The Economics of European Agriculture under Conditions of Climate Change (Editorial)

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This Special Issue on "The Economics of European Agriculture under Conditions of Climate Change" brings together a selection of papers that contribute to the understanding of recent developments related to agriculture and climate change in four European countries. The focus of the Special Issue is on quantitative modeling and empirical analyses. The papers presented here not only cover the heterogeneity of agriculture in Europe with case studies from the Mediterranean (Italy), central (Austria) and north-western Europe (Ireland and Scotland) but also give insights into the diversity of quantitative modeling approaches in agriculture.

The potential economic consequences of climate change for agriculture and the development of tools and models to analyze them have been scientific topics for over three decades. The major research agenda did not change during that time: to "provide information and recommendations [...] to assess the direct and indirect economic impacts associated with CO_2 buildup not only as they relate to the agricultural sector, but to other sectors [...]" (CALLAWAY et al., 1982). Research interests also broadened towards understanding the adaptive and mitigative capacity of agriculture. A literature review reveals that most economic studies analyze the agricultural sector as whole of a country or are modeling responses to climate change on global scale. There are many partial equilibrium studies focusing solely on climate change aspects in agriculture. However, they are mainly economic models that do lack the linkages with agronomic and ecological factors. Early studies (e.g. MENDELSON, NORDHAUS and SHAW, 1994) had to overcome a lack of spatially explicit plant growth responses in climate scenarios in various ways. Today there is an effort to develop economic models that integrate detailed spatial information based on plant growth models, and thus to quantify economic consequences to changing climate conditions by modeling bio-economic causal relationships in much detail. The current Special Issue present some examples of the scientific advancements made in the recent past.

The large number of global models even allows comparing the results when identical scenarios are analyzed (VON LAMPE et al., 2014). The results of such exercises make it evident that there is a need to better understand how economic models behave and how they can be improved. This need is even more evident when it comes to models that are specific for one region or one country and in cases where alternative modelling tools are not available. To improve such models and to make the integration of crop and livestock models with economic models possible, is among the topics of the international research project MACSUR (Modeling European Agriculture with Climate Change for Food Security). MACSUR brings together researchers from 71 different institutions in 17 European countries and Israel. The call for the special issue was motivated by this endeavor. The papers in this issue show various approaches to accomplishing this goal with farm or regional scale models. Each of the case studies demonstrates how results from other models can be integrated into an economic model in order to provide an accurate analysis of climate change aspects in agriculture. This interdisciplinary approach is useful to help designing targeted agri-environmental policies.

The paper of Eory et al. presents a case study of mitigation measures using an economic farm model that is linked to a life-cycle analysis model. The modeling framework quantifies the whole-farm and life-cycle effects of greenhouse gas (GHG) mitigation measures on emissions and farm finances. In their case study the authors show that using sexed semen on dairy farms might be a cost-effective way to reduce emissions from cattle production by increasing the amount of lower emission intensity 'dairy beef' produced.

The paper of Shrestha et al. explores the diversity of regional effects on grassland yield and responses of profit maximizing farmers in a climate change scenario for Ireland. The results of crop models show that a substantial increase in yields of grass (49% to 56%) can be expected in all regions in Ireland. However, the impact of climate change on dairy farms in each region will be different. While some dairy farms are likely to suffer, others will generally be better off under the analyzed climate change scenario. For a majority of farms, a substitution of concentrate feed with grass based feeds and increasing stocking rate will likely be more profitable.

In their article Schönhart et al. apply an integrated modelling framework to analyse climate change impacts and the effectiveness of adaptation measures in Austrian agriculture. This combined approach couples a crop rotation model, a bio-physical process model and a bottom-up economic land use model at regional level considering also agri-environmental indicators. The results suggest that for Austrian crop production, climate change might on average have positive effects on productivity. Furthermore, the study shows that implementation of adaptation measures might reduce yield losses at regional level and also stabilize agricultural revenues.

Dono et al. employ a farm-level Discrete Stochastic Programming (DSP) model to evaluate the farmer's response to changing climate conditions in the homogenous climate of the central Mediterranean basin (north-west Sardinia, Italy). The uncertainty in farmer's planning decision involves two climatic variables: water accumulation in a reservoir used for irrigation, and net evapotranspiration, which is a proxy for crop irrigation requirements. The results show that the near-future climate scenario may be perceived by farmers as an indication of lower overall variability in expected incomes, but with a general trend to lower incomes. This may cause farmers to discount insurance tools that intervene only when there are extreme drops in income compared to an expected value. In this context, the set of tools to insure against adversity and catastrophic events may not be considered by farmers as suitable devices to deal with the future climate regime.

The articles provide not only an impression about the diversity of climate change effects on European agricultural development but also about economic implications for farmers. Climate change induces regional shifts of crop production, while mitigation measures in the livestock sector might also increase production costs. The regional analyses across Europe also indicate that adaptation measures have strong effects on food supplies and consequently on food security, both inside Europe and on a global scale. Further research is required to upscale these regional case studies to the European level to identify opportunities implementing climate smart agriculture, to balance mitigation/adaptation strategies, while maintaining productivity in agriculture. European strategies for smart, green, and inclusive growth also aim at increasing the role of the bio-based economy, processing agro-raw material for biofuels, pharmaceutics, textile and new bio-medical material.

The issue in hand gives a first glance of potential win-win actions for mitigation that could reduce costs and emissions. The combined modeling approach also helps to identify relevant economic drivers of agricultural development at farm and regional scale. It also provides an analytical tool to show how climate change impact trade in agricultural products within Europe and with other non-European countries.

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