Irrigation canals as tools for climate change adaptation and ichthyological biodiversity management

A case study of integrated development in Southern France

Chantal Aspe, André Gilles, Marie Jacqué
Aix-Marseille Université/ IMBE / LPED

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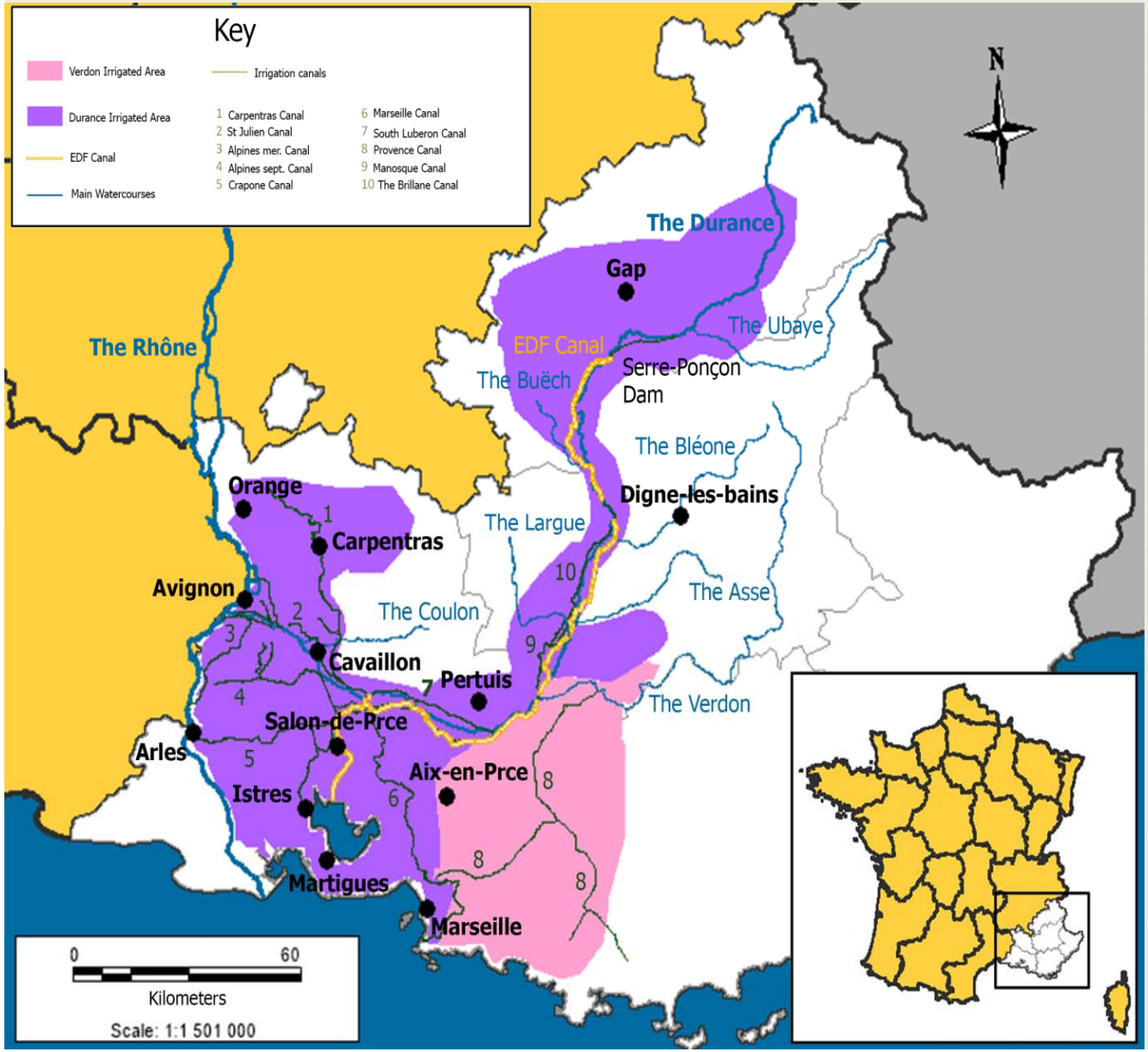
Introduction

Our project is to emphasize on the tools of adaption and not on impacts of climate change. That's why in this presentation we will focus on Mediterranean hydraulic infrastructure : the irrigations canals.

We will argue that beyond their productive role, which is to supply farmers with water, they fulfil other environmental services and may play an important role in sharing the resource in the context of future climate change. We will point up the ecosystem services provided by such canals: e.g., replenishing the water table, the development of riparian vegetation and wet areas in the Mediterranean zone, tools for regulating flooding and drought, the bases for new cultural approaches to nature, as well as the maintenance of an ichthyological biodiversity that is indispensable for the proper functioning of the natural environment

A brief presentation of traditional irrigation canals in Durance basin



- Fifteen large canals along the Durance basin, representing 540 kms of works and 4000 kms of secondary networks.

- The network of canals and their irrigated area covers a very important part of provençal territory.

- They are managed by users associations which are lead by farmers

Methods

Results presented here are based on an **interdisciplinary research** (ecology and sociology).

Sociological analysis : we have past interviews with the directors and presidents of users associations, with a sample of farmers, institutional actors, local politicians, ….. We have also participated at general meetings.

Quantitative survey : empirical observations with exhaustive collection of practices and administration of semi-structured interviews

Ecological and genetics analysis : Electrofishing during 4 periods. Fish under electro narcosis was placed in containers in order to proceed with their examination (morphological identification, mensuration and tissue samples). For each individual, a small sample was taken from the caudal fin.

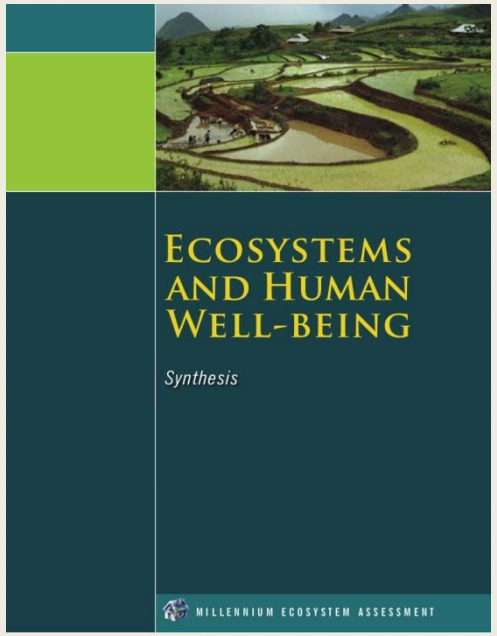
Fish is a particularly interesting indicator since it is a species central to the aquatic ecosystem given the key position it plays in regulating the phytoplankton and zooplankton populations.

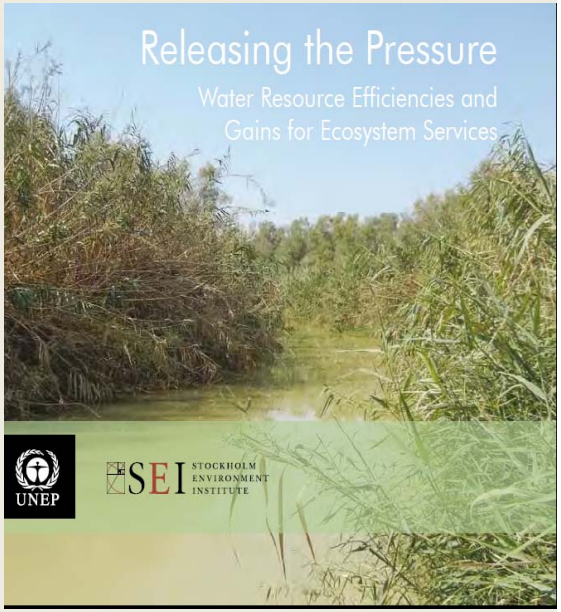
International environmental policies

Since the recommendations of the 2005 Millennium Assessment, promoting ecosystem services is one important angle of contemporary environmental policy. These services are defined as "*the favoured means to understand how certain ecosystems have a positive, often unknown, impact on economic activity and 'human well-being'*"

Such services are divided into four categories: provisioning (food, energy), regulating (water quantity and quality), supporting (soil creation) and cultural services. The report estimates that 60% of these services are in decline due to anthropic pressure on ecosystems.

It therefore appears that one of the current challenges in water management is limiting its agricultural use while maintaining the ecosystem services provided by irrigation practices. A recent report entitled *Releasing the Pressure: Water Resource Efficiencies and Gains for Ecosystem Services* by researchers from the Stockholm Environment Institute (SEI) for the UNEP invites decision-makers and resource managers to shift from thinking in terms of traditional water productivity per unit of agricultural yield to a broader understanding of the concept that would encompass ecosystem services.





• The use of water for farming purposes, which represents 70% of the resource's global consumption, is presented in international reports as the sector that needs to make the greatest water-saving efforts. It is as such that European and international policy support measures to modernize irrigation networks and reduce the use of surface irrigation techniques in favour of systems that consume less.

• The specific services provided by gravity-fed networks address two major challenges that Mediterranean societies will have to face: the scarcity of the resource and protection during increased periods of intense rainfall

• In the Durance sector, irrigation water also plays an important role in the maintenance of several groundwater resources.
ex. According to a study commissioned by the Canal St Julien user's association in 1999, the water table of the lower Durance region is supplied for 75% with irrigation water versus only 25% by natural means (watercourses and precipitation). Recent research into the water table that supplies the city of Avignon further confirmed the importance of this proportion and the major role played by irrigation water in replenishing the aquifer.

Sharing Water in a context of climate change

- Gradually, the role of canals is shifting towards multi-functionality : inclusion of increasingly urban uses foreign to their primary role. Rural space is slowly being consumed by housing developments and business zone.
- The water in irrigation canals represents a useable supply for the needs of irrigated Mediterranean agriculture, as well as for new urban and peri-urban uses in the zones they transect (for example increase of watering gardens). Use of water from the canals as such limits the amount of water drawn from the groundwater; further, the hydraulic infrastructure they form is a structural tool for sharing the resource (between urban and agricultural needs) that exists and can continue to play an essential role in a context of heightened water stress.
- “Agricultural water” has also become a bargain for local municipalities : Several municipalities have recently signed agreements with users associations in order to use the water in agricultural canals to irrigate public green spaces.

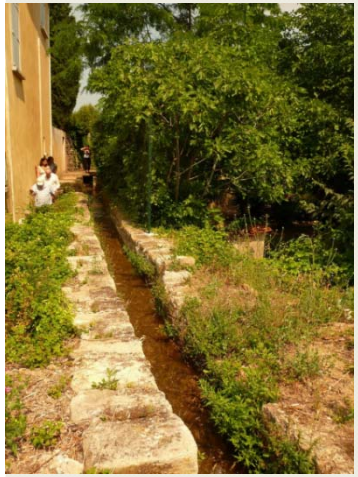
Protecting against flooding

Irrigation canals are also water draining facilities.
They as such supply another indirect service – rainwater disposal – and play a significant role in protecting against flooding during periods of intense rainfall. For example, in the Salon de Provence sector, irrigation canals drain off 35% to 100% of rainwater depending on the municipality. An economic evaluation of the canal's replacement cost was conducted by the city of Sisteron. Were the Canal de Saint Tropez hydraulic structure to disappear, the municipality would have to invest a million euros, in addition to the cost of maintaining a drainage system, whereas the annual maintenance cost of the main agricultural canal and its secondary network is estimated at 30 000 euros / year. The Canal de Carpentras user's association has signed an agreement with the city of Carpentras for the regulation of rainwater. As a result, the municipality invested in the construction of a balancing tank to relieve the main canal when necessary.

- Agricultural irrigation canals are equipped with paths along their entirety and have allowed for the creation of a specific landscape and biodiversity.

- Use the banks of canals, seek to find in these controlled spaces an interaction with nature that corresponds with both popular tastes (walking, cycling, jogging, picnic areas, fishing spots) but also with the expectations of other social strata more attuned to a scientific and cultural approach to nature (landscape, biodiversity, heritage, know-how).

On 108 observations : 51% walkers, 21% joggers, 15% cyclists, 9% equestrians, 2% fishers and 2% others.



Maintain an icthyological biodiversity

• The biodiversity of aquatic ecosystems will likely be particularly affected by hydrological changes connected to climate change.

• Often authors think that dams, reservoirs and diversions for irrigation and industry, will endanger or extinguish many freshwater fish species in the future, by creating physical barriers to normal movements and migration of the biota and by decreasing habitat availability.

• But our first results show that the hydrological network comprised of all of the main canals and their distributaries has produced an aquatic environment with ecological dynamics that are distinct from those in the river but which are also complementary for the ichthyological population of the Durance

• The samples taken in irrigation canals show the presence of numerous fish species

• Our findings point up a close relationship between the hydraulic infrastructure of the canals and the circulation of fish upstream and downstream in the river. The canals play a role in maintaining piscicultural biodiversity in the river via a return to the natural environment through tailwater and drainage water, as well as being a refuge zone for reproduction.

The canals are an “active” repository in the sense that they receive not only a collection of individuals from the river that can live for one to ten years in the canals, but over time they also generate new hybrid combinations in addition to “pure” individuals, thus giving the canal population great biodiversity.

All of these changes are proof of a gradual acknowledgment of the multi-functionality of irrigation canals and the services they provide beyond their primary agricultural role.

Conclusion

The Stern Review on the Economics of Climate Change was the first to calculate not the cost of environmental damage but rather the cost of inaction, advancing the idea that preventive measures are economically more profitable than those that seek to repair.

In France, the public policy so called “Grenelle de l’environnement” point up the triptych: “avoid, reduce, compensate”.
Too often, however, the “avoid” and “reduce” steps are skipped and focus is placed directly on the act of “compensating” and estimating how great the impact that needs to be compensated.

The services provided by irrigation canals cannot be disconnected from the overall working of hydraulic infrastructure (at once ecological, economic and social) and their preservation cannot be bound up in a compensatory logic. Rather, the contemporary challenge resides in their perpetuation and avoiding even their partial disappearance

THANK YOU !