Give competitors a helping hand or throw a spanner in the works? An agent-based model simulating the the development of a corn stover market in Flanders.

Anouk Mertens[1,2], Jef Van Meensel[1], Jeroen Buysse[2]
[1] Institute for Agricultural and Fisheries Research (ILVO), Burg. Van Gansberghelaan 115, 9820 Merelbeke, Belgium
anouk.mertens@ilvo.vlaanderen.be, jef.vanmeensel@ilvo.vlaanderen.be
[2] Ghent University, Coupure Links 653, 9000 Gent, Belgium J.Buysse@UGent.be

Faced with increasing resource prices and environmental challenges, the Flemish government seeks to transform its fuel-based economy into a bio-based economy [1]. Since biomass in Flanders is limited, there is an increasing interest for the valorisation of currently unutilized or under-utilized by-products, including corn stover [2]. The yearly production of corn stover in Flanders is about 450,000 ton DM, but it is hardly harvested. The success of new valorisation trajectories for corn stover will therefore not only depend on their profitability, but also on the willingness of farmers to apply a new harvesting technique, and on the development of a corn stover market [3].

This issue is particularly relevant for an investor in a lignocellulosic bio-ethanol plant or biorefinery, needing to process at least 200,000 ton DM yearly in order to be economically viable. How can the investor tackle his feedstock risk? As the feedstock risk seems less relevant for smaller and more decentralised valorisation trajectories, such as anaerobic digestion or combustion, we propose the following research question. Could the feedstock risk for a biorefinery be reduced by first promoting these small-scale decentralized valorisation trajectories? On the one hand, once these valorisation trajectories have gained ground, the biorefinery might be able to operate at full scale in less time and therefore have a higher chance of becoming economically successful. On the other hand, promotion of other valorisation trajectories would increase the competition for this limited biomass resource. Put differently, should a potential investor in a biorefinery give a helping hand to small scale valorisation trajectories of corn stover or should he throw a spanner in the works? This abstract presents the first part of our research.

Because markets are examples of complex adaptive systems, we believe agent-based modelling is the most suitable approach to capture the different market characteristics into a model [4]. Our agent-based model simulates both the corn stover harvest of farmers and the decision of the biorefinery manager to purchase corn stover from farmers, depending on their requested price and the distance to the plant. Overall, we assume revenue maximization for farmers and feedstock cost minimization for the plant manager. The farmers are split up into two groups: factual farmers and social farmers [5]. Factual farmers behave as economic rational agents, while social farmers also take into account the activities of the other farmers in their network.

Figure 1 shows the results of a sensitivity analysis for the percentage of factual farmers included in the model. Regardless of the amount of factual farmers, the biorefinery manager is able to purchase only part of the corn stover necessary to operate at maximum capacity. This equilibrium is reached faster when the number of factual farmers is higher. Two reasons explain the absence of a transaction between farmer and biorefinery: either there is no agreement on the price, or the transportation costs are too high. Therefore, in order to allow the biorefinery to operate at full scale, appropriate measures are required, e.g. centralized storage of corn stover leading to lower transportation costs by using larger trucks or even transport over water. Our results give insight in the adoption of corn stover harvest and the development of the corn stover market. We are currently investigating if these results stand in case of the promotion of other small scale valorisation trajectories and whether the promotion of such trajectories could decrease the feedstock risk for investors in a lignocellulosic bio-ethanol plant.

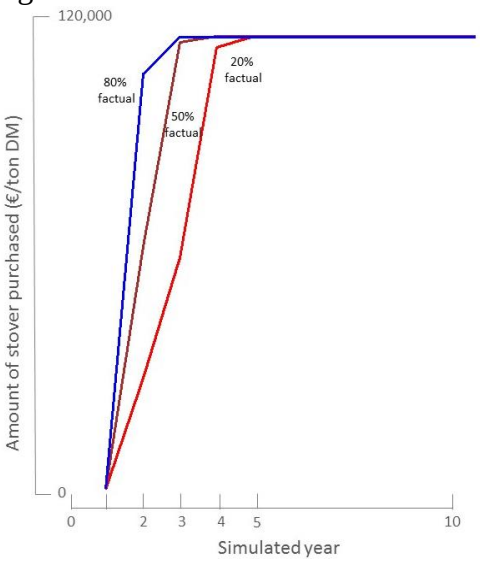

Figure 1: Amount of stover purchased by the biorefinery manager from the farmers in ton DM for 20%, 50% and 80% of factual farmers.

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