



Original Research Paper

## An agent-based model of farmer behaviour to explain the limited adaptability of Flemish agriculture

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## ABSTRACT

Transition projects have been implemented for Flemish agriculture since 2003, but these did not enable a transformation of the agricultural sector. This paper looks at pre-transition scenarios that have been collectively designed by stakeholders of the agricultural sector in 2002. These foresaw decreases in the regional animal stocks in Flanders. However, the real evolution of the sector did not reveal such a decrease. It is assumed that the individual adaptive behaviour of farmers can explain the unexpected stability of the Flemish agricultural sector. A detailed agent-based model has been built to replicate the past evolution, accounting for structural diversity of farmers, heterogeneity in behaviour, and natural resource constraints. The results indicate that different forms of rigidity in the individual behaviour of farmers slow down the adaptation of the agricultural sector. Future transition scenarios should account for these elements in order not to overestimate the speed of change in the sector.

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### 1. Introduction

The agricultural sector plays a pivotal role in a transition to a more sustainable society. Changes in agriculture are induced by a rising interest in sustainable agricultural practices, by shifts in international trade and by external markets trends for qualitative products and biobased materials. The growing uptake of sustainable practices follows the increasing demand for organic materials of all kinds, fresh crops, agricultural waste streams and new cultures. But despite these forces, the overall adaptation of the agricultural sector remains slow. In order to speed up the adaptation of the sector, several projects were implemented in the Flemish agricultural sector. In 2001, a principle text was published outlining regional aspects of sustainability in agriculture (Reheul et al., 2001). The objective of this text was to start the discussion on the definition and implementation of sustainable agricultural practices. In 2001, the non-governmental organisation DP21 or “Dierlijke productie in de 21ste eeuw” (Animal products in the 21st century) was created. DP21 started a dialogue between farmers, agro-industrial sector federations and authorities, and conducted a large pre-transition project to define future scenarios for animal husbandry and animal products in Flanders. This vision exercise grew through intensive interaction with over hundred stakeholders in agriculture and the food industry between 2001 and 2003. The scenarios each described a different potential path for the future development of the animal husbandry sector in Flanders. Following general trends, three central scenarios were elaborated in stories, taking multiple social and economic aspects into account. The project raised the

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**Table 1**  
Particular consequences for the different vision scenarios.

	The race	The European forum	The global bazaar
Number of farms	Large farms remain, family-businesses disappear, specialisation.	Reduction with approximately 25%, mix of smaller and larger farms, specialisation.	Reduction with approximately 30%
Jobs	Large reduction	Reduction tempered by increased demand for landscape management.	Moderate reduction.
Animal stock	Cattle for beef – 70% Dairy cows – 35% Pigs – 50% Chickens – 30–50%	Pigs – 60% Chickens – 60%	Cattle for beef – 50% Dairy cows: stable Pigs – 50% Chickens – 50%
Export	Reduction. Sales restricted to local and European markets.	Reduction. Local market is growing. Larger export potential for quality products.	Sales mostly local. Interregional sales with collaborative efforts of farmers and authorities.

awareness within the sector of the future challenges of agriculture and the importance of scenarios in this respect (Magiels, 2003, 2004). The three central scenarios were elaborated to cover widely diverging future trajectories for the sector:

- The race: this scenario assumes a low economic growth, limited consumer spending power, strict environmental regulations and an international fully freed trade for agricultural products. Farms respond individually, by increasing specialisation, efficiency and scale. In this scenario, family farms gradually disappear, and large individual farms specialise in order to remain competitive against foreign imported food products.
- The European forum: this scenario assumes limitation to free trade in order to improve environmental and social aspects of European agriculture. New export opportunities arise due to the EU enlargement and the collaboration between agriculture and agrifood actors intensifies. The farmers react more in cooperation, with emergence of niche productions and high-quality products.
- The global bazaar: this scenario assumes a consumer concerned about quality and willing to pay for additional environmental values. International free trade allows the rapid growth of international consortia. Farmers respond individually with highly specialised niche production and flexible cooperation with other actors in the food chain. The market becomes highly dynamic with large international consortia, challenged in niche products and niche markets with small versatile highly-specialised producers.

Table 1 shows the estimated sector impact for each scenario. The corresponding market conditions span future possibilities from low consumer interest in quality to high spending power, from low international competition to fierce extra-European import, etc. A remarkable outcome of the sector discussions was that despite the large variations in market conditions, some general tendencies were outlined that were replicated for each scenario. The most important tendency in this respect was the reduction of animal stock, to be expected over the coming years. In each scenario, animal stocks were expected to decline. This indicated the acknowledgement of the structural overproduction of animal products at the start of the 21st century, and the sector faced the challenge to reduce this structural overproduction.

In a consecutive project, two participatory transition trajectories were started (i) on animal welfare, and (ii) on coherence in visions and actions for a future agricultural and food system (Claes et al., 2008). The scenario project of DP21 has also contributed to further research in sustainable agriculture. Building on this development, a Flemish policy research centre for sustainable agriculture (Stedula) was created (Nevens et al., 2008). Stedula continued the participatory approach for vision creation in a transition thinking setting and developed multiple sustainability measurement methods (Meul et al., 2008; Van Passel et al., 2007). Further research led to a holistic system analysis of the ongoing transitions in agriculture (VMM, 2012). These highlighted the links between niche-development in different scenarios and crucial issues that accelerate or hamper the emergence of more sustainable agricultural practices.

At this point in time, the effects of these activities remain small. Despite the strong stakeholder involvement, the transition projects did not enable a corresponding transformation of the agricultural sector. The developed ideas and visions became common knowledge in the sector, but the actual evolution of the agricultural sector does not seem to take its lessons into account. Animal stocks did not decrease and the production levels of animal products remained relatively stable, especially for dairy products and pork. This contradiction between the scenarios and the actual evolution is puzzling. The scenarios resulted from structured discussions with diverse stakeholders, and represent an acceptable idea of the future sector evolution for most stakeholders. Moreover, reduction of production levels was foreseen, regardless of the precise market conditions, by combinations of farmers, scientific and practical sector experts, and policy makers. It is therefore important to investigate more closely the insights that supported these scenarios, and to compare those to the actual sector evolution.

A principle starting point of the scenarios was the description of overarching market conditions for the sector, such as extra-European trade, quality standards, consumer spending power, etc. Following trends in these conditions, the impact on an adapting agricultural sector was outlined. The implicit assumption here is that changing price conditions both for inputs

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