Farmers’ drought adaptation in the southwest Netherlands: an agent-based approach

Rianne Van Duinen*, Tatiana Filatova†, and Anne Van Der Veen‡

*Speaker
†Corresponding author: t.filatova@utwente.nl
‡Corresponding author: veen@itc.nl

Abstract

The Netherlands has a maritime climate characterized by annual average precipitation surplus. Even though, summertime droughts occur causing a decline in fresh water availability and increasing salinization. With climate change the probability and severity of droughts during summer are expected to increase. Fresh water is a vital production factor for the agricultural sector. Insufficient fresh water or water with too high salt concentrations causes damage to crop production and crop quality. Depending on crop prices, crop damage eventually results in a loss of farm income.

Adaptive capacity, the ability of farmers to take adaptive actions, is a prerequisite for adaptation and an important determinant of the vulnerability and performance of the agricultural sector at an aggregate level. Adaptation options include amongst others, irrigation, the purchase of water basins and fresh water injection in sand or creek ridges. Understanding farmers’ adaptive behavior and its relation with the sector’s vulnerability is a challenging task as farmer communities are complex systems in which individual adaptive behaviour and interaction between agents shape outcomes at the sector level through changes in crop prices, the rate at which drought adaptation technology diffuses through an area and the initiation of governmental subsidies. In turn, there is a feedback from macro outcomes into individual decision-making; individual farmers observe these outcomes at the macro level and adapt to them. Agent-based modelling (ABM) appears to be a promising approach to study the role of farmers’ adaptive behaviour in explaining aggregate scale drought vulnerability as it allows for agent specific behaviour, the interplay between scales and the influence of past decisions and future outcomes on individual behaviour.

This paper presents an ABM to explore how the adaptive behaviour of farmers at the micro level affects the vulnerability of the agricultural sector to climate-induced uncertainty regarding water availability. Agents’ decision rules and social networks are calibrated based on the results of a survey among farmers in the southwest Netherlands. During January and February 2013 we run a survey amongst a population of 1500 farm households in the southwest Netherlands. This area is characterized by its spatial diversity of water supply and salinity issues, and will be highly affected by climate change. The survey was specifically designed to gather information for the ABM.

The model explores the emergence of diffusion patterns of adaptation strategies and the overall vulnerability of the agricultural sector in the case-study area under various drought conditions.
scenarios. The macro outcomes of interest include the changes in (1) the vulnerability of the agricultural sector, for example the annual loss of harvest, % of farmers that go bankrupt and on near-zero profit margin, (2) the diffusion of adaptation strategies (% of adopters) and (3) land-use patterns (2D maps, quantity of land under certain agricultural activity/technology) emerge as result of farmer’s adaptation and interaction in social networks and markets.

**Keywords:** droughts, agriculture, adaptation, agent based model, survey, social networks