‘MARÍA DE MAEZTU’ PhD RESEARCH PROJECT

Project 1 MdM 2016: Climate change and the Spanish agricultural sector. Water requirements and water availability, Are they compatible?

Theme: Integrating socio-economic and policy studies with natural science studies

Supervisors: Dr. Gonzalo Gamboa and Dr. David Saurí.

CANDIDATE SPECIFIC QUALIFICATION REQUIREMENTS:

Candidates should have the ability to communicate fluently in English and Spanish. In case the candidate does not meet this requirement, s/he has to commit her/himself to take language course and master both languages within six months.

Candidates should have skills in GIS. In case the candidate does not meet this requirement s/he has to commit her/himself to take a GIS course within the first semester of the academic year 2016/2017.

BRIEF SUMMARY:

This research project aims at assessing the current and future metabolic patterns of the Spanish and Catalan agricultural sectors and its requirement of natural resources, with special emphasis on water. The research will contrast potential water requirements against future scenarios of water availability due to climate change. As well, the research considers the study of different strategies used by farmers to cope with water scarcity. From this analysis, water policy and water management options will be proposed to pursue sustainable use of water resources in the Spanish territory.

RESEARCH PROJECT PROPOSAL:

1. Project statement and research questions

In the last decades, the Spanish agricultural sector has experimented with important changes in their productive structure. According to FAO data, while the volume of vegetable production has remained fairly constant during the last two decades (with some decreases due to climate variations) the production of meat has constantly increased. This change has been accompanied by a steady growth in imports of feed and exports of animal products. As well, the production of vegetables for feed has nearly doubled during the last two decades. In parallel, traditional products such as
wine, olive oil, tomatoes and citrus have continuously increased their participation in international trade (i.e. exports) in volume and economic terms.

Spain is considered one of the most vulnerable European countries to climate change: this region would face further increase in temperatures and decrease in rainfall in the upcoming years and decades (European commission 2009, AgenciaEstatal de Meteorología 2009). Therefore, water availability is expected to change as well: Spain would face higher inter-annual variability as well as higher incidence of heat waves and droughts, experiencing longer periods of hydric deficit along the year (Ministerio de Medio Ambiente, 2005). These impacts would be more pronounced in the south, south-east and the Mediterranean coast (CEDEX 2011), regions characterized by their high shares in agricultural production.

In this context, this research project is aimed at answering the following questions:

- What are the current requirements of water resources from the agricultural sector and its current metabolic pattern? What would be the future water requirements of the agricultural sector?
- Is the current evolution of the metabolic pattern of the agricultural sector compatible with expected water scarcity due to climate change? That is, are the current changes in production, import and export trends compatible with water availability?
- Which are the main strategies used by farmers to match water requirements and water availability? Would these strategies be effective in future climate conditions? For whom?

2. Scientific approach

This research project proposal falls within the realm of integrated assessment of societal metabolism and water governance. The project also goes beyond these fields of research, including geography, climatology and agriculture.

The project’s priority theme is “integrating socio-economic and policy studies with natural science studies (including modeling simulations and projections) to enhance consilience of climate policy science”. This research project proposal tackles Objective 2.3: Lesson for mitigation, adaptation and protection policy. As well, the research project will generate key information to tackle Objectives 2.2: Assessment of conflicts triggered by climate hazards and impacts.
In order to answer the research questions, the research project considers the following phases:

**Phase 1. To understand the evolution of the agricultural system in economic and biophysical terms.** This includes describing the evolution of the metabolism of the agricultural sector: the flows of energy and natural resources (especially water), the production of goods and residues, the generation of added value, and the use of fund categories land, human activity and technological capital.

In order to characterize the current metabolic pattern of the agricultural sector the following data bases are necessary:

- FAOStat (agricultural production, trade and food balances)
- ILOStat (labour and weekly hours actually worked in the sector)
- IDAE (energy balances of Spain)
- INE (National accounts: Added value generated by sector and subsector)
- Map of crops and land uses 2000-2010 - MAGRAMA

**Phase 2. To develop future scenarios of the agricultural sector and its metabolism** based on relevant plans and policies (e.g. white paper of agriculture and rural development – Ministerio de Agricultura, Pesca y Alimentación 2003, Common Agricultural Policy). Also, in depth interviews with relevant social actors (e.g. representative of the agri-food industry and from different agricultural subsectors) will provide inputs for the development of the future scenarios.

Scenarios will be characterized in biophysical terms. It will also be expected to reflect these changes in the Spanish crops and land use map.

**Phase 3. To contrast potential changes in the metabolic pattern of the agricultural sector against the availability of water across the territory.** This phase considers the review of the main studies of climate change impacts in Spain, as well as the model forecasts for the region. With this information it will be possible to develop potential scenarios regarding resource availability (especially water) in Spain. These scenarios of water availability will be contrasted against potential scenarios of water requirements from the agricultural sector.

**Phase 4. Identification of technological, management and productive strategies used by farmers to cope with water scarcity.** This phase of the research considers carrying out case studies on horticulture, cereals and pork meat production. Case studies also encompass the evaluation of the metabolic pattern of the farming systems under study.
Phase 5. Development of policy proposals. Based on the information generated during the research project, this last phase considers the development of policy proposals to deal with potential water scarcity and to foster agricultural and rural development.

3. Feasibility and expertise

The feasibility of the research project highly depends on the availability of information. All the above mentioned data bases are open access, with exception of the map of crops and land use. This GIS data base has a cost of 6 € per province (300 € for the whole country)

David Sauri has experience in water planning and management in Catalonia and Spain. He was author of a chapter on the impacts of climate change on water available for agriculture in Catalonia, edited by the Catalan Water Agency. He has also written on the exchange of water of different qualities between agriculture and tourism in the Benidorm area of Southeastern Spain, and has advised two doctoral dissertations on rural water in Nepal and Paraguay.

Gonzalo Gamboa has experience in the application of the MuSIASEM approach (i.e. societal metabolism). He has applied it to rural systems and to the Spanish economy. Currently, he is evaluating the metabolism of the agricultural sector in terms of production and international trade, in terms of energy consumption and generation of added value, and in terms of land use and human time.

4. Significance of the research (policy relevance and main innovation)

As of today, the framework to study the water metabolism has been already developed (Madrid et al. 2013; Madrid-López and Giampietro, 2015) and it has been applied to the study Andalusian agricultural sector (Madrid and Cabello 2011), but there is no study for the whole country. On the other side, there is no study contrasting future water requirements from the agricultural sector and water availability changes due to climate change. This will provide new insights on the dependency or fragility of the agricultural sector in the face of future climate dynamics, and will provide insights for the design and development of public policies to strengthen this sector and its relations with the territories.

The research project will also analyze, in three case studies, the main strategies used by farmers to match water requirements and water availability. Future water scarcity in the Mediterranean region may foster competition for water between economic sectors such as agriculture, tourism and cities. Agriculture would depend on water of lower quality than the required by cities and tourism, which may avoid such a
competition. But it remains to assess the distributional aspects of these changes (e.g. costs for consumers and farmers). One may think that intensive agriculture in the Mediterranean coast would have to reduce water use by means technological change or due to price increases. However these changes may also entail differential impacts across sectors and among users, which have to be analyzed as well. This research will produce key information to further assess such distributional impacts.

5. References

Agencia Estatal de Meteorología, 2009. Generación de escenarios regionalizados decambio climático para España

Centro de Estudios y Experimentación de Obras Públicas - CEDEX, 2011. Evaluación del Impacto del cambio climático en los recursos hídricos en régimen natural. Resumenejecutivo


Ministerio de Medio Ambiente, 2005. Informe Evaluación Preliminar General de los Impactos en España por Efecto del Cambio Climático