Understanding the role of disruptions in the assessment of the sustainability of a supply network

a case of study on the Peruvian fishmeal production sector

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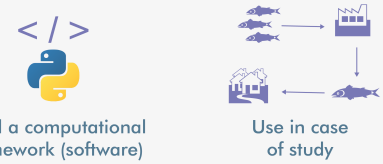
Motivation

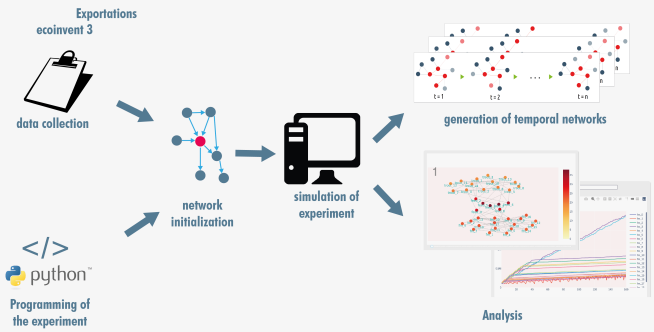
- A ***supply network*** is a ***complex system*** where parties interact to satisfy costumer's orders and their own objectives. Recent disruptive events have shown the necessity of understanding how companies re-adapt to still generate value. There is still a gap on understanding the affectation that system's adaptability can generate on different dimensions of sustainability, especially on highly dinamyc industries
- We use agent-based modelling (ABM) as the core tool to simulate network's interaction and considering aspects of its evolution to assess its sustainability. We selected the fishmeal production in Peru as a case of study because of its relevance in the worldwide fishmeal supply chain and consumer industries[1].

Projects goals:

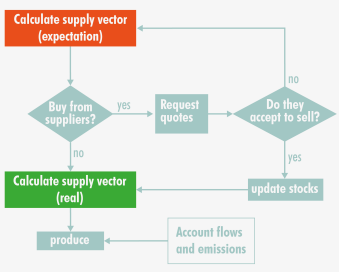


An agent-based model for supply networks

We proposed a framework for ABM adapted from the computational frameworks used in LCA[2], that allows the systematic creating of agents and operational configurations.

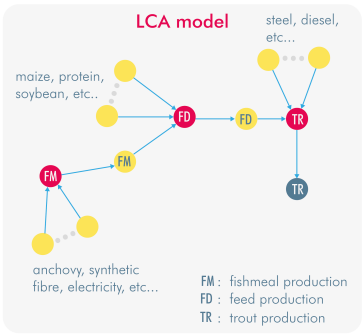


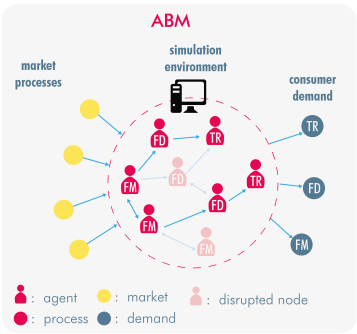
- Different modules to provide general mechanism for ST agents were implemented (e.g., buy, sell, produce, negotiate).
- Agents decide using their information (expectation) and act based on their real operational configuration and location in the supply network.
- Direct emissions are accounted only after real actions accur.



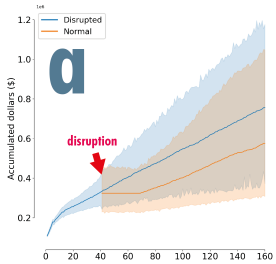
agents' production mechanism

An experiment in the Peruvian fishmeal sector

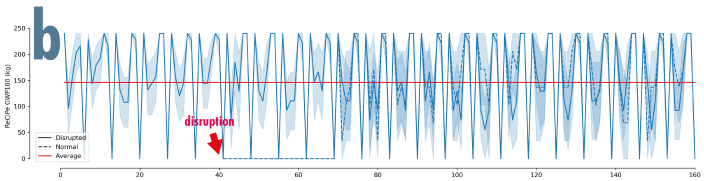




- Sudden variations are buffered when averaging
- System's total flows are obtained after solving an algebraic problem (i.e., technosphere)
- Disruptions can be induced by overriding nodes in the supply network.
- System's flows are accounted after every agent solves its own decisional and technological problems.



a Accumulated money for both groups of disrupted and undisrupted agents in a simulation of 160 days



b Daily impact generated by disrupted and undisrupted agents, and daily average impact of the system (fishmeal producers only).

Conclusions

- Introducing simple supplier selection mechanisms can influence average and accumulated impacts, meaning that behavioural aspects are critical to study.
- Agent-based methods can explicitly model disruptions in supply networks and sustainability results can substantially vary from the linear model. Further research should focus on identifying specific behaviours and action mechanisms that could lead to a more sustainable state.
- Impacts associated with short-term consequences (e.g., job losses, food availability, and resilience-related) require further developement to enhance the sustainability assessment process.

References

1 *Fréon, P., Durand, H., Avadí, A., Huaranca, S., & Moreyra, R. O. (2017). Life cycle assessment of three Peruvian fishmeal plants: Toward a cleaner production. Journal of cleaner production.*

2 *Kätelhön, A., Bardow, A., & Suh, S. (2016). Stochastic technology choice model for consequential life cycle assessment. Environmental science & technology*

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