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Agroecological Adoption Pathways in Europe: Drivers, Barriers, and Policy Implication Opportunities in the Czech Republic, Hungary, and Portugal

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Abstract

Agroecology offers a transformative pathway toward sustainable food systems by integrating ecological, economic, and social dimensions of farming. While its conceptual and policy foundations are increasingly recognized in European Union (EU) strategies, the practical adoption of agroecological principles at the farm level remains uneven, particularly in socio-economically peripheral Member States. This article investigates the enabling and constraining factors of agroecological uptake in three EU countries - Czech Republic, Hungary, and Portugal. Combining literature review, national policy mapping, and 42 in-depth farmer interviews, the study identifies shared challenges such as limited institutional coordination, subsidy dependency, and structural inequalities in land ownership. Despite these constraints, country-specific dynamics - such as farmer-to-farmer learning in Portugal, family farm identity in Czechia, and high trust in advisors in Hungary - reveal unique pathways for agroecological transition. The findings highlight that systemic barriers, rather than conceptual misunderstandings, impede agroecological adoption, and that context-sensitive strategies are essential for meaningful transformation. The paper contributes to the literature by providing empirical insight into farmer attitudes and practices in Central and Southern Europe and by offering actionable recommendations for designing policies and training aligned with agroecological values.

Keywords: transition to agroecology; adoption barriers; sustainable farming; farmers' agroecological attitude

1. Introduction

There is a consensus among supranational agencies and conventions monitoring food and the environment (e.g., [1–3]) that the global food system is failing. It is responsible for 26% of the global greenhouse gas emissions, it uses 70% of global freshwater sources, producing water stress and pollution, and it is a driver for deforestation and loss of biodiversity [4]. At the same time, it is falling

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short in several crucial aspects, such as addressing hunger and malnutrition, ensuring the sustainability of agricultural livelihoods, and mitigating the environmental impact of agriculture. Meeting the challenges of enduring malnutrition and rural poverty, compounded by the escalating effects of climate change, requires a significant and profound transformation [5].

The European Union acknowledges the significant role of food systems in contributing to climate change, water stress, and pollution, while also recognizing their potential to address and reverse these challenges. The EU's sustainability goal involves transforming food systems to bring about environmental, health, social, and economic benefits, with a specific emphasis on rectifying issues like the low income of small-scale producers and their limited market access. The Farm to Fork Strategy, for instance, states that the EU will support the global transition to sustainable food systems, in line with its objectives and the Sustainable Development Goals (SDGs) [6], improving nutrition and alleviating food insecurity by strengthening the resilience of food systems and reducing food waste, with an emphasis on cooperation in the area of agroecology. This reflects the EU's shift towards a more comprehensive, resilient, and sustainable approach, placing food systems and their stakeholders at the core of a green, just, and inclusive transition.

Beyond climate change, depressed farming regions, which are typically socio-economically disadvantaged and politically neglected, face persistent challenges. The most disadvantaged individuals, often engaged in agriculture or related activities, confront systematic exposure to social, economic, and environmental risks. The persistent vulnerability of these rural populations leaves them inadequately prepared to cope with the impacts of climate change and other socio-economic shocks [7].

Agroecology has emerged as an alternative paradigm to food and farming for food system transformation [8], evolving over the years and across territories, not only in its conceptualization but also at the level of scale and dimensions within which it is understood: from a purely scientific discipline to a set of more ecological agricultural practices, and finally to a movement that works towards achieving food sovereignty [9]. In recent years, it has been ever more strongly promoted and legitimized by the interaction of different social actors such as social movements, farmer organizations, institutions, and academia [10].

According to [11], the application of agroecology has changed at different scales. While in the beginning the focus was only on the plot level (1930s - 1960s), later it was also considered how the plot influenced and in turn was influenced by its surrounding ecosystem (1970s - 2000). Currently, the application of agroecology has shifted to a food system level, with [12] defining it as the integrative study of the ecology of the entire food system, merging ecological, economic, and social dimensions.

The highly territorial and context-dependent nature of agroecology makes it challenging to establish a single, universal concept that encompasses all ecosystems and social actors where it is applied. Therefore, for this article, the definition developed by Agroecology Europe is used:

Agroecology is considered jointly as a science, a practice, and a social movement. It encompasses the whole food system from the soil to the organization of human societies. It is value-laden and based on core principles. As a science, it prioritizes action research, holistic and participatory approaches, and transdisciplinarity, including different knowledge systems. As a practice, it is based on the sustainable use of local renewable resources, local farmers' knowledge and priorities, the wise use of biodiversity to provide ecosystem services and resilience, and solutions that provide multiple benefits (environmental, economic, social) from local to global. As a movement, it defends smallholder and family farmers, rural communities, food sovereignty, local and short marketing chains, diversity of indigenous seeds and breeds, healthy and quality food [13].

In the context of the Agroecological Vocational Training for Farmers nº2019-1-HU01-KA202-060895 (trAEce) project (see below), the consortium has applied the following definition of agroecology as the most appropriate for partners' regional context based on a literature review, a geographic background analysis and the combined input of our diverse project team members: "Agroecology is considered jointly as a science with a transdisciplinary, participatory and action

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research approach to research the farms ecological relationships as well as the sustainability of the whole food system; a practice that nurtures soil ecosystems, nutrients' recycling, the conservation of energy at all scales and the dynamic management of biodiversity; and a social movement reshaping the relations within the food system, promoting proximity and solidarity between consumers and producers, both challenge and transform power structures in society and thereby fostering food sovereignty leading to self-governing communities loosening corporate control of food." [14].

The trAEce project's vision was to equip farmers and trainers with tools that support them in the transition of agricultural practices toward agroecological principle—embracing not only environmental but also social dimensions—and to share this knowledge and experience across European farming communities. It aimed to advance the understanding of agroecology as both a discipline and a practical approach, drawing on the expertise of six leading institutions from five European Union member countries (Hungary, Romania, Austria, Czech Republic, and Portugal). Each partner conducted a country-specific analysis to assess farmers' knowledge, perceptions, and experiences with agroecology, while also mapping relevant policies, regulations, actors, networks, and practices. Insights from these analyses served as the foundation for creating a vocational training program in agroecology.

While the theoretical and policy rationale for agroecology is increasingly well-established, its practical adoption across Europe remains uneven and poorly understood. Despite the growing interest in agroecology within international and EU frameworks, empirical research on actual uptake at the farm level—particularly in socio-economically vulnerable and institutionally peripheral EU countries—is still limited. Most existing studies focus on conceptual advances or success stories in Western and Northern Europe, leaving significant knowledge gaps regarding the specific drivers, constraints, and lived experiences of farmers navigating agroecological transitions elsewhere. Furthermore, the role of farmer attitudes, knowledge exchange, and policy support mechanisms in shaping agroecological adoption has received inadequate attention.

This research seeks to generate empirically grounded insights into the enabling factors shaping agroecological adoption in EU contexts, with the objective of informing policy tools and support mechanisms that can strengthen agroecological transitions.

Agroecology in the European Union with special focus on the three selected countries (Czech Republic, Hungary and Portugal)

Agroecology (AE) is increasingly spreading across Europe, as evidenced by numerous examples presented by [15]. However, its evolution and thus its level of adoption differ by country.

The AE term was first used by Russian, German, French, and Italian scientists in the 20s and 30s of the last century [16,17], but the AE concept was barely known in Europe until a few years ago [18]. In Eastern Europe, the agroecology concept became popular starting in the 1990s.

The OEP (Osservatorio Europeo del Paesaggio) report [19] indicates that, historically, a pattern developed across Europe whereby science and practitioners work on agroecology mainly within their fields. It also shows that several movements have emerged in recent years, such as the European Coordination of La Via Campesina [20] and Friends of the Earth Europe [21]. The AE movement is strongly represented in Spain, where the first School of Agroecology at the University of Andalucia has existed for more than 30 years [22]. However, surprisingly, this development has not yet had an impact on other European countries, having only just been initiated in France [23].

The scientific dimension of agroecology is currently well-recognized In Europe [16]. As a result, AE is predominantly understood as a science, followed by its perception as a practice, and its recognition as a movement can only be found in third place [9]. The latter authors distinguish three groups of European countries with regards to their acceptance of AE: in the first group - Romania, Portugal, and the Netherlands - AE is conceived as a science; in the countries of the second group - Switzerland, Poland, Denmark, Germany, United Kingdom, Austria, and Spain – AE is considered primarily a science, but also a practice, and limitedly perceived as a movement; the third group - Finland, Slovakia, Iceland, Ireland, Lithuania, Belgium, Czech Republic, Norway, Hungary, Sweden, Italy, and France - deem AE primarily a practice, followed by science and lastly movement.

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AE in Europe is based on a multiplicity of agricultural practices, which have appeared, on the one hand, as a response to the growing dependency on external factors and, on the other hand, as a response to the unequal value distribution in agricultural supply chains [24].

Despite the differing definitions of AE in Europe, and since cooperation is essential for operationalizing it, the development of networks at different levels has kicked off, of which a good example is Agroecology Europe [15]. The Association aims to promote the agroecological transition in the continent and foster interactions among stakeholders and disciplines [25]

As several institutions in Europe conduct research on agroecology, the publication activity has significantly expanded in the last two decades [26]. [15] state that research in this field is well-developed and structured. They also conclude that agroecological research and higher education are most characteristic of Western and Northern Europe. This probably can be explained by the fact that AE is less developed and applied in Eastern Europe. Notwithstanding, agroecology has been developing in Eastern Europe since the 1990s, closely linked with the increase in sustainable agricultural activities in general and with the growth of organic farming in particular [27].

Agroecology-related national programs, policies, and action plans have been initially developed in only a few European countries (France, Denmark, and Italy), which might be explained by the lack of an explicit EU strategy for AE [28]. However, according to the new Common Agriculture Policy framework countries had to incorporate AE aspects in the 2021/2023-2027 CAP Strategic Plans through the eco-schemes.

Agriculture remains a significant sector in the Czech Republic, with over half of the land under cultivation. However, 89% of arable land is controlled by large-scale industrial farms, mostly under leasing arrangements, limiting access to land for smallholders and new entrants (access to land, n.d.; [29]. Land ownership is highly fragmented, while high prices and insecure tenancy present further barriers to agroecological adoption.

Agroecology has intensified institutional presence since the 1990s, especially in higher education and research institutions: Mendel University in Brno offers accredited study programs in agroecology at both the bachelor's and master's degree levels. Mendel University also offers short courses as part of its lifelong learning programs, covering topics such as sustainable cultivation practices and permaculture. The university has a robust research capacity, as well as strong teaching programs in soil science, ecology, and plant nutrition. The Czech University of Life Sciences in Prague provides a new online master's study program in tropical agroecology. The University of South Bohemia offers an accredited program in agroecology at the bachelor's, master's, and doctoral levels. The program combines agroecology and applied ecology. Other study programs, such as multifunctional agriculture at the University of Bohemia, offer courses that deal with sustainable farming practices, organic farming, and agroecological principles. These formal courses are supplemented through non-formal training initiatives spearheaded by entities like AMPI as well as PRO-BIO, which deal in soil health, resilience to climatic stress, as well as sustainable production. [30,31].

Policy instruments that implicate agroecology remain the CAP Strategic Plan 2023–2027[6], Agro-environmental–climate Measures (M10), as well as the Rural Development Programme (2014–2020), institutionally supported by the Ministry of Agriculture (MZe), Ministry of Environment (MŽP), as well as Institute of Agricultural Economics as well as Information (ÚZEI) [32]. Though these instruments promote sustainable production as well as organic production, there is no specialized national agroecology platform.

Hungary possesses a rich institutional background in agriculture and research, yet agroecology is still at a developmental stage [33]. AE is often understood narrowly as a scientific or technical discipline, with social and systemic dimensions largely underrepresented [34]. According to recent researches, there is no change in this attitude: A bibliometric analysis which examines the relationship between agroecology and public policies worldwide found that fields such as sociology, public administration, and economics remain underrepresented, although interdisciplinarity is a defining feature of agroecology [35].

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Formal AE education is still fragmented: although no full-degree BSc or/and MSc programs exist, related courses are offered at higher education institutions such as Hungarian University of Agriculture and Life Sciences (MATE), University of Debrecen, University of Nyíregyháza, University of Szeged, University of Pécs, University of Sopron, University of Miskolc, University of István Széchenyi, University of Pannonia, Budapest Business University, and Edutus University [36]. As a promising step toward the progressive integration of agroecology into Hungarian higher education can be mentioned e.g. the MATE's two postgraduate study programs (Organic Farming and Biological Soil Fertility Management) as well as the inception of a specific agroecology-dedicated MSc program design. Adult and non-formal training programs cover topics such as community-supported agriculture, soil management, and permaculture, often as part of EU-funded projects. Civil organizations like ESSRG, Védegylet, and Kislépték play critical roles in AE promotion and policy advocacy [37,38].

While Hungary's past programs (e.g., the National Agri-environmental Program, VP AKG1 and AKG2) supported organic and ecological practices, AE is still not explicitly recognized in national policy. The new Agro-ecological Program, launched in 2023 under the CAP 2023–2027, introduces eco-schemes that could incentivize agroecological practices [39]. Hungary is among the six Member States (others include Czech Republic, France, Ireland, Netherlands, Slovakia) that adapted a multi-dimensional eco-scheme offering a package of options. In addition, the Hungarian eco-scheme is points-based (similar to the Dutch), allowing farmers to earn points based on the perceived environmental impact of practice packages. This adds nuance and also assigns importance on proper scoring and outreach to farmers [40]. However, actual impact will depend on implementation and farmer engagement [41,42].

The creation of the Hungarian Agroecology Network in 2020—with over 60 active members including farmers, researchers, and NGOs—marks a significant milestone in promoting agroecological transition [29]. The 2023 Agroecology Europe Forum in Hungary further strengthened its visibility and collaboration potential.

Portugal's agricultural sector exhibits significant structural imbalances: although 71.5% of farms are smaller than 5 hectares, they account for only 9.1% of the total agricultural land. In contrast, farms larger than 50 hectares represent just 4.2% of all farms, yet they cover an impressive 66.9% of the total agricultural area [43]. This disproportion, together with the demographic challenges of an ageing population and the erosion of traditional agroecological knowledge, is hindering agroecological transitions [44,45]. Nevertheless, while small-scale family farming with ancestral practices can still be observed [45], an increasing number of young adults, both Portuguese and foreign, are returning to rural areas to start agroecological projects [46,47]. After Portugal's accession to the EU in 1986 and the financial crisis of 2008–2013, many smallholders also returned to farming, reviving interest in sustainable models [48,49].

Although a unified agroecology movement is still emerging, several grassroots initiatives have gained momentum. CNA (Confederação Nacional de Agricultura), which represents small-scale farmers and is affiliated with La Via Campesina, has embraced agroecology in the context of food sovereignty [50]. The AMAP (Community Supported Agriculture) movement also promotes agroecology as one of the foundational principles of this community-supported agricultural model [50]. Importantly, two large civil society events called "Confluências pela Agroecologia" (Confluences for Agroecology) were organized in 2023 and 2025, marking the first steps towards establishing a much-needed national agroecology network, deemed an accelerator of the agroecological transition in Portugal [51].

Public education related to agroecology is mainly offered at polytechnic institutes. In 2024, the Polytechnic Institute of Viseu hosted the 10(th) International Agroecology Congress, marking the first time it was held outside of Spain.

An emerging institutional framework is also taking shape: In 2018 the Family Farming Statute was approved in the National Parliament (Decree 64/2018) and in 2020 the Ministers Council passed the National Organic Farming Strategy and the Innovation Agenda for Agriculture 2020–2030

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(Resolution No. 86/2020). Within the latter Agenda a public structure was set up in 2021 named Centro de Competências para a Agricultura Familiar e Agroecologia (CeCAFA: Competence Center for Family Agriculture and Agroecology) as part of the national network for agricultural innovation and research centers. In spite of the fact that this was a governmental initiative, it is one of the few national competence centres that does not receive dedicated funding or institutional backing [52]. Finally, in recent legislation, such as the 2023 amendment to Law 151/2016, the Agricultural and Forestry Advisory System (SAAF) was established to support the integration of agroecology into agricultural advisory services [53]. While these policy instruments recognise AE principles, they lack robust implementation mechanisms.

Agroecology is progressively emerging across the three countries through academic programs, grassroots networks, and some policy instruments. However, widespread adoption remains constrained by structural land inequalities, limited institutional coordination, and the persistence of conventional farming paradigms. Nonetheless, farmer-led initiatives and civic engagement provide an important foundation for further agroecological transformation.

Policy Context for Agroecology

Although there is no unified legal framework explicitly defining agroecology at the EU level, the concept is increasingly referenced in EU strategic documents and funding mechanisms as a tool for sustainable agricultural transformation [54–56]. Agroecology is mentioned in a limited number of secondary legal acts, such as Regulation (EU) 2021/2115, where it is framed as a specific best practice addressing societal demands on food and health and contributing to climate and environmental goals.

The European Green Deal, adopted in 2019, seeks to make the EU climate-neutral by 2050. Central to this goal is the transformation of the food system, as outlined in the Farm to Fork Strategy, which promotes reduced pesticide use, lower antimicrobial dependency, increased organic farming (targeting 25% of agricultural land by 2030), and biodiversity restoration [57](European Commission, 2021b). Agroecology aligns strongly with these priorities, offering a systemic approach to integrating ecological, economic, and social dimensions in food systems [5,58–61].

The CAP 2023–2027 includes environmental sustainability objectives that resonate with agroecological principles, particularly within its so-called "green architecture." In Pillar I there are mandatory and voluntary measures as well. According to Article 12 of 2021/2115/EU a conditionality was introduced. The latter means that Member States shall include in their CAP Strategic Plans a system of conditionality under which farmers are subject to an administrative penalty if they do not comply with the statutory management requirements (SMR) under the good agricultural environmental conditions (GAEC) standards. These conditions, established in the CAP Strategic Plans, are relating among others to the climate and the environment, including water, soil and biodiversity of ecosystems.

Another essential novelty in the new green architecture is so called eco-scheme, a voluntary element within the Pillar I. which, however, Member States are obliged to develop and offer to farmers as an option. It is a payment to farmers who implement practices beneficial to the environment and climate [62]. At least 25% of direct payments are to be allocated to these schemes [39]. Pillar II offers longer-term agri-environment-climate commitments, which fund voluntary practices that go beyond statutory requirements [62].

Despite these policy openings, most Member States—including Hungary and Portugal—have incorporated only fragmented agroecological elements into their CAP Strategic Plans [41]. According to the current EU regulation 'Member States shall establish, and provide support for, voluntary schemes for the climate, the environment and animal welfare ('eco-schemes')' and these schemes shall cover at least two areas of actions for the climate, the environment, animal welfare and combatting antimicrobial resistance. In Hungarian practice a so-called agroecology program was established. Farmers can apply for additional financial support, similar to the first pillar basic income support, if they undertake practices beyond the mandatory conditionality practices. The packages of

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practices are available to everyone in all three land use categories: arable land, plantation and grassland. Among the optional elements there are progressive practices, such as mulching, crop diversification, field size limitation and biodiversity protection or even the use of no-tillage techniques. However, the experience of the past three years since the launch of the program shows that farmers tend to choose practices that are less costly and easier to implement. As a result, the program has not led to a significant change in their attitudes [63].

The regulatory flexibility granted to Member States means that support for agroecology remains inconsistent and often marginal relative to conventional agriculture. Furthermore, structural support mechanisms continue to favor large-scale industrial farms, limiting access to CAP resources for smaller, agroecology-oriented operations [28,64].

Since 2018, there has been some progress in integrating agroecology into EU policy—for example, the EU officially launched the Agroecology Partnership in 2024, fostering Living Labs, research infrastructures, and coordinated funding mechanisms. While some countries—such as France, Italy, and Denmark—have taken initial steps to formalize agroecology in national frameworks, other Central and Eastern European countries still lack strong legal recognition, dedicated national programs, or targeted support, meaning that much of agroecology's integration remains aspirational [5,27,65].

Consequently, although the EU's evolving policy environment offers potential pathways for agroecological adoption, the lack of a coherent legal definition, consistent implementation, and institutional support continues to pose significant barriers across much of Europe.

Objectives of the study

This study aims to:

1. Identify the institutional, socio-economic, and attitudinal drivers and barriers influencing agroecological adoption at the farm level in three EU Member States: the Czech Republic, Hungary, and Portugal.
2. Provide empirical insights into the perceptions and experiences of farmers with regard to agroecology.
3. Compare national policy contexts and their alignment with agroecological principles.
4. To provide evidence-based insights for the development of supportive policy tools enabling agroecological transitions.

2. Materials and Methods

The purpose of the personal consultations with farmers presented below was to assess their opinions on agroecology and local conditions. The questions examined farmers' general knowledge of the concept of agroecology, which elements of agroecology they apply in practice, what motivates them to adhere to the principles of agroecology, what hinders them from doing so, and much more. Accordingly, we conducted 42 interviews (17 Hungarian, 13 Portuguese, 12 Czech). By analyzing the summary of the interviews, it was possible to highlight the strengths and weaknesses characteristic of the farmers' different approaches and attitudes, while also keeping in mind their development needs.

To answer the research questions, we chose in-depth interviews as our primary research tool, as this is particularly effective in exploring personal motivations, the reasons behind actions, and behaviors in a given research area. [66]. Qualitative interviews are recognized as a sensitive and powerful technique for understanding individual experiences, allowing participants to articulate their perspectives in their own words [67,68].

Interviewees represented diverse farm typologies and were selected through stratified purposive sampling. In selecting interviewees, it was a priority to engage with a diverse group which would provide a comprehensive picture of agriculturists' different conceptual approaches to farming, level of professional knowledge and willingness and openness towards new practices, however this paper focuses their attitude as it is crucial in the agroecological transition [69]. Accordingly, the study did not focus specifically on organic farmers, as organic farming is identified with agroecology in

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many countries and the four principles of organic farming (health, ecology, fairness, and care) are already reflected in agroecological practices. There was a particular interest in assessing the opinions and farming environment of conventional farmers, in the hope of gaining a better understanding of attitudes towards agroecology among stakeholder groups who are not necessarily expected to be familiar with the concepts or practices. The interview questionnaire was designed to include arable crop producers, vegetable growers, fruit growers, livestock farmers and farmers of mixed farms, while also focusing on surveying farms of different scales (with land size categories of less than 75 hectares; between 75 and 200 hectares, and land with more than 200 hectares). In general, while being guided by a set of baseline questions, the length and level of detail of interviews and transcriptions varied, as both were influenced by the personality, openness and agroecological awareness of the interviewee, and the style of interviewers. Interview durations ranged between 45 and 90 minutes. Information obtained during interviews was summarized by interviewers and systematically interpreted to develop a descriptive matrix which included a synopsis of the attitude of farmers along with suggestions for improvement. The risk of researcher bias was minimized by team discussions and by applying standardized protocols. Interviews covered four main sections: (1) farm and demographic profile - 5 open-ended and multiple-choice questions; (2) attitudes toward agroecology - 17 open-ended questions; (3) knowledge and learning - 29 open-ended questions; and (4) skills and practices - 9 open-ended questions. Some of the interview questions were specific to the farm profile (e.g. large, 200< arable farm; small, <=20 field vegetable farm; medium, 50 < <=150 pig farm etc.) .

The responds were evaluated according to the following aspects:

Activity, sustainable farming practices, sustainability challenges of the farm

Self-perceived attitude, knowledge and skills of the farmer, and their presence and application in everyday practice

Agroecology attitude, knowledge and skill elements considered as important by the farmer

Needs and ideas of the farmer for further improvement.

On the basis of the improvements highlighted during the interviews, the research team delineated the main focus areas concerning farmers' attitudes.

Agroecological Evaluation of Farms

A structured content analysis was performed, using a hybrid approach combining inductive (data-based) and deductive (theory-based) coding. The interview summaries were entered into a shared Excel matrix, in which predefined categories were aligned with four dimensions of analysis: (1) agricultural activities and sustainability practices, (2) self-perception, knowledge, and skills, (3) agroecological orientation, and (4) desired and suggested improvements. (The interview summaries were compiled into this shared Excel matrix, with statements organized into rows and coded into thematic categories in columns.) This provided a consistent framework for comparing responses across interviewees and countries. Coding was performed manually by researchers, and newly emerging themes were discussed in weekly team meetings to ensure consistency and uniformity of interpretation. To avoid overrepresentation of recurring ideas, only newly formulated statements were entered into the matrix. Instead of counting frequency, presence/absence analysis was used. To enhance reliability, initial codes and interpretations were compared and discussed among the research team. Diverging interpretations were resolved through consensus in team debriefings. Although inter-coder agreement was not statistically measured, internal validation ensured shared understanding and minimized researcher bias.

3. Results

Hungary – Strengths in Farming Practices and Farmers' Attitudes

Hungarian farmers exhibit a growing openness to continuous learning, particularly through practice-oriented training formats. Interviewees expressed a clear preference for concise, in-person training sessions that include field demonstrations, provided these align with seasonal agricultural

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schedules. Respondents articulated an interest in skill development not only for managerial effectiveness but also for enhancing the economic viability of their farms.

Knowledge transfer is primarily facilitated through professional advisory services and consultants, whom farmers generally trust and are willing to remunerate. While advisory relationships are seen as effective in disseminating best practices, respondents noted that such services often lack sufficient capacity and expertise in agro-environmental, organic, and sustainable farming systems.

A noteworthy attitudinal strength among respondents is their expressed commitment to land stewardship, particularly among landowner-operators. This includes an intergenerational ethic focused on preserving soil health and the broader agroecosystem. Farming is frequently conceptualized not merely as an economic activity but as a lifestyle with socio-cultural dimensions. Farmers acknowledged the importance of their role as exemplars for younger generations and as contributors to local development. A nascent interest in peer cooperation and local impact was also observed, albeit limited by structural and relational constraints.

Hungary – Weaknesses in Agroecological adoption and farmers' attitudes

Agroecology remains a relatively novel and fragmented concept within the Hungarian agricultural sector. Decision-making continues to be driven predominantly by short-term economic considerations, particularly among larger and more intensively managed operations. Many respondents indicated that while they are aware of the principles underlying agroecology, they are hesitant to adopt these practices due to perceived risks to yields and efficiency. Rather than reducing external inputs, there is a tendency to compensate for technological or environmental challenges with increased chemical usage.

A further limitation is the underutilization of rural development programs aimed at fostering social benefits through agriculture. Farmer participation in cooperative structures or professional networks remains low, constrained by both limited institutional support and a lack of interpersonal trust. Advisory services, while generally respected, are not uniformly perceived as accessible or tailored to local needs. Older farmers in particular tend to express skepticism toward new practices and innovations.

Desired Improvements as Articulated by Hungarian Farmers

Interviewees identified a range of areas where improvements in knowledge, skills, and attitudes could facilitate a shift toward more sustainable practices. Notably, many farmers expressed the need to reconcile economic performance with environmental responsibility. Increased awareness of the often-hidden externalities associated with conventional farming was seen as crucial. Respondents emphasized the value of diversifying activities, applying systems thinking, and enhancing the social relevance of farming through local employment and community engagement.

The development of risk-sharing partnerships was also seen as a priority to lower barriers to experimentation and support innovation adoption. Farmers emphasized the need for accessible, field-based learning structures and more integrated support services.

Hungary - Proposed Improvements Based on Synthesis

Beyond the improvements identified by farmers themselves, the synthesis of findings suggests that future agroecological programs should cultivate farmers' intrinsic motivation for ecological and social performance alongside technical advancement. Training initiatives must not only provide technical knowledge but also promote a holistic, ethics-based understanding of sustainability.

It is imperative to strengthen the role of advisory systems in promoting soil conservation, input rationalization, and overall resource efficiency. These achievements should be sequenced in a way that fosters progressive engagement, requiring both openness and long-term commitment. A curriculum targeting practicing farmers should embed principles of continuous learning, ecological resilience, and community-based innovation.

Czech Republic – Strengths in farming practices and farmers' attitudes

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Respondents in the Czech Republic predominantly operate family farms, which they view as advantageous due to the autonomy, responsibility, and regional embeddedness such structures afford. A strong sense of identity with the land, landscape, and livestock was evident across responses. Many interviewees emphasized their pursuit of management specialization and reported confidence in their own competence, particularly in domains where they felt well-trained.

Organic producers highlighted the dual benefits—economic and environmental—of their farming systems. The sample was largely composed of younger, formally educated farmers with significant practical experience. Many reported a relatively high application rate of organic fertilizers, particularly on arable land, as a perceived strength of their operations.

Czech Republic - Weaknesses in Agroecological Adoption and Farmers' Attitudes

A critical limitation noted across interviews is the low degree of cooperation among farmers. Despite their autonomy, many respondents are heavily reliant on national and EU subsidy schemes. Economic constraints and policy frameworks oriented toward market crops contribute to a prioritization of production intensity over environmental sustainability, particularly in conventional systems.

Narrow crop rotations and limited diversification persist as common challenges. Achieving feed self-sufficiency is often unfeasible due to land constraints or structural inefficiencies. The absence of local processing capacity compels many farmers to sell through intermediaries, resulting in diminished profit margins. Moreover, farmers expressed that time constraints due to farm responsibilities impede their capacity to seek new information or engage in policy navigation. Leased land is common, creating financial burdens and fostering competition for access and tenure rights.

Desired Improvements as Articulated by Czech Farmers

Interviewees emphasized the need for significant reductions in bureaucratic complexity and greater transparency regarding access to support schemes. They expressed frustration with the time required to remain compliant with administrative obligations, particularly for smaller-scale operators.

Many also highlighted the difficulty of investing in on-farm processing infrastructure, even when capital is available. Selling through intermediaries was identified as a source of inefficiency, and farmers called for fairer and more direct trading relationships.

Czech Republic - Proposed Improvements Based on Synthesis

Structural constraints—including land access, processing infrastructure, and unbalanced competition—limit the viability of small family farms. Greater support is needed to rebalance market structures and safeguard farmers' positions within land, product, and capital markets. Policy instruments should not only address productivity but also contribute to rural development, demographic retention, and the continuity of rural traditions. Agroecological adoption in this context is contingent upon structural reform and institutional support that enables family farms to thrive as agents of sustainable landscape management.

Portugal - Strengths in Farming Practices and Farmers' Attitudes

Portuguese respondents articulated a holistic, regeneration-oriented worldview, embedding agroecological practices within broader efforts to combat climate change and restore socio-ecological systems. Practices such as tree planting, landscape rehabilitation, and reductions in fossil fuel use were seen not only as agronomic strategies but as moral imperatives aligned with intergenerational responsibility.

Interviewees demonstrated strong identity-based motivations and conceptualized agriculture as a cultural and communal act. Peer-to-peer knowledge exchange—facilitated by networks, associations, and civil society—was widespread and considered highly effective. Collaboration

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extended to universities, municipalities, and activist groups, indicating a broad multi-actor engagement.

Market orientation was food-centric, focused primarily on domestic and local consumption. Some respondents also engaged in value-added processing and maintained traditional labor practices (e.g., manual harvesting) to reinforce cultural continuity and local employment.

Portugal - Weaknesses in Agroecological Adoption and Farmers' Attitudes

Time constraints were a recurrent theme, particularly regarding participation in formal training. Collective farming arrangements were rare, and some respondents described limited cooperation with neighbors due to entrenched conservative mindsets.

Subsidy dependence remains high, particularly through agro-environmental or young farmer schemes. A divide was observed between (i) farmers seeking to balance income generation with sustainability, and (ii) so-called "lifestyle" regenerative farmers, often financially supported by off-farm income or educational activities. The latter group, while embodying the ideals of agroecology, was noted to prioritize exemplarity over movement-building, limiting broader systemic impact.

Desired Improvements as Articulated by Portuguese Farmers

Respondents emphasized the need to strengthen relationships between producers and consumers in order to enhance trust and support the expansion of short food supply chains. Both farmers and stakeholders highlighted the importance of recognizing farmers as central actors in food system transformation and ensuring fair compensation for their efforts.

Key actors called for improved cooperation among farmers, underlining the importance of collective action for achieving transparency, fair pricing, and mutual accountability throughout the value chain. Consumer education was also identified as essential for raising awareness about the environmental and social dimensions of food production.

The co-development of agroecology training programs—jointly designed by municipalities, cooperatives, farmer associations, and vocational institutions—was proposed as a mechanism to support adoption and skill development.

Portugal - Proposed Improvements Based on Synthesis

Portuguese farmers must be equipped to recognize farming as an interconnected activity influencing biodiversity, soil health, climate change, food security, and local livelihoods. Agroecology should be framed not only as a technical alternative but also as a systemic paradigm encompassing ethics, equity, and place-based development.

Food must be treated as a common good, not merely a commodity. Building trust-based farmer–consumer relations is essential for scaling alternative markets. Farmers also require tools and training to make networking and cooperation more efficient. Finally, greater societal recognition of farmers as stewards of ecosystems and providers of public goods is essential for raising the professional and economic status of agroecological farming.

The operational definitions and a summary table about the results can be found in the Appendix A.

4. Discussion

This study highlights that in three selected EU countries—Hungary, the Czech Republic, and Portugal—the spread of agroecological approaches is shaped less by the awareness of individual farmers than by broader institutional, structural, and sociocultural contexts. In all three countries, farmers expressed their commitment to responsible farming and their openness to learning, but their ability to put this into practice was influenced by the specific paths taken by each country. We identified three general patterns: advisory-dependent learning systems (Hungary), structural and institutional constraints (Czech Republic), and network- and identity-based transitions (Portugal).

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Hungary: advisory-dependent learning systems. Hungarian farmers rely heavily on professional advisors for knowledge transfer, reflecting a "knowledge broker" model in which application depends on the credibility and capabilities of the intermediaries [70].

This suggests that the advisory infrastructure in Hungary is both a strength and a bottleneck: while trust in advisors promotes learning, limited advisory capacity on agroecological practices hinders their adoption. This finding is consistent with studies examining the importance of advisory activities in shaping behavioral change. [71,72]. Future implementation depends on whether advisory services extend to agroecological expertise and risk-sharing demonstration platforms.

Czech Republic: structural and institutional constraints. In the Czech Republic, family farms demonstrate flexibility and commitment to land management, but face systematic barriers in market structures, bureaucratic frameworks, and land tenure systems. Farmers are constrained by narrow crop rotation patterns, dependence on subsidies, and dependence on intermediaries for processing and marketing. These findings are consistent with the literature on "constraints" [73], where institutional and structural dependencies restrict transitions even when individual motivation exists. Policy interventions that reduce administrative burdens and restore power balances in land and product markets are therefore essential for implementation. Without structural reforms, family farms risk being marginalized in an agricultural sector dominated by large-scale, input-intensive enterprises.

Portugal: network- and identity-based transition. Portuguese farmers embed agroecology in a broader cultural and regenerative identity, emphasizing intergenerational responsibility, food as a public good, and collaboration through networks and civil society. This dynamic reflects a path of "networked transition," where adoption is driven not only by technical practices but also by values, identities, and social movements. [74]. The presence of experimental centers (e.g., agroforestry) indicates a willingness to innovate despite the risks, facilitated by peer-to-peer learning and civic engagement. However, dependence on subsidies and the continuing divide between subsistence-oriented and "lifestyle-oriented" regenerative farmers highlight the tensions between symbolic and systemic transformation. Even if grassroots networks are strong, agroecology may remain marginal without institutional embeddedness and formal support structures.

Overall, these pathways show that the adoption of agroecology cannot be understood solely as a question of farmers' attitudes or technical awareness. Instead, it is determined by the interaction between advisory systems, institutional structures, and social networks. The comparative analysis highlights three key findings:

Systemic support is more important than awareness. Farmers in all three countries showed openness to sustainable practices, but the institutional, advisory, or market conditions for widespread adoption were lacking.

There are different transitional barriers. In Hungary, the barrier lies in advisory capacity, in the Czech Republic in structural inequalities and bureaucracy, and in Portugal in the compatibility of practices based on local identity and economic viability.

One-size-fits-all EU policies risk missing these national dynamics. Instead, interventions should be designed around country-specific adoption pathways, strengthening advisory capacity in Hungary, reducing lock-ins in Czechia, and consolidating networked movements into institutional frameworks in Portugal. This analysis advances the literature on agroecology in Europe by proposing that adoption trajectories can be categorized into distinct pathways of transition, shaped by institutional context rather than farmer-level variables alone. While much of the existing literature emphasizes conceptual advances or Western European cases [16,75], our findings contribute an empirically grounded understanding of adoption in less-represented EU contexts. By framing Hungary, Czechia, and Portugal as examples of advisory-dependent, structurally locked-in, and network-driven pathways, respectively, this study provides a comparative lens that can guide both scholarship and policy design across diverse European settings.

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5. Conclusions

This study shows that in the Czech Republic, Hungary, and Portugal, the transition to agroecology depends not so much on farmers' awareness as on systemic conditions that determine the feasibility of the transition. In all three countries, farmers demonstrated responsible farming values and a willingness to learn, but the transition took three different paths.

These paths underscore that agroecology in Europe cannot be promoted through general, one-size-fits-all measures. Instead, targeted approaches are needed:

In Hungary, strengthening advisory capacity with agroecological expertise and practical demonstration sites is essential to move beyond technology transfer towards systemic learning.

In the Czech Republic, structural reforms are needed to reduce bureaucratic burdens, balance land and market inequalities, and support family farms as anchors of rural development.

In Portugal, the challenge lies in integrating dynamic local networks and cultural identity into institutional frameworks that ensure a decent livelihood and prevent agroecology from playing a marginal or symbolic role.

At the European level, the findings call for a recalibration of the Common Agricultural Policy and related strategies to recognize differentiated adoption pathways. While the EU's Green Deal and Farm to Fork Strategy offer a promising policy frame, their implementation must account for advisory, structural, and networked contexts that determine how farmers can engage with agroecology.

By comparing three underrepresented EU contexts, this study advances understanding of agroecological transitions in Europe. It highlights that adoption is shaped by institutional configurations—advisory infrastructures, structural lock-ins, and social networks—rather than farmer attitudes alone. Recognizing these distinct pathways provides a conceptual lens for future research and a practical guide for tailoring policies, training, and support mechanisms to diverse regional realities.

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Appendix A

Appendix A.1

Table A1. Operational Definitions (Qualitative).

Category	Operational Definition
Strengths	Farmer attitudes, capacities, and practices that facilitate agroecological adoption. These are positively valenced features evidenced in the interviews

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	(e.g., behaviours or routines currently performed effectively in day-to-day operations).
Weaknesses	Farmer attitudes, constraints, and practices that impede or are misaligned with agroecological adoption. These are negatively valenced features identified in the interviews (i.e., barriers or suboptimal practices relative to agroecological principles). Avoids normative phrasing like 'doing it wrong.'
Desired improvements	An unfiltered inventory of farmer-expressed needs, preferences, and ideas for change (skills, supports, conditions). Items are as reported by farmers and are not prioritised or weighted.
Proposed improvements	A synthesised set of recommendations combining (i) farmer-expressed needs deemed relevant, (ii) competencies highlighted in the literature, and (iii) country-specific attitudinal context (areas of improvement). This is an analytic integration, not a direct tally of interview mentions.

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Table A2. Summary of farmers' attitudes of Strengths, Weaknesses, Desired needs, and Desired improvements.

Farmers Attitudes			
Category	**Hungary**	**Czechia**	**Portugal**
Strengths	• They are more open to educating themselves, to learn from their mistakes, and to develop their abilities, and they also have definite ideas about what training they would spend their time on. • Tend to accept the utility of professional advisory services and are more willing to pay for them. • Tend to recognize the importance of sustainability and preserving their land and other resources. • Social considerations and local communities are increasingly part of farmers' thinking, and they start to keep in touch with like-minded farmers. • For many of them, farming is a lifestyle, and new generations of farmers can make it more popular and more accepted in society.	• A generally positive approach to protecting and promoting biodiversity around the farm. • Support for the biodiversity of crops and livestock. • High perception of agriculture's role in rural development. • Farms are commonly passed down through generations.	• Farming is seen as central to climate change mitigation. • They are committed to sustainability and land regeneration. • Widespread adoption or exploration of agroforestry systems. • Food is viewed as a public good. • They are open to new experiences and maintain traditions like seed saving. • They aim to contribute to the local food system and provide jobs. • High level of cooperation within associations and networks.

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Weaknesses	• The agroecological approach is less widespread in Hungary than in other European countries; agroecological initiatives are fragmented. • Most decisions are dominantly made on an economic basis, and much less along ethical considerations. • Lack of commitment to the reasonable use of fertilizers and pesticides. • A significant proportion of farms base their viability on subsidies and tax benefits. • The link between the farm and regional development is not recognized, and they do not pursue the local social benefits of agriculture. • Low willingness for cooperation, networking, and social organization participation. • They are mostly skeptical about innovations.	• Prioritize economic over environmental aspects • Switching to organic farming is considered risky due to financial and market concerns • Farm renewal is difficult due to historical reasons. • Do not distinguish between organic farming and agroecology.	• No large-scale collective farming initiatives. • Dependency on subsidies • Lack of entrepreneurial initiative. • Limited engagement in advocacy or lobbying for sustainable farming. • Varying definitions of agroecology and neglect of its social component. • Over-reliance on internet sources not tailored to regional conditions.
Desired Improvements	• Optimizing trade-offs between competitiveness (intensive farming) and sustainable agricultural performance • Understanding the essence of rural development • Scaling up farm activities • Creating partnerships with local actors • Willingness to take risks	• Should assume greater responsibility, especially when working with leased land. • Stronger motivation is needed to encourage transition to more environmentally friendly or organic farming practices • Lack the courage to make the shift.	• Stronger recognition of the farmer's role in regional and national development. • Consumer education on environmental and social food impacts. • Interest in working with consumers to support each other mutually. • Desire for accessible, systematized knowledge and clarity on agroecological farming systems.

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Proposed Improvements	• Striving for continuous improvement • Adopting a holistic approach to ecological, social, and ethical farming values • Openness to new farming techniques • Better use of extension services • Building upon agroecological achievements	• Promotion of environmentally friendly farming systems should be prioritized • Perceive ecology as costly and challenging to implement, but still recognize its value	• Adopt a systemic view that incorporates biological, social, cultural, and political dimensions • Use landscape regeneration to guide decisions while considering farm viability • Recognize food as a shared good among communities

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