Abstract of the presentation held at the International Land Use Symposium (ILUS) on Trends in Spatial Analysis and Modelling of Settlements and Infrastructure, November 11-13 2015, Dresden, Germany.

Simulating the adoption of alternative climate adaptation strategies in Dutch arable farming systems under uncertainty and costly land-use reversibility

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Future changes in climatic conditions are expected to affect the economic viability of agricultural systems in the Netherlands. Particularly, more frequent extreme events and related emergence of pests and disease are likely to severely undermine the relatively strong market position of Dutch agriculture. The need to design and implement adaptation measures to help reducing the effects of negative impacts is therefore increasingly recognized. However, not all climate change impacts are necessarily negative. For instance, higher temperatures may provide opportunities for the production of new crops in areas where this was previously not possible. Since the biophysical environment is spatially heterogeneous, location is a key factor in describing the economic viability and feasibility of adaptation in agricultural production systems. Yet, there is limited understanding of the interplay between local production capabilities, regional climatic changes and more general socio-economic conditions that determine the viability of agricultural production systems.

Farm enterprises can be considered as long-term economic activities, involving e.g. capital investment in crop specific machinery and long-term agreements with procurers of processing chains. Therefore Net Present Value (NPV), a standard method used in capital budgeting to appraise long-term projects, has been applied on spatially-explicit assessments of the economic performance of agricultural production to assess and compare the attractiveness of alternative production and adaptation options according to expected future conditions. However, empirical studies have shown that farmers often do not switch to different farm management practices even when it is profitable to do so under the NPV rule. In fact, NPV method does not take into account the role that risk aversion and uncertainty (e.g. climate sensitivity, price volatility, political commitment to specific targets) might have on farmers' decisions. Furthermore, NPV approach also ignores that sequence of strategic investment decisions might be taken in time as future unfolds; for instance, farmers may have the flexibility to optimally adjust scale in time and/or postpone their actions until better information is gained. Therefore, NPV approach may be too static and deterministic to either explain observed hysteresis and inertia of land-use or provide a reliable basis for projecting the effectiveness of future policies.

In this study, we develop and apply a mapping method based on Real Option Valuation (ROV) method to assess in a spatially-explicit way the value of undertaking certain farm managements decisions under uncertainty and costly reversibility of land use. We apply the method to compare the value of adopting three different strategies to cope with the impacts of more frequent extreme events: 1) not adopting any measure; 2) adopting farm practices/technology that help reducing crop damage; 3) switching to a perennial biofuel crop (Miscanthus) that is less sensitive to climatic extremes. We appraise the role of factors such as perceived uncertainty of opportunities and risks, incomplete information and financial/technological conservatism in adopting different climate adaptation strategies. The findings of this research aim to help improving the understanding on farmers' decision-making processes under uncertain conditions, thus allowing policy-makers to devise better strategies to cope with future challenges in agricultural systems.

Keywords: *Agriculture, Climate Change, Adaptation, Extreme events*