Regenerative soil systems as a commons: a community-based approach towards soil health in city-regions

Liesbeth de Schutter[1], Joana Wensing[1,2], Eveline Van Leeuwen [1]

1 Urban Economics Group, Wageningen University & Research

2 Maastricht Sustainability Institute, Maastricht University

Abstract

The European Union faces two critical challenges: (1) the accumulation of biowaste in (growing) cities and (2) the depletion of nutrients from agricultural soils in less dense regions. Both problem contexts have been associated with the global structure and mostly linear practices in urban food provisioning. From this problem perspective, cities can " close the loop" by developing biowaste recycling strategies oriented at soil health, by converting collected biowaste into soil improvers. Yet, urban waste services and related actors (food retailers, households, restaurants, farmers) tend to lack a sense of shared responsibility in governing their dependence on healthy soils in rural and peri-urban regions in their trade network. Based on the concept of commons and community-based governance of resource systems, developed from an ontological lens of complex social-ecological systems, we propose the concept of "regenerative soil system" as a commons. Using the case city Amsterdam, we apply the lens of commoning as an epistemological tool to identify distinct biowaste communities in the city-region, i.e. neighborhood, municipal and industrial communities, operating at respectively the local, regional and macro-regional scale. In a participative approach, we construct causal loop diagrams of the key barriers and enablers perceived by stakeholders in urban biowaste recycling and analyse if and how their perception of soil health – e.g. as a shared value, as an economic resource, as a social-ecological system, among others, mobilises community capacities to govern regional soils and/or soil health as a commons from an urban perspective.

Objective and contribution of the paper

Soil health has been defined as the capabilities of a soil to maintain its functions for the support of life on Earth, including plant growth, water regulation and storage, breaking down pollutants (i.e. sink capacity), nutrient cycling and providing a habitat for living organisms, including humans. Modern linear food systems—which operate on a take-make-waste model—contribute to depleting soil health in rural and peri-urban areas, and to accumulating biowaste (i.e. food and green waste) in cities. In urban centers, the majority of organic kitchen waste, restaurant waste and waste from food manufacturing ends up in incinerators rather than being reintegrated into nutrient cycles. This not only exacerbates waste management challenges in city regions, but also fails to contribute to soil regeneration elsewhere.

In rural and peri-urban areas, intensive agricultural practices deplete soils through nutrient mining, erosion, and organic matter loss, reducing their ability to support plant growth, regulate water, and store carbon, among other essential soil functions. The disconnect between urban organic waste streams and soil restoration contributes to a cycle of soil degradation, reduced agricultural productivity, and increased reliance on synthetic fertilizers, further straining natural ecosystems. Bridging this gap through circular approaches—such as composting, regenerative farming, and urban-rural nutrient cycling—can help restore soil functions while reducing

environmental burdens in cities. To this end, we propose the concept of regenerative soil systems as a community approach for the governance of soil health in city-regions. The main research question is if and how urban biowaste stakeholders, including urban households, municipalities, waste companies and land users can adopt a transformative community approach in biowaste recycling oriented at soil health. By distinguishing three different biowaste communities, i.e. a neighborhood composting network at the local level, a composting plant owned and operated by different municipalities at the regional level, and an industrial waste company collecting and servicing customers at the national and international level.

Methods and data

In case city Amsterdam, in a living lab approach, we organised participatory modelling workshops with diverse stakeholders in bio-waste sorting (households), collection (cities), processing (waste companies, composting initiatives) and end-use of soil improvers (urban gardeners, farmers). We used fuzzy-logic cognitive mapping with the software program 'Mental Modeler', that allowed us to make the mental models of stakeholders explicit by means of individual interviews and to create an empirical database of mental models from participants. During the interviews, we construct causal loop diagrams (CLDs) of the factors (barriers, enablers and their relations) that determine the functioning of the biowaste system in the urban context. The mental modeler supports a systems thinking approach that can incorporate different types of knowledge in interdisciplinary problem contexts, while providing a cognitive approach to the perceived functioning of complex social-ecological systems. Quantitative analysis of the mental models is supported by the software in terms of network metrics, e.g. centrality, out-bound (driving) and in-bound (dependent) factors, to identify intervention points that can change the functioning of the system. In a second step, we organized community workshops to identify the perception and value of soil health, the critical factors that influence soil health directly and indirectly, and to develop intervention strategies that can help improve system functioning, i.e. to govern the biowaste recycling system towards soil health. Figure 1 gives an example of a CLD including central and driving factors.

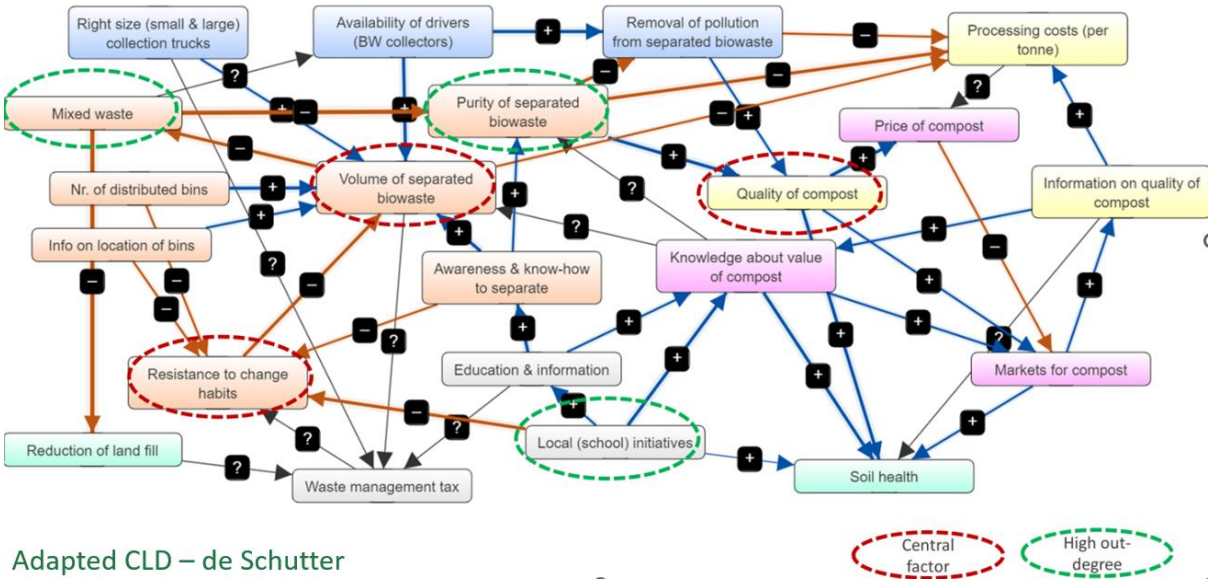

Figure 1: CLD of urban biowaste system (workshop approach)

Conclusions

We find that local neighborhood composting is a transformative approach to the governance of soil health, i.e. soil health as a commons, more than regional cooperatives and industrial networks oriented at the valorisation of biowaste in regional and macro-regional contexts, i.e. biowaste as a commons.

we regret to not have a more advanced extended abstract available as we are in the midst of the participatory workshops (available end-March). Nevertheless, we hope you can consider our contribution to the session.