

## Decision support tools in agriculture and agroecology – Review

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### Abstract

Agroecology has emerged as a key approach for promoting sustainable agricultural systems by integrating ecological principles, social equity, and economic viability (Ernesto Méndez, Bacon and Cohen, 2013a; Bezner Kerr *et al.*, 2023). Moreover, agroecology is not only a science but also a set of practices and a social movement that can be applied across the entire food system, from production to consumption (Jouan *et al.*, 2021a; Sullivan, 2023). Agroecological transition planning needs tools that can handle spatial complexity, criteria-based decision-making and stakeholder participation simultaneously (Sylvain, Bertrand and Dominique, 2023; Nasr and Orwin, 2024; Nungula *et al.*, 2024). For that reason, decision support tools were developed. Decision support tools optimize agricultural solid waste management by managing decisions on composting, biomass pyrolysis (biochar), and manure reuse (Río *et al.*, 2011), and greater use of data-driven decision-making. The aim of this study is to identify and evaluate the available tools used to support decision-making process in agriculture and agroecology focusing on their ability to incorporate environmental, economic, and social dimensions of sustainability (Dumont, Wartenberg and Baret, no date; Gascuel-Odoux *et al.*, no date a). A systematic literature review was conducted to classify and assess existing tools according to their methodological approach, scale of application, and support for agroecological transitions. The findings indicate that Geographic Information Systems (GIS) (Akpoti, Kabo-bah and Zwart, 2019; Rahmawaty *et al.*, 2020; Tercan and Dereli, 2020), Analytic Hierarchy Process (AHP) (Ramamurthy, Reddy and Kumar, 2020; Ma, Ritsema and Wang, 2024; Guo *et al.*, 2025), and Serious Games (Jouan *et al.*, 2021b; Assogba *et al.*, 2025; De Graeuwe, Dumont and Maréchal, 2025) are the most commonly used approaches. While these tools effectively support environmental and economic assessments, the integration of social criteria and stakeholder participation remains limited (Gascuel-Odoux *et al.*, no date b; Ahmad and Köpke, 2024). The study highlights the need for more holistic and participatory decision-support frameworks to facilitate sustainable agroecological transitions and improve the resilience of agricultural systems (Ernesto Méndez, Bacon and Cohen, 2013b; López-García and de Molina, 2021; Zhang, 2024). In conclusion, the combination of agroecology, with appropriate decision-making tools, can offer multidimensional sustainability outcomes in all food systems.

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