ADAPTING TO CLIMATE CHANGE IN THE FIELD OF WATER: TYPOLOGY & RECOMMENDATIONS FOR ACTION

Water and Climate: a priority

The United Nations' climate conferences (COP) aim to find responses to a number of fundamental challenges:

- **How can our greenhouse gas emissions be reduced?**
- **How can we adapt to climate change?**
- **How can we finance our attenuation of and adaptation to climate change, particularly in the Least Developed Countries (LDCs)?**

Adaptation, a significant concern in developing countries, is an increasingly important part of climate negotiations. It is defined as the process of adjusting to the current or expected future climate, and its consequences, so as to attenuate harmful effects and take advantage of beneficial ones.
A temperature increase of more than 2° Celsius forces the world to adapt. An increase of more than 4°C could cause a breakdown in water management especially in the most vulnerable countries.

Water is the principal vector by which climate change impacts on societies and ecosystems; it has to be at the heart of issues and strategies for adapting to climate change. A large part of **international and national funding should support adaptation actions in the water sector and in risk management**. This is already the case for more than **80% of the funds for adaptation of the French Development Agency[1] and approximately 60% for the Adaptation Fund[2].**
82% of the Intended Nationally Determined Contributions (INDCs) presented for COP21 have an adaptation section. Among these contributions, 92% mention water, which indicates its high priority. The countries concerned are mainly developing countries[3].

1 Water and sanitation department, Agence Française de Développement
2 Doc AFB/PPRC.1715, 2015
3 Data analysed by FWP, November 2015, sources: INDCs, UNFCCC

With the adoption of a Water Goal in the United Nations' 2015-2030 Agenda for Sustainable Development, the international community has recognised how important water management is to both people and the environment. It has begun defining indicators to monitor implementation of the Water Goal, which already gives an **initial indication of what 'sustainable water management' represents in changing contexts.**
Adaptation is still difficult to define, both in climate negotiations and for the various decision-makers. Despite some progress, there is still a long way to go to characterise the concept and develop tools to guarantee transparency, follow-up and verification of adaptation actions focusing on water management.
French water actors gathered within the French Water Partnership encourage the international community to extend its reflections on sustainable water management in the current context of climate change. **To do so, they propose a number of recommendations and a typology of actions,** while also underlining the importance of avoiding situations of maladaptation.

French Water Partnership members call on the international community to:

- take into account water in the strategies for adapting to climate change set up in Intended Nationally Determined Contributions, National Adaptation Plans and other plans to manage water
- take into account climate issues within water and risk policies at the national, regional, territorial, basins and local levels;
- give water a bigger role in the public or private funding mechanisms set up for adaptation to climate change, in particular in the Green Climate Fund., at the basin and national scale.

french water partnership — fwp pfe — partenariat français pour l'eau

The **French Water Partnership** (FWP) is a muti-actor platform which gathers 120 public and private members and which works on conveying key consensual messages on the governance and management of water resources in the international arena.
@PFE_FWP #Climateiswater
www.partenariat-francais-eau.fr

afd — AGENCE FRANÇAISE DE DÉVELOPPEMENT

Agence Française de Développement (AFD), a public financial institution that implements the policy defined by the French Government, works to combat poverty and promote sustainable development. AFD operates on four continents via a network of 71 offices and finances and supports projects that improve living conditions for populations, boost economic growth and protect the planet. In 2014, AFD earmarked EUR 8.1bn to finance projects in developing countries and for overseas France.
@AFD_France
www.afd.fr

What impact will climate change have on water?

Climate scenarios in the IPCC's fifth report indicate an increasing number of water-related risks caused by climate change. Many parts of the world are already affected. Climate change **exacerbates** the difficulties of water management associated with ongoing global changes such as demographic growth, urbanisation, increased energy needs and changing ways of life.

The most vulnerable countries and populations will suffer the greatest impact, along with those already affected by extreme weather events.

The principal consequences of climate change on water, which may vary from one region to another are:

• **decrease in precipitation or river flow (water stress)**: climate records and/or forecasts show that, in areas already at risk, average annual precipitations will decrease and droughts will be harsher, leading to more water stress.

• **increase in episodes of heavy rainfall and flooding**: climate records and/or forecasts show that in some parts of the world the frequency and/or intensity of episodes of heavy rainfall will increase, thus exacerbating the risk of flooding.

• **rise in sea level:** records and/or forecasts of sea level indicate that the frequency of exceptionally high tides will rise, along with average sea level, increasing the risk of submersion and salinization of coastal aquifers.

• **increase in the overall temperature of oceans and waterways, and glacial melting.**

What are the principal risks for the environment?

• **Risk of shortage (including droughts).** This risk has high impact on many sectors: drinking water supply, agricultural production, energy production, etc.

• **Risk of excess** (including flooding and coastal flooding). These destructive events cause significant human loss and damage to property and the environment.

• **Risk of inadequate quality** caused by an increase in water temperature or saline intrusions—or indirectly by other risks—may lead to a shortage of water of sufficiently good quality for humans and the environment.

• **Risk of undermining the resilience of freshwater systems (ecosystems).** Climate change is likely to increase pressure on the environment and thus damage aquatic ecosystems (wetlands, waterways). OCDE 2014

As a result, climate change will have significant social impact, in particular on access to safe drinking water and sanitation, health, food security and migration. Many economic sectors that depend on water will also be affected: agriculture and fishing, energy, tourism, etc. Likewise, these phenomena will have repercussions on the natural environment and ecosystems.

What are the main guidelines for adapting to climate change in the field of water?

LOOKING AT DEVELOPMENT ACTIONS THROUGH A CLIMATE LENS

The goal now is to succeed in **reconciling territories' development needs with climate constraints** and to support countries and populations in their ecological transitions. One major focus is to set up development actions in the field of water that are **resilient to climate change** and also make it possible to **anticipate, absorb or cope with the current or future effects** of climate change. **The flexibility and sustainability** of adaptation actions are important criteria that should be taken into account in developing these actions.

For all actions considered, decision-makers at all levels must **analyse the hazards, vulnerability and exposure** of populations and the environment to short- and long-term climate change. Implementing **'no regrets' measures** (actions that are beneficial no matter how the climate changes) should be given priority. In addition, sometimes specific actions are required in order to integrate climate change in a project's design. Example: increasing the height of a dike to prevent land from being flooded by the sea, or examining scenarios of changes in river flow to construct an optimal dam.

Adaptation actions for water management should take into account technical, traditional or innovative actions that combine **institutional actions** (regulations, capacity building, awareness), **ecological actions** (protection of soils and wetlands, restoration of rivers, making cities permeable, agro-ecology, etc.) and **technical actions** (dikes, dams, desalination, water treatment, irrigation, urban or agricultural drainage, etc.).

BUILD KNOWLEDGE & CAPACITIES

To better analyse needs in terms of response to climate change, we need to **strengthen knowledge on climate and its impact on water management, particularly at the local level.** To decrease the climatic uncertainty and thus enable better planning, we must strengthen social knowledge of the potential risks as well as scientific knowledge (climatology, hydrology and meteorology). What we truly need is a maximum of information so we can **act for the best** on the basis of data that has either been measured (hydro-weather stations, swell metres, etc.) or forecast (models), while also taking into account local knowledge on changes in the climate and local practices to deal with that change. Improving dialogue and information sharing amongst actors - in particular scientists and decision-makers, water and climate actors - is crucial.

STRENGTHEN THE INSTITUTIONAL FRAMEWORK

Adaptation actions should not be implemented in isolation; they should be part of a coherent adaptation strategy. Policies to adapt to climate change (national adaptation plans, national contributions by country - INDCs, local adaptation plans, etc.) and risk management should make water management an integral, contributing part of their plans of action. At the same time, policies and governance associated with Integrated Water Resource Management, access to drinking water and sanitation and management of water-related risks (flooding, submersion) at the national, regional, local and catchment area levels should take climate into account. For such policies to succeed, one essential condition is the coordination of sectoral policies (water, agriculture, energy, and urbanism) to arrive at convergent objectives on water and climate change issues.

Integrated Water Resource Management, which promotes water management at a water basin scale and a balance between uses and participatory management of water resources, is an appropriate institutional framework to tackle climate issues.

A balance between uses, policies based on water demand and availability are a necessary condition to guarantee sustainable actions for water management. A mix of structural and non-structural measures is the key to getting adaptation on the right track.

INVOLVE ALL ACTORS

The **participation of all actors** – local elected officials, scientists, farmers, industrial manufacturers, users and citizens - in developing, implementing and following up on actions is primordial. Inclusion of civil society requires that **their capacities be strengthened** and that they be **made strongly aware** of water and climate issues.

AVOID MALADAPTATION

Some measures aimed at reducing vulnerability to climate change can have a negative impact on other systems, sectors or social groups, or even increase their vulnerability. **It is important that adaptation measures do not transfer vulnerability from one system to another, or from one period to another,** or to avoid any "greenwashing".

Some examples of adaptation

Hydrological monitoring and decision-support in the Congo River basin

Agence Française de Développement (AFD)

The **Agence Française de Développement (AFD)** is providing support to the International Commission for the Congo-Oubangui-Sangha Basin, (CICOS) for the implementation of hydrological monitoring for the Congo River which is critical for its exceptional characteristics: 204 million hectares of forests, 60% of African biodiversity, 25,000 km of waterways, 100 GW of hydro-power generating capacity which is enough to supply half the needs of the continent.

The Congo River is at the center of global concerns on climate change and biodiversity, but carrying out environmental monitoring for such a large hydrological basin is a real challenge. France is assisting the transboundary basin organization in improving Integrated Water Resources Management (IWRM), through projects amounting to 2.6 million euros. One of these projects, which was finalized in 2015, consisted in developing a modelling and decision-support tool in order, among other things, to estimate sensitivity to climate variability. Hydrological monitoring will be improved notably thanks to a world-first innovation that uses Earth observation satellites. Better knowledge will lead to better planning and resilient local economic development that will benefit over 160 million people in Central Africa.

http://www.afd.fr/home/projets_afd/Eau_assainissement

In Myanmar (Burma), agro-ecology is providing a solution for development and climate

GRET

The heavy rains that hit the south of the country in August 2015 left more than 100 dead, triggered landslides and caused devastating floods. These disasters affected more than one million Burmese and destroyed hundreds of thousands of hectares of rice fields.

Farmers are among the worst affected by the consequences of these recurring extreme events and periods of severe drought. Here, climate hazards reinforce existing vulnerabilities resulting from inadequate food production and incomes that are too low to allow adaptation. Migration is often the only option for people. **GRET** helps some 2,500 impoverished farmers to conserve water and restore soil fertility for rain-fed crops by deploying agro-ecology methods such as earth dykes, ground-covering plants, composted organic materials, etc. These actions, involving both crop and livestock farming, are not only beneficial in that they increase production volumes, they also promote agricultural practices producing low greenhouse gas emissions.

www.gret.org

Copenhagen, now a more flood-resistant city

Veolia

On 2 July 2011, extraordinarily heavy rains in Copenhagen caused severe flooding, the cost of which was estimated at 700 million euros. The city's rainwater drainage system was unable to cope with this severe weather phenomenon. Acting on advice from Krüger, a **Veolia** subsidiary that manages water and wastewater treatment in Scandinavia, Finland, Poland and the Baltic states, the city decided to invest in better retention basin surveillance systems and weather alerts to prevent possible damage from any future episodes of this intensity.

The installation of a smart grid with a number of intelligent and modular software solutions, associated with better weather monitoring as part of an anticipation strategy, means the city can now use existing infrastructures to channel water in and out of storage basins. This choice allowed the city to reduce investment costs by 93% as compared with an alternative solution involving the creation of additional basins. The number of sewage overflows decreased by 90% between 2013 and 2014, highlighting the effectiveness of the systems implemented in Copenhagen.

http://www.veolia.com/fr/copenhague-une-ville-qui-resiste-aux-inondations

Early warning system in the transboundary MAP region of Madre de Dios (Peru), Acre (Brazil) and Pando (Bolivia)

International Network of Basins Organizations (INBO)

The Acre River basin is located southwest of the Amazon River basin, in the MAP transboundary region named for Madre de Dios (Peru), Acre (Brazil) and Pando (Bolivia). The region covers some 36,000 km2. This catchment basin has been exposed to extreme weather events (drought and flooding) over the past few decades. The project to adapt to climate change in this transboundary region, supported by the **INBO**, aims to set up a georeferenced data base to statistically determine the impact of climate change on this region. Using this data, a tri-national early warning system was developed and implemented in the three countries concerned: Peru, Brazil and Bolivia.

www.oieau.fr

SCAMPIS Development of micro-irrigation systems in Madagascar

Agronomes et Vétérinaires Sans Frontières (AVSF)

Market gardening, an activity that requires a great deal of water, fertilizer and in some cases plant health products, is disappearing as a result of constraints associated with access to water: distance to sources, early depletion and the chronic reduction of water resources. **Agronomes et Vétérinaires Sans Frontières (AVSF)** has worked in cooperation with more than 60 market-garden communities in Madagascar to launch the SCAMPIS project, a drip irrigation system that reduces water consumption and the harmful side effects of traditional irrigation such as nutrient leaching, soil compaction, spread of disease, etc. With micro-irrigation, greater yields can be obtained on larger areas, thus saving water. The technique also respects soils and the environment, and thus the mitigation potential of soils.

www.avsf.org

Preserve migration of aquatic species in the Allier Riveraquatiques dans l'Allier

EDF

The presence of hydroelectric installations has a well-known impact on the capacity of migratory fish to swim upstream to their spawning grounds.

In 2016, **EDF** will begin work to completely reconfigure the Poutès dam on the Allier River. A technological solution being implemented for the first time in the world will make it possible to significantly reduce the height of the dam. The goal is to facilitate the movement of migratory fish and the transit of sediments required to maintain the river's biodiversity. With water retention practically eliminated, the river will recover its natural profile and create habitats for aquatic species in the valley. Despite its smaller size, the new installation will produce 85% of its current capacity, i.e., enough low-carbon renewable electricity to meet the needs of a city of 20,000 inhabitants.

www.edf.fr

In California: protecting and recycling water

SUEZ

The unprecedented drought that has hit California for the past 5 years has serious repercussions on water supply, agriculture and aquatic ecosystems. Water continues to be pumped from underground reserves, creating the risk of ground instability as well as future water shortages and conflicts between uses for farming, industries and municipal practices. One alternative practice is water recycling.

The Edward C. Little recycling plant, a **SUEZ** subsidiary south of Los Angeles, reuses treated wastewater for non-domestic purposes. It is the only plant in the world capable of producing five different qualities of water for industrial activities or irrigation. The installation also has a unique system for reinjecting recycled water in underground reserves. It also helps stop infiltration by sea water and thus assists in the reconstitution of freshwater reserves for the future. In addition to reducing the Los Angeles area's dependence on imported water, this plant helps reduce the quantity of wastewater discharged into Santa Monica Bay.

http://www.suez-environnement.com/

Paris: non-potable water for urban uses

Eau de Paris and Paris City

Paris is one of only a few cities in the world with two water supply networks, one of which distributes the non-potable water used to clean streets, water parks and gardens and perform some sewer-cleaning operations, as well as for a small number of private uses. In 2012, a consultation launched by the city's government and its water supplier (Eau de Paris) concluded that the network should be both maintained and optimised for more diversified uses. Fed by the Ourcq Canal and the Seine River, run by Eau de Paris, the network flows through 1,700 km of pipes and underground tunnels and is a precious tool in the fight against climate change.

http://www.paris.fr/

TYPES OF ACTIONS FOR WATER MANAGEMENT ADAPTED TO CLIMATE CHANGE

The French Water Partnership presents of typology of the different types of action in the field of water that its members carry out to adapt to climate change. This non-exhaustive list provides an idea of actions that can be considered in various territories and on different scales. It is important to keep in mind that vulnerability to climate change is linked to a specific local context; thus the adaptation responses presented below are not to be implemented everywhere.

These actions should be inscribed in the framework of the previously stated principles for integrating adaptation into water management: looking at development actions through a climate lens, strengthen knowledge and capacities, strengthen the institutional framework and steer it toward Integrated Water Resources Management, involve all actors, avoid maladaptation.

Actions implemented should include technical solutions T (physical, technological, infrastructures), institutional solutions I (whether social, economic or political) and ecological E, i.e., (based on ecosystems).

ACTION TO ADAPT TO THE RISK OF FLOODING AND SUBMERSION

Actions aimed at retaining excess surface water upstream from zones at risk

	T	I	E
Increase in water retention capacities: dams, reservoirs and wetlands serving as barriers, vegetated retention basins	●		●
Barriers to prevent submersion by the sea: sea dikes and restoration of natural barriers (embankments, mangroves, etc.)	●		●
Barriers to prevent floods: dikes, restoration of natural barriers (dunes, coral reefs, etc.)	●		●
Reforestation to reduce the risk of mudslides			●
Creation of flood expansion zones		●	●
Payment for environmental services		●	

Actions aimed at reducing territories' exposure to flood risks

	T	I	E
Protection of high-priority infrastructures (drinking water plants, wastewater treatment stations, latrines, wells, etc.)	●		
Improvement of drainage capacities to evacuate excess water: eliminate soil sealing in urban areas, restore natural drainage capacities, improve storm drainage systems	●		●
Regulation of construction standards		●	
Zoning restrictions for cities, urban development and planning, building permits		●	
Land use management		●	
Guidelines on rainwater		●	
Coordination of urban development planning, wastewater treatment and household waste management		●	

Actions aimed at reinforcing populations' capacity to deal with marine submersion and floods

	T	I	E
Territorial strategies (basin, local level) for managing floods		●	
Early warning system for floods / hurricanes / marine submersion	●	●	
Community assessment of risks		●	
Awareness and capacity-strengthening for populations, simulations		●	
Strengthening of local teams' risk management capacities		●	
Hydrologic and weather measurements		●	
Flood modelling for waterways		●	
Moving populations to secure areas: construction of shelters, management of population flows	●	●	
Risk management plan for floods / submersion and back-up plan for humanitarian crisis situation	●	●	

T Technical actions (physical, technological, infrastructures)
I Institutional actions (institutional, economic, political)
E Ecological (based on ecosystems)

ACTION TO ADAPT TO THE RISK OF A DECREASE IN THE AVAILABILITY OF WATER

Actions aimed at reducing water consumption (demand-based management)

Action	T	I	E
Improve water efficiency during transfer and use: reduce leakage in water supply networks, optimise industrial sectors to obtain processes that consume less water	●	●	
Improve water efficiency in agricultural usages: planting of crops that require less water, micro-irrigation, agro-ecology, etc.	●	●	●
Installation of meters	●	●	●
Economic instruments to reduce the wasting of water: quotas, taxes, deductions, water pricing		●	
Change eating habits (reduce consumption of foods that require large quantities of water to produce, such as animal proteins)		●	
Make users aware of the need to reduce water consumption (individuals, farmers, manufacturers)		●	
Verification or reduction of water taken from various sources and water policing		●	

Actions aimed at increasing the amount of water available (offer-based management)

Action	T	I	E
Increase capacities and improve management of storage systems and areas such as dams, reservoirs and wetlands, increase retention of water by the ground	●		●
Transfer of water between basins	●		
Enhanced or artificial recharging of aquifers (groundwater), protection of soils and restoration of the local water cycle by encouraging infiltration and revegetation	●		●
Payment for environmental services		●	
Rainwater recovery	●		
Reuse and recycling of treated wastewater	●		
Extension of non-potable water networks	●		
Desalination of sea water and brackish water	●		

Actions aimed at securing large quantities of water for the drinking water supply

Action	T	I	E
Local treatment of drinking water	●		
Improvement / enlargement of drinking water plants	●		
Well drilling	●		
Sustainable management of surface waters and groundwater		●	
Interconnection and diversification of drinking water resources	●		
Set up emergency water storage and distribution of drinking water in case of extreme drought	●		

Actions aimed at strengthening the capacities of populations and territories to deal with drought

Action	T	I	E
Assessment of drought risks with participation of the community		●	
Strengthening of local actors' and communities' capacities to manage water services; creation of a water management committee		●	
Monitoring of aquifers, modelling		●	
Warning systems to trigger management of water shortages	●	●	
Strategies to manage drought risks: drought plan, mechanism for coordinating emergency assistance		●	
Awareness programmes and training for local actors: population, local civil society, communities, etc.		●	

ACTION TO ADAPT TO THE RISK OF A DROP IN WATER QUALITY

Actions aimed at securing the quality of the drinking water supply

Action	T	I	E
Upgrade treatment of drinking water	●		
Quality standards for drinking water, joint regulatory framework for water quality		●	
Prevention of health risks to exposed populations		●	
Warning system for pollution of drinking water sources	●	●	
Measurement systems	●	●	
Monitoring and assessment of water quality	●	●	

Actions aimed at improving the quality of surface waters and groundwater

Action	T	I	E
Quality standard for sanitation and regulatory framework for sanitary, agricultural, and industrial waters		●	●
Re-establishment of natural systems to purify water: purifying marshes, belt filters, etc.			●
Rehabilitation of natural drainage systems			●
Construction of vegetated retention basin	●		●
Improvement of capacities to collect and treat sanitary, industrial and agricultural wastewater	●		
Regulation of sanitary and industrial wastewater discharge		●	
Improved management of agricultural inputs and other sources of pollution		●	
Sustainable management of solid waste landfills located in flood-prone areas	●	●	
Elevation of wells and latrines	●		
Prevention of the discharge of pollution-bearing waste in areas that serve to collect groundwater used for drinking water		●	●
Reforestation of the shores of waterways		●	●

ACTION TO ADAPT TO CLIMATE CHANGE AND PROTECT AGAINST THE RISK OF DEGRADATION OF ECOSYSTEMS

Actions aimed at preventing or reducing anthropogenic pressure on ecosystems

Action	T	I	E
Protected wetlands			●
Protected areas			●
Programmes to make the general public, companies and investors aware of ecosystem services		●	
Improvement of the management of agricultural inputs and other sources of pollution		●	
Ecological flow or instream flow in rivers	●	●	

Actions aimed at reconstituting the migratory capacities of animal and plant species

Action	T	I	E
Installations to allow plants and animals to get past infrastructures: ladders, fish passes, etc.	●		
Creation of natural ecological corridors		●	●
Environmental monitoring and inventories of aquatic animal and plant populations		●	●

Actions aimed at protecting and repairing ecosystems hit by extreme weather events

Action	T	I	E
Reinforcement of natural barriers: dunes, embankments, mangroves		●	●
Reforestation, replanting		●	●

T Technical actions (physical, technological, infrastructures)
I Institutional actions (institutional, economic, political)
E Ecological (based on ecosystems)