with the means to take action;
- **Include climate and water-related issues** in all local policies and projects;
- **Ensure compliance with all legislation** related to the water cycle, such as protecting bodies of groundwater (see the work on protecting catchment areas carried out by Eau de Paris, for instance) and surface water by implementing sustainable water extraction; also, improve the monitoring and evaluation of local climate-related public policies;
- **Focus on returning nature to urban areas** to minimise soil sealing;
- **Encourage stormwater reuse** by installing rainwater harvesting equipment;
- **Reduce the number of areas with impermeable surfaces** to ensure water can soak into the ground and recharge the aquifers. The Local Urban Development Plan, which is managed by individual municipalities, is a useful tool for taking effective local action;
- **Install water-saving kits in public places;**
- **Help raise public awareness** of how the water cycle works and its fundamental link to the climate and of water as a common pool resource that needs to be preserved. Facilitate the creation of areas, programmes and activities that focus on this theme;
- **Encourage the development of long-term international cooperation activities** to share lessons learned and jointly address the challenges of climate change;
- **Support organic farming and small-scale family agriculture;**
- **Contribute to climate funds**, such as the green fund for cities and local authorities set up by Paris city council in 2015, to help more vulnerable regions tackle the effects of climate change, both in France and abroad.

## For individuals

### At the individual scale

There are a number of everyday actions you can take to reduce your impact on the water cycle and climate. For instance, if you are interested in **learning more about what causes disruption of the global and local water cycles and microclimates**, numerous organisations have published documents on the water cycle and climate, such as: the France Libertés Foundation, Coordination Eau-Île-de-France, Coalition Eau, Green Cross, WWF, Greenpeace, Surfrider Foundation, and many others. It is also possible to take part in water and climate-related forums and conferences where you can speak to subject-matter experts and meet like-minded people. On the Transition Network website, you can also find ideas of local activities and initiatives to carry out within your community.

### FOCUS

#### Simple, everyday actions for preserving water resources and the environment

**Save water** at home and reduce your consumption by: turning off the tap when washing your hands or washing up; having a shower rather than a bath; using devices such as flow restrictors or mixers; using a dishwasher, which uses 10 litres of water per cycle, instead of washing up by hand, which uses 42 litres; harvesting rainwater for domestic use, such as watering plants or washing the car; or installing a dual-flush toilet ...

**Consider the water footprint** of the products you use and consume on a regular basis: it is important to find out where our food, clothes and – more generally – all the everyday items we buy come from. To reduce your water footprint, try to buy locally sourced and seasonal products when possible and reduce your consumption of red meat; you can also buy recycled or second-hand goods.

**Reduce the amount of waste you produce** at home by sorting and recycling your rubbish, composting your vegetable waste, avoiding overly-packaged products and, again, buying second-hand goods.

**Save energy** as, not only is it a major source of greenhouse gas emissions, but energy production can also cause the disruption of entire water cycles. It is also possible to choose energy suppliers that have more sustainable production practices, such as Enercoop in France, which promotes renewable energy (hydroelectricity, wind power, solar and biogas) and production through regional cooperatives.

**Place your savings with an ethical financial institution** that focuses on projects that have social, environmental or cultural benefits, such as Crédit Coopératif or NEF in France.

As well as many others!

## On a collective scale

As individuals, we can also come together and take joint action to reach a wider audience:

- **By creating or joining an association to work together as a group**, raise public awareness of water cycle and climate-related issues and/or play a role in local authority decision-making. The Coalition Climat 21 website brings together over 130 organisations that have joined forces to tackle climate change. The movement is open for everyone to join and you can also create your own local Coalition group.

- **By meeting with elected officials and making our voices heard at the political level.** As citizens, we have the means to influence elected officials and policy-makers as we are the people who elect them.

- **By organising water and climate-related events** (of different scales, such as within a district, town, city, etc.) to bring together the various stakeholders involved and define water and climate-related public policy in a participatory manner.

And if you would like to get more involved in water-related and environmental campaigns, take a look at the online version of this booklet, where you will find the details of a wide range of associations and organisations listed.



© Cooperativa Integral Catalana

The water cycle and the climate are intrinsically linked. Although climate change has a direct impact on water resources, it is also important to understand how the water cycle, at all its levels, influences the climate and our environment. The infiltration of water into the soil and the evapotranspiration process help ensure that ecosystems are able to continue functioning properly and that living creatures, including humans, are able to live in a healthy and sustainable environment.



The Béganne Allaire citizen's wind farm (France)

In order to tackle climate change, it is thus necessary to take the impact of human activities on the water cycle into account. The many alternatives outlined in this booklet show that it is already possible for our societies to develop whilst ensuring the water cycle continues to function as it should.

There are numerous diverse actions that can be taken to return water to the earth and restore the climate and each of us, whether individuals or elected officials, can adopt these and implement them in our local area. We all need to get involved to ensure our voices are heard at COP21, to tackle climate change over the long-term and protect our planet and its inhabitants.

**Let us return water to its rightful place!**

« Beyond its commitment to a global public authority responsible for water,  
the ambition of France Libertés is to help unite these forces  
and to demonstrate thanks to many examples that another world is possible. »

*Danielle Mitterrand* *Mot à mot, éd. cherche midi, 2010, p.64*



# To get involved and find out more...

## Readings

- **Fifth Assessment Report: «Climate Change 2014: Synthesis Report»**, IPCC, 2014
- **Water for the Recovery of the Climate - A New Water Paradigm**, M. Kravčík et al., 2007
- **OECD Environmental Outlook to 2050 : The Consequences of Inaction**, OECD, 2012
- **World Water Atlas - Defend and share our common good**, David Blanchon, 2013 [in French]
- **Water – Keys to Act**, Green Cross, 2014-2015
- **One million of peaceful revolutions**, Bénédicte Manier, 2012 [in French *Un million de révolutions tranquilles*]
- **The COP21 official website** : [www.cop21.gouv.fr/en](http://www.cop21.gouv.fr/en)
- **The Coalition Climat 21 website**, a broad network of NGOs committed to solve the climate crisis : [www.coalitionclimat21.org/en](http://www.coalitionclimat21.org/en)
- **The Climate Action Network (RAC-F) online library « Ma COP21 »** [in French]
- **9 tips to save water at home** : <http://www.savewater.com.au/how-to-save-water/in-the-home>

## Videos

- **Les vidéos « Comprendre le climat et la COP21 »** du magazine en ligne « Terra Eco »
- **La vidéo « Changements climatiques : quels enjeux pour la Cop 21 ? »** de la Fondation Nicolas Hulot pour la nature et l'Homme
- **La vidéo « Eau et changement climatique : adaptons-nous ! »** de l'Agence de l'eau Rhône-Méditerranée-Corse

## Petitions

- The petition set up by the French national landscapers union, UNEP, and the green cities observatory, Observatoire des Villes Vertes, to promote urban gardens and parks: **« COP21 : N'oublions pas le végétal ! Multiplions les jardins et espaces verts pour limiter les effets du réchauffement climatique en ville »**

## Some other examples of a good water cycle management

- **The Pilat diversion bays**: the voluntary organisation, Les Biefs du Pilat, based near St-Etienne in France, is constructing a network of 'biefs' or diversion bays, which are low gradient channels that follow the contours of the land and help increase surface infiltration and groundwater recharge;
- **The Valencia Water Tribunal in Spain**: this community-based tribunal is several centuries old and settles disputes between farmers using the local irrigation channels (acequias);
- **The Kokkedal district in Fredensborg, Denmark**: the city of Fredensborg has launched a 'Blue- Green Garden City' project in the district of Kokkedal where water (a lake and river) is being reintegrated into the urban landscape, being used to store surplus rainwater. This rainwater is in turn then used to water the replanted public spaces;
- **The ATM town planning agency in France**: this agency specialises in the harvesting and open air treatment of rainwater, as well as in restoring urban rivers;
- **The 'Rives du Bief' eco-district in Longvic, France**: the local council has created landscaped ditches (planted ditches, which collect water used either for on-site infiltration or evapotranspiration) and green spaces in this district to reintegrate water into the town.

## Glossary

**Anaerobic:** relating to an organism or activity that requires little or no oxygen.

**Catchment:** «a topographic area in which rainwater is collected and flows into a body of water. Different catchments are separated by a drainage divide. A catchment can also include groundwater, which will sometimes have a different drainage divide to that of the surface water» [54].

**Consumption:** water consumption is defined as freshwater withdrawals that are not returned to the natural environment.

**Crusted (soil):** describes soil that has a thin but dense surface layer with low porosity. It is sometimes referred to as a 'slaking crust'. This crust can form on any soil that has no plant cover, with the exception of soil that contains high levels of coarse-grained sand, gravel or stones, etc.

**Water body:** a technical term introduced by the Water Framework Directive to describe part of a watercourse, groundwater or surface water.

**Extraction:** «water extraction involves taking water from a watercourse or aquifer for agricultural, industrial or domestic use. This does not include rainwater directly used by crops. Some of the water extracted is returned to the natural environment. This can be as much as 97% for the water used to cool nuclear power plants and just a few percent for the water used in modern irrigation techniques, where virtually all the water is absorbed by the plants. Only the water that is not returned to the environment (as it has evaporated or been incorporated into the final product) is considered to have been consumed [see 'consumption']» [55].

**Water stress:** «occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of fresh water resources in terms of quantity (aquifer over-exploitation, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.)» [56].

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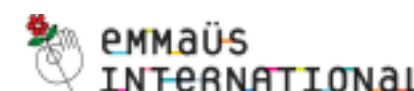
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Water, universally free, naturally springs up, flows, evaporates and reappears. It merely passes through. There are so many water cycles that it is no exaggeration to say that water is everywhere where there is life.

Danielle Mitterrand, *Mof à mof*, éd. cherche midi, 2010, p.51-52

Climate change has become a major concern for our societies and its adverse effects on the environment, people and the economy are now widely recognised. Generally speaking, and in particular during official negotiations between states, climate change is always linked to greenhouse gas emissions; however, it is far from being caused by greenhouse gas emissions alone.

The water cycle and the climate are intrinsically linked. Climate change most notably manifests itself through water and related catastrophic events, such as storms, flooding and drought, etc. However, whilst these events are given prominent media attention, the impacts on the climate of human-induced changes to the water cycle receive much less coverage. As such, we believe it crucial to highlight the need to ensure there is a properly functioning water cycle to restore the climate.

Through this booklet, the Danielle Mitterrand – France Libertés Foundation aims to achieve three objectives:

- to explain how the water cycle and the climate are linked both globally and locally by consciously focusing on water infiltration, evaporation and evapotranspiration;
- to present alternatives from around the world that prove that human activities do not always have to have an adverse effect on the water cycle and the climate;
- to show that it is possible for everyone to take positive action and put management methods in place that respect the local water cycle and help improve the balance of the climate.

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