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Co-evaluating and -designing a Sustainable Agriculture Matrix for Austria in an international context

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Agricultural ecosystems provide essential services mainly through food, feed, fiber and consequently income but they also contribute cultural, supporting and regulating services. In turn, farming can adversely affect ecosystem services, especially those from natural ecosystems, if farming practices are unsustainable.

Recently, a Sustainable Agriculture Matrix (SAM; <https://doi.org/10.1016/j.oneear.2021.08.015>) of indicators across environmental, economic, and social dimensions has been developed by an international research team to coherently quantify the sustainability of countries' farming systems globally. The focus was on indicators that can be tracked over time and relate to performance to facilitate analyzes of synergies and trade-offs. At present, this indicator system is being co-evaluated with stakeholders in ten countries within an international consortium including Austria, to elicit stakeholders' appraisal of the framework's applicability in their specific geographical and socioeconomic context and eventually co-design a revised matrix based on stakeholders' requirements.

A first workshop has shown that most indicators from the *environmental dimension* are useful for stakeholders in the Austrian context, but some need further refinements. Biodiversity, for example, is only considered via *land cover change* whereas threats to (agro-)biodiversity in Austria and the EU foremost occur in-situ. The *economic dimension* is ranking second in its usefulness for Austrian stakeholders with few indicators such as food loss being of little relevance. The indicators presently included in the *social dimension* are least relevant as they cover aspects such as land rights, undernourishment, and rural poverty, which do not pose major issues in Austria and more broadly the EU.

General concerns of stakeholders are the directionality of indicator ratings and their scope which is in part considered too narrow. E.g., high *government expenditure* for agriculture is considered positive in the matrix regardless of its purpose and may cause dependencies. *Human nutrition* is only included via *undernourishment* and *soil nutrient status* solely as surplus, whereas in both cases also the other extreme may be adverse. Accordingly, a bell-shaped indicator and rating would be favored in such cases. A general requirement was expressed for an additional *context*

dimension. Governance arrangements and the overall socioeconomic situation are so far deliberately not included due to the focus on performance in the existing SAM. Yet, indicators describing such framework conditions can be essential to interpret synergies and trade-offs and the effectiveness of policy measures aiming at achieving SDGs. Beyond the evaluation of existing indicators, the stakeholder process yielded comprehensive suggestions for additional indicators, covering biodiversity, research and education, self-sufficiency, as well as various aspects of resilience and stability. Overall, the co-evaluation with stakeholders highlights that only few globally defined indicators are readily applicable in a regional context where consideration of local conditions and specifics is vital.

The proposed revisions are now being matched with available data across geographic scales to revise the matrix and perform further analyses on trade-offs and synergies. This will also include further context information to facilitate the evaluation of policies, ultimately allowing for improved policy-making to attain agricultural sustainability. Results will be further co-evaluated iteratively with stakeholders to eventually produce a globally applicable indicator system.