The future of the greenhouse; ABM concept to explore trends in Dutch Tomato Industry
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Background
The Dutch greenhouse industry is situated in the economic heart of the country (Westland) and is an important driver for the Dutch export-economy. Due to a combination of land pressure (urbanization) and economic recession, the industry experiences more and more difficulties. Insufficient margins and increasing loan restrictions, limits its innovative character or frustrate possible tipping points.

Objective
In order to investigate the robustness of the sector and future developments, the objective is to develop an ABM and to explore interactions between the producing industry and other links within the food chain. Because of its complexity it is initially decided to focus on the tomato producing industry.

Generally the Dutch greenhouse industry is a well-studied topic and therefor a lot of literature is available, even on the specific issue like migration behaviour. [1][2][4] Currently the entrepreneur’s behaviour is studied as a set of self-contained, independent and static components, neglecting the impact of factors like adaptive capabilities of individual entrepreneurs or interaction with other entrepreneurs, auctions, distribution networks, etc. In this study we want to convert all the available knowledge into an ABM to study these interactions and system dynamics.

Methods
Literature is used to zoom in on the basic concepts of ABM, agent parameterisation but also on the conceptual schematization of the Dutch food-industry. Subsequent unstructured interviews are kept with 14 greenhouse experts, resulting in the first conceptual ABM of the Dutch greenhouse industry.

Literature
Traditionally, greenhouse famers are based in the West of the country, because of several reasons. First, the climate in Western part of The Netherlands is very favourable for greenhouses, meaning sufficient hours of sun and ‘clean’ precipitation water. Second, the Western part of the country is densely populated, meaning a high and stable demand for fresh products and short distances to the market. And third, the Western part of the country is well connected to sea- and airports. [4]

Despite the greenhouse industry is seen as an important export driver, it is in itself part of a larger Food chain including production, processing, distributing and finally consumption [3]. In 2007, Grievink summarized the entire food sector as an hourglass-model, subdividing numerous levels. These levels not only differentiate entities, they also visualise the number of existing individuals for each level, revealing the power and control purchasing organizations have in relation to the individual entrepreneur or consumer.

As the investments are high and the returns insecure, an entrepreneur tends to act from a short term perception. Only whenever the entrepreneurs’ vitality is being at
risk, three strategies are being considered: (1) stopping and selling its enterprise, (2) innovating by cost price reduction, or (3) innovation by up scaling production value.

Up scaling production value, is the link with various preferences from different target groups. Whereas the first target group is only interested in the product price, other groups care about flavours, organic produced, etc. The latter preferences form an incentive for a niche product, in where higher margin can be obtained. Whereas exiting the business is simply a matter of lacking a prosperous perspective. Deciding between cost price reduction or up scaling product value is the result of several factors, mainly related to the social network of an entrepreneur. Once determined a strategy, other aspect become important, such as the type of cultivation and storage capacity, and may lead to migration away from the Westland. [2]

**Interviews**

In conversation with 11 experts, the following trends, for different levels of food chain, are identified that will dramatically influence the situation on the producing level;

1. **‘Non-agrarian’ financing construction** (Supplying industry): Allows entrepreneurs to grow, with a consequence a demand for higher economical return
2. **Access to geothermic** (Greenhouse entrepreneurs); Demand large investment and will probably to scale increase.
3. **New cooling facilities on containers** (A Trading industry); Makes it possible to export further and cheaper
4. **Alternative market routes** (Buying desks); Decrease the power and control of the retail industry
5. **Consumers will cook less and consume more out-of-home** (Retail industry); The food-service industry will take over part of the retail turnover, reducing their power and control
6. **Local4Local** (Consumers); Local producers become in favour when producing authentic products

**ABM Concept**

Conceptually each agent is seen as a production unit, dropping products on the market. The sum of the entire production determines the total supply, whereas the supply in combination with the demand sets the price of the production.

Whenever insufficient margins are generated an entrepreneur can decide to change it strategy and to innovate. Regardless the new chosen strategy, investments are necessary for such a conversions. In case insufficient financial resources are available, it prevents the entrepreneur to adapt and forces him either to continue the current strategy or to go bankrupt. Once bankrupt, the agents exit the model. But this ‘stopping’ strategy could also imply entrepreneurs deciding to exploit their greenhouse in an alternative manner instead of tomato production.

**References**

