

Decision support tools in agriculture and agroecology - Review

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INTRODUCTION

- Agroecology has emerged as a key approach for promoting sustainable agricultural systems by integrating ecological principles, social equity, and economic viability (6, 8).
- 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 (13, 26).
- Agroecological transition planning needs tools that can handle spatial complexity, criteria-based decision-making and stakeholder participation simultaneously (19, 27).
- Decision support tools optimize agricultural solid waste management by managing decisions on composting, biomass pyrolysis (biochar), and manure reuse (25).

AIM OF THE CURRENT RESEARCH



To identify and evaluate the available tools used to support decision-making process in agriculture and agroecology (including scientific, environmental and social aspects)

Categories of the Decision support tools used in Agriculture and Agroecology (Strengths and Limitations)

Component	Strengths	Limitations addressed by others
 GIS	<ul style="list-style-type: none"> Processes diverse spatial data, assesses land suitability, and illustrates landscape patterns. 	<ul style="list-style-type: none"> Cannot prioritize criteria or manage value trade-offs on its own (4, 23, 28)
 AHP	<ul style="list-style-type: none"> Weights multiple factors; incorporates expert/stakeholder judgment; structures complex decisions. 	<ul style="list-style-type: none"> Lacks spatial explicitness; difficult for non-experts to understand trade-offs (1, 11, 17, 24)
 Serious Games	<ul style="list-style-type: none"> Promote systems thinking, learning-by-doing, exploration of alternatives, stakeholder engagement. 	<ul style="list-style-type: none"> Models often simplified; need structured data and decision rules to make scenarios realistic (5, 10, 13)

Applications of the different Decision Support Tools in Agriculture and Agroecology

Category	Example	Purpose
GIS & Agroecology	GIS Agroecologist Online	Soil fertility monitoring & agroecological planning (15)
	Agroecological potential mapping (Bulgaria)	Soil-climate char (16)
	Species land suitability mapping	Agroforestry/agroecological suitability assessment (24)
AHP & Agroecology	OSAHP for agroforestry	Prioritizing agroforestry adoption areas (23)
	AHP/ANP in rice field ecosystem services	Prioritizing ecological functions (12)
	AHP + GIS for rural landscape planning	Integrating social & biophysical factors (18)
Serious Games & Agroecology	SEGAE	Teaching integrated agroecology systems (13)
	QUEEN	Improving crop-livestock integration (5)
	La Grange	To evaluate a serious game that supports stakeholder dialogue and sustainable decision-making in livestock systems (27)

INTEGRATION OF THE DIFFERENT SUPPORT TOOLS

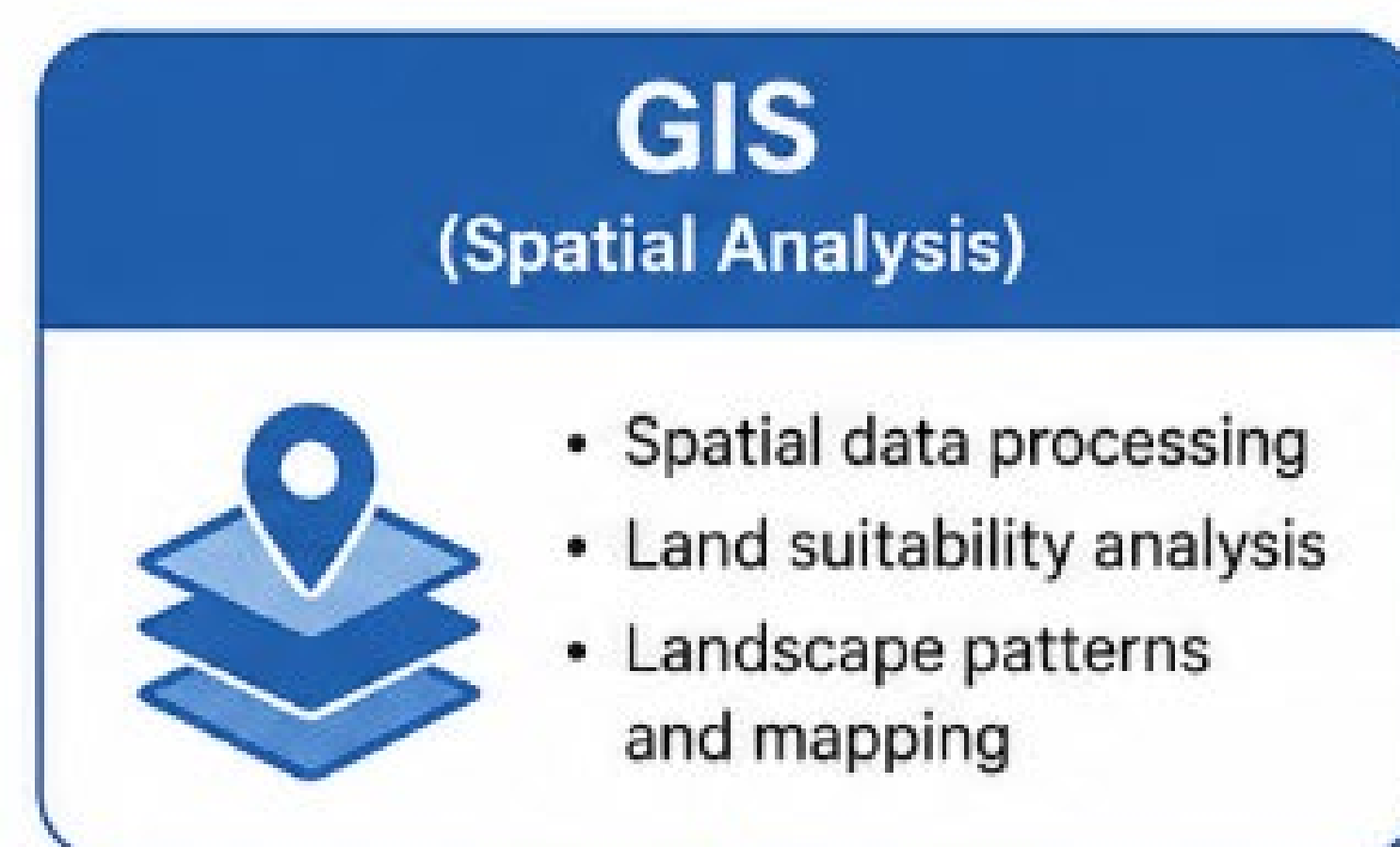
To support agroecological transition through the integration of spatial knowledge, multi-criteria decision-making and participatory processes.

1 Agroecology faces challenges in implementation and learning

Agricultural education often remains fragmented and discipline-specific, limiting the development of interdisciplinary approaches necessary to understand agroecology's complexity (2, 9).

3 Agricultural education often remains fragmented and discipline-specific

The development of interdisciplinary approaches necessary to understand the complexity of agroecology is limited (7, 22).

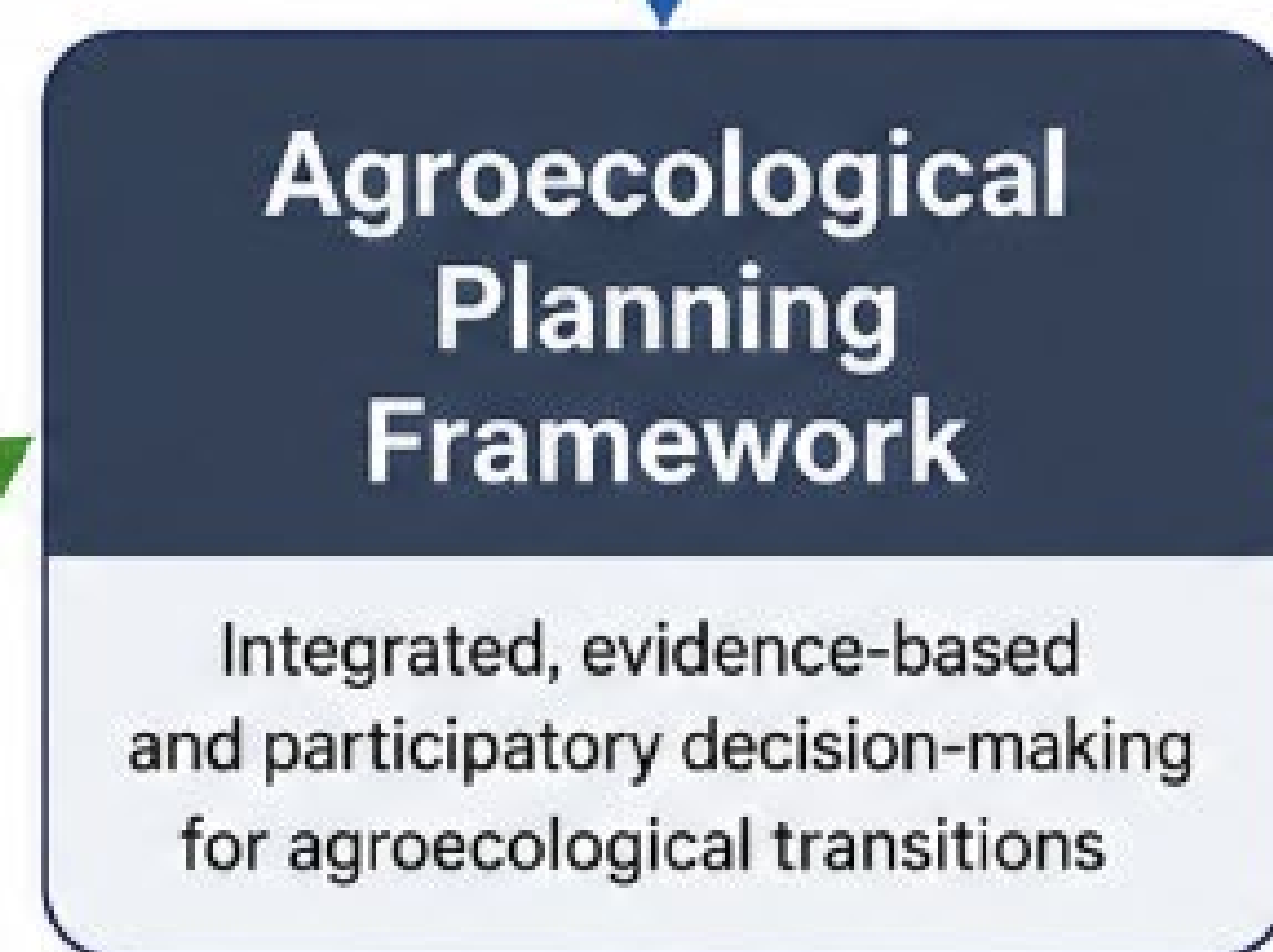
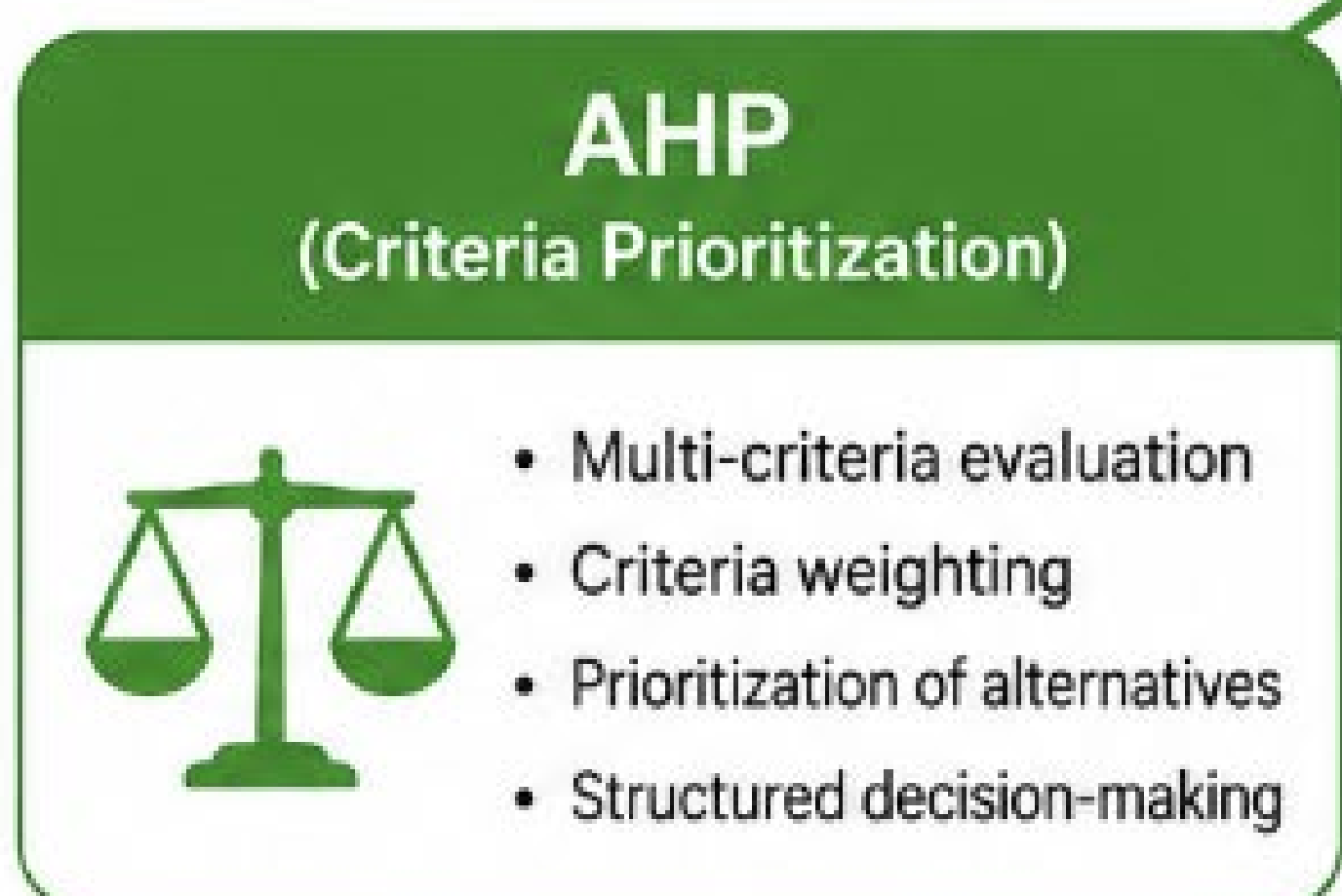


2 Innovative teaching tools, such as serious games, have been developed

Improving agroecological learning through simulation of integrated agricultural systems and their impacts on sustainability (13, 17).

4 Complementary teaching tools: GIS & AHP

GIS supports spatial analysis and land suitability assessment, while AHP allows for prioritization of multiple ecological, social, and economic criteria (9, 29).



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