INITIATIVES POUR L'AVENIR DES GRANDS FLEUVES
INITIATIVES FOR THE FUTURE OF GREAT RIVERS

Synopsis sheets

Rivers of the World

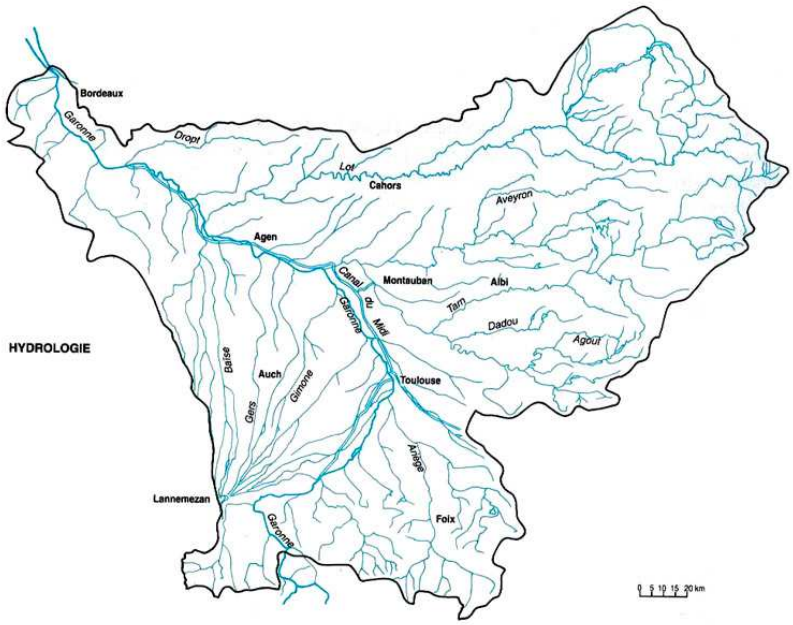
The Garonne and the Adour-Garonne basin

The Garonne and the Adour-Garonne basin

The Garonne is a French-Spanish river whose source lies in the central Spanish Pyrenees, in the Maladeta massif, at an altitude of 3,404 m. It flows for 50 km before crossing the border with France, through the Gorges du Pont-des-Rois in the Haute-Garonne department. After a distance of 525 km, it finally reaches the Atlantic Ocean via the Garonne estuary, where it merges with the river Dordogne. The Garonne is joined by many tributaries along its course, the most important of which are the Ariège, Save, Tarn, Aveyron, Gers, Lot, and others, and crosses regions with varied characteristics.

The Garonne is the main river in the Adour-Garonne basin and France's third largest river in terms of discharge.

A little history…



A powerful river taking the form of a torrent in the Pyrenees, the Garonne's hydrological regime is pluvionival, characterised by floods in spring and low flows in summer. It flows are strongly affected by the inflows of its tributaries subject to oceanic pluvial regimes. The variations of the Garonne's discharges are therefore the result of these inputs of water, staggered as a function of geography and the seasons.

In the past its violent floods have had dramatic impacts, such as that of 23 June 1875 at Toulouse, causing the death of 200 people, and that of 3 March 1930 which devastated Moissac, with around 120 deaths and 6,000 people made homeless.

In spite of these constraints, to which must be added to the problem of the river bed, shallow at certain points, the need to use it for navigation is ever-present: bargemen have faced the risks of the river in all weathers to transport salt, wine (the gold of the Garonne) and other agricultural products.

The ambition has always been to ensure the link between the Mediterranean and the Atlantic Ocean.

The Garonne and the Adour-Garonne basin

The **Canal du Midi** was built in the 17th century to link the Garonne with the Mediterranean and is 240 km long. But at the end of the works, it was necessary to transfer the goods carried by barges on the canal du Midi at Toulouse to other lighter boats, to continue until Bordeaux. It took an average of 5 days to sail down the Garonne to Bordeaux but 15 days to transport goods upstream in the other direction. It wasn't until the 19th century that the Garonne Canal, desired from the beginning by Pierre-Paul Riquet, the creator of the Canal du Midi, saw the light of day.

The construction of this canal running alongside the Garonne, built to provide security and lower navigation costs, ran into a host of financial, legal, political and economic difficulties due to competition with the construction of a railway line.

On 12 March 1856, **the side channel of the Garonne** was opened in full to navigation. 211 km long between Toulouse and Castets en Dorthe, in Gironde, its construction took 17 years. Finally, along with the Canal du Midi, it **formed the Canal des Deux Mers**.

However, river transport on the Garonne Canal will always remain marginal in comparison to rail transport. Mainly used for goods up to the 1970s, navigation on the Garonne Canal is now mostly devoted to pleasure cruising, as on the Canal du Midi.

The Garonne Valley has always been a **site of human settlement**. Access to drinking water, hydroelectricity, agriculture, industry, tourism and leisure make the river the backbone around which a large number of human activities have clustered.

It is also a territory with a **remarkable natural heritage**, with numerous wetlands and eight species of migrating fish identified. 15,000 ha have been labelled Natura 2000.

Technical sheet

Average discharge	630 m^3/s
Length	525 km, more than 75 km in the Gironde estuary
Watershed	56,000 km^2 (10% of national territory)
Countries crossed	France, Spain
Main tributaries	Lot, Tarn, Gers, Ariège, Aveyron, Baïse…

The Garonne and the Adour-Garonne basin

The Adour-Garonne basin

The Adour-Garonne hydrographic basin in southwest France covers a fifth of the **country's land surface** (i.e. 117,650 km²), meaning the regions of Nouvelle Aquitaine and Occitanie and part of the Auvergne-Rhône-Alpes region.

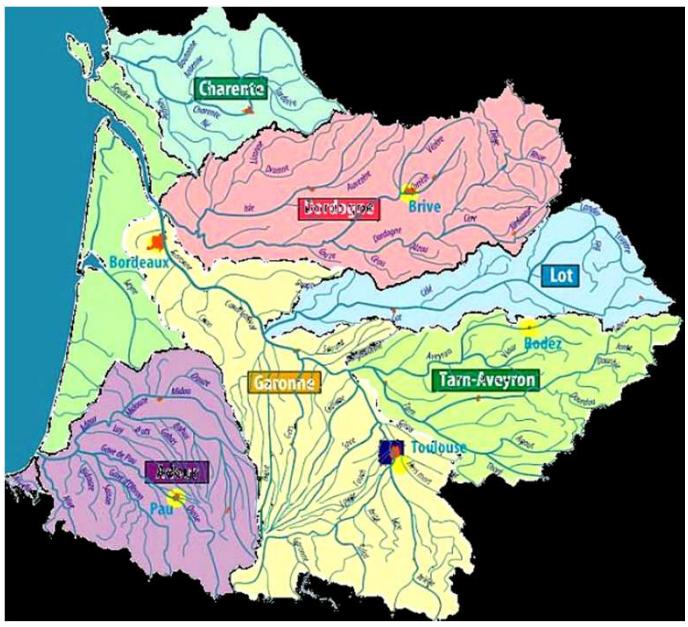
It comprises:

- 2 natural water towers, the Pyrenées and the Massif Central;
- 120,000 km of river;
- considerable resources in underground water;
- a coastline of about 630 km.

A very rural territory, it accommodates a population of 7,000,000 (ie 10% of the national population) of which 30% live in sparsely populated areas.

It can be divided into **7 hydrographic sub-basins**:

The watershed of the Garonne straddles the the regions of Occitanie and Nouvelle-Aquitaine and is the largest watershed of the Adour-Garonne basin (28,900 km²). It is drained by the largest river of the basin, the Garonne. It is also the most populated, with more than 3 million inhabitants, for the most part concentrated in the cities of Bordeaux and Toulouse.



The Garonne and the Adour-Garonne basin

Its uses

Irrigation of farmland

The Adour-Garonne basin has 120,000 farms, with a surface area of 53,000 km^2 dedicated to agriculture. It represents 20% of the French's Utilised Agricultural Land (UAL). The UAL is estimated to cover around 50% of the basin's superficy.

The variety of reliefs, climate and "terroirs" (specific local terrains) has led to a great variety of different produce, with certain crops predominating, along with cattle, sheep and goats, multi-crop-livestock farms, and large areas dedicated to wine-growing (Bordeaux, Cahors, Cognac, Gascogne, Fronton, Gaillac, Bergerac, etc.).

About 10% of farm surfaces are irrigated, representing the **consumption of 900 million m^3 a year** on average, as this consumption varies greatly according to climatic conditions. The water consumed mostly comes from the rivers and groundwater. The rest is supplied by hill reservoirs and captive water.

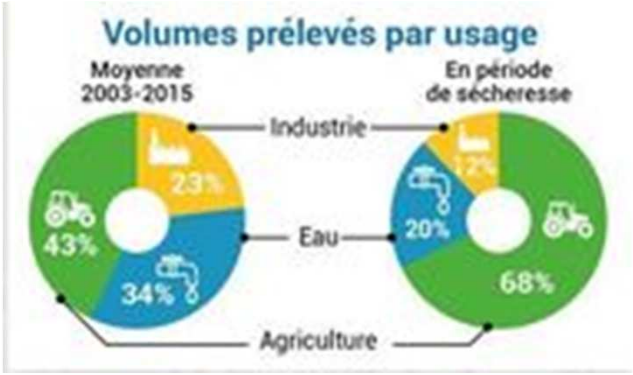
The surface area covered by irrigable farmland increased considerably from the 1970s to the 2000s, with an increase in the production of maize, a cereal that consumes a great deal of water during low flow periods. However, since the 2000s, the irrigated surface area has fallen to around 20% due to the combined effect of recurrent droughts that have led to restrictions, and changes in the European Common Agricultural Policy.

The region's climate makes water withdrawals necessary, leading to strong pressure on the basin's water resources. To offset this imbalance, hill reservoirs and upstream dams make it possible to release water during low flow periods. However, the Adour-Garonne basin is poorly equipped to sustain the low flow of its main rivers, including the Garonne, in comparison to the Loire and the Seine. In addition, the Garonne, whose flow depends on the rain, snow melt from the Pyrenees and aquifers, is subject to sometimes extremely low flows whose intensity is aggravated by the withdrawals necessary to satisfy needs. **During these periods of low water, agricultural withdrawals make up almost 70% of total withdrawals**. Arbitration regarding irrigation has become crucial, likewise for the challenges to be met with the water of hydropower installations to strengthen the flows of the basin's main rivers, due to the lack of dedicated structures.

Agriculture is now forced to adapt with respect to the intensity of types of crop and the irrigation techniques employed to reduce water losses and withdrawals.

The Garonne and the Adour-Garonne basin

Its uses



Infographics: Dépêche du midi – 23/03/2018

The Adour-Garonne basin benefits from 90 billion m³ of water every year of which 35 billion m³ is "useful rain" (not immediately lost by evapotranspiration). Human withdrawals of water amount to an average of 2 billion m³/year, although they can reach up to 2,4 billion in a dry year.

Electricity production

The Adour-Garonne basin has considerable hydropower potential, with the **production of 15,000 GWh a year** (20% of national hydroelectricity production) and a useful capacity of 2.3 billion m³. A large number of the installations are located in Haute-Garonne, downstream of the Pyrenees, due to the substantial differences in level that favour hydroelectricity production, in addition to increasing the discharges of the river.

The two industrial companies involved are:

- EDF is the main actor which is responsible for 80% of the production with 20% of the installations.
- Société Hydroélectrique du Midi (SHEM) / ENGIE, with 58 plants and 12 large dams.

EDF also operates two nuclear power plants in the basin: Golfech, between Toulouse and Agen, and Blayais, in the Gironde estuary.

Industry

More than 90% of the water withdrawals destined for industry (paper, automobiles, aeronautics, etc.) are taken from the rivers. These withdrawals amount to about **400 million m³/year**. Almost 90% of the water is returned to the natural environment.

However, the effluents discharged by waste water treatment plants have an impact on the river, especially when the water level is low.

The Garonne and the Adour-Garonne basin

Its uses

Drinking water

Withdrawals for drinking water amount to about **700 million m³/year**. They are taken from rivers, groundwater and confined water.

The Garonne valley provides **nearly two million people with water for drinking**, following treatment, with an average daily consumption of about 150 litres per person.

Navigation and tourism

The Garonne is now navigable for the largest boats in the estuary up to Bordeaux. In particular, it has been used to transport components of the A380 airliner between Pauillac and Langon since 2004. It is a difficult operation that requires crossing the stone bridge of Bordeaux, followed by that of Saint-Jean and the Passerrelle Eiffel, a railway bridge. That latter can only be crossed during low tides in the estuary, due to the large size of the parts transported. The crossing can take up to 11 hours, for a distance of about 150 km. The rest of the journey is by road.

The Garonne and its canals are now mostly used **by pleasure boats and nautical activities** (fishing, canoes-kayaks, rowing, bathing, etc.). The number of boat hires is increasing every year (20% more in 2018 in comparison to 2017): every year more than 10,000 boats sail on the Canal du Midi, listed as a UNESCO World Heritage.

The **Port of Bordeaux** is a stopping off point for ocean liners and river cruisers for tourism. There are 5 river cruise companies and 6 river cruise liners sail on the Garonne, the Dordogne and the Gironde estuary. This activity demands intensive maintenance of the river with regular dredging.

Water for environment is another use. For example, 70% of the water managed by the CACG *(see below)* in the Neste system is dedicated to preserve rivers' biodiversity. Nature-based solutions and the notion of ecosystem services of rivers and wetlands have emerged in the debate about climate change. The environmental use of the water should be much considered and taken into account in the governance for water.

The Garonne and the Adour-Garonne basin

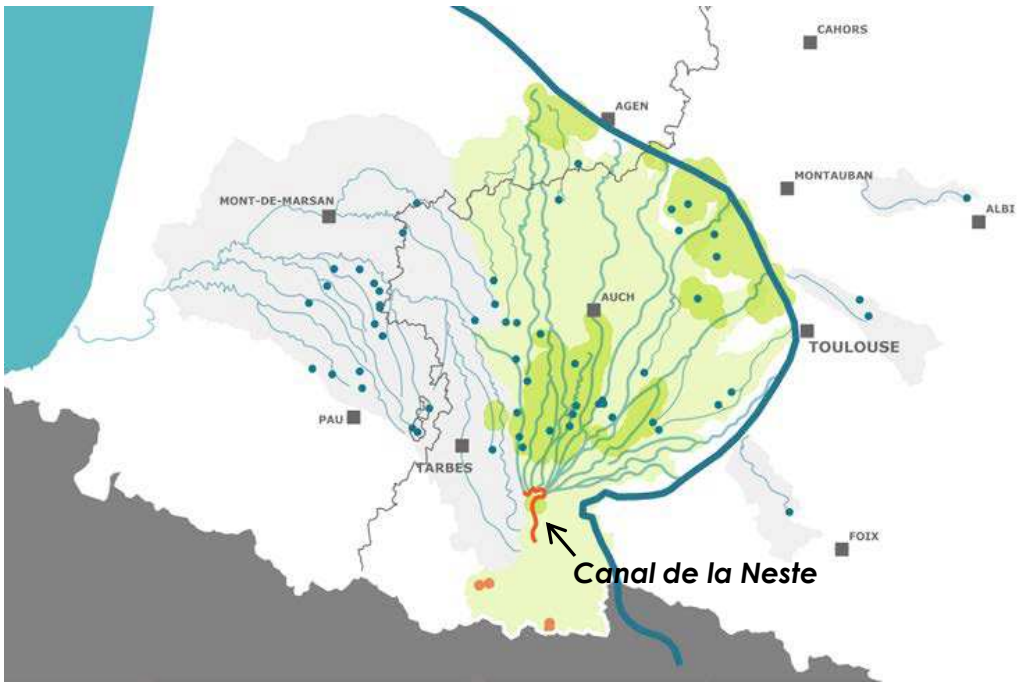
Its uses

The CACG, water resource manager

The Compagnie d'Aménagement des Coteaux de Gascogne (CACG) (Gascogne Hills Development Company) is one of the main regional actors in water, and a long established participant in the development, construction of installations and economic development of the Midi-Pyrénées and Aquitaine regions. It now aids the territories with sustainable water resource management as well as energy and agricultural transition.

The essential component of the Neste system, the Canal de la Neste, built in the 19th century, conveys water from the mountains for consumption by the population, irrigation, the environment, industry, tourism and leisure - via a huge network composed of 2,000 km of rivers (17), several lakes and 90 km of channels covering a territory of 7,000 km^2.

In addition, on the river territory of Gascony, the CACG has built reservoirs with a total capacity exceeding 65 M m^3 for both local economic activities and for recharging rivers in order to maintain minimum flows during periods of low water. It also manages structures in other basins (in particular the Adour and Dropt).



Pumping stations and networks under concession.

Reservoirs managed.

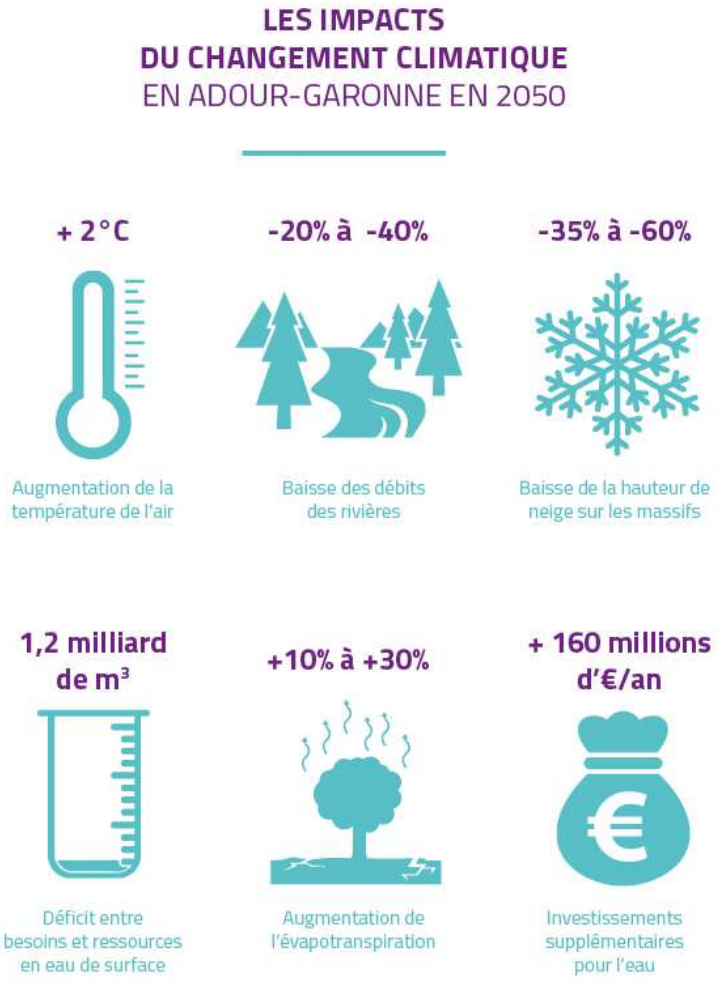
Reservoirs supplying the Neste system (SHEM).

The Garonne and the Adour-Garonne basin

The challenges of climate change

Of France's six main hydrographic basins, that of the Adour-Garonne is subject to the greatest impacts of climate change. **It is now estimated that the deficit between water resources and consumption has reached 200 million m³/year. It is expected to reach between 1 and 1,2 billion m³ by 2050.**

The increase in temperature, already observed, should reach +2°C by 2050, which will have numerous consequences for the climate, the landscape and water resources. Whereas water resources will become less abundant and more variable, demographic pressure will increase, with an additional 1,5 million inhabitants in 2050.



Source:
Adour-Garonne Water Agency

The Garonne and the Adour-Garonne basin

The challenges of climate change

Three strong impacts

The impact on resource availability

The regime of the river will likely be greatly affected. The quantities of water provided by the Pyrenees mountains will decrease considerably, due to lower snowfall at altitude. The volume of water provided by rainfall will not change, although an increase in evapotranspiration (from 10 to 30%) will contribute to the general reduction of river discharges. Rainfall will also be more variable according to season and region.

These phenomena will have major impacts on the basin. Indeed, an overall reduction in the level of rivers will lead to longer and more severe low flow periods, with **discharges falling by as much as 50%**. Soils will be adversely affected more regularly, with more intense droughts, and aquifers will no longer have the same recharging capacities.

The impact on the quality of water and wetlands

The reductions in discharges will decrease the river's capacity to treat the effluents caused by human activities naturally, since it will no longer have the volumes of water necessary to dilute them.

Furthermore, the temperature of the water will increase: an increase of 1.5°C over the last forty years has already been recorded. This leads to many consequences: lower rates of dissolved oxygen, increased eutrophication and the proliferation of algae, greater ecotoxicity, etc.

These two phenomena, combined with soil erosion, will lead to perceptible pollution at the mouth of the river and be dangerous for humans and the basin's ecosystem.

Increased exposure of the regions to extreme events

Extreme climatic events (drought, heatwaves, floods) will become more numerous and intense, with other associated risks on the shoreline such as coastal erosion and flooding by the sea. The most urbanised regions will be the most exposed.

The Garonne and the Adour-Garonne basin

The challenges of climate change

The issue of the artificialization of soil:

An example: More than 9% of the surface area of the Nouvelle-Aquitaine region has been urbanised, with an increase of 12% in less than 10 years. Urbanisation occurs to the detriment of natural soil (- 4,799 ha), especially to that of farmland (-79 623 ha)

Source: Report "Anticipating climate change in Nouvelle-Aquitaine" – Acclimaterra – June 2018.

The recommendations

Finding a new balance between the uses of water and available resources in time and space

Several levers could be used in order to achieve a better match between supply and demand for water in terms of both quality and quantity:

- **save water;**
- **rethink activities and the uses to which water is put**, in terms of their distribution in space and time, and as a function of the future availability of water;
- **offset the modification of hydrology** over time by favouring transfers and storage (natural, in soil, and artificial via hydraulic structures) to make water available as close as possible to periods and places of consumption;
- **think of the availability of water in terms of hydric mix** that blends different solutions (surface water with groundwater) in the same region.

Reduce pollutions at source and improve their treatment

- **limit** as much as possible at source **the discharge of pollutant substances** into aquatic environments,
- **increase the levels of treatment** before discharge into aquatic environments.

The Garonne and the Adour-Garonne basin

The challenges of climate change

The recommendations

Strengthen the resilience of natural and aquatic environments and wetlands

Favour:

- **the good functionality of wetlands**
- **living soils** capable of retaining water
- **the diversity of landscapes** at the scale of watersheds,

Be prepared against natural risks

Reduce the adverse impacts of natural risks:

- where the socioeconomic stakes are high for the protection of people and property by **building protective structures;**
- elsewhere by **restoring natural spaces**.
- **limit** as much as possible at source **the discharge of pollutant substances** into aquatic environments,
- **increase the levels of treatment** before discharge into aquatic environments.

The Garonne and the Adour-Garonne basin

What river for tomorrow?

In addition to the diagnostic and the predictive analysis for evaluating the impacts of climate change on the Adour-Garonne basin, the different actors involved are drawing up actions plans to define new strategies for sustainable water management:

- **The Basin Committee** adopted a **climate change adaptation plan** in July. It sets out several measures to preserve water resources and the ensure the investments required. A regular and constant investment of about €160 M/year will be necessary from now to 2050. These measures should be integrated in all public policies and applied by the water management bodies and the users.

- **The Occitanie Region** set out an **integrated water management action plan** for the same period, following a large-scale campaign known as H2O 2030 carried out since June 2017. It determines 21 priority projects for the sustainable management of water resources, the efficient functioning and enhancement of wetlands and the reduction of flood risks.

- **The Nouvelle-Aquitaine Region**, the region with the highest agricultural revenue in France and Europe, has also defined **a regional water strategy** that aims in particular at controlling and optimising water consumption; taking into account the stakes of water in territorial development and managing natural risks; and reserving and restoring water resources and wetlands.

The Garonne and the Adour-Garonne basin

What river for tomorrow?

The basin climate adaptation plan

The is **no single solution** for solving the challenges and achieving significant results. Many natural levers must be brought into play at different spatial and time scales.

1/ Institutional, intangible, flexible and reversible measures: governance at the right scale, knowledge, especially in the hydro-climatic domain, and support for innovation.

2/ Territorial development and urban planning also play a major role for adapting the installation of economic activities, land use and residential areas in a context of strong demographic growth.

3/ The adaptation of our individual behaviours, lifestyles and production: it is necessary to act at source with water-thrifty practices that are less pollutant and friendlier to the functions of ecosystems and biodiversity. The plan intends to involve the basin's economic actors in another model of development, in particular climate sensitive activities like **agriculture** which must henceforth predict disturbances and transform itself. The plan also encourages **the territorial authorities** and **the population** to involve themselves in the sustainable management of the resource, continue improving the quality of the water and combine mitigation and adaptation.

4/ Measures based on nature or which require ecological engineering: their diversity, self-cleansing capacity and function as buffers bestow aquatic and wetland ecosystems with an important role in ensuring the quality and regulation of water at watershed scale (infrastructures agro-ecological, green and blue belts, humus bearing and living soils, etc.).

5/ Tangible infrastructures: storing water when abundant and conveying it close to where it is needed, recycling it and protecting people. This entails relying on installations, notably hydropower facilities, new facilities (reservoirs, dikes, etc.) and modern and innovative technologies. These measures are sometimes expensive and have considerable local environmental impacts that must be compared, case by case, with the benefits expected from the service they provide.