Urban living laboratories: Opportunities for modelling sustainability transitions

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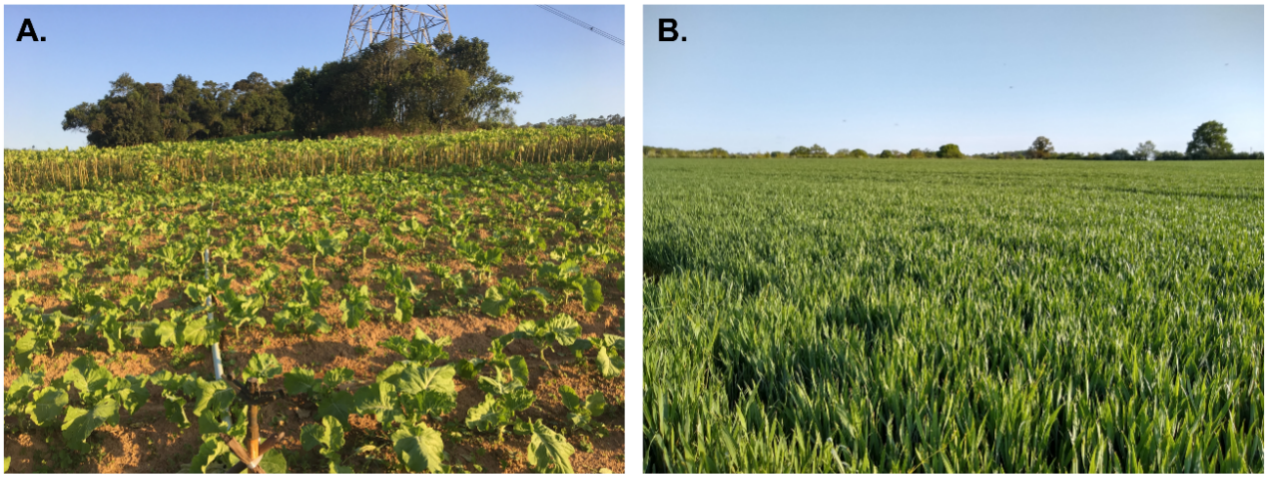

Figure 1: A. Agroecological farming methods, “Parelheiros”, to produce greens to be marketed at local co-operatives in Sao Paulo, Brazil. B. A field of wheat grown using conventional farming methods in the UK

Here, a group of academics present Urban Living Laboratories to study sustainable food production systems, using systems dynamic modelling to analyse policy alternatives

Urban Living Laboratories (ULLs) have shown first promising signs of being valuable platforms for understanding transition phenomena.

To address our time’s diverse grand societal challenges (like climate change and biodiversity loss), we must transition to truly sustainable systems, possibly the most significant shift facing modern civilisations. Such transitions involve coupled technological, social, economic and environmental shifts and demand transformative approaches with new forms of organisation and management.

Urban Living Laboratories can be used in a mission-oriented experimental setting to observe, investigate, validate and involve diverse actors to co-create inclusive and relevant sustainable alternatives for the systems of interest.

Among these actors to be included in such an experimental arrangement are: citizens, specific industries, market agents, policymakers and government, regulatory agencies, academia and others, depending on the guiding questions of inquiry.

The diversity of groups involved in the decision-making process to achieve sustainability is a crucial factor: it is the fundamental first step on the path to ensure that experiences and knowledge about more socially robust transition pathways are generated.

Exploring the food-energy-water nexus

The WASTE FEW ULL Project, a Belmont Forum-funded initiative, sought to identify inefficiencies in city-region's food-energy-water (FEW) nexus to investigate and test internationally applicable methods for reducing waste (Fried et al., 2022).

The project was centred around four Urban Living Laboratories – one in Brazil (São Paulo), one in South Africa (the Western Cape) and two from Europe (Bristol and Rotterdam) (Winter et al., 2023; Black et al., 2023). The ULLs experimentally demonstrated the dynamics and investigated pathways for transitions towards sustainability in the FEW nexus.

São Paulo in Natura Lab

The Brazilian Urban Living Laboratory – the São Paulo in Natura Lab – focused on a metropolitan food production area around the city of São Paulo. The sustainability level of several relevant FEW policies was included in a study by Francisco et al., 2023; this article demonstrates the use of a) Ecosystems Service Index (ESI) – Payment for Environmental Service's proxy and b) the Consumer Supported Agriculture Index (CSAI).

Both were assessed using system dynamics modelling (SDM), allowing the modelling of the interactions between technological, environmental, political and social variables and multiple policies.

Also, relevant factors to facilitate an understanding of the complex nexus system's potential to transition to sustainability were used in the overall study, including the Human Development Index focusing on land use and measures, indicating the potential for sustainable food production, including water and energy use.

Modelling of ESI and CSAI allowed a comparison of the impacts different policies to promote sustainability could have on agroecological and conventional food production modes. For example, traditional approaches make use of agrochemicals, such as pesticides and fungicides, to keep fields free of weeds and pests, plus artificial fertilisers to add necessary nutrients to the soil; agroecological principles, on the other hand, do not use artificial methods to support their crops, but rather organic fertilisers and biological pest control are used (Figure 1).

Six predictive scenarios for land areas

To support this investigation, six predictive scenarios were considered, using SDM to model trends for a range of different land areas (from 4 to 10 acres), implementing ESI and CSAI at rates from 1, 5 and 10% per month over the modelled 10-year period.

The six modelled scenarios:

1. No implementation of CSAI or ESI; this represents the benchmark.
2. CSAI and ESI are implemented at a rate of 1% per month.
3. CSAI and ESI are implemented at a rate of 5% per month.

4. CSAI and ESI are implemented at a rate of 10% per month.
5. No CSAI and ESI with the climate crisis is represented by a reduction in rainfall of 30%.
6. CSAI and ESI were implemented at a rate of 10% per month with the climate crisis implemented as under scenario 5.

Results were applied to Land Use Earnings (LUE) to find whether implementing a more sustainable approach to a food production system would attract the producers and encourage its use. Compared to benchmark scenario 1, all these scenarios indicated that LUE increased for agroecological and conventional systems.

The agroecological system had a higher prospect of transitioning to sustainability

However, occasionally, the benefits of the agroecological system appeared to be slightly more significant than that of the conventional system (Francisco et al., 2023). This comparison suggests that the agroecological system had a higher prospect of transitioning to sustainability.

However, there was no statistically significant difference between scenarios 2-4 as the payment for ESI implementation is low, which has minimal impacts on both production systems.

Overall, the tests and comparisons using this modelling approach revealed that:

- a) The FEW Nexus is a complex system; SDM can support decision-makers by representing the system as a whole while providing an overview of interactions between individual aspects of the system.
- b) SDM enabled a better understanding of the potential for sustainability transition due to implementing FEW policies when applied to agroecological and conventional farming systems.
- c) Urban Living Laboratories can be used to model real-time and real-world experiments representing the relationship between sustainability challenges and public policy. ULLs can guide policy and management decisions, as in this case, by valuing ESI more and enabling better uptake of FEW-related policies.

References

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More About Stakeholder

Waste FEW ULL project

Lessons on sustainable solutions from the Waste FEW ULL project by Jana Fried, Adina Paytan and Waste FEW ULL project participants