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AGROECOLOGY FOR EUROPE

ESTABLISHING AN EFFECTIVE EUROPEAN NETWORK OF AGROECOLOGY LIVING LABS: ENTRY POINTS FROM A FARMLAND BIODIVERSITY PERSPECTIVE

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Scope

This Policy Brief presents a synthesis framework aimed at supporting the EU Partnership on Agroecology Living Labs and Research Infrastructures in its vision to establish an effective European network of living labs. It reaches out to policy and partnership coordinators as well as practitioners, providing insights to inform their decisions on where and which kind of living lab to fund in the future. This decision support can help to fully achieve policy targets related to farmland biodiversity and an agroecological transformation of European farming.

1) Farmland biodiversity crisis

The intensification and specialisation of food production have fundamentally altered agriculture during the past decades. Although productivity often increased, yields have plateaued in many high-productivity regions in Europe and worldwide. At the same time, the high input of synthetic fertilisers and pesticides and the loss of semi-natural habitats have substantially accelerated the loss of biodiversity in agricultural land systems, i.e., decreased farmland biodiversity. This has impaired essential ecosystem services such as pest regulation, pollination, and nutrient recycling that are associated with farmland biodiversity and required for the functioning of many farming practices, in particular agroecological practices. Hence, agriculture needs to be transformed in order to reverse the ongoing biodiversity and food system crisis.

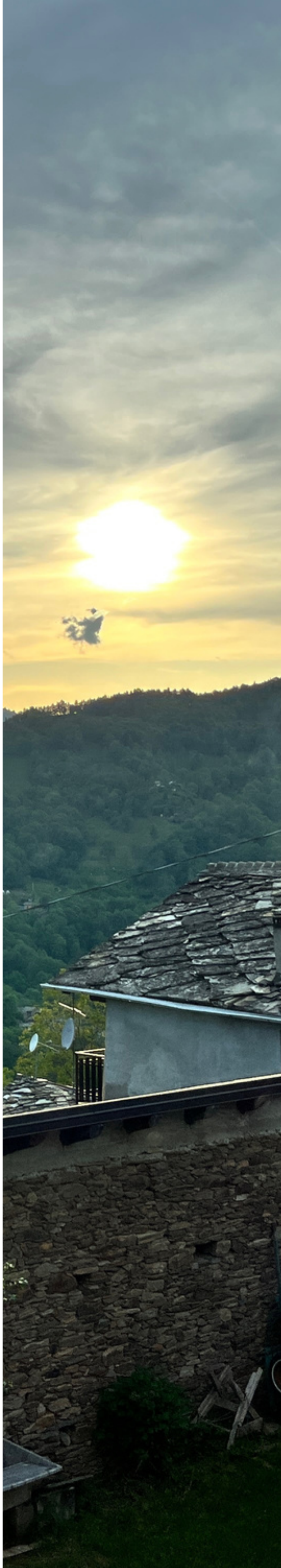
At the heart of the European Green Deal, a range of policy objectives have been framed to support this transformation. For example, the European Union's Farm-to-Fork Strategy set targets to reduce chemical pesticide use by 50%, nutrient losses by at least 50%, fertiliser use by at least 20%, and to farm 25% of agricultural land organically by 2030. However, regional differences in agricultural intensity, farming practices, and biodiversity in Europe greatly challenge the achievement of these uniformly defined policy targets. To increase the currently limited effectiveness of policies, policymakers need to tailor targets to specific farming systems. The newly formed European Partnership on Agroecology Living Labs and Research Infrastructures raises the question: how should a network of living labs be composed to suitably cover differences in farming contexts and co-design tailor-made application options of farming practices?

2) Option space for agroecological transition

Systematic understanding of the interactions between agriculture and farmland biodiversity is crucial to address this question. Empirical evidence shows a declining relationship between agricultural production and farmland biodiversity, which can be illustrated as S-curve (Figure 1a). Agricultural production subsumes land use intensity, management strategies, and the composition of agricultural landscapes. It depicts a gradient ranging from extensive land use, (e.g., low livestock density, no-tillage) in complex landscapes where agriculture is embedded in a semi-natural habitat matrix, to intensive land use, with high external inputs and structurally simplified or cleared agricultural landscapes. Farmland biodiversity captures all species that live in and around agricultural land and provide ecosystem services.

Extensive farming systems that have well-structured landscapes and maintain high biodiversity resemble the conditions in the upper part of the S-curve (Figure 1a and example in Figure 1b). Here, abandonment can decrease farmland biodiversity (see lower branch of the S-curve in upper left-hand corner, Figure 1a). Hence, extensive farming needs to be maintained to avoid this degrading branch pointed out by a functional space called minimum required production. Yet, abandonment may also increase farmland biodiversity to some extent linking to natural or rewilded landscapes (see dotted branch in upper part of the S-curve, Figure 1a).

In contrast, intensive farming systems that maximise the production of few, often calorie-rich but nutrient-poor crops rely on substantial external inputs of synthetic fertilisers and pesticides at the expense of farmland biodiversity (see lower part of the S-curve, Figure 1a and example in Figure 1b). While some degree of degradation may be reversed, strongly degraded farming systems that lost key functional species and propagule sources may resist recovery. This indicates a minimum required biodiversity threshold (see red dotted line, Figure 1a), below which restoration requires significantly more effort or may even become impossible. Given the risk of depleted farmland biodiversity, restoration potential needs to be maintained translating to a maximum tolerable production level (Figure 1a).



The broad policy objective to re-enhance farmland biodiversity presents a vision that transforms the declining relationship between agricultural production and farmland biodiversity (see green dashed line, Figure 1a). This transformative vision implies that at a given level of agricultural production, farmland biodiversity increases. The area between the current relationship and the transformative vision indicates the option space for transformative change (see light green area, Figure 1a). Farming systems may transition to this option space in the future depending on their current conditions and applied farming practices.

Agroecology provides established knowledge and proven practices to guide the necessary transformation of farming and food systems over the next decades. It shifts the focus away from maximising productivity toward optimising the use of natural resources and biodiversity, providing affordable healthy food, and building resilience. Decreasing or phasing out agrochemical inputs and reorganising agricultural management are key elements of agroecology essential to alter the structure and functioning of agriculture. Yet, agroecological practices are context-specific and need to be fitted to the diverse interactions between agriculture and farmland biodiversity. For example, diversified crop rotations, establishing semi-natural habitats at field edges, and managing service-providing species contribute to intensifying ecological processes in more intensively used farming systems with low farmland biodiversity (see Type C, Figure 1a). These practices can reduce pest infestation and the need for insecticides while increasing crop yields and profitability. In contrast, mixed grazing of cattle and sheep can simultaneously enhance farmland biodiversity and livestock production in extensively used farming systems that still contain high biodiversity (see Type A, Figure 1a).

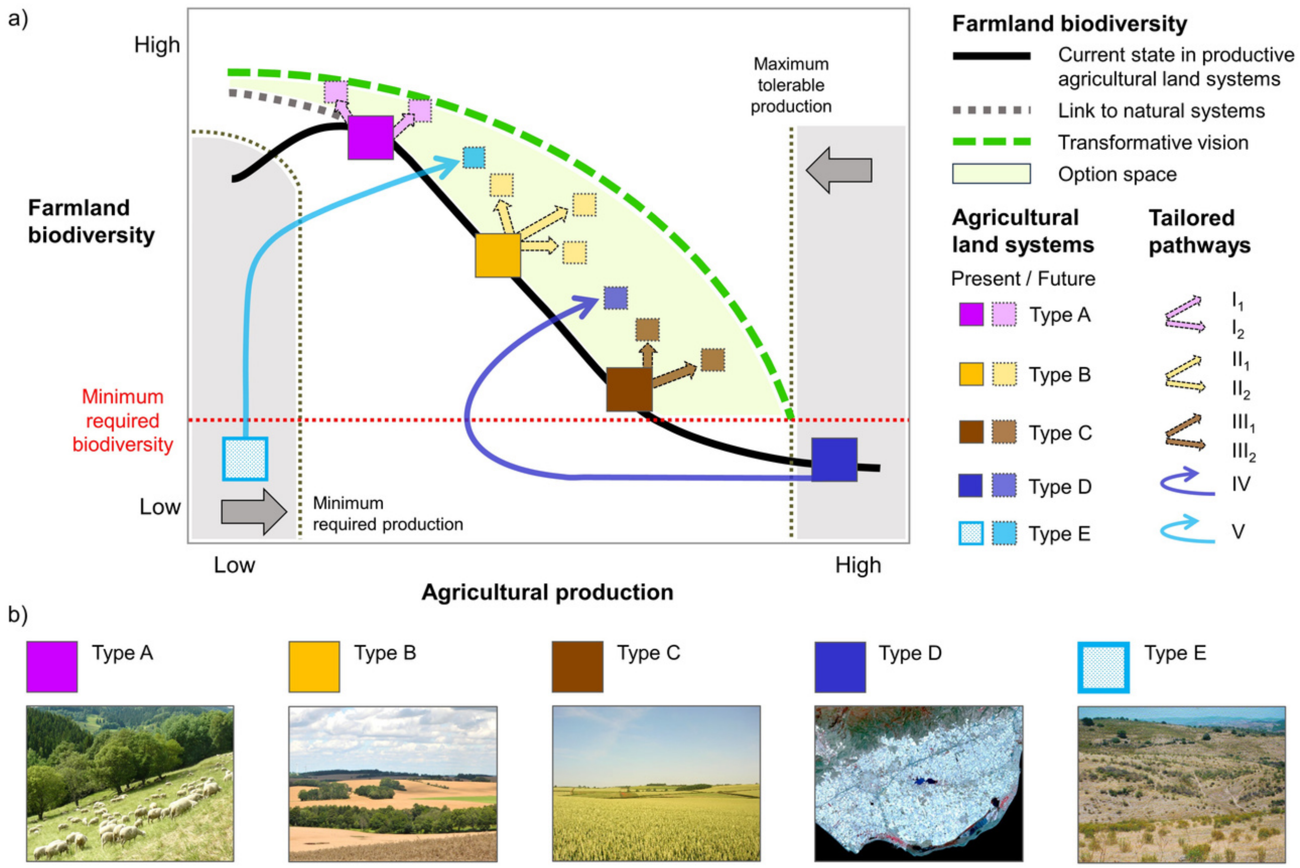


Figure 1 Synthesis framework to guide the development of the European network of agroecology living labs and research infrastructures.

1a) S-curve depicting the current relationship between agriculture and farmland biodiversity and option space between the current relationship and transformative vision. Examples of farming system types are given together with possible future locations in option space and tailored pathways to reach these locations. Boxes with solid borders indicate present conditions of agricultural production and farmland biodiversity in various types of farming systems. Boxes with dotted borders represent possible envisaged conditions in the future.

1b) Photographs presenting real-world examples of farming system types. These include low-intensity sheep grazing in a structurally complex mountainous landscape, southern Germany (Type A), medium-intensive crop production in a diverse landscape with forest remnants, south-eastern Germany (Type B), high-intensity cereal cropping in a simple, homogenised landscape, England (Type C), intensive horticultural production in a severely disturbed landscape due to massive greenhouse constructions and agrochemical inputs, south-eastern Spain (Type D), and abandoned land with severe soil erosion and land degradation, southern Portugal (Type E).

(Photo credits: Type A—Sebastian Klimek, Type B—Diana Sietz, Type C—Jens Dauber, Type D—NASA/GSFC/METI/ERSDAC/JAROS, U.S./Japan ASTER Science Team, Type E—Pedro Cortesao Casimiro).

3) Developing an effective European network of living labs and research infrastructures

This integrative view on the current relationship between agriculture and farmland biodiversity and the option space for transformative change provides a synthesis framework to guide the development of a European network of agroecology living labs and research infrastructures. Seven steps set out the framework's application below. Two steps (3.1) support the Partnership in building a comprehensive network of living labs and research infrastructures. One step (3.2) addresses policy effectiveness requiring action in both living labs and the Partnership. The remaining four steps (3.3) are focussed on a clear understanding of current conditions and potential future development in living labs and associated farming systems.

3.1) Comprehensive network of living labs

From the perspective of the European Partnership on Agroecology, the synthesis framework presented here may help to define priority regions for establishing living labs to address the most pressing transformation needs. It may further help to balance the number and distribution of living labs across Europe and structure the discussion of where to establish living labs so that they form a network that effectively fosters the envisaged agroecological transformation across Europe.

The framework may also serve to systemise information on the coverage of current relationships between agriculture and farmland biodiversity and envisaged areas in the option space of transformative change. For example, if clusters in the position of current living labs would be apparent along the S-curve (see Figure 1a), then the reasons for such clustering would need to be identified. Important aspects to clarify would be if particular conditions are not relevant for agroecological transformation or if they exist only in underrepresented niches in Europe. In turn, living labs' regional distribution in Europe can be mapped onto the S-curve to reveal regions with similar current interactions between agriculture and farmland biodiversity but different drivers of current conditions, future conditions envisaged in the option space of transformative change, and/or transformative pathways leading to these envisaged future conditions. If gaps remain in the current distribution of living labs, the European Partnership can launch calls for living labs in explicit regions to purposefully adjust and build up the network of living labs.

In developing promising solutions and testing these on real farms with farmers and other food system actors, the thirteen principles of agroecology help focus actions aimed at starting or reinforcing transformative change. For example, land and natural resource governance may be a priority element to develop innovative policies (e.g., regulatory laws) that reward regenerative production in a living lab located in a region resembling the conditions depicted in Type C (see Figure 1a). In contrast, culture and food traditions may be prioritised in a living lab located in a region resembling the conditions depicted in Type A (see Figure 1a). This can support the Partnership on Agroecology Living Labs and Research Infrastructures in designing vivid spaces for long-term, contextualised experimentation and providing direction for research activities on agroecology at European scale.

3.2) Effectiveness of current policy targets

EU strategies and laws target general goals but their objectives are not effective under all farming and environmental conditions. It is therefore recommended to assess which policy objective can effectively re-enhance farmland biodiversity and ecosystem services while safeguarding food production under given current conditions. The framework presented here is designed to help evaluate conditions under which existing policy targets, such as those defined by the EU's Farm-to-Fork Strategy, are suited to support the sustainable transformation of farming systems.

For example, the targets of a 50% reduction in chemical pesticide use, a 20% reduction in fertiliser use, and a 50% reduction in nutrient losses would be most ecologically effective in intensively used farming systems (see Type C, Figure 1a). They lay the foundation for transformative change based on an intensification of ecological processes. To enable this, it may be essential to establish semi-natural habitats (e.g., hedgerows, tree lines) allowing wild species to recolonise these farming systems and provide ecosystem services. In its original form, the proposed Nature Restoration Regulation defined a minimum target of 10% of agricultural land with high-diversity landscape features underlining this necessity. In contrast, the target to farm 25% of agricultural land organically is best suited for farming systems with intermediated land use intensity and landscape complexity (see Type B, Figure 1a). Farming systems resembling Type A (Figure 1a) are often characterised by high-diversity landscape features and low inputs of pesticides and fertilizers. Here, the abandonment of farming poses a threat to both food production and biodiversity. Hence policies targeted towards stabilising socio-ecological systems, for example via improving social services in rural communities, designing new value chains for goods, and developing novel agroecological farming opportunities, may be most effective under those Type A conditions.

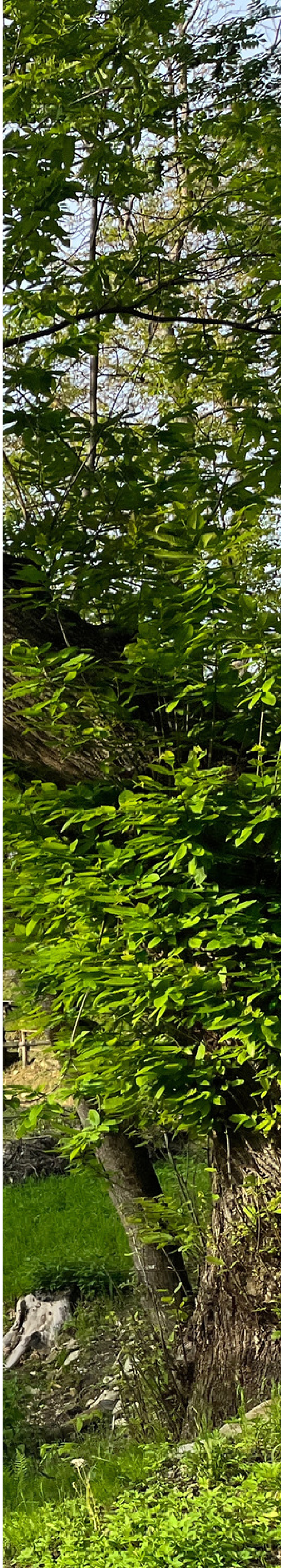
3.3) Potential future development of living labs

The framework allows to analyse the potential of living labs regarding their contribution to agroecological transformations. First, the current position of a given living lab can be analysed along the S-curve (see example boxes with solid borders, Figure 1a). This allows to contextualise the living lab in the full gradients of agricultural production and farmland biodiversit analyse the potential of living labs regarding their contribution to agroecological transformations. First, the current position of a given living lab can be analysed along the S-curve (see example boxes with solid borders, Figure 1a). This allows to contextualise the living lab in the full gradients of agricultural production and farmland biodiversity.y.

Second, the factors and processes that drive the current status of farmland biodiversity, including the composition and configuration of agricultural landscapes and intensity of agricultural production, need to be examined. This helps to specify how agriculture and farmland biodiversity interact in a given living lab.

Third, depending on the current interplay between agriculture and farmland biodiversity, possible future locations can be defined for a living lab in the option space for transformative change (see boxes with dotted borders, Figure 1a). The envisaged locations of future farming systems imply various changes in agricultural production and farmland biodiversity. Co-design is essential to reflect and balance different stakeholders' expectations, demands, and preferences, as well as the specific social-ecological context of a living lab.

Last, transformation pathways can be defined to link the current and envisaged future positions (see tailored pathways, Figure 1a). These pathways need to be tailored to the characteristics of current farming systems. Targeted farming approaches using agroecological principles can be tested in the living labs to underpin the tailored pathways with contextualised management approaches.



Recommendations

To the European Partnership on Agroecology Living Labs and Research Infrastructures

1) Define priority regions for establishing living labs to address the most pressing transformation needs.

2) Balance the number and distribution of living labs across Europe.

To the European Partnership on Agroecology Living Labs and Research Infrastructures and practitioners in agroecology living labs

3) Assess which policy objective can effectively re-enhance farmland biodiversity and ecosystem services while safeguarding food production under given current conditions.

To practitioners in agroecology living labs

4) Determine the current position of a farming system along the S-curve

5) Evaluate drivers of the current status of farmland biodiversity

6) Co-design the envisaged location of the future farming system

7) Co-design associated transformation pathways linking the current and envisaged positions

Further reading

Lomba, A., Moreira, F., Klimek, S., Jongman, R.H.G., Sullivan, C., Moran, J., Poux, X., Honrado, J.P., Pinto-Correia, T., Plieninger, T., McCracken, D.I. (2020) Back to the future: rethinking socioecological systems underlying high nature value farmlands. Front Ecol Environ 18(1):36–42, doi:10.1002/fee.2116

Oberlack, C., Pedde, S., Piemontese, L., Václavík, T. and Sietz, D. (2023) Archetypes in support of tailoring land-use policies. Environ. Res. Lett. 18 060202, https://doi.org/10.1088/1748-9326/acd802.

Sietz, D., Klimek, S. and Dauber, J. (2022) Tailored pathways toward revived farmland biodiversity can inspire agroecological action and policy to transform agriculture. Nature Communications Earth and Environment 3:211, https://doi.org/10.1038/s43247-022-00527-1.

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www.twitter.com/ae4eu_H2020
www.youtube.com/channel/ UCOsUVqM8tOhE28Gr2xcp2_w

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