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Multi-actor rural innovation ecosystems: Definition, dynamics, and spatial relations

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ABSTRACT

Innovation Ecosystems (IE) is an emerging concept that highlights the evolution of a group of actors working around common practices, products, processes, actions, and initiatives. While we can find various definitions of urban innovation districts/ecosystems and common traits that coherently define them at the urban level, only a few scholars have focused on understanding and further defining Innovation Ecosystems in the rural context. While rural communities and territories can be a generative ground for Innovation Ecosystems, housing resources and capacities to become vibrant centres of innovation based on local heritage and resources, the activation of multi-actor Rural Innovation Ecosystems in these areas still remains a challenge. This article presents a proposal for defining Rural Innovation Ecosystem, departing from the main differences with the urban IE highlighting common traits and main differences in order to accelerate and better disseminate their establishment. The rural contexts present relevant characteristics in which innovation can thrive, such as dependencies and relationships represented by geographies, area of interested corresponding to sectors, and social, human and cultural capitals which harness the potential of all community members.

1. Introduction

Rural areas have not always been considered as places of progressive thinking but rather as places of depopulation, social and cultural degradation, and poverty (Bell and Jayne, 2010; Labianca and Navarro Valverde, 2019). Despite increasing urbanisation, in rural areas remain central both economically and in terms of population within the EU. Rural areas have the possibility to increase their competitiveness with cities, as they are key holders of many resources and they can take the lead in the ecological transition, working towards environmental balance, biodiversity conservation and valorisation, climate change adaptation, sustainable food production, nature reserves, and the production of renewable energy production (Bock and Krzysztofowicz, 2021; Slätmo, 2017).

While acknowledging the fact that the availability of resources in a territory does not always lead to an increase in its competitiveness and level of development, after Covid19 pandemic, and the rising issues of urban crises (Vicino et al., 2022; Westman et al., 2022; Thorbeck and Troughton, 2016) rural areas in Europe may experience a momentum of opportunities of revitalization (de Luca et al., 2020).

Indeed, almost a third (30%) of the EU population now lives in rural areas and more than 80% of the land mass is considered rural (European Commission, 2021b). At the same time, rural areas, as key holders of social and cultural diversity, biodiversity and landscape diversity, as well as key producers of food and non-food materials, should be recognised as offering opportunities for inclusive and sustainable growth (Schmied, 2022). The European Commission claims that rural areas will play a crucial role in achieving the green transition and meeting Europe's ambitious climate and environmental goals (European Commission, 2020). This role is recognised in the Green Deal and the Long-Term Vision for Rural Areas (LTVRA), with the latter highlighting how rural areas could seize the emerging opportunities of the EU's green and digital transitions and the lessons learned from the Covid-19 pandemic.

As expectations of rural areas grow, the importance of new types of rural services and products grow (Knickel and Renting, 2000; Korf and Oughton, 2006). However, the historic trend of migration from rural to urban areas, the de-agrarianisation process (Hebinck, 2018) and the

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relative lack of investment and attention given to rural areas over the last decade, has resulted in a lack of renewal and innovation. Many rural areas are trapped in a "cycle of decline" due to a lack of economic activity and inadequate services.[1] Addressing these issues and creating an enabling environment to counteract demographic trends of depopulation are essential to achieving a vibrant rural revitalization. However, according to the European Network for Rural Development (ENRD), in 2019 over 23.6% of the EU-27 population living in rural areas faced the risk of poverty or social exclusion compared to urban areas.[2] Regional disparities often manifest as a rural-urban divide, with rural areas experiencing higher rates of poverty and other negative economic and social indicators compared to urban areas (Young, 2013; Widuto, 2019; Chen and Norgaard, 2016).

The issue of spatial inequality and disparities has become increasingly important on the European public and political agenda (Widuto, 2019). In the aftermath of the financial and economic crisis, and in the context of political guiding principles representing the "places left behind", the focus on inequality has expanded beyond income and wealth to include access to basic services, education, and infrastructure (Alkire and Foster, 2011; Lee and Rodrı'guez-Pose, 2013; Panori et al., 2017; Lelo et al., 2019). Other studies examine non-material aspects, such as perception of quality and life satisfaction of people living in rural areas (Senlier et al., 2009; Ballas, 2013; Okulicz-Kozaryn, 2013). Spatial inequalities also take form of governance fragmentation and innovation in rural areas is often obstructed by non-coherent administrative borders in vision, policy and funding.

Among instruments and strategies for promoting local rural development, smart specialisation strategies[3] are a crucial instrument to boost innovation at a regional level. They represent a place-based approach characterised by the identification of strategic areas for intervention, based both on an analysis of the strengths and potential of the economy and on an entrepreneurial discovery process involving a wide range of stakeholders. Member States and regions across the EUare currently updating their smart specialisation strategies, in line with the established approach and relevant legal provisions for cohesion policy support. Despite these efforts, regional disparities in research and innovation performance across the EU remain high and the innovation gap has widened. Therefore, the EU has set a flagship on accelerating and strengthening innovation in European Innovation Ecosystems across the EU and tackling the innovation divide, mirrored by downturns in economic growth, connectivity and income, alongside rising inequality, and lower cohesion across the EU. (European Commission, 2022).

The concept of Innovation Ecosystem has evolved and raised within urban contexts. The concept of Innovation Districts (Rissola et al., 2019), Urban Innovation Districts (Wagner, 2019), Place-based Innovation Districts (Galan-Muros et al., 2021) are described with the characteristics of physical proximity, density and accessibility, followed by relationship and human capital, dynamic identity and network. While some research have deepened the knowledge about rural-urban synergies, underlining the importance of creating new localities, managing network governance and initiating smart development, there is still a gap in understanding the characteristics of Innovation Ecosystem in rural areas.

Rural communities and territories have the resources and capacity to become vibrant centres of innovation based on local heritage and resources, with a high potential for raising grassroots action to stimulated by through social and digital innovation, and ultimately to become attractive places for all people to live, work and stay. Moreover, the potential of Innovation Ecosystems to attract population, knowledge, and skills makes social innovation in rural areas more feasible. In this sense, further defining and understanding the characteristics, traits, and potential of activating Rural Innovation Ecosystems for community-led development and empowerment can be a crucial milestone in rural transition and transformation.

This paper, departing from Marshall and Murphy (2017), aims at developing a broader interpretation of Rural Innovation Ecosystem (RIE) (Marshall and Murphy, 2017): i) identify traits and characteristics that may differentiate RIE from Urban Innovation Ecosystems (UIE) and ii) explore the spatial distribution of the actors of the RIE also depending on diverse innovation sectors. After an introductory discussion on the definition of Innovation Ecosystem and its relationship with the urban and rural space, the article aims to propose a framework for the establishment of Multi-actor Innovation Ecosystems for rural areas, that seeks to answer to the following questions.

- How is an Innovation Ecosystem defined? How do rural and urban Innovation ecosystem differ? How can the creation of rural Innovation Ecosystems reduce spatial disparities?
- How the spatial distribution of RIE actors may affect innovation development in rural areas?

2. Theoretical framework: Defining innovation ecosystem

There are many definitions of Innovation Ecosystem. In general, the concept of an Innovation Ecosystem has developed in relation to strategy, innovation, and entrepreneurship. Within these definitions certain key traits are encircled as defining the concept. In Table 1 the different definitions of Innovation Ecosystem are included. In the Horizon Europe Regulation programme (REGULATION EU, 2021), Innovation Ecosystems are defined as an ecosystem that brings actors or entities together with the functional goal to enable technology development and

Table 1
Comparison of Innovation Ecosystem definitions.

Definition of Innovation Ecosystem	Key aspects/Traits	Reference
Cooperative networks with a web of entities to source supplies, draw capital, build partnerships and attract customers.	Resources; sound governance; clear strategy and patient leadership; organizational culture; human resources management; people; partners; technology and clustering	Ghazinoory et al. (2020)
The evolving set of actors, activities, and artifacts, institutions and relations (including complementary and substitute), that are important for the innovative performance of an actor or a population of actors.	Institutions; actors; artifacts; activities; collaborative/ complementary relations; competitive/substitute relations; co-evolution	Granstrand and Holgersson (2020)
Network of actors involved in developing and in commercializing innovations.	Value co-creation; location of actors, integration, challenges distributed across partners and complementors	de Vasconcelos et al. (2018)
The complex relationships formed between actors or entities whose functional goal is to enable technology development and innovation.	Explicitly systemic; digitalization; open innovation; public relations value; differentiated roles; market forces importance	Oh et al. (2016)
Members of an ecosystem are bound together by common goals (value propositions or market objectives) and the need to leverage one another's knowledge and capabilities and coevolve to achieve those goals.	Dependencies; Common goals and objectives; Shared knowledge and skills	Nambisan and Baron (2013)

[1] https://ec.europa.eu/enrd/enrd-thematic-work/social-inclusion/information-sources_en.html#:~:text=To%20tackle%20these%20disparities%2C%20ENRD,persons%20with%20disabilities%20and%20minorities.
[2] https://ec.europa.eu/enrd/index.html.
[3] https://s3platform.jrc.ec.europa.eu/what-we-do.

innovation at local and EU level. It encompasses relations between material resources (such as funds, equipment, and facilities), institutional entities (e.g., higher education institutions and support services, research and technology organizations, companies, venture capitalists and financial intermediaries) and national, regional, and local policy-making and funding entities (Regulation EU2021/695).

Granstrand and Holgersson (2020) defines an Innovation Ecosystem as «the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors». In this definition artifacts include products and services, tangible and intangible resources, technological and non-technological resources, and other types of system inputs and outputs, including innovations. (de Vasconcelos et al., 2018) have delineated how the Innovation Ecosystem theory is related to value creation while business ecosystem refers to value capture. Adner and Kapoor (2009) argue that complex innovations tend to involve a series of actors, demanding changes not confined to the supply networks. Marshall and Murphy (2021) underlined that the term in itself borrows ecological concepts to describe a process of creating the suitable environment, nurturing and support actions for more sustainable forms of development.

Previous scholars within urban studies have indirectly investigated Innovation Ecosystems, while using other words. Taking a stance from here, approaches and concepts that are closely associated with Innovation Ecosystem, at times used interchangeably, have emerged.

Yigitcanlar et al. (2020) define Innovation Districts as a type of land use, with specific function (industry type, investment type, management model), feature (economic scale, locality setting, social activities) and space-use (mixed use, urban design, natural environment). In 2020, European Commission's Joint Research Centre (JRC) initiated a study on innovative investment models for sustainable urban Innovation Ecosystems – focused on the attraction of mainstream private investors.[4] In this theoretical framework the Innovation Ecosystems are called Innovation Districts and defined as: dense, walkable hubs of economic activity where innovation, entrepreneurship, creativity, and place making intersect and where actors collaborate as a collective to increase their competitive potential.

Rissola et al. (2019) discusses how place-based innovation is spatially located in innovation districts, whose urban fabric is supportive of social interaction and whose economic development is framed within a wider planning strategy that allows relating the economic growth objective with the regeneration of a larger area. Creation, circulation, and the commercialization of new ideas are facilitated within these thriving atmospheres that leverage the intrinsic qualities of the virtuous urban context: physical proximity, relational density, dynamic identity (Rissola et al., 2019). Other examples of studies on Innovation Ecosystems are strictly connected to their proximity to cities and amenities (Eurocities goals[5]; Lund et al., 2020). On the other hand, the World Bank study on the impact of social and geographic connections on ecosystem success had previously stated that social connectivity is more influential on funding outcomes than geographic connectivity (Mulas et al., 2015).

Another EU commission JRC study on the concept of geographies of innovation relates them to the concept of place-based innovation and defines them as designed to foster sustainable regional growth based on geographical collaboration in science, technology, and innovation. Human capital, relationships and networks of actors in the quadruple helix are the base of these places. Geographies of innovation are planned and actively managed spatial clustering of a wide range of innovative organizations and intermediaries to undertake collaborative innovation activities (Galan-Muros et al., 2021).

Reformulating previous definitions, Nambisan and Baron (2013) states that the three defining characteristics of an Innovation Ecosystem are the dependencies established among the members, a common set of goals and objectives, and a shared set of knowledge and skills. Systemic public policies targeting specific goals is the focus of mission-oriented programs which presents key aspects such as clear targeted missions, political agenda setting, civic engagement, portfolio of projects bottom-up implementation, areas of interest and cross-sectors. Missions should result in investment across different sectors and involve different types of actors (Mazzucato, 2018).

Besides, the connection with the concept of community of practice comes easy, defined by Wenger in 1998 as a living context that can give newcomers access to competence and also can invite a personal experience of engagement by which to incorporate that competence into an identity of participation (Wenger, 1998, p. 214). The community of practice is primarily intended as an informal learning organization, strictly connected to the creation of knowledge. In 2002 Wegner et al. described the concept in relation to more formal organizations as groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis (Wenger et al., 2002, p. 4).

The World Bank Group (WBG) defines Communities of Practice (CoPs) as "a gathering of individuals motivated by the desire to cross organizational boundaries, to relate to one another, and to build a body of actionable knowledge through coordination and collaboration." In practical terms, CoPs are organized groups of people who share an interest in a defined area and want to coordinate efforts to achieve specific goals. They collaborate regularly to exchange information, learn together, improve their skills, and advance the general knowledge of the area.[6] The concept of the community of practice is based on the need of individuals to gather in social learning networks to exchange information, tackle common problems, improve performance, reach personal or collective objectives and maximise the impact of their activities. In fact, previous studies remarked the importance of matching the concept of Innovation Ecosystem with knowledge building and the quadruple helix model, integrating the academic, private, and government sectors with the civil society in order to address co-creation and open innovation at the local level (Spinosa and Costa, 2020). In such areas, scholars underlined the need for connecting the innovation process with rural territories, with the quintuple helix model, which considers the natural environment as an asset to produce knowledge and innovation (Provenzano et al., 2016).

3. Relevance of adapting the concept of innovation ecosystems in rural areas

Even though most of the concepts mentioned in the previous paragraph have mainly applied to an urban context, some scholars have already started to look at the potential of IE in rural areas, reflecting upon their main characteristics and traits (see Table 2). While Innovation Ecosystem has mainly emerged in an urban-based context, the potential of exploring a rural counterpart is increasingly sought for. However, current challenges are greatly different in a rural from an urban area today. To better develop a framework for a rural Innovation Ecosystem, it would be required to first of all understand difficulties occurring in rural areas.

Douglas mentioned the distinctive facets of rural contexts such as size, density, scale (these as universal considerations among literature on being rural), level and distance, as well as its representation, its power dynamics, and identity (Douglas, 2018). Other specific characters of rural areas in relation to Innovation Ecosystems have been explained

[4] https://knowledge4policy.ec.europa.eu/event/new-investment-models-urban-innovation-ecosystems_en.

[5] https://eurocities.eu/goals/local-innovation-ecosystems/.

[6] https://collaboration.worldbank.org/content/sites/collaboration-for-development/en/groups/communities4Dev/blogs.entry.html/2021/03/24/definition_of_communityofpractice-zmku.html.

Table 2
Comparison of definitions of concepts connected to Innovation Ecosystem in rural settings.

Concept	Definition	Key aspects/Traits	Reference
Rural Innovation Ecosystem	An array of diverse organizations (businesses, research organizations, business support intermediaries) and individuals (entrepreneurs, investors, policymakers, researchers, students), their linkages and modes of collaborating or networking together.	Focus on sustainability, balance, and wellbeing; Skill access; Anchor institution	Marshall and Murphy (2021)
Smart village	The concept of smart village aims at bringing out and strengthening the potential of the area and its inhabitants through, among other things, rational and justified use of new technologies (including digital technologies).	Institutions; Service chains; Local resources; Social innovation; Technologies; Entrepreneurship; Relationship with the surrounding environment	Bokun and Nazarko (2023)
Startup village	A startup village is a place (or a network of small places) that embraces innovation and ambitious entrepreneurship to unlock development potential and support wellbeing in rural areas, provide favourable conditions for entrepreneurial and innovative ecosystems to flourish.	Innovation; Entrepreneurship; Rural space; Multiple scales; Ecosystems; Local people; Purpose with external knowledge; Resources, Markets	Goodwin-Hawkins et al. (2023)
Rural Heritage Hub	Social spaces or communities of stakeholders at the local level, embedded in physical spaces where knowledge transfer and sharing takes place.	Physical space; Community engagement; Coordination; Co-developed strategies	De Luca et al. (2021)
Living Lab	User-centered, open Innovation Ecosystem based on systematic user co-creation approach, integrating research and innovation processes in real-life communities, and setting.	Digital technologies; Domain-dependent taxonomies; Community; Co-creation	Bacco et al. (2020)
Sustainable Communities	Community defined by either natural geographic or political boundaries in places that are associated with an environmental issue (s) that have a common interest in protecting an identifiable, shared environment and quality of life.	Common interest; Community; Environment; Quality of life	Ravazzoli and Valero (2020)

by Marshall and Murphy (2017), such as dispersed populations, physically remote and isolated business and communities, small public and private sector organizations, harder recruitment and retention of skilled professionals, greater rural reliance on volunteers in services. "Wellbeing", associated with a better work-life balance, is assumed to be available within a more relaxed rural landscape, and have the potential to be more focused on sustainability, balance, and wellbeing, than growth and ambition (Marshall and Murphy, 2017). The lack of an anchor institution become a problem in rural areas (Marshall and Murphy, 2021) which could be reflected in some cases to the dependency to an urban centre. Challenges in rural areas are hence multifaceted, while some areas are blooming economically others suffer from depopulation, dislocation of the young workforce and competences, and lack of services and infrastructure. The concept of urban innovation districts brings systemic differences if it is defined as places in proximity – as an extension of urban areas – to large cities of regional or national significance, with strong economies and business concentration (Lund et al., 2020). The main difference with the definition of urban Innovation Ecosystems lays in the un-sharable traits of density, proximity, and accessibility, as defined by Wagner (2019) The lack of these characteristics brings difficulties in the integration between local authorities and social cohesion depending on the dispersion in space and competition for resources. A variety of emerging concepts connect to innovation in rural areas.

First introduced by the European Network for Rural Development (ENRD) in 2017, Smart Villages have been defined in 2020 as « communities in rural areas that use innovative solutions to improve their resilience, building on local strengths and opportunities» (European Commission Directorate-General for Agriculture and Rural Development, 2020, p. 60). Besides being characterized by participatory processes and the use of new technologies (Bokun and Nazarko, 2023), one of the leading agents of the smart village approach is the digital transition. Digital solutions can turn disadvantages of rural regions, due to distance and low population density, making communication and access to new instruments possible (Cavalieri et al., 2024).

The Long-Term Vision for Rural Areas (LTVRA) also introduced the concept of Startup Villages in 2021, which combining two different dimensions (startups and villages) focuses on innovation and ambitious entrepreneurship to connect local businesses to extra-local production networks and tap into wider markets, resources and knowledge to enhance the competitive performance of rural areas (Goodwin-Hawkins et al., 2023). An important feature needed for the successful implementation of the model is the definition of a network of startup villages which relies on place-based approaches, with the aim to connect villages and key stakeholders facilitating the exchange of knowledge and expertise (Cavalieri et al., 2024).

Within the context of projects funded by the European Commission, other concepts have been developed in connection with innovative practices. The Rural Heritage Hubs, for instance have been defined within RURACTIVE as spaces and places for a fruitful engagement, dialogue, and collaboration among the key local actors, including proponents, stakeholders, local leaders and the whole community, to better integrate their needs, perceptions and views within the development of local regeneration plans, and to strengthen their active role in the implementation of such plans (De Luca et al., 2021). In other cases, the digital component becomes central like with the Living Labs of DESIRA project. Their main purpose is to assess the past and present situation in the geographical area, identifying both drivers and obstacles in the current socio-technical system, and then agree on a desired future situation, highlighting the role that the introduction of digital technologies play in enabling it (Bacco et al., 2020). On the other hand, it is argued that innovation can be reached with the reconfiguration of social practices around environmental issues, such as the sustainable communities, seeking to enhance outcomes on societal well-being and necessarily including the engagement of civil society actors (Ravazzoli and Valero, 2020).

4. Recognising sectors for innovation in rural areas

One of the traits that is common both to urban and rural innovation ecosystems definitions are a common domain or sector. The methodology of the current research lays its foundation on the search for specific sectors that can best qualify the real needs and innovation potential of rural areas, and for their contaminations. Yet, they lack examples of areas of innovation were actors act across sectorial boundaries. For example, the implementation of climate related solution in cities often depends on coordination between sectors. Neither previous projects nor existing definitions of innovation ecosystems speak of the relevant sectors that should be addressed. Going beyond preconceptions related to the monofunctionality of rural areas and their dependence of cities, it is possible to identify domains of interest that revolve around specific sphere. The Organisation for Economic Co-operation and Development (OECD) suggest ten areas of innovation for rural areas (OECD, 2018). Among these are innovation connected with mobility such as more

efficient ways to distribute manufacturing and driverless cars. They recognise that it is necessary to invest in innovating energy systems and thereby a sustainable energy transition. As it is inevitable speaking about rural areas, the OECD see the importance of innovation for the future of food. On the same lines, the OECD see that there is a need to put emphasise of a more innovative future for health in rural areas well. Although not stated in the OECD report, based on the report from the EU Commission (European Commission, 2018) and previous publications (Egusquiza et al., 2021), culture and cultural innovation are also considered as a crucial pillar of rural development. To balance development and the protection of cultural heritage, sustainable cultural tourism is then considered an excellent tool (European Commission, 2019b).

Based on these considerations supported by the OECD Innovation areas and acknowledging challenges and opportunities of in rural areas today across the EU within the Long Term Vision for Rural Areas (European Commission, 2021c), we recognise six sectors of innovation that can support an efficient establishment of rural Innovation Ecosystems. These sectors of innovations are also at the core of the Horizon Europe project RURACTIVE (GA no. 101084377) where this study is embedded. RURACTIVE aims at developing a model for supporting just and sustainable transformation of rural communities furthering working on the following six rural development drivers:

Energy transition and climate neutrality. In the context of the European Green Deal, Europe's new growth strategy, rural areas will play an important role in making the EU the first climate neutral continent by 2050 (European Commission, 2019a). A green energy transition should not only support urban areas but be beneficial for rural communities (Karlsdóttir et al.). According to the EU Green Deal, the green transition will require the development of partnerships in all economic activities in rural areas, between businesses of all sectors, local authorities, researchers, and services based on innovation, knowledge sharing and cooperation (European Commission, 2019b).

Sustainable agri-food systems and ecosystem management. While the energy transition has been recognised as a large priority and been thereby received a lot of support from the private sector (Schulte, 2023), innovation within agri-food and agroecology is lagging behind (Kibria, 2024). During At COP28, 159 countries signed a declaration for sustainable agriculture and thereby recognise "the profound potential of agriculture and food systems to drive powerful and innovative responses to climate change". This confirms that tomorrow's agriculture requires attention, aside from an immense increase in funding, to ensure a sustainable development and food provision (Climate Policy Initiative, 2022). The EU highlights the need for better soil health (European Commission, 2023a), smarter digital solutions (European Commission, 2023c) and efficient ways of supporting farmers to establish, grow and become more equal. From an environmental perspective agroecology is suggested as a key innovation to achieve better farming. Agroecology is not only about promoting ecological farming but it a diversity of solutions for better farming. Through better soil management and crop diversification, agroecology can reduce dependencies on external inputs (European Commission, 2023b). Through agroecology sustainable farming and food systems can be accelerated.

Sustainable multimodal mobility. While the mobility sector has seen novel innovations in cities, rural areas across the Europe are still a large extent dependent on private transportation (Poltimäe et al., 2022). Along with greener energy comes the need to also make transportation greener, better connections, and Recognising the needs of various user groups (Poltimäe et al., 2022). By improving infrastructure that enables an easier everyday transportation would greatly support the regeneration of rural areas.

Local services, health and well-being. With a growing elder population in rural areas (European Commission, 2023d), there is not only a need to regenerate through a younger generation but also ensure a good life for elderly. Elder are generally more dependent on help from either family or institutions and while the lack of accessible healthcare is a common issue across rural areas in the EU (European Commission, 2023e), older adults may decide to migrant somewhere where they can access better assistance. During the Covid-19 pandemic the weaknesses within the rural healthcare system became visible: rural doctors and hospitals were not equipped to deal with the unfolding crisis and increased pressure. A guaranteed healthcare, as well as social services, should be an innovation sector that cannot be overlooked any further.

Culture and Cultural innovation. Rural areas are increasingly valued for their cultural and recreational values (Bole et al., 2013) despite their situation of scarcity. One of the fourth pillar of sustainability has been argued to be culture (Nurse, 2006). In addition, UNESCO argues that preserving cultural values is key to development (UNESCO, 2010). Rural areas are seldom seen as centres of innovative and fine cultural offers, while the presence of cultural and creative industries could represent a crucial driver to innovation. Culture could not only make rural areas more attractive but also more accessible, with smart tools and a diverse cultural offer.

Nature-based and cultural tourism. In addition, culture, arts, and natural features offer great possibilities for regenerating rural areas through sustainable tourism offers (Mariani and Guizzardi, 2020; Lindholm and Ekhlom, 2019; (Matei, 2021)). Areas with specific amenities, natural and cultural, especially coastal or with cultural features are seen as more attractive. Thereby, there areas are under an increased pressure from tourism but are also less prepared than urban areas (European Parliament, 2023). Therefore, tourism must be planned carefully taking local assets and capacity into account. As emphasised in the EU Biodiversity Strategy for 2030, "the recent COVID-19 pandemic makes the need to protect and restore nature all the more urgent, the pandemic is raising awareness of the links between our own health and the health of ecosystems" (European Commission, 2020), and this could also be viewed as a moment to invest in rural areas and their natural sites.

As a first step towards the establishment of a Multi-actor Rural Innovation Ecosystem, it is necessary to identify and engage local stakeholders and actors including marginalized and vulnerable groups at risk of social exclusion. Besides the actors specifically connected to the six sectors (some examples can be found in Fig. 1), local

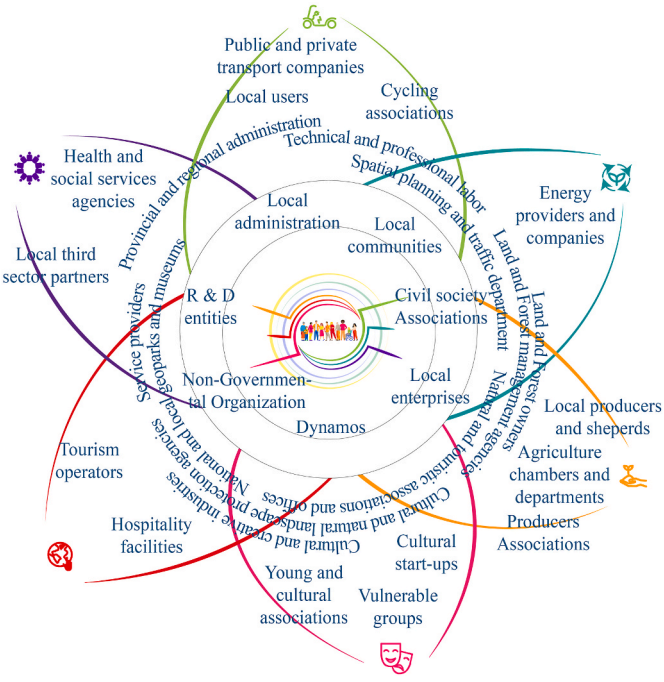

Fig. 1. Multi-actor Rural Innovation Ecosystem's stakeholders identified per sector.

administration, local communities, civil society associations, local enterprises, non-governmental organizations, and R&D entities need to be located to be involved.

Multi-actor RIEs represent a dynamic framework that goes beyond traditional rural participation models. They are aimed at fostering collaboration environments among communities and stakeholders to identify local challenges and co-develop innovative solutions tailored to specific rural contexts. These ecosystems are driven by the interaction and collaboration of people (stakeholders), places (physical spaces in which the interaction occur, like meeting sites) and practices (current or planned solutions) that together facilitate innovation through co-development and active participation.

The actors within these ecosystems are diverse and include a wide array of stakeholders from various domains, across the quadruple helix.

- Policy domain: includes governmental bodies, regional authorities, municipalities, and public institutions that play a crucial role in shaping policies and creating an enabling environment for rural innovation. These actors can influence local politics, development agendas, and strategic directions of rural innovation processes.
- Research domain: includes academic institutions, research organizations, and think tanks that provide the necessary knowledge, data, and scientific input to inform evidence-based decision-making.
- Industry/services/investors domain: ecompasses private sector entities, including businesses, service providers, investors, and entrepreneurs, that contribute financial resources, technical expertise, and market-driven perspectives. Their involvement is essential for ensuring the economic sustainability of innovation initiatives and for scaling successful solutions.
- Users domain: includes the local communities, residents, and end-users who are directly impacted by the innovation processes. Their involvement ensures that the developed solutions are responsive to local needs and grounded in real-life contexts.

These stakeholders can be further categorized into two types: transversal and sector-specific.

Transversal stakeholders are relevant across multiple rural development sectors due to their broad influence on local politics, policies, and crosscutting priorities like climate, biodiversity, and social justice. Examples include local municipalities, regional offices, educational institutions, and organizations focusing on gender equality and social inclusion.

Sector-specific stakeholders are those particularly relevant to a specific sector, due to their unique role, expertise, or local influence. These stakeholders may not necessarily engage in all RIE activities but are critical within their specific domains.

A fundamental aspect of stakeholder involvement in RIEs is the intentional inclusion of historically excluded or underrepresented social groups in rural development decision-making and innovation processes. Among the foundational principles of RIEs are participation and inclusion. This commitment is essential for creating inclusive ecosystems that reflect the diversity of rural communities. To this end, stakeholders should proactively engage groups at risk of social exclusion, such as rural women, minorities, and economically disadvantaged populations, ensuring that gender concerns and intersectional perspectives are integrated throughout the innovation process.

These groups are recognised by the European Network for Rural Development. Additionally the European Rural Vision addresses specifically the gender issue in rural areas while young women are more likely to leave rural regions than young men (European Commission, 2021a) in addition to a lack of female farmers.

Conducting a thorough community assessment is recommended to identify potential underrepresented groups and understand their unique experiences and challenges. This assessment should consider demographic factors such as age, gender, ethnicity, race, religion, language, and socioeconomic status, alongside local social, economic, and environmental issues. Employing an intersectionality lens helps to recognise the complex realities faced by individuals belonging to multiple identity groups and allows for the design of more inclusive and equitable innovation strategies. This approach to stakeholder identification and engagement ensures that RIEs not only foster innovation but also contribute to broader goals of social equity, sustainability, and resilience in rural areas.

What becomes crucial in these contexts is the actors' social connectivity, common goals, shared knowledge, well-balanced dependencies and their relationship with space. Experimenting with the proposed six sectors allows to challenge the concepts of proximity and density, which rarely can be applied to rural areas and envision the connections that can be created beyond geographical borders of an area. We argue that mapping the stakeholders sectorizing the drivers (Fig. 2) helps in interpreting better the rural area in regeneration processes and addressing their challenges, since the actors are more driven to be more specific and give more details. Also, in rural areas the innovation geography often results vaster than the urban context and the presence of more than one anchor institution is a common trait. Going beyond the administrative borders is crucial to avoid obstacles to innovation that occur specifically in rural areas. It is necessary to achieve a vision that encompass actors which create clusters in form of Innovation Ecosystems.

5. Conclusions

The overall aim of this paper was to better understand the relevance and application of Innovation Ecosystems in rural areas. By fostering economic growth, supporting local entrepreneurship, promoting community engagement and participation, and improving access to resources and services in rural communities, Multi-actor Rural Innovation Ecosystems (RIEs) have the potential to play a crucial role in addressing rural socio-spatial disparities in rural areas. RIEs provide a structured framework for promoting entrepreneurship, fostering collaboration, and harnessing technology. By supporting local innovation and socio-economic development, these ecosystems help to narrow the rural-urban divide, improve quality of life and create a sustainable future for rural communities.

So far, Innovation Ecosystem is a concept that has mostly been applied in urban areas with a specific spatialization and that involves synergies between different actors and sectors. From the review of the mentioned concepts, it is possible to find common traits that describe the Innovation Ecosystems: actors and resources, dependencies and relationships within a network, common goals and objectives besides a political agenda, social connectivity or relational density, access to skills and shared knowledge, areas of interest or domains. The urban IE stakeholders are in most cases located in urban areas and this is highlighted as a strength. Another element considered important for the presence of IEs is the proximity to a university or research centre, which serves as the only attractor pole related to the R&D sector.

We argue that the concept of Innovation Ecosystem is relevant in rural areas. Similar to urban areas, some characteristics to be taken into account when analysing the potential of an innovation ecosystem in rural areas are the dependencies and relationships within a network, the areas of interests, the social connectivity or relational density, the access to skills and shared knowledge. On the other hand, we argue that in rural areas the presence of an anchor institution, a multi-scale approach and a focus on sustainability, balance and well-being become very relevant.

Given the different challenges, another methodology needs to be adopted when approaching rural areas. Innovation sectors in rural areas are greatly different from urban and can take numerous of forms (OECD, 2018). The use of specific drivers for regeneration can be taken as the lens through which address the determined challenges. This framework should not focus on challenges but on action. It recognised areas of improvement, innovation, and implementation. It aims to create synergies across sectors. In line with the European Long-term vision for

Fig. 2. Multi-actor Rural Innovation Ecosystem's stakeholders mapped per sector (in grey: administrative borders; colored are the areas of influence and the actors related to: nature-based and cultural tourism (red); sustainable multimodal mobility (green); sustainable agri-food systems and ecosystem management (orange).

rural areas community-led innovation should support rural areas to become stronger, connected, resilient and prosperous. This objective can be achieved by starting to look at how urban-rural relationships work, what dependencies are created in the different sectors in which innovation takes place, and by avoiding the generalisation of macro-dependency of rural areas on urban areas for services and urban areas on rural areas for supply. Recognising the growing importance of the role of rural areas in the energy transition and as hubs of culture, and sustainable tourism, as well as working towards a just distribution of services related to health and mobility can be considered the first example in balancing power relations.

Governance in rural areas often involves fragmentation of resources and policy choices, tied to administrative boundaries. When considering these adaptable boundaries by sectors, spatialization analysis can highlight new geographies and dependencies. Going beyond the idea of administrative boundaries in the context of innovation can help manage investments more efficiently and making the rural areas the place of opportunity for the transition, avoiding inequalities for the future.

This research can represent the theoretical framework built on grey and scientific literature of future studies that aims at investigating multi-level governance in rural areas, place-based development and new ways of approaching participation and co-creation. Some limitations to highlight are the lack of references to studies beyond the European area from which it would be invaluable to learn innovative practices, and the lack of reference to case studies. This contribution lays the foundations for future research that will focus on the establishment of Multi-actor Rural Innovation Ecosystems that can develop a set of community-led solutions to be shared and tested in other rural areas, mobilise knowledge and skills particularly in the context of climate change mitigation and adaptation, preserving biodiversity and social justice and inclusion.

CRediT authorship contribution statement

Simona Bravaglieri: Writing – original draft, Visualization, Investigation, Data curation. **Hanna Elisabet Åberg:** Writing – original draft, Resources, Investigation. **Alessia Bertuca:** Writing – original draft, Investigation. **Claudia de Luca:** Supervision, Methodology, Conceptualization.

Declarations of competing interest

None.

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Data availability

Data will be made available on request.

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