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A Regional Manure, Biogas and Compost Cycle in Northern Germany – Scaling a Soil Health Business Model as a Sustainability-Oriented Innovation

Ronja Herzberg[1*], Gerald Schwarz[2], Marie von Meyer-Höfer[1], Elke Plaas[2]
[1]Thünen Institute of Market Analysis [2]Thünen Institute of Farm Economics
**corresponding author: ronja.herzberg@thuenen.de*

ABSTRACT

Restoring soil health is a crucial challenge in agri-food systems due to the soils essential role in providing ecosystem services. This study, part of the Horizon Europe project SoilValues, explores the implementation and amplification of a soil health business model (SHBM) in Northern Germany. Such a value-based business model envisions a transition towards a more sustainable agricultural system. Using theoretical perspectives on sustainability-oriented innovation networks and amplification processes, the research identifies the barriers, enablers and incentives for SHBMs and co-creates pathways for its amplification through establishing an innovation network. Initial findings highlight shared ambitions among stakeholders, including climate-adapted production, soil carbon sequestration, humus formation and soil biodiversity conservation. Key incentives and enablers for reaching these ambitions include influencing policies, ensuring economic viability of soil preserving practices, education and establishing cooperatives and regionalized cycles. The research shall inform policies to support similar innovations across food systems and provide a blueprint for amplifying sustainability initiatives. Future work will address the further development of the innovation network and the co-creation of pathways to amplify the SHBM's impact.

Keywords

social innovation, amplification processes, ecosystem services, soil fertility, co-creation

1. Problem Statement

Restoring unhealthy soils and maintaining healthy soils is one of the pressing challenges in agri-food systems, which ultimately depend on the proper functioning of soils. The concept of soil health refers to the ability of soil to provide ecosystem services (Lehmann et al. 2020). A key challenge is the widespread adoption of soil preserving practices by land managers. Therefore, it is essential that land managers integrate these practices into their business models.

As part of the Horizon Europe project *SoilValues*, one of six soil health business models (SHBM) has been implemented in Northern Germany. Such a sustainable business model provides ecological and/or social value besides economic value (Bocken et al. 2014). The SHBM in this case study aims at establishing a regional cycle in which cow manure is used to produce biogas and digestate, that will be composted and applied back to farms. To generate benefits for the wider food system, the SHBM needs to be amplified beyond its initial boundaries. Therefore, the project establishes a multi- stakeholder network to bring together innovation intermediaries with different perspectives on farming, food and energy systems. This innovation network aims to support the successful amplification of the SHBM.

2. Theoretical Background

We use the social science theoretical perspectives on sustainability-oriented innovation networks and on the amplification of sustainability initiatives to explore the capacity of this innovation network to expand the impact of the SHBM. Thereby, central processes in innovation are the recombination of existing knowledge elements, co-creation and knowledge transfer (Wilke und Pyka 2023). Social innovations describe such innovations that aim at initiating social change for sustainable futures (Wittmayer et al. 2024). Sustainability-oriented innovations are able to change norms and cultures of organizations that then lead to products or processes that have a positive social and/or ecological impact (Adams et al. 2016). Within this study, the newly emerging SHBM can be seen as such a social or sustainability-oriented innovation.
Concepts of scaling and amplification describe processes of how a social innovation or sustainability initiative can increase its influence (Moore et al. 2015). Lam et al. (2020) and Moore et al. (2015) thereby distinguish between different pathways of scaling or amplifying a sustainability initiative. Potential pathways are replicating, growing, becoming more stable or faster, influencing rules, laws and policies (scaling up) or values, norms and cultures within society (scaling deep).

3. Research Objectives

The aim of this research is to examine the motivations for and preconditions of implementing a SHBM as a sustainability-oriented innovation and its amplification in an experimental setting.

The specific research objectives are

(1) to explore the key motivations and ambitions of stakeholders within an innovation network that drive their support for implementing a SHBM as a sustainability-oriented innovation,

(2) to examine the barriers, enablers and incentives influencing the implementation of a SHBM within and around innovation networks,

(3) to identify pathways for amplifying a SHBM and preconditions for its amplification.

4. Methods

Co-creation in transdisciplinary networks is described as the basis for innovation as it enables interactive learning, trust building, and flowing of dispersed knowledge, that are particularly relevant in the context of social innovation (Wilke & Pyka 2023, 2024). Moreover, experimenting (transition experiments, Living Labs) is a central process in developing sustainability-oriented innovations (Luederitz et al. 2017; Wilke & Pyka 2023). Therefore, we establish an innovation network and design an experimental and participatory case study to address the research objectives. This stakeholder engagement process is scientifically accompanied by a mixed methods approach, using stakeholder workshops with follow-up interviews and questionnaires.

The stakeholder engagement process begun with the co-creation of the SHBM with a practice partner in Schleswig-Holstein, Northern Germany, in 2023. The establishment of the innovation network to support and amplify the SHBM started in 2024. Stakeholders were and are identified and recruited based on their specific knowledge and agency concerning the implementation and amplification of the SHBM. The first in presence full-day workshop with 29 participants took place in October 2024. The stakeholders conducted group activities to identify their motivations and common ambition and the resources they can provide to achieve this ambition. The workshop was followed by telephone interviews to recap the workshops outcomes as well as to conduct a questionnaire on barriers, enablers and incentives of the implementation and amplification of the SHBM. Two further stakeholder workshops will be carried out before July 2025 to engage missing stakeholders and to co-create pathways for the amplification of the SHBM that address the barriers and enablers of supporting soil health within the region.

5. Preliminary Findings and Outlook

The innovative SHBM simultaneously addresses several challenges, such as soil carbon loss, emissions of climate-relevant gases and odors, partial substitution of maize with surplus farm manure in biogas plants and partial substitution of mineral fertilizer with compost. It will explore whether innovative (combinations of) incentives are able to improve long-term soil fertility and health while ensuring economic sustainability. The outcome of the first co-creation workshop sheds light on the motivations and ambitions of the engaged stakeholders that drive their support for implementing the SHBM, illustrating common aspects (Table 1).

Table 1: Summarized outcome of the group activity on the common ambition of the network*

What do we want to achieve?	Why do we want to achieve it?	How do we want to achieve it?
• long-term safeguarding of agricultural production adapted to climate change • carbon capture in the soil • humus formation • healthy soils • (soil) biodiversity	• provide healthy and safe food independently • increase soil fertility and secure it for the next generation • preserve resources • feed the population today and in the future	• by influencing regulatory requirements • through adapted and sustainable production methods • through the formation of cooperatives • through partly regional cycles • through economically viable practices that maintain/increase long-term soil health • through appropriate incentives • by use of certification systems • through education and improvement of the social image of agriculture

*participants were asked to complete a template in small groups, outlining their ambitions, the reasons behind them, and the strategies they plan to use to achieve them

It becomes clear that ensuring production adapted to climate change in the long term, including the maintenance and increase of soil carbon stocks, humus and soil biodiversity are concerns shared across the network. The reasons why stakeholders want to achieve this common ambition are to

provide healthy and safe food, increase soil fertility and secure it for future generations in a self-sustaining and resource-efficient manner. Several enablers and incentives for pathways to achieve the ambition were suggested, namely a supporting policy environment, economic viability of sustainable production methods, education and the formation of cooperatives and thereby partial regionalization of raw material and food cycles.

An inventory of resources, skills, collaborations and innovations within the small groups showed that there are already several resources on which the network could build. Different kinds of knowledge, infrastructure, land, technologies, networks, motivation and interest are already at disposal. However, the willingness to take risks and responsibilities, legal advice, critical questioning, practical knowledge of soil conservation practices and raw material preparation are still lacking in the eyes of some stakeholders.

One of the next tasks will be to steer the development of the network in a direction that fills these gaps. Moreover, the questionnaire conducted in follow-up telephone interviews will provide insights into the barriers and incentives of implementing and amplifying a soil health business model. Upcoming workshops will then focus the innovation network on addressing the barriers and leveraging the incentives as well as on co-creating pathways for amplification.

On a broader scale, the preliminary findings shed light on the process of developing a shared vision in a soil health related innovation network. The insights will serve as an inspiration for other soil health-related or even food systems-related business model innovations aiming to achieve greater impact. While based on a single case, the findings offer valuable examples of how policy support can be harnessed to strengthen sustainability-oriented innovation networks that then need to be adapted to different local contexts. From a transitions research perspective, it offers guidance on applying concepts of social innovation and amplification in a real-world experimental context.

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