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A multi-model nexus framework for assessment of the systemic impacts and efficacy of nature-positive transformative pathways

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Addressing interconnected global challenges—biodiversity loss, climate change, land degradation, water scarcity and food insecurity—requires integrated approaches that capture the complex interactions linking human and natural systems. Nexus approaches offer a powerful means of understanding these interdependencies, yet their implementation is often limited by modelling tools that treat sectors independently or fail to represent key feedbacks, synergies and trade-offs influencing sustainability outcomes.

The IPBES Nexus Assessment highlighted two major gaps in current modelling capabilities: (1) the need for tools that better account for interlinkages among multiple nexus elements and can simulate pathways toward sustainable outcomes, and (2) the need for scenarios and models that represent diverse policy response options and their interactions across three or more nexus elements.

This presentation introduces a nexus modelling framework designed to address these gaps. It integrates three complementary models: a regional integrated model quantifying cross-sectoral dynamics in land, water, biodiversity and ecosystem services; a system dynamics model capturing non-linear interactions among biodiversity, food, water, energy, climate, transport and health; and an agent-based model representing land system dynamics and land-management decisions in the provision of food, energy, biodiversity, climate, water and health-related services. Together, these models form a coherent platform for exploring how transformative actions propagate across interconnected nexus elements.

Within the BIONEXT project (www.bionext-project.eu), this framework is being applied to evaluate the effectiveness of just transition pathways aimed at delivering nature-positive visions for Europe. These pathways are co-developed through an iterative, participatory process involving stakeholders from multiple sectors, including policymakers, industry and civil society. Repeated cycles of engagement, pathway refinement and modelling support mutual learning, transparency and alignment of scientific evidence with stakeholder priorities. The modelling assesses the efficacy of response options within three pathways grounded in the value perspectives of the Nature Futures Framework, examining their system-wide impacts, co-benefits, trade-offs and potential unintended consequences.

By embedding modelling within a participatory process, BIONEXT strengthens the relevance, legitimacy and robustness of transformative pathways. The resulting insights provide a stronger

evidence base for European decision-making and advance the role of nexus modelling in supporting integrated, equitable and solution-oriented transitions toward nature-positive futures.