

ABM for a better understanding of complex byproduct economic system

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Abstract

The valorization of by-products from all productive activities is a major strategy to support the ecological transition. Regarding the agricultural and food sectors, the majority of by-products are nowadays valorized. There are four ways of valorization: (i) agronomic (spreading, compost), (ii) animal feeding, (iii) energy (biogas production, etc.) and (iv) as raw material for industries (cosmetic, pharmaceutical, textile, etc.). In fact, currently, biomass mainly uses the first three routes. The use of the fourth route remains limited, in spite of the fact that, unlike others, it would allow (i) a cascading valorization and (ii) the production of medium to high economic and environmental value raw materials for the industry (extraction of high value molecules). This entire system brings together multiple stakeholders from different economic sectors with contrasting technical and economic backgrounds. Together they construct byproduct valorization value chains. The problem we are facing is to understand how to combine the fourth way of valorization with the others into one viable value chain. Doing so raises organizational, regulatory, logistic and technical issues. To address this complex issue a computational approach has been chosen. Facing the diversity of computational model, agent-based model appears to be the best option for having a dynamic glimpse of a system emerging from the interaction of heterogeneous players.

We propose thus a agent-based model to simulate the emergence of a by-product value chain consisting of one, several or all of the valorization ways. Based on evolutionary theory (Dosi et al, 1990), we aim to simulate interactions among six types of economic agents : farmer, primary processor, extractor of molecules of high interest, composter, biogas plant, animal feed industry. Each of them can realize three types of action: (i) produce/store/transform, (ii) sell/buy, (iii) invest/disinvest. The decision-making process is based on individual characteristics (risk aversion, production capacity and location, past performance) but also on those of other agents. Whether or not the other agents information are taken into account for decision making depends on the existence of a bond of "trust" between the two agents. This link is bound to evolve as agents interact with each other. The outputs of the model are the dynamic of the bond of trust and commercial link between agents, the benefit of each actor, the investment they have realized. These results will give us information on whether or not a value chain has emerged (i.e. arising of a vertical organization from the interactions of the units), its characteristics and performances. A first version is currently implemented on the case of pomegranate by-product value chain. This model uses data collected from interviews with farmers, industrials and public institutes.

References

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