Using participatory foresight approaches for improving agriculture preparedness to increased water scarcity in the long term

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Abstract

This paper describes how participatory foresight methodologies can be used to identify long term (2050) agricultural impacts of increasing water scarcity and drought risk aw well as adaptive strategies. It is based on a case study conducted in Mediterranean Southern France as part of two long term research projects on hydro-climatic change. The methodology consisted in organising foresight seminars with a group of experts and three groups of farmers. Participants were first invited to react and debate on four visions of regional agriculture in 2030, constructed by researchers before the seminars. A second series of workshops was then organised to analyse how these scenarios could be affected by climate change. These workshops were based on the results of the VULCAIN research project (http://agire.brgm.fr/VULCAIN.htm) which estimated future climatic changes (temperatures, rainfall, evapo-transpiration) and resulting hydrological impacts (decrease of river base flow, longer drought periods). The communication describes this participatory process and its outcome.

Keywords. Adaptation; agriculture; climate change; water management instruments.

Une démarche de prospective participative pour identifier aider l'agriculture à faire face à une rareté de l'eau croissante à long terme

Résumé.

Cet article présente une démarche de prospective participative visant à identifier les impacts à long terme (2050) pour le secteur agricole d'un accroissement de la rareté de l'eau et du risque de sécheresse ainsi que les stratégies d'adaptations. Il s'appuie sur un cas d'étude réalisé dans le sud de la France, dans le cadre de deux projets de recherche portant sur le changement hydro-climatique. La méthodologie mise en œuvre consiste à organiser des ateliers de prospective avec un groupe d'experts d'une part, et trois groupes d'agriculteurs d'autres parts. Les participants aux ateliers ont d'abord été invités à réagir sur des visions préétablies de l'agriculture en 2030. Une deuxième série d'ateliers a ensuite été organisée pour analyser comment l'agriculture correspondant à chacune de ces quatre visions pourrait être impactée par le changement climatique et hydrologique. Cette deuxième série d'ateliers est basée sur les résultats du projet VULCAIN qui a permis d'estimé les changements climatiques futurs à l'échelle régionale (températures, précipitations, évapotranspiration) ainsi que les conséquences hydrologiques de ces changements (variation du régime des cours d'eau). L'article décrit le processus participatif mis en place et les principaux résultats qui en ressortent.

Mots-clés. *Adaptation ; changement climatique; instruments de gestion de l'eau ; prospective participative.*

I – Objective and methodology

In the Mediterranean basin, regional policy makers are increasingly enjoined to develop plans and strategies to adapt to anticipated future climate change and increasing water scarcity. However, given the large number of economic actors concerned, adaptation strategies are not something that can be decided, defined and implemented through top-down approaches. Instead, their identification requires an active involvement of stakeholders, including grass root level actors who will actually have to change investment, production or consumption practices at enterprise or household level. This is particularly true in agriculture where adaptation will necessarily (but not only) occur at farm level.

It is however not easy to involve economic actors and stakeholders in discussions related to changes that may occur, with a certain degree of uncertainty, in the long (2030) or very long term (2050 to 2100). This is all the more difficult for economic actors who often have a strong preference for the present and who are concerned by economic risks in the very short term. Most farmers in the Mediterranean are typically in this situation, being more worried by short term agricultural price fluctuations and cash flow constraints than by climate changes that may occur in 30 to 50 years.

The objective of this paper is to present a participatory foresight approach which was successfully implemented in a case study conducted in the *département des Pyrénnées Orientales*, in southern France. The paper reports on the organisation of foresight seminars with a group of experts and representatives from the farming sector on the one hand, and with three groups of farmers ojn the other hand. The participatory foresight approach was implemented in five main steps as follows.

(1)- The first step consisted in identifying the persons to be invited to the seminars; an expert group was first formed, comprising representatives from chamber of agriculture, winegrower union, irrigation associations, fruits and vegetable commercial cooperatives, local technical and research institutes, government agricultural department and district council. Three additional groups of farmers (7 to 10 participants each) were also established: a group of organic farmers, a group of farmers designed by the Chamber of agriculture as representative of the diversity of agriculture in the region and a group of young farmers. Most of the farmers were interviewed prior to organising the seminars, in order to identify factors which they consider will determine future evolution of regional agriculture; and to capture their vision of climate past and future evolution and related water management problems (see Bento et alii., 2009).

(2)- Foresight seminars were then organised with the four different groups to explore possible evolutions of agriculture at the 2030 time horizon. To facilitate the debates, four visions of agriculture, constructed by researchers, were presented to participants. These visions were inspired from scenarios constructed at the national level (De La Bussière Group scenarios) and from additional local information collected though interviews with farmers during the first step of the project. These four visions were clearly presented as a support for discussion which participants should modify and adapt according to their perception. The visions were criticised and modified by participants during the seminars. They were also ranked according to the perceived probability that they become true and their level of desirability.

(3)- A second series of seminars was then organised to debate on the impact of future changes in climate in river hydrology on agriculture. Experts and farmers were asked to identify possible agronomic and economic impacts of hydro-climatic changes. They were also asked to anticipate adaptive actions which could be engaged at different levels (farm, industry, territory).

(4)- A third series of seminars will soon be organised to specifically debate on adaptation required in terms of water resources management. Three water management scenarios will be proposed to participants as starting point. The first scenario consist in developing a system of transferable water rights defined in such a way that ecological water requirements from aquatic ecosystems are guaranteed, taking climate change impact into consideration (cap and trade approach). The second scenario consists in implementing a system of ambient tax (inspired from Seggerson and Kritikos) which level is determined on observed river discharges and groundwater table levels. The third scenario is inspired from collective action and social control mechanisms observed in certain regions of Spain (rules in use described by Ostrom).

(5)- The last step will consist in a final workshop will be organised to confront the visions of the four groups which have been run in parallel.

II – Case study: presentation and hydro-climatic changes scenarios

Location - The research was conducted in the *département des Pyrénées Orientales*, a 4200 km² territory located at the western end of the French Mediteranean coast, on the Southern side of the Pyrenean Mountains. In this region, agriculture mainly rely on three main productions (wine, fruits and vegetables). It benefit from a very favourable climate (mild temperatures in winter, dry wind, high solar radiation) but also from significant surface water resources (rivers, dams, dense irrigation network) and groundwater resources. Changes in climate and water resources availability could however threaten its comparative advantage.

Anticipated climate change - Future temperature and precipitation climate scenarios were built as part of the VULCAIN project, using outputs of 5 climate models that have been used for the IPCC's last assessment report (AR4, Trenberth et al. 2007). Monthly temperature and precipitation anomalies – defined as future (2020-40 and 2040-60) against present (1980-2000) mean monthly differences – were calculated using five climate models. The results shows a clear signal of increasing temperature for both future periods, which mean seasonal values ranging between +1.2 and +1.7°C for the 2020-40 period and between +1.9°C and 3°C for the 2040-60 period. Concerning precipitations, the projected seasonal anomalies for the 2020-40 period show no clear signal, as the seasonal values range between 0% and -7%, but with a mean seasonal uncertainty of +/- 15%. Thus, it can reasonably be considered that the precipitation will be the same than that observed for the present period. For the 2040-60 period, a rather significant decreasing trend of the projected seasonal precipitation appears, as the anomalies range between -12% and -21%, with a mean seasonal uncertainty of +/-16%.

Future hydrological changes - Hydrological models were built on different watersheds to assess the climate scenarios impact on river discharges. The assessment of the current water demand in the drinking water and agricultural (irrigation) sectors allows showing to define the water withdrawals impact on the natural river discharge. Starting from the modelling designed for the purpose of the present water demand estimation, a foresight exercise allowed to estimate the future (2030) water demand evolution in both sectors. The climate scenarios were downscaled at the study region scale (using the SAFRAN downscaling model) in order to simulate the climate change impact on the river discharge. The results show that water resource availability will drastically decrease in the future. At 2020-2040 time horizons, average in-stream flow should decrease by 20% in spring and summer. At 2040-2060 time horizons, the reduction in available discharge could reach 40% to 50% of current levels between March and November. The impact on reservoir and irrigation canals management – and ultimately on crop irrigation - is likely to be tremendous.

III – Preliminary results of the foresight seminars

Visions of agriculture in 2030 - In order to stimulate the debate, four contrasted scenarios were presented to groups of experts or farmers. In scenario 1, we depict a vision of an ultra-competitive agriculture which does no longer benefit from public subsidies and where only large capitalised farms can survive; agriculture declines as compared to the 2010 situation, in terms of area, employment, economic and political weight but also water use. At the other extreme of the spectrum of possible futures, scenario 4 depicts a high environmental value agriculture, which looks like today's organic farming with a higher level of technology. This scenario assumes a great social demand for the production of environmental services and food products exempt from pesticides – which are paid at much higher prices than conventional farm products on the world market.

Scenario 2 assumes that two types of agriculture can coexist – large farms as depicted in scenario 1 together with much smaller farms which benefit from significant European subsidies for the production of environmental services. Scenario 3 assumes a devolution of agriculture policy from the European to the regional level, each region promoting productions and farming systems making the best use of their comparative advantages – climate, soils, water and its image abroad.

Different levels of discussions took place during this first series of seminars. Inconsistencies in the description of the different scenarios were first identified. Discussions also revealed very different visions among participants on certain issues, such as the capacity of family farms to adapt and resist in a highly competitive environment. Overall, discussions lead to the identification of two scenarios to be considered in future discussions. Scenario 1 was clearly considered as a representation of the most probable (although pessimistic) evolution of agriculture; due to decline of cultivated areas, water demand from agriculture should decrease in this scenario, and farmers should therefore not suffer too much from increasing water scarcity. Scenarios 3 and 4 (combined) were considered by a majority of participants considered as a description of a desirable future of agriculture; participants clearly noted that this hybrid desirable scenario would generate increased irrigation water demand. These two scenarios were considered as starting points for the second series of foresight seminars.

Another main result of this first series of seminars was the increased awareness among participants of the diversity of possible futures. Moreover, participants clearly realised that the seminars could help them identifying control levers which could be used (at individual, collective or regional levels) to increase the chances of survival of local agriculture in different unfavourable economic contexts. At the end of this first series of seminars, experts and farmers alike were clearly able to consider long term horizon, whereas they were only concerned by very short term issues when they entered the room. They were then ready to look at changes in climate and hydrology likely to occur after 2050.

Impact of climate change and adaptation - Farmers were mainly concerned by predicted temperature increase as this may prevent them from producing certain vegetables in greenhouses during the summer months, have a negative impact on the maturation of fruits and change the characteristics of wines produced in the area. Concerning precipitation, the most concerned are winegrowers as they already experienced declining yields during the last ten years. Another key issue of concern is the risk that wind regime would change, with less dry wind coming from inland and more humid wind coming from the sea. Such an evolution would reduce the comparative advantage of the region for organic farming (wind helps preventing diseases).

Overall, farmers are relatively optimistic concerning their possibility to adapt to the new hydro-climatic context. They think that crops cultivated further South such as citrus may become more present in the area and farm; and that farmers will progressively change type of vines and trees variety. In fruit production, more efficient irrigation techniques (underground drip irrigation system) should also replace existing ones, the increased productivity of water partly compensating reduced water availability. Wines could also be cut back differently in order to minimise evapo transpiration. Irrigation of wines is however likely to generalise, increasing total water demand ain a context of reduced resources. Water crisis is considered as looming but its intensity will also depend on future evolution of urban water demand and on the decision to use of alternative water resources (desalination) to satisfy it.

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