Pilot Freshwater

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'Without adaptation a change in the precipitation pattern can lead even in water rich regions to water shortage in reservoirs'

Pilot Fresh-water

General introduction

Worldwide, many examples of unsustainable management have shown that water shortages can have significant social and economic impacts. Reduced river flows and lowered lake and groundwater levels lead to a decrease in the quality of surface water, as less water is available to dilute pollutants. It also leads to insufficient water to meet environmental and industrial needs, as well as household demands for fit-for-purpose water. Water supply infrastructures (e.g. transfers, reservoirs and desalination plants), and efficient drought monitoring and forecasting systems are means to prevent and handle situations of severe drought.
The supply-demand balance and the needs to address and create reductions and efficiencies in the demand side of sustainable water management are part of the solutions to cope with more prolonged periods of water shortage. Solutions for a sustainable management of water resources, including an optimized management of multi-purpose reservoirs, are still necessary to increase resilience to drought and water scarcity. The urge to induce new demand and supply strategies is high, due to the economic interests of the reservoirs and the increasing demands of their different users. The pilot Freshwater illustrate the experiences in realizing innovative technological measures for reservoir management in Brittany (France) and Eifel (Germany), to better manage droughts and combat water scarcity for freshwater supply.

Facts

Location

Arzal, Morbihan, France

Project scale

The Arzal dam is located at the outlet of the Vilaine River basin, which has an area of approximately 10 000 km^2. The water storage capacity of its reservoir is about 50 million m^3, and supplies nearly 1 000 000 people (local inhabitants and tourists) in summer.

Implementer

Institution d'Aménagement de la Vilaine (IAV) and IRSTEA (Institut national de recherche en sciences et Technologies pour l'environnement et l'agriculture)

In collaboration with

Local and regional municipalities

'The misty rains and the long-lasting winters do not ensure immunity against droughts'

For more information

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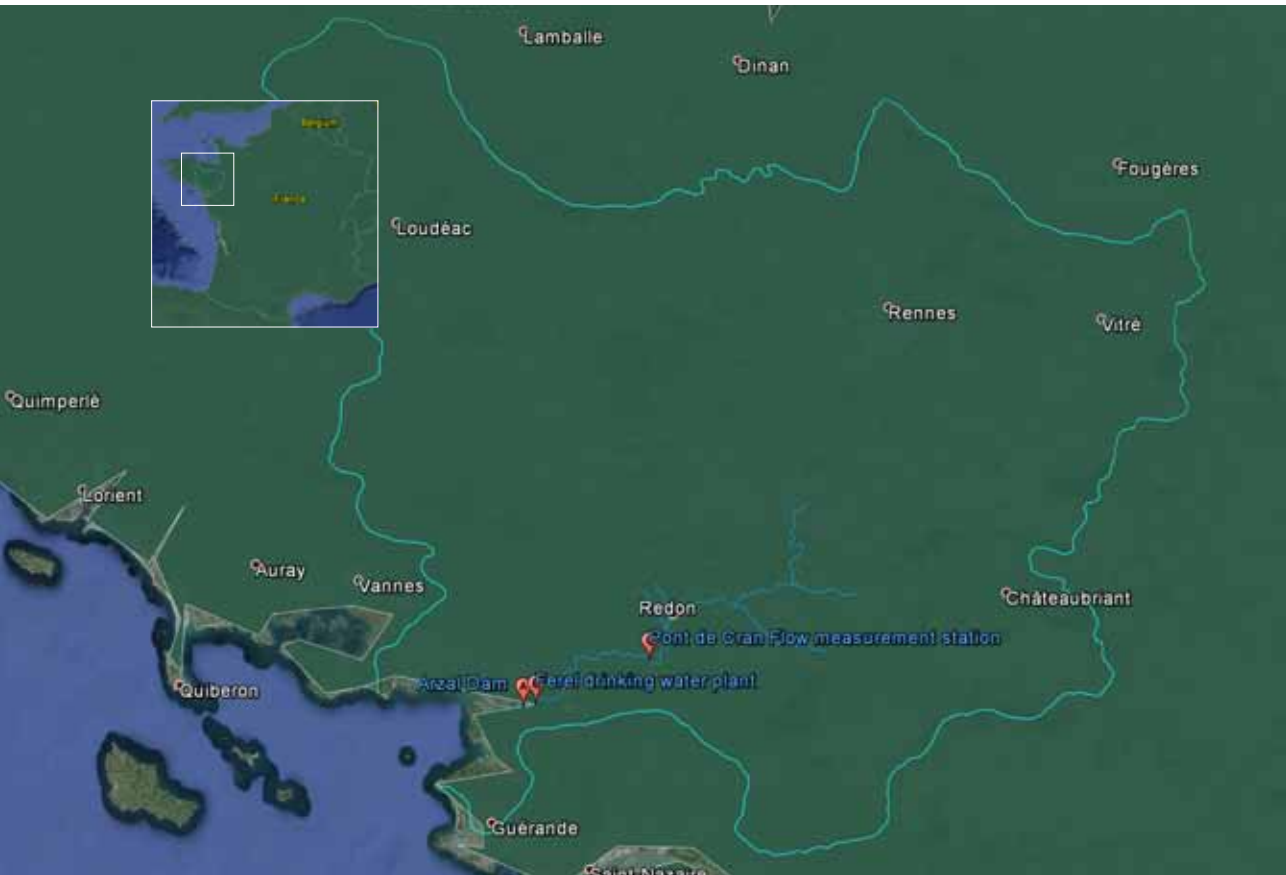

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Freshwater ›

Institution d'Aménagement de la Vilaine

Region Brittany

Challenge

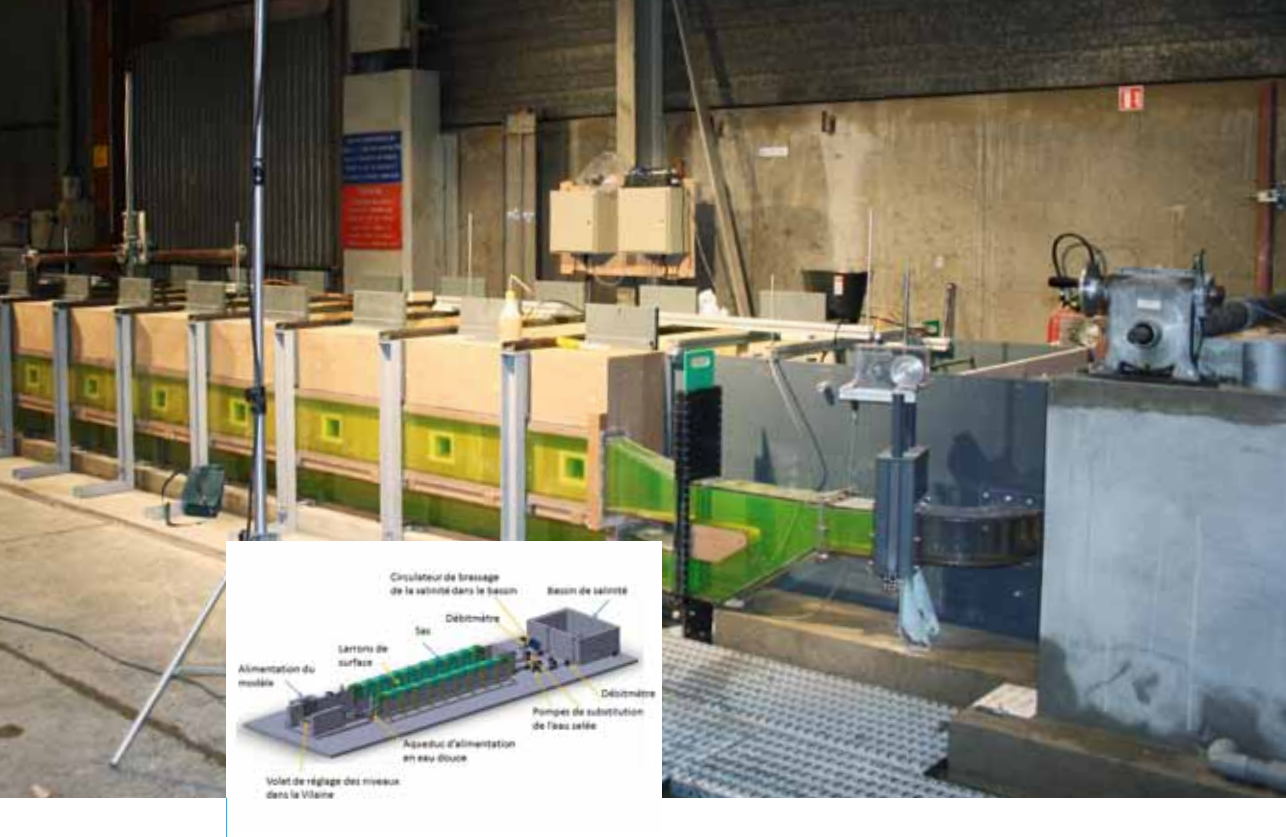
The challenge of this project is to ensure an adequate level in the reservoir for all uses to be possible, and at the same time to keep saltwater out of the reservoir as much as possible so as to preserve freshwater quality and guarantee drinking water supply.

Pilot description

Context

The Vilaine River basin has an area of approximately 10 000 km^2, which drains to the estuarine Arzal dam located just before the Atlantic Ocean in Brittany (France). Built in 1970, its original goal was to protect inlands (and especially the city of Redon) against flooding, by disconnecting the tide wave of the river flood wave. Nowadays, even if flood prevention remains one of the major issues, another very important purpose of the dam is the regulation of the fresh water reservoir (50 million m^3) controlled by the dam, mainly during low flow periods.

Regulation actions comprise the management of water levels and the protection against salt water intrusions. The drinking water plant, which collects water in the freshwater reservoir controlled by the Arzal dam, supplies nearly 1 000 000 people (local inhabitants and tourists) in summer. The challenge of the freshwater regulation in the Arzal dam lies mainly in the multi-purpose nature of the resource. It has a central role in providing water supply, but, also to agricultural activities and for recreational purposes, such as sailing and fishing. This can lead to severe conflicts among users, especially in drought periods and under risk of water scarcity.



The possibilities for development of a new lock, preventing salt water from penetrating into the fresh water reservoir, was studied. A scientific model has allowed to verify the technical data in this innovative project.

IAV, the institution which manages the Arzal dam, faces several challenges related to salt water intrusion and reservoir management during the low flow season (June to October), when both water quantity and water quality constraints apply on the management of the dam. Salt intrusions in the reservoir mainly occur when boats cross the lock of the dam. When water inflows tend to be the lowest (during the low flow season), touristic activities, including sailing, are generally at the highest (since it involves the summer period), and lead to a peak of salt water intrusions in the reservoir, which can affect fresh water quality. To prevent salt intrusions, siphons have been installed upstream of the dam to pump the contaminated water from the reservoir back to the sea. However, this system leads to huge losses of fresh water, which, during prolonged periods of droughts, may aggravate the problem of freshwater supply. Currently, the only solution to limit salt water intrusions and, consequently, pumping losses, is to make restrictions in the use of the lock in summer, the period when the traffic of boats is at its highest. This generates conflicts and has prompted IAV to the implementation of new solutions through this project. In the context of climate change, which may result in longer and more intense periods of low flows and droughts in the region, and aggravated conflicts, these new solutions will also contribute to the implementation of adaptation measures.

Strategy and measures

The two principal strategic management objectives in the Arzal reservoir during low flow periods are:

1. to ensure an adequate level in the reservoir for all uses to be possible, and
2. to keep saltwater out of the reservoir as much as possible so as to preserve freshwater quality and guarantee drinking water supply.

Current and future challenges related to declining water quality and quantity push towards automated and integrated tools for improved drought management and efficient adaptation initiatives for the Arzal reservoir. IAV and the national research institute IRSTEA are working in close collaboration to take up these challenges, through two main actions: the implementation of a new lock, and the development of drought forecasting and risk management tools.

IAV has worked on developing an innovative lock on the dam that prevents salt water to intrude when boats pass the dam to and from the Atlantic Ocean. Significant efforts have been put into developing a physical model of the new lock. Currently, all preliminary studies are finished, model calibration is achieved and all simulations have been completed. The global cost of the project is estimated to be 20 million euros (based on preliminary studies). In parallel, IRSTEA has developed a tool that forecasts inflows to the reservoir during the low flow season and helps in anticipating critical situations for a better drought risk management. The tool incorporates information from a hydrological forecasting model into a graphical representation of the drought risk. The model transforms future possible weather scenarios over the Vilaine catchment into river inflows right upstream to the dam.

The graphical representation of the drought risk provides a visual assessment of the risk of being below given critical low-flow thresholds in the next weeks or months, both in terms of flow intensity and duration (i.e., mean flow and number of days below each critical threshold, respectively). This risk assessment visualisation tool aims to help the managers of the dam in deciding on whether or not to release water from the reservoir and on how to operate the corresponding dam components. It can be integrated into the various reservoir operations and management rules necessary to fulfil its multiple operational uses, connecting the utilities in a pre-operational framework.

'As soon as drought perceptions are raised, drought adaptation measures can rapidly be designed and implemented'

Governance

In addition to managing the Arzal dam, IAV hosts the Local Water Committee, where water issues are discussed with all the stakeholders. This Committee defines the Vilaine river basin management plan, where measures are taken to prevent low flows in several tributaries. However, except for emergency measures, there is no global plan set up to manage drought vulnerabilities induced by climate change.

The overall current situation is of low drought risk perception, compared to a more significant flood risk perception. This is explained by a lack of drought risk awareness, due to the absence of critical drought events in the past years in the region, and the lack of a culture of drought forecasting and risk communication. However, it is expected that as soon as drought perceptions are raised, drought adaptation measures can rapidly be designed and implemented by the efficient, existing water governance for freshwater in the basin, which is supported by a dense stakeholder network driven by IAV.