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## Agricultural living labs: bridging theory and practice through transformative learning

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### Abstract

This conceptual study addresses methodological and conceptual gaps in Agricultural Living Labs (ALLs) by integrating Mezirow's Transformative Learning (TL) theory into their design, aiming to enhance agricultural education and knowledge co-creation while enabling stakeholder-driven resilience amid climate volatility. Following a qualitative, conceptual, and meta-analytical design, the study was developed through a four-step, inductive–deductive process that constructed the proposed TRANSFORM-ALL framework. This approach integrates literature mapping and conceptual synthesis in the initial steps, followed by interpretative analysis and validation to align the principles of TL theory with the methodological architectures of ALLs.

The resulting framework organises ALLs into six phases that correspond directly with Mezirow's TL steps: Initiation (disorienting dilemmas), Insight Research (critical reflection), Prototyping (collaborative experimentation), Field Testing (adaptive application), Feedback Loop (iterative discourse), and Scaling/Dissemination (systemic change). These phases bridge instrumental rationality with holistic innovation, fostering critical reflection and context-adaptive solutions.

Practically, the study offers an actionable tool for designing ALLs that systematically foster transformative learning by prioritising dialogue, collective norm-creation, and stakeholder-aligned solutions. This flexible yet rigorous model empowers practitioners to strengthen agricultural resilience through learning and iterative adaptation. Theoretically, the research enhances pedagogical coherence in agricultural education by linking TL theory with participatory methodologies in ALLs. It clarifies how ALLs internalise TL principles, providing greater epistemological rigor to experiential approaches and addressing conceptual heterogeneity in the field. By complementing existing social and experiential learning perspectives with a more systematic TL framework, the study advances current understandings of learning in ALLs.

The originality and value of TRANSFORM-ALL lie in its unique integration of TL theory into Living Labs, positioning ALLs as tools for harmonising ecological stewardship with collective learning. Its structured yet adaptable architecture enhances agricultural systems' capacity to respond to climate challenges through stakeholder-driven innovation, contributing a novel model for sustainable transitions.

**Keywords:** Participatory action research, real-world labs, social learning, transdisciplinary research