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Value-Driven Futures for Nature: Using the Nature Futures Framework and Agent-Based Models to Link Local Decisions with European Policy Pathways

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Achieving biodiverse and sustainable futures requires understanding not only which nature-centred pathways are desirable, but how diverse actors might actually navigate them. The Nature Futures Framework (NFF) provides a pluralistic foundation for exploring such futures by articulating conservation-oriented, human well-being, and relational value perspectives. However, scenario development still faces a major challenge: translating these value perspectives into dynamic representations of real-world decision-making that capture behavioural diversity, local context, and emergent system-wide outcomes.

Agent-based modelling (ABM) offers a powerful means to address this challenge. By explicitly representing land managers and other decision-makers as agents acting according to distinct value orientations, social norms, and environmental feedbacks, ABMs allow scenario developers to explore how NFF perspectives play out through concrete choices on the ground. This makes it possible to analyse how local behaviours collectively produce landscape-wide patterns—and how these patterns respond to different policy interventions or governance approaches.

In this study, we apply the NFF within a Europe-wide ABM-based scenario design to investigate how value-driven decision processes influence long-term land-use trajectories for biodiversity and ecosystem services. By embedding the three NFF perspectives into both land-management behaviour and societal demand, we create scenarios that reflect not just alternative visions for nature, but also the underlying pathways that lead reaching these visions.

Our work demonstrates how ABM can significantly strengthen NFF-based scenario development by addressing key challenges inherent in biodiversity futures. First, ABM enables the exploration of uncertainty and complexity by capturing heterogeneous decision-making and the feedback dynamics that emerge from interactions among actors and their environments. At the same time, it supports the integration of social, ecological, and governance dimensions, linking individual land-use choices with policy settings and environmental outcomes across multiple scales. Crucially, this approach also generates actionable, policy-relevant insights by revealing where interventions, such as incentives and regulation changes, can most effectively shift system trajectories toward futures aligned with the Nature Futures Framework.

By linking value-oriented scenarios with actor behaviour and emergent system dynamics, this study shows how ABM can operationalise the NFF and support evidence-informed pathways from local decisions to coherent European strategies for biodiversity stewardship.