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Steps to Promote Agrifood Twin Transitions: From Identifying Innovation Paths to Enhancing Future Competencies

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Abstract. Twin transitions aim to address grand challenges, such as climate change and food insecurity, through simultaneous systemic shifts toward more sustainable and digitalized production models. In this work, we present three key steps for supporting twin transitions. The first concerns the determination of the digital technologies that can enhance the process. The second is about anticipating potential futures. The final step involves equipping actors who undergo transitions with key competencies.

Keywords: twin transitions, agricultural digitalization, sustainability, innovation, climate change

1. Introduction

Climate change is a significant challenge for contemporary societies, impacting food production, food security, and the health of ecosystems and humans. The World Health Organization (2023) estimates that between 2030 and 2050, approximately 250,000 people will lose their lives every year due to undernutrition, heat stress, or diseases associated with climate change.

Concerning agricultural production, the need to design functional climate adaptation strategies is well-documented in the literature (Mahli et al., 2021; Shahzad et al., 2021; Aydinalp and Cresser, 2008; Howden). The interrelation between agricultural productivity and climate is cyclical and complex. As agriculture, in its conventional form, continues to produce greenhouse gas emissions, it contributes to climate change, which, in turn, jeopardizes the sustainability of agricultural production (Agovino et al., 2019).

Considering the pivotal role that agriculture plays in supplying societies with food and fibers, policies emphasize the need to move to a new, essentially sustainable model of agrifood production. In the European Union, the "European Green Deal" supports the transition to a greener and climate-neutral society.

Agrotechnological research, on the other hand, has intensified its efforts to provide solutions to the climate crisis by facilitating the development of innovations that can pave the way for a sustainable future. The term "sustainability transitions" was developed to describe the synergistic approaches that aim to facilitate the movement of current production systems to a more sustainable state (Markard et al., 2012).

Parallel to these efforts, both research organizations and the industry have made impressive progress in producing a wide range of digital technologies that promise to offer practical solutions to the climate problem, either directly (e.g., by collecting and analyzing climate data) or indirectly (e.g., by reducing the amount of energy consumed during the use of conventional technologies or improving management decisions). This line of evolution led to the so-called "digital transition," which is a general term used to denote the shift to a state where digital tools facilitate production and transform living in society.

Interestingly, digitalization and the consequent digital transformation have the potential to expedite the shift to a more sustainable future (Rosário and Dias, 2022). Hence, by combining the two processes, we can accelerate a twin transition in which digital technologies facilitate the achievement of sustainability targets and sustainability thinking governs the development and exploitation of digital tools (Charatsari, 2024).

In this study, we present three steps for promoting twin transitions in the agrifood sector. Our work is based on the experience of an ongoing research project (TWIN-IN) aiming to support the responsible twin transition of agrifood systems in the European Union. In the following section, we briefly outline the sequential TWIN-IN approach through which one can support twin transitions in the agrifood systems.

2. Steps

2.1. Identifying the innovations that can be exploited

The first step in initiating twin transitions is determining digital innovations that can enhance the sustainability transition process. Currently, several digital tools are available, each with distinct functionalities (Idoje et al., 2021), thereby displaying varying potential to transform agrifood systems and support the fight against climate

change. At the same time, each type of these artifacts faces unique challenges (Fountas et al., 2020). Estimating the suitability of varying digital artifacts at the early stages of transition is pivotal for ensuring a good fit.

2.2. Foresighting potential futures

Transitional processes are systemic shifts from one state to another. Although the endpoint might be well-determined, the transition process is associated with several uncertainties. Both sustainability (McGowan and Antadze, 2023) and digital transitions (Lioutas et al., 2021) might be accompanied by several risks and unintended side effects. Forecasting the futures that twin transitions will create enables the taking of preventive measures to mitigate any negative impact that digitalization and the pursuit of sustainability may have. Moreover, it can help anticipate whether and to what extent the exploitation of digital tools can lead to achieving climate change mitigation targets.

2.3. Supplying actors with competencies needed to navigate transitions

Undergoing transitions is competence-demanding since it requires changing operational paradigms and developing future-related skills (Charatsari et al., 2022). Beyond digital skills, a range of competencies can facilitate actors in dealing with the complexities and uncertainties of digital and sustainable operational paradigms. For those orchestrating transitions, it is critical to pre-define these skills, based on the futures pursued, and develop strategies to upskill actors.

3. Conclusion

Twin transitions represent a means to achieve both digitalization-related and sustainability targets, including those related to climate change adaptation and mitigation. However, transitions are complex and uncertain processes. In this work, based on the TWIN-IN approach, we summarized some crucial steps for effectively supporting the transition of agrifood systems to a digitalized and sustainable future.

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