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Barriers to the development of innovation ecosystems in inland regions: evidence in the Brazilian context

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Abstract

Purpose – Innovation ecosystems are important environments for fostering innovation and entrepreneurship. They are an important strategy for successfully targeting strategic subsidies, and their development is key for regions seeking development. With this in mind, the purpose of this paper is to identify and analyze the barriers to the development of innovation ecosystems in inland regions of Brazil.

Design/methodology/approach – Through quantitative research with primary data and fully assisted by experts (n = 44), barriers to the development of innovation ecosystems were identified and validated through the Fuzzy Delphi method, later the Fuzzy Dematel method was used to analyze priorities and causal relationships of validated barriers.

Findings – The results show that, out of 37 barriers listed in the literature, only 14 are verified by experts in the regions surveyed. Of these, the most prioritized and influential are related to ecosystem orchestration and

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collaboration. This shows that efforts must be made to mitigate these barriers so that these ecosystems can develop effectively, further fostering innovation and entrepreneurship.

Originality/value – This study highlights relevant information that contributes in a theoretical and managerial way, as it generates insights and reflections on the development of innovation ecosystems and future directions for spreading knowledge about the development of innovation ecosystems, especially in regions far from capital cities.

Keywords Innovation ecosystems, Inland regions, Barriers to innovation, Fuzzy Dematel, Fuzzy Delphi

Paper type Research paper

1. Introduction

The different regions existent in a given land play a central role in the production of knowledge and innovation (Lopes and Farinha, 2018; Tung and Hoang, 2024). They serve as a crucial source of economic development, even in the context of a globalized economy (Huggins and Williams, 2011; Yan *et al.*, 2020; Zhao and Li, 2022). Each region establishes its own conditions for the appearance of innovations, and its characteristics become a factor of competitiveness. Some of these factors are related to levels of social and economic development, productive structure, institutional efficiency, knowledge generation capacity, accumulated skills and cultural attitudes of the population (Pidorycheva *et al.*, 2020; Soto Kiewit and Vienni Baptista, 2023; Arman and Al-Qudsi, 2024).

Regional competitive advantage relies on the ability to attract talent, foster growth opportunities and stimulate high-tech companies, thereby generating wealth and creating jobs. These conditions are enhanced by high levels of innovation, modernization and economic growth (Huggins and Williams, 2011; Lopes and Farinha, 2018; Huang *et al.*, 2020).

In developing countries, innovation becomes a strategic factor when it comes to bridging their gap with developed nations, thus strengthening economic competitiveness. In this context, it is essential for local governments to have autonomy, power and adequate resources to drive such dynamic (Lowe and Wolf-Powers, 2018; Liu and Stephens, 2019; Pidorycheva *et al.*, 2020; Câmara *et al.*, 2024).

Cirera and Maloney (2017) highlight that issues such as excessive bureaucracy, complex regulations, limited financial resources and a shortage of skilled labor remain as recurring obstacles in emerging economies like India, Brazil and South Africa. Radosevic and Yoruk (2018) add that restricted competition and limited access to international markets affect the innovation capacity of developing countries, restraining their sustainable economic growth. In this regard, Bogers *et al.* (2019) and West *et al.* (2014) emphasize the importance of innovation-driven leadership, and an organizational culture open to change – key aspects for creating innovation ecosystems.

Regional innovation ecosystems (RIEs) play an essential role in bringing together various actors and their interactions, by transforming cities and regions into hubs of innovative entrepreneurship (Cai and Huang, 2018; Huggins *et al.*, 2018; Kiseleva *et al.*, 2022). In addition, they help to mitigate barriers to economic development, while stimulating innovative entrepreneurship (Pidorycheva *et al.*, 2020). Ghazinoory *et al.* (2020) demonstrate that the generation of innovation in certain locations can be partially explained by their ecosystems efficiency. Innovation ecosystems can be understood as a dynamic set of actors, activities and artifacts (Granstrand and Holgersson, 2020). They comprise a heterogeneous group of participants who, despite being hierarchically independent, are interdependent and collectively generate value for all stakeholders involved (Thomas and Autio, 2019).

Spinosa *et al.* (2015) describe these ecosystems as environments that host knowledge-based companies and entrepreneurial initiatives that foster continuous innovation development. Furthermore, they function as spaces for collective learning and knowledge sharing, by

facilitating synergy among different innovation agents (Russo-Spena *et al.*, 2017; Da Silva *et al.*, 2023b). Although initially associated with technology parks, science centers or technopoles, these ecosystems are not limited to such structures (Baierle *et al.*, 2021). Etzkowitz *et al.* (2007) point out that innovation ecosystems also include investors, entrepreneurs and academic researchers, as well as specialized technology transfer offices, which play a crucial role as sources of technological development and investment opportunities.

According to Kon (2016), understanding the characteristics of innovation ecosystems is essential for formulating effective strategies among all the actors involved. Thus, the formation of these ecosystems must align with strategic objectives and specific capabilities of each region, to leverage existing expertise at local level (Pidorycheva *et al.*, 2020; Henderson *et al.*, 2024).

Given the significance of innovation ecosystems, considerable investments have been made to create and strengthen such ecosystems. But despite those efforts, many attempts to establish successful ecosystems have failed, with below expectations results. This is primarily due to various constraints that hinder innovation promotion and make the adoption of a unified innovation management model unfeasible across cities (Rabelo and Bernus, 2015; Elia *et al.*, 2016; Pidorycheva *et al.*, 2020).

To mitigate risks and implement effective strategies, it is necessary to understand the existing challenges and barriers within an innovation ecosystem. This understanding allows for the development of strategic planning, which can minimize failures and promote successful initiatives. One of the main characteristics of Brazil is its diversity, vast natural resources and rich cultural heritage. The country comprises 5,570 municipalities; 34% of those are classified as inland cities, that is, areas considered distant from major urban centers, and with lower population density compared to metropolitan regions (IBGE, 2022). Such localities present distinct challenges and opportunities for the development of innovation ecosystems. In many of those regions, innovation is still a distant concept for many stakeholders, although it can be driven by specific sectors such as agribusiness, sustainable tourism, creative industries and technologies adapted to the local context (Abreu *et al.*, 2024).

Studying and investing in the development of innovation ecosystems in inland regions of Brazil should be considered a comprehensive national development strategy. By valuing local potential, promoting innovation and creating a conducive environment to entrepreneurship, the country can achieve a more equitable and sustainable economic growth. This approach contributes to strengthening the identity and autonomy of inland regions (Medina-Bueno *et al.*, 2024), while building a more prosperous and inclusive society (Hwang, 2015).

In emerging economies, institutional infrastructure plays a crucial role in fostering innovation. The absence of intermediaries and the lack of collaboration among different actors result in fragmented initiatives, with limited impact on the ecosystem. Moreover, the inexperience of local actors (Jucevicius *et al.*, 2016) and difficulties in accessing financial resources suggest significant obstacles to the development of innovation ecosystems. Those challenges are even more pronounced in cities far from major capitals, due to the absence of essential elements such as strong institutional actors, skilled expertise and investment capital.

Previous studies have identified valuable lessons regarding the development of innovation ecosystems in different countries such as Finland, South Korea and Singapore (Khorsheed, 2017); France, Poland and Germany (Jucevicius *et al.*, 2016); and in the cities of Rotterdam (Witte *et al.*, 2018) and Tomsk, Russia (Kobzeva *et al.*, 2012). These experiences demonstrate that different barriers to the development of innovation ecosystems require distinct strategic approaches. In addition, Vonk (2025) emphasizes that the formulation of strategies must consider many levels of innovation ecosystems.

Based on these findings, studying the barriers to the development of innovation ecosystems in inland regions of Brazil is interesting not only to researchers but also to

policymakers, entrepreneurs and regional development agents. Theoretically, the research helps one understand the reasons that limit innovation in regions far from major urban centers; it also expands the debate on territorial inequalities and regional innovation strategies. Practically, this topic is essential for guiding public policies and private initiatives aimed at strengthening innovation ecosystems in such municipalities. By identifying the primary challenges those regions face, this study can support the formulation of more effective strategies to reduce inequalities, attract investments and boost strategic sectors, thus making innovation a viable tool for regional development.

In light of the above, one needs to understand the obstacles that hinder the development of innovation ecosystems in municipalities located far away from capital cities. Therefore, the central research question is: What are the main barriers that most influence the development of innovation ecosystems in inland regions of Brazil?

To answer the question, this study seeks to identify and analyze such barriers. By challenging the conventional view, that tells us innovation is concentrated solely in large urban centers, this research advances academic understanding by demonstrating that traditional innovation models are not always suitable for those regions. Furthermore, a contextualized approach is proposed, where local specificities and regional strategic sectors are considered. To validate the main barriers, the study broadens the discussion on decentralized and adaptive innovation policies, by offering practical insights for effective strategies capable of driving innovative ecosystems in areas located far away from capital cities.

2. Theoretical basis

2.1 Development of innovation ecosystems and their importance for the innovation regional

The development of innovation ecosystems has gained relevance from Jackson (2011) understanding that innovation is an important source of knowledge, value-added and wealth for an economy. According to Thomas and Autio (2019), innovation ecosystems are defined as a heterogeneous set of actors, which have hierarchical independence, but still have interdependence, which together produce results arising from the ecosystem and offer value to participants. Jin-fu (2010) states that it is a dynamic system composed of interconnected people and institutions that play an essential role in stimulating technological and economic development. Furthermore, Etzkowitz *et al.* (2007) highlight that it also includes investors, entrepreneurs and academic researchers, as well as offices specialized in technology transfer. Both entities play a crucial role as sources of development and investment opportunities.

When investments in knowledge lead to innovation and generate profits where the ecosystem is located, it can be considered balanced, prosperous and healthy. Thus, innovation ecosystems shape the economy and the dynamics of complex relationships between actors and organizations, with the aim of promoting technological development and innovation (Jackson, 2011). Therefore, highly developed ecosystems provide the necessary infrastructure to enable innovative entrepreneurship in a region (Romano *et al.*, 2014) and the continuous development of innovations (Gastaldi and Corso, 2016; Spinosa *et al.*, 2018). This infrastructure makes it possible to carry out pilots, validation, prototyping, expansion and demonstration of new technologies and ideas, minimizing risks and reducing costs for new entrepreneurs. Consequently, investors are attracted to participate in these ventures, as they increase the prospects of profitability with innovative businesses that have a greater chance of success (Jucevicius *et al.*, 2016). Innovation ecosystems also empower these entrepreneurs (Schwartz and Bar-El, 2015).

In addition to physical infrastructure, developed innovation ecosystems have a network that can be explored, of entrepreneurs, mentors, service providers and investors where there is a path that can be followed through a regional infrastructure that supports the creation and

development of high-growth and scalable startups (Haines, 2016). Regions also benefit, as they foster competitiveness through high levels of innovation, modernization and growth, rather than low labor costs (Huggins and Williams, 2011). The ecosystem allows companies and territories to generate higher income, with greater added value, by providing an organizational basis for creating a growth model driven by innovation (Russell and Smorodinskaya, 2018), fundamental for the development of new economies (Gomes *et al.*, 2018).

Adding value to what is produced and sold, the regional competitive advantage provided by a highly developed ecosystem is capable of attracting development opportunities, high-technology companies and talents to the region, resulting in greater creation of jobs and wealth (Lopes and Farinha, 2018). Romano *et al.* (2014) summarize that the innovation ecosystem can improve the competitiveness of regions in the following way:

- stimulating interactive learning networks driving innovation of small and medium enterprises (SMEs);
- facilitating the involvement of universities in innovation systems;
- strengthening the absorption capacity of SMEs;
- sustaining labor mobility to accelerate knowledge flows;
- promoting technologies with multiple applications;
- encouraging openness to external knowledge;
- designing, guiding and developing training programs for;
- beginning entrepreneurs with technological knowledge, but with low market specialization; and
- promoting high-potential, knowledge-intensive companies.

However, barriers are raised in the literature, mainly in emerging and developing ecosystems. As is the case with the Philandan ecosystem, where according to Almpanopoulou *et al.* (2019) a complex set of institutional, regulatory, normative and cultural-cognitive barriers were found, hindering its emergence and affecting the legitimacy, resources and potential growth of new initiatives. Ovchinnikova and Topoleva (2023) identified the barriers that limit the development of the technological entrepreneurship ecosystem in Russia. Among them are institutional, financial, economic and programmatic mechanisms to support the high-tech sector and entrepreneurship. With regard to small- and mid-sized companies participating in innovation ecosystems as suppliers, Ates (2022) identified barriers related to financial support, strategic mindset, trust, effective partnerships and knowledge about risks and returns for participating in collaborative innovation. To overcome such challenges, Cao *et al.* (2023) analyzes that building a RIE can be an effective way of using innovation resources while breaking down existing regional barriers. His study proposed the need to stimulate market-oriented innovation entities to improve Hebei province's innovation capacity, building an innovative environment that is livable and business-friendly.

For developing countries, innovative development is the most important condition for overcoming the gap with developed countries, significantly increasing the competitiveness of the economy and well-being, ensuring the security and sovereignty of the state (Pidorycheva *et al.*, 2020). Although developed economies such as the USA, Germany and Japan benefit from established innovation ecosystems with ample financial, infrastructural and human capital support, emerging economies face different and more complex challenges (Freeman and Soete, 1997; Nelson and Winter, 2009; Mazzucato, 2018). In countries such as China, India, Mexico and Turkey, significant efforts are being made to overcome barriers such as excessive bureaucracy, shortages of skilled labor and limited financial resources (McKinsey Global Institute, 2020; World Economic Forum, 2021). In China and India, for

example, investment in high-tech and manufacturing sectors has been a central component in achieving global competition, contrasting with the focus of developed countries on areas such as advanced research and cutting-edge technological innovation (Dahlman, 2009). Similarly, Mexico and Turkey use free trade agreements and special economic zones to integrate their economies into the global market. These strategies, although different from the ones applied in developed countries, are proving to be effective in promoting growth and attracting investment (OECD, 2022; Gallagher, 2020). This comparison highlights the importance of public policies adapted to local conditions and highlights how emerging economies can learn from developed countries while developing specific solutions to their challenges. Thus, exploring these different approaches contributes to a broader understanding of how innovation ecosystems can be improved globally, adapting strategies according to the economic and social context of each country.

Understanding the characteristics of innovation ecosystems is crucial for formulating strategies among the various players involved. Initially, this understanding was more geared toward policymakers and sectorial organizations. Therefore, as advocated by Gobble (2014), it is essential that organizations and individual innovators understand the ecosystem to which they belong and comprehend their respective roles within it.

Spinosa *et al.* (2015) broaden the perspective of innovation ecosystems by highlighting their role in promoting urban and environmental development; establishing connections between urban development and knowledge centers; stimulating socio-cultural and institutional capital; considering public policies, environmental sustainability and social networks in decision-making processes related to urban planning. The authors emphasize the need for openness to promote the flow of knowledge inside and outside the ecosystem, to accelerate internal innovation and its distribution on the market.

However, the development of the innovation ecosystem often presents specific challenges and barriers. In other words, limited infrastructure, lack of financial capital, scarcity of qualified labor and geographic isolation are some of the barriers that need to be overcome. Furthermore, it is necessary to promote cultural change and stimulate an entrepreneurial mentality in different regions. By overcoming the inherent barriers and challenges, innovation ecosystems have the potential to attract economic progress and investment, to generate qualified jobs and improve the communities' quality of life. The continuous preservation and investment in ecosystems are essential to foster a culture of innovation, maintain competitiveness and promote a prosperous and sustainable future. Innovation ecosystems, therefore, are arrangements that insert regions into the knowledge economy (Russo-Spena *et al.*, 2017; Spinosa, Krama and Hardt, 2018; Costa and Moreira, 2022), creating an environment where the dynamics of creation, diffusion and absorption of knowledge sustain the emergence of innovative entrepreneurship and the production and dissemination of new knowledge (Romano *et al.*, 2014; Russo-Spena *et al.*, 2017; Shmeleva *et al.*, 2021).

Therefore, innovation ecosystems typically combine knowledge production and transformation into value-added products and services. They seek a constant balance and incentives to develop new and better businesses, involving all actors in the ecosystem. These ecosystems are becoming increasingly relevant, as they facilitate interaction between government, academia, industry and the general community, in the development of technologies and knowledge in the regions. This interaction contributes to the establishment of collaborative platforms, technological prospecting, strategic alliances between players, besides other actions aimed at converging investments to develop technologies, products and services that boost the region's economic, social, environmental, cultural and innovative potential (Oksanen and Hautamäki, 2014; Shashlo *et al.*, 2018).

3. Method

To identify and analyze the barriers to the development of innovation ecosystems in inland regions of Brazil, a descriptive and quantitative survey was carried out between March and July 2023, with 44 actors from 10 different interior municipalities from different regions of Brazil. To identify the barriers, a systematic literature review was carried out to identify what different authors consider to be barriers to the development of innovation ecosystems. This leads to 37 barriers (see Supplementary Material 1); however, to validate the ones found in municipalities located in the interior of different states.

The systematic literature review to identify the barriers was carried out through a systematized search in the databases Scopus, Web of Science, Science Direct and Scielo. The search strategy used to retrieve the articles had the following descriptors: "innovation ecosystem" or "ecosystem innovation" or "ecosystem of innovation". The articles were filtered by descriptors in the title, abstract and keywords; articles in English; research and review articles and journals. This search retrieved 405 articles. After reading the abstracts of the 405 articles, 185 articles were selected to be fully read. After thoroughly reading the articles, 37 barriers were identified and categorized into five dimensions.

After surveying the barriers using the RSL, an online form was developed via Google Forms in two stages. In the first stage, the experts assessed the level of importance of the barriers surveyed using the RSL, based on a five-point linguistic scale (see Table 1). Second, the experts analyzed the causal relationships between each of the barriers, expressing a weight of influence (see Table 2). It is worth noting that each expert was selected using the nonprobabilistic convenience method, based on the inclusion criterion of actively belonging to the governance of an innovation ecosystem in inland regions. Each expert (n = 44) was contacted through social networks and institutional e-mails.

Subsequently, we used the Fuzzy Delphi method to validate the barriers (Section 3.1) and the Fuzzy Dematel method (Section 3.2) to establish the causal relationship between the barriers that were validated.

Table 1. Fuzzy Delphi method linguistic variables

Linguistic variable	Fuzzy numbers
Extremely unimportant	(0,1, 0,1, 0,3)
Unimportant	(0,1, 0,3, 0,5)
Normal	(0,3, 0,5, 0,7)
Important	(0,5, 0,7, 0,9)
Extremely important	(0,7, 0,9, 0,9)

Source(s): Singh and Sarkar (2020)

Table 2. Fuzzy linguistic scale

Linguistic expressions	Triangular fuzzy number (l, m, u)
No influence (No)	(0, 0, 0.25)
Very low influence (VL)	(0, 0.25, 0.5)
Low influence (L)	(0.25, 0.5, 0.75)
High influence (H)	(0.5, 0.75, 1.0)
Very high influence (VH)	(0.75, 1.0, 1.0)

Source(s): Wu and Lee (2007)

3.1 Selection of barriers using the Fuzzy Delphi method

Once the barriers had been identified, the experts (n = 44) were able to analyze them using a linguistic assessment of their level of importance, as shown in Table 1.

The Fuzzy Delphi method is a modification of the traditional method, where fuzzy logic is used to correct imperfections such as poor data return, loss of relevant results and an extensive research process that can lead to higher costs (Ishikawa *et al.*, 1993; Bui *et al.*, 2020; Wang and Peng, 2020; Da Silva *et al.*, 2023a).

After the experts' evaluation, the linguistic variables expressed by them are converted into triangular fuzzy values (see Table 1). After that, the fuzzy values $a_{ij}\sim$ where the importance of the expert comes from $a_{ij}\sim = (a_{ij}, b_{ij}, c_{ij})$ to i =1, 2, 3…, n; j = 1, 2, 3, …, m. Thus, the fuzzy aggregate value of the barriers is given by: $a_{ij}\sim = (a_j, b_j, c_j)$, where $j = min\{a_{ij}\}$, $b_j = (\Pi_i^n b_{ij})^{\frac{1}{n}}$, $c_j = \max\{c_{ij}\}$.

The next step is to identify which the barriers for the development of innovation ecosystems in municipalities in the interior of the states are. At this stage, the weight of the barrier is verified along with the threshold a∼, which is given by the average of all the values for each barrier $a_j\sim$ indicated by the experts. In addition, it is necessary to transform them into clear numbers, where the technique used for defuzzification is the center of gravity method (Bouzon *et al.*, 2016; Da Silva *et al.*, 2023a). Therefore, the exclusion and inclusion criteria follow the following premise: If $a_j \sim \geq a\sim$, then criterion *j is selected; if* $a_j\sim < a\sim$, *then the criterion j is rejected.*

After validation, it was verified the importance, and the cause-and-effect relationships of the Fuzzy Dematel method.

3.2 Fuzzy Dematel method

The Fuzzy Dematel method is an extension of the Dematel method proposed by The Battelle Memorial Institute, through the Geneva Research Center (Chang *et al.*, 2011). Feldmann *et al.* (2022) show that this modification overcomes the limitations of the uncertainty of the information provided by the experts, using fuzzy logic.

It should be noted that the method has been implemented assertively in analysis processes where there are relationships between different constructs. For instance, identifying factors that influence service innovation in manufacturing companies (Feng and Ma, 2020) and identifying the challenges of human resources in start-up companies (Priyanka *et al.*, 2023).

To implement the fuzzy Dematel method, we used the approach applied by Wu and Lee (2007) and Si *et al.* (2018) by following the steps:

Step 1: Formulate the decision committee, with a view to evaluating the factors that meet the decision objective, thus evaluating each of the barriers using the fuzzy values shown in Table 2.

Based on the experts' evaluations, $E = \{E_1, E_2,\ldots,E_l\}$ the fuzzy matrix of individual direct relations is obtained: $Z\sim_k = \left[Z\sim_{ij}^k\right]_{nxn}$, where $Z\sim_{ij}^k = \left(z_{ij1}^k, z_{ij2}^k, z_{ij3}^k\right)$ this is the fuzzy evaluation of experts E_k regarding the degree of influence between the barriers B_i e B_j.

Step 2: After obtaining individual decision matrices $Z\sim_k(k = 1,2,\ldots,l)$, the diffuse matrix of direct influence is calculated $Z\sim = \left[Z\sim_{ij}^k\right]_{nxn}$ adding to the answers, where $z\sim_{ii}$ is given as triangular fuzzy numbers and $z\sim_{ij}$ comes from:

$$z\sim_{ij} = (Z\sim_{ij1}, Z\sim_{ij2}, Z\sim_{ij3}) = \left(\frac{1}{l}\sum_{k=1}^{l} z_{ij1}^k, \frac{1}{l}\sum_{k=1}^{l} z_{ij2}^k, \frac{1}{l}\sum_{k=1}^{l} z_{ij3}^k\right) \quad (1)$$

Step 3: After aggregation [see equation (1)], the results of the group's direct influence fuzzy matrix are transformed into clear values $Z\sim = \left[Z\sim \frac{k}{ij}\right]_{nxn}$, obtaining a direct evaluation matrix for the Z group. For doing so, the center of area method is used (Hsieh *et al.*, 2004), as seen in equation (2):

$$x_{ij} = \frac{\lfloor (u_{ij} - l_{ij}) + (m_{ij} - l_{ij}) \rfloor}{3} + l_{ij} \tag{2}$$

Step 4: Once the direct influence matrix of group Z has been obtained, the normalized direct influence matrix $X = [x_{ij}]_{nxn}$ is generated, by using equations (3) and (4):

$$X = \frac{Z}{s}, \tag{3}$$

$$max\left(\sum_{j=1}^{n} z_{ij}, \sum_{i=1}^{n} z_{ij}\right) \tag{4}$$

All the elements belonging to matrix X comply with $0 \le x_{ij} < 1$, $0 \le \sum_{j=1}^{n} x_{ij} \le 1$, where at least one i such that $\sum_{j=1}^{n} z_{ij} \le s$.

Step 5: Using the normalized direct influence matrix X, the total influence matrix is calculated $T = [t_{ij}]_{nxn}$ using the sum of the direct effects and the indirect effects, where I is denoted as an identity matrix according to equation (5):

$$T = X + X^2 + X^3 + \ldots + X^h = X(I - X)^{-1}, \; when \; h \to \infty \tag{5}$$

Step 6: At this point, equation (6) defines the R and C vectors, which are the sum of the rows and the sum of the columns of the total influence matrix T:

$$R = [r_i]_{n\times 1} = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1},$$
$$C[c_j]_{1\times n} = \left[\sum_{i=1}^{n} t_{ij}\right]^{T}_{1\times n} \tag{6}$$

where r_i is the sum of the rows of the T matrix and shows the sum of the direct and indirect effects dispatched from barrier B_i to the other barriers. Still, c_j is the jth is the sum of the T matrix column representing the sum of the direct and indirect effects that barrier B_j received from other barriers.

Letting $i = j \; e \; i, j \in \{.,2, \ldots, n\}$ the horizontal axis vector $(R + C)$ is called prominence, which demonstrates the force given and received from the barrier. In other words, (R + C) represents the degree to which the barrier plays a central role in the system. Similarly, the vertical axis vector (R-C) called relationship, which presents the net effect that the barrier contributes to the system. If $(r_j - c_j)$ is positive, barrier B_j influences the other factors and is grouped into the group of causes, however if $(r_j - c_j)$ is negative, then this barrier is influenced by other factors and must be grouped into the group of effects. In this way, the map of influential relationships can be structured by mapping the set of $(R + C, R - C)$ data that produces information relevant to the decision-making process (Si *et al.*, 2018).

4. Analysis and discussion of results

In the light of the survey carried out, it was possible to obtain a response from 44 actors from different innovation ecosystems from 10 different interior municipalities, all of them play an active role in their respective innovation environments. Table 3 shows the data of the experts surveyed.

Table 3. Data from the experts surveyed

Variable	$n = 44$	%
Sex		
Female	17	39
Male	27	61
Education		
PhD	13	41
MSc	18	34
Complete higher education	13	19
Position held		
Innovation agent/manager	19	43
Entrepreneur	10	23
Professor/researcher	13	29
Consultant	2	5
Time in position		
0–4 years	8	18
4.1–8 years	7	16
8.1–12 years	20	46
> 12 years	9	20

Source(s): Research data

4.1 Selection of barriers using the Fuzzy Delphi method

Based on the responses, from 37 barriers highlighted in the literature, 14 were identified by the experts as hindering the development of innovation ecosystems in inland municipalities. Therefore, in Table 4, the selected barriers can be verified using the Fuzzy Delphi method.

Table 4. Selected barriers

Dimensions	Barriers
Orchestration	B1 – Managing the ecosystem without knowing it;
	B2 – Inadequate governance;
	B3 – Difficulty in finding information about the players in the innovation ecosystem;
	B4 – Lack of clear division between the players on the work to be done;
	B5 – Lack of interaction, coordination, collaboration, contact and communication between the players;
Collaboration	B6 – Inadequate local mentality;
	B7 – Lack of motivation of actors;
	B8 – Restricted technology transfer mechanisms;
	B9 – Lack of entrepreneurial mentors, main service providers and investors;
Talents	B10 – Few innovative and technological projects to attract investors;
Infrastructure	B11 – Lack of support between research and the market;
	B12 – Weak institutions;
	B13 – Lack of intermediaries (universities and research laboratories, law firms, recruitment agencies, media and public relations companies, accounting firms and investment banks);
Financial resources and legal structures	B14 – Inadequate legal structures/protection of intellectual property rights;

Source(s): Research data

Table 5 shows that orchestration is the dimension with most barriers to the development of innovation ecosystems, totaling five. Orchestrating an innovation ecosystem means managing tensions and contradictions between actors, as well as the elements and relationships between industry, government, academia and intermediaries. Therefore, a culture of coordination is necessary to unite the correct elements with appropriate links. Even though there are strategies and the right ways to orchestrate an innovation ecosystem, none of them are the same in all parameters; however, they do represent the different combinations of factors (Jucevicius *et al.*, 2016). Thus, the challenges of orchestration arise from the combination of parallel interests in the various stages of the innovation process (Viitanen, 2016). As they are complex projects based on the collaboration of legally independent agents, ecosystems cannot be managed in traditional ways. Special attention should be paid to their orchestration (Russell and Smorodinskaya, 2018).

Specific strategies to address these orchestration challenges have been identified internationally and in Brazil. Pidorycheva *et al.* (2020) reveal the need for Regional Research Centers to serve as coordination mechanisms for the Innovation ecosystems of Ukraine. In Wroclaw, Helman (2020) states that there is a need to design adaptation mechanisms and plans that allow for the full use of the experience and achievements of various organizations that support innovation. In Coimbra, Portugal, the innovation ecosystem gradually introduced a more entrepreneurial perspective into the local innovation system from the university incubator (Santos, 2022). In Cairns, Australia, an Innovation Hub was created to orchestrate the innovation ecosystem (Haines, 2016).

A few examples of successful orchestration can be mentioned in Brazil, such as Porto Digital in Recife, the *Pacto pela Inovação* in the state of Santa Catarina, the INOVA RS program, and the *Pacto Alegre* in the city of Porto Alegre – RS. These are examples of RIEs that are impacting and thinking about the territory. (AUDY, *et al.*, 2022). These orchestration projects aim to develop strategies for the long-term development of a region or territory. The *Pacto pela Inovação* in Santa Catarina, Brazil seeks to unite government, companies, universities, support institutions, communication channels and citizens in a pact to consolidate Santa Catarina in the knowledge and innovation economy (Santa Catarina, 2017).

In Porto Alegre, the capital city of Rio Grande do Sul, Brazil, a similar action is the *Pacto Alegre*, which aims to articulate the realization of transformative projects with a broad impact on the city. Through the *Pacto Alegre*, challenges are identified, possible solutions are discussed and agreed upon, and projects are created to promote transformation through a collective commitment to sharing responsibilities, combining forces, making the best resources available and a sense of urgency. From this combination of axes and challenges emerge the projects in which the institutions concentrate their efforts to work together for the benefit of the ecosystem (Pacto Alegre, 2024).

The INOVA RS program is a program of the state of Rio Grande do Sul, Brazil, through the construction of strategic partnerships between organized civil society, the business, academic and government sectors. The program brings together the actors of these regions and builds a common agenda. It is inspired by the European Union's Intelligent Specialization Strategy (RIS3) (Rio Grande do Sul, 2024).

4.2 Analysis of causel relationships using Fuzzy Dematel

To establish an analysis of the causel relationship between the barriers, the experts listed a linguistic weight, where each value represents triangular fuzzy numbers (see Table 2). They were aggregated using equation (1) and defuzzified using the area center method, according to equation (2). Based on that, Table 5 could be drawn up.

Table 5. Defuzzified relationship matrix

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	Sum
B1	0.000	0.928	0.939	1.083	1.083	0.833	1.083	0.833	1.083	1.083	0.833	0.833	0.833	0.833	12.283
B2	0.928	0.000	0.944	1.083	1.083	0.833	1.083	0.833	0.833	0.833	0.833	0.833	0.833	0.833	11.789
B3	0.978	0.978	0.000	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	13.872
B4	0.983	0.983	0.883	0.000	1.083	1.083	0.833	1.083	1.083	0.833	0.833	1.083	0.833	0.833	12.433
B5	0.978	0.978	1.033	1.083	0.000	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	13.822
B6	0.978	0.978	0.883	0.833	0.833	0.000	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833	11.172
B7	0.928	0.928	0.894	1.083	0.833	0.833	0.000	0.833	0.833	0.833	0.833	0.833	0.833	0.833	11.333
B8	0.861	0.861	0.811	1.083	0.833	0.833	0.833	0.000	0.833	0.833	0.833	0.833	0.833	0.833	11.117
B9	0.922	0.922	0.911	1.083	1.083	1.083	1.083	1.083	0.000	1.083	1.083	1.083	1.083	0.833	13.339
B10	0.983	0.983	0.867	1.083	0.833	1.083	1.083	1.083	1.083	0.000	0.833	0.833	0.833	0.833	12.417
B11	0.883	0.883	0.939	1.083	1.083	0.833	1.083	0.833	1.083	1.083	0.000	0.833	0.833	0.833	12.289
B12	0.900	0.900	0.883	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.833	0.000	0.833	0.833	11.017
B13	0.889	0.889	0.906	0.833	1.083	1.083	1.083	1.083	1.083	1.083	1.083	1.083	0.000	1.083	13.267
B14	0.828	0.828	0.811	0.833	0.833	0.833	1.083	0.833	0.833	0.833	1.083	0.833	0.833	0.000	11.300

Source(s): Elaborated by the authors

Once the values of the defuzzified relationship matrix were obtained (Table 5), equations (3) and (4) could be applied, where the Z matrix and T matrix were generated. This resulted in the values to be applied to equations (5) and (6), expressed in Table 6, which presents the cause-and-effect relationships.

From the results shown in Table 6, out of 14 barriers, seven were characterized as cause barriers and seven as effect barriers. This result is due to the fact that the effect barriers have a negative R-C, leading to the understanding that they are influenced by those that have a positive R-C (Addae *et al.*, 2019; Khan *et al.*, 2019; Schaefer *et al.*, 2021). The behavior of the barriers can be observed in Figure 1.

Table 6 and Figure 1 show the main barriers influencing the development of innovation ecosystems in inland municipalities. By checking the prioritization of the barriers in the R + C values (Table 5), it can be seen that they were prioritized as follows: B5>B9>B3> B4>B13>B10>B11>B7>B1>B2>B6>B8>B12>B14.

4.3 Discussing the results

Observing Figure 1, it is possible to verify that the barriers with the greatest impact on the development of interior ecosystems are B5 – lack of interaction, articulation, collaboration, contact and communication between actors, B9 – lack of mentor entrepreneurs, main service providers and investors and B3 – difficulty in finding information about the actors in the innovation ecosystem. It is therefore advisable to prioritize the mitigation of these three barriers first.

B5 – Lack of interaction, articulation, collaboration, contact and communication between actors – has the highest importance value (R + C). Based on the assumption that an innovation ecosystem is structured on the basis of interaction, it is vital to foster and develop it, so that innovation ecosystems away from capitals develop and fulfill their purpose (Saurabh *et al.*, 2014; Roukouni *et al.*, 2020; Linde *et al.*, 2021). It should also be noted that one of the distinguishing features of innovation ecosystems is their complementarity and interdependence (Cobben *et al.*, 2022).

In the study from Tolstykh *et al.* (2023), the authors add that the interaction becomes relevant for the development of the ecosystem, generating both commercial and reputational

Table 6. Cause and effect matrix of barriers

Barriers	R	C	R-C	R + C	Relationship
B1	7.567	7.407	0.160	14.974	Cause
B2	7.271	7.407	−0.136	14.678	Effect
B3	8.448	7.211	1.237	15.659	Cause
B4	7.622	8.011	−0.389	15.633	Effect
B5	8.416	7.710	0.706	16.127	Cause
B6	6.899	7.575	−0.675	14.474	Effect
B7	6.996	7.989	−0.993	14.985	Effect
B8	6.866	7.575	−0.709	14.441	Effect
B9	8.144	7.713	0.431	15.856	Cause
B10	7.601	7.562	0.039	15.163	Cause
B11	7.571	7.414	0.157	14.986	Cause
B12	6.810	7.429	−0.619	14.240	Effect
B13	8.092	7.138	0.954	15.229	Cause
B14	6.963	7.128	−0.165	14.091	Effect

Source(s): Elaborated by the authors

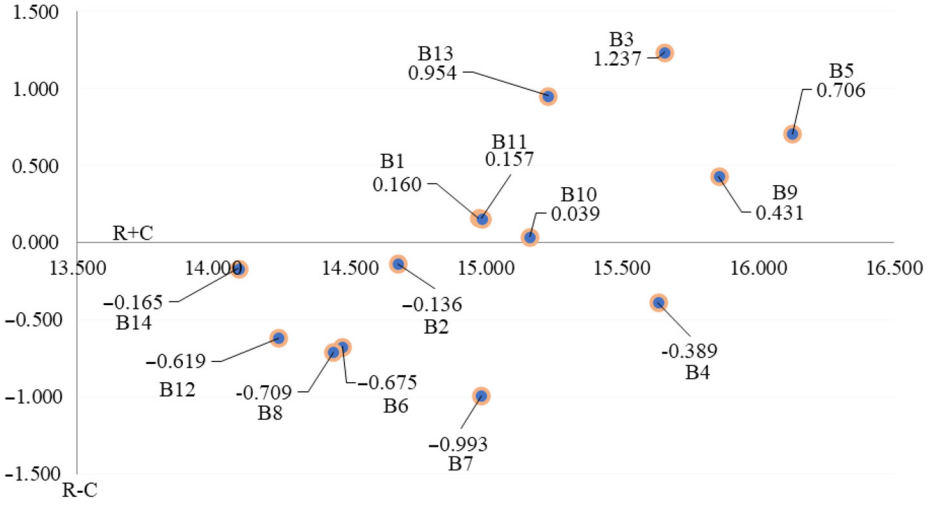

Figure 1. Cause and effect diagram of barriers
Source(s): Elaborated by the authors

benefits for the ecosystem. It is understood that collaboration is important from the first phase of an ecosystem's life cycle. It is at this point that the ecosystem players understand the requirements, which then guarantees collaboration, as they understand the common objectives to be achieved. It is also necessary for ecosystem leaders to build forms of relationship and trust that do not depend so much on formal and bureaucratic contracts, so that the ecosystem can develop in a healthy way (Dedehayir *et al.*, 2018). In the view of Autio (2022), you ecosystems differ from other arrangements due to the specificities of challenges related to governance and coordination. As the author argues that leaders must provoke a voluntary feeling in partners to carry out ecosystem activities, and not through command and control. Therefore, to the verifying barrier of aimed at orchestration to be most priority, can demonstrate the relevance of achieving greater engagement on the part of the relationship between the actors, therefore, the governance of the ecosystem must verify what may be leading to this barrier being present in the context studied, applying efforts so that participants voluntarily engage. Because if this problem is occurring, it could be a lack of more active governance or using inefficient articulations, so it is their role to check where the problem is and quickly mitigate it (Könnölä *et al.*, 2021; Banerjee *et al.*, 2024).

In the research carried out by Foss *et al.* (2023), the authors elucidated that the inability to manage problems related to cooperation and coordination generates transaction costs aimed at disorganization and the inability to reach continuous partnerships. Therefore, it is understood why this barrier is the most prioritized, as it is vital for the good development of ecosystems.

The second most relevant barrier was B9, characterized by the absence of entrepreneurial mentors, main service providers and investors, which stands out as relevant in the innovation ecosystems surveyed. According to Ferreira and Oliveira (2023), this absence makes the development of startups difficult, due to limited access to knowledge, experience, resources and capital. The lack of mentoring is pointed out as one of the main barriers to the companies' success, strategically affecting areas such as strategy guidance, business development and fundraising.

The presence of entrepreneurial mentors is essential to offer specialized guidance and share their practical experiences. As highlighted by Carayannis and Campbell (2012), guidance from experienced entrepreneurs helps beginners avoid common mistakes and make more informed decisions. The absence of service providers creates obstacles for companies to access technical advice, administrative support and specific skills that are crucial to optimizing their operations (Nambisan and Baron, 2007).

Lack of adequate investment can impede the progress of innovative ventures. This highlights the importance of the role of investors in the growth, development and generation of wealth in startups (Nambisan and Baron, 2007). When it comes to barrier B5, related to the lack of interaction, the challenges faced by entrepreneurs, mentors, service providers and investors are amplified.

To mitigate the B9 barrier, it is necessary to implement specific strategies, such as tax incentives, training programs and events designed to promote interaction between entrepreneurs and investors. Adopting an integrated approach to simultaneously address the B5 and B9 barriers is key to boosting resilient and dynamic innovation ecosystems in inland regions, and then drive the sustainable development of these entrepreneurial communities.

The third most important barrier was B3 – Difficulty in finding information about the players in the innovation ecosystem. According to Kobzeva *et al.* (2012), this compromises establishing efficient partnerships, coordination and collaboration in the innovation ecosystem. The concentration of actors in an innovation ecosystem that enables the constant exchange of information is fundamental to generating new knowledge, business ideas, scientific and technological developments, using a productive partnership of scientific, educational and business structures (Shashlo *et al.*, 2018). Spicka (2022) points out that creating clusters is an efficient strategy for enabling this exchange of information. The author's case study highlighted the specific relationship between the cluster and the ecosystem. The cluster does not determine the boundaries of the ecosystem, as it is a much broader system of cooperation and interaction between organizations. Clusters emerge after an ecosystem has existed for a certain period to coordinate collaboration and information between organizations and stakeholders. In this sense, the orchestration of the innovation ecosystem serves to provide actors with information, resources and knowledge (Rajahonka *et al.*, 2015).

The fourth most prioritized barrier was B4 – Lack of a clear division between the actors regarding the work to be carried out. However, if you look at Figure 1, you can see that this is an effect barrier. Authors such as Brea (2023) explain that one of the central points for effective innovation is the clear idea of what actor should be in the ecosystem, and what activity should be carried out. Knowing what role, the actor plays in the ecosystem and what they have to do is extremely important for the ecosystem's development. This may explain why, despite being a barrier that suffers effects from the others, it has become a prioritized barrier. For this barrier to be mitigated, active governance is needed to establish the role of each actor, their activities and responsibilities. A successful ecosystem is a reflection of the coherent actions of its actors, clearly assuming their role and developing a sense of belonging to the innovation ecosystem (Reiter *et al.*, 2024).

The strategies to be adopted for the development of innovation ecosystems must be aligned with their level of maturity. According to the perspective presented by Pique *et al.* (2019), ecosystems go through different levels or stages, one of which is maturity, ranging from beginner, launch, growth and finally maturity. So, the activities in each phase are different, as are the challenges faced, as the focus and complexity evolve. In this sense, the barriers raised in this study can change according to the level of maturity, taking priority and relationships to different paths (Dedehayir *et al.*, 2022). It is important to note that in the case of emerging countries such as Brazil, as well as in inland regions,

ecosystems are often at beginner or start-up level, so the barriers highlighted in this study are centered on this context.

In order for the findings of this study to have a practical impact and be able to guide public policies, it is recommended that policymakers in Brazil and other countries with similar challenges prioritize strategic initiatives focused on strengthening collaboration networks and mentoring programs in innovation ecosystems in inland regions and the creation of municipal innovation laws. Structures such as inter-organizational networks, incubation programs and knowledge-sharing platforms can alleviate the lack of collaboration, an element identified as crucial to the cohesion of such ecosystems. Encouraging policies that promote synergies between local companies, universities and research institutions would be an effective approach to developing an environment that robustly supports innovation and entrepreneurship. In addition, mentoring programs, encouraged by public policies, could allow experienced professionals to guide emerging entrepreneurs and innovators, mitigating the barrier of the shortage of mentors pointed out in this study. An innovation fund with resources earmarked for local initiatives would also be an important strategic action, which could be governed by the municipal innovation law, as in the case of Ijuí-RS-Brazil.

By extending the analysis to a global context, it is possible to observe that the barriers identified reflect international trends, in which collaboration and mentoring are central elements for the success of innovation ecosystems, especially in less urbanized areas. Successful international cases, such as the innovation ecosystems in Finland and Israel, demonstrate the importance of collaborative networks and comprehensive mentoring systems – models that can be applied in Brazil. However, although these international examples often benefit from advanced infrastructure and significant government support, Brazil's interior and peripheral regions may require adaptive approaches that consider local economic and cultural limitations. Thus, a critical comparison between the Brazilian model and these international references can generate a more refined and contextualized strategy, adapting the best global practices to the specific needs of these regions.

Finally, understanding the practical implications of the barriers identified is essential for promoting regional economic development and strengthening the resilience of these ecosystems. Given the importance of orchestration and collaboration for the impact of such ecosystems, policymakers could consider creating specific incentives for investment in innovation ecosystems in inland regions, for both the public and private sectors. This local investment approach can result in long-term benefits by reducing the outflow of talent to metropolitan areas and creating sustainable growth opportunities in the regions themselves. Thus, addressing these barriers not only favors immediate results in innovation, but also boosts regional economic development, making these ecosystems viable for continuous innovation in line with global trends in economic and social development.

5. Final considerations

The aim of this research was to identify and analyze the barriers to the development of innovation ecosystems in inland regions of Brazil. To achieve this, a systematic literature review was carried out to list the existing barriers to the development of innovation ecosystems and then validate them in the context of Brazil's inland regions, using different experts and the precepts of the Fuzzy Delphi method. From 34 barriers presented in the literature, the experts highlighted 14 of them as being part of the context presented (see Table 4). After the validation process, an analysis of the cause-and-effect relationship was carried out with the 44 experts, as well as the priority of the barriers, with a view to highlighting the ones with higher priority and those with greater influence on the others. The Dematel fuzzy method was used to calculate the analysis results.

The results of the analysis show that three barriers are the priority and most influential: B5 – lack of interaction, articulation, collaboration, contact and communication between the actors, B9 – lack of mentor entrepreneurs, main service providers and investors and B3 – difficulty in finding information about the actors in the innovation ecosystem, respectively. Two of them are focused on the orchestration dimension (B5 and B3) and one on collaboration (B9). Significant efforts must be made so that these barriers are mitigated, and solutions are presented. The aim is for these ecosystems to actually develop in regions that are often far from large cities. They need support to develop in terms of innovation and entrepreneurship, generating not only economic but also social gains. The orchestration dimension was highlighted, demonstrating that the main challenges for these regions are related to this aspect, thus requiring more careful attention, so that there is an effective development of the innovation ecosystems in these inland regions.

The limitations of this study include the scarcity of material on the subject, especially in relation to innovation ecosystems in inland regions, and the availability of respondents to analyze the relationships. Barriers that already exist in the literature were highlighted, and others that may exist in more specific regions were not listed; many of the barriers exposed may change according to the maturity of the ecosystem analyzed. The lack of previous research on the subject presented challenges for the theoretical foundation, especially in relation to the barriers observed in contexts that have been less studied. Furthermore, the barriers identified and validated by the experts reflect a specific focus on regions in inland Brazil, which may limit the generalizability of the findings to other geographical or economic contexts. As these regions have distinct economic and social characteristics compared to other areas, caution is needed when extrapolating the results to innovation ecosystems in different environments or at different stages of maturity.

Future research could expand on these results by developing a detailed set of actions to mitigate the barriers identified, promoting both academic research and practical application in the field of RIEs. They could also investigate these barriers in a different way, considering their direct and indirect influences on the effectiveness and sustainability of ecosystems. Comparative studies between inland, peripheral and metropolitan regions would also be valuable in identifying patterns, specific challenges and contextual variables that shape these types of environments. This would potentially result in a more robust and comprehensive theoretical framework. In addition, longitudinal research is recommended to assess the impact of specific interventions over time, helping to validate or refine the causal relationships identified. This could broaden the applicability of the models in different contexts.

In addition, it would be pertinent to investigate how the level of maturity of ecosystems influences the relevance of the barriers identified, potentially revealing differences in the strategies needed to mitigate such challenges. Qualitative research, including interviews with the governance of innovation ecosystems in various regions, could also provide deeper insights into local specificities, highlighting whether there are more barriers to be taken into account.

Finally, developing a framework of concrete actions and strategies to mitigate barriers for innovation ecosystems in inland regions would be a valuable contribution, offering practical guidelines for the development of these environments in different contexts, also taking into account the level of maturity of the ecosystems, comparing the results and showing which barrier is most influential from this perspective.

5.1 Theoretical and managerial implications

Given the above, this research presents some theoretical and managerial implications. As for the theoretical implications, this research advances the development of the theory of

innovation ecosystems in remote regions, when it generates theoretical and empirical support for this knowledge. The research also generates insights and reflections that can serve as basis for future research, once there are still few studies focused on more remote or smaller regions. Furthermore, by using the Fuzzy Delphi and Fuzzy Dematel methods, the methodology adopted contributes significantly to the body of knowledge, once it provides insights to be used in other global regions with similar characteristics. By showing the main barriers and the causal relationships applied to a not highly explored context, this study advances the literature on innovation ecosystems. It also points out gaps that need to be filled in regions located far away from major capitals, which can often receive less investment and attention than they need to properly develop and innovate. Thus, this research brings to light reflections that defend the importance of innovation ecosystems in inland regions.

In addition, the results of this study provide critical and innovative insights that may advance the understanding of innovation ecosystems in inland regions, especially in the context of emerging economies like Brazil. The evidence suggests the necessity to delve deeper into the barriers identified, such as orchestration and collaboration within ecosystems, which are proving to be determining factors in the development of such networks.

Concerning managerial implications, this study presents fundamental barriers to developing innovation ecosystems in inland regions of Brazil. It offers practical support that goes beyond theoretical implications, and points to concrete strategies to strengthen regional growth. By identifying and prioritizing obstacles such as the lack of collaboration between actors, the scarcity of mentors and investors, and the difficulty of accessing information on the ecosystem, this research provides specific recommendations for public managers and policymakers to boost innovation and entrepreneurship. It also demonstrates the primary needs and priorities for supporting the development of ecosystems in regions located far away from major centers. The results also highlight the importance of approaches adapted to the unique challenges of orchestration and collaboration in such contexts. According to this research results, future public policies can benefit from those if they apply programs dedicated to strengthening connectivity, mentoring and communication infrastructure within innovation ecosystems in inland areas. Managers and innovation agents can also use the results of this study to implement strategic actions, specifically focused on collaboration and on the effective and structured orchestration of relationships. Innovation ecosystem professionals should focus on mechanisms that facilitate clear communication, establish trust between actors and sustain inter-organizational alliances.

This study shows that when the capacity for self-organization and coordination between stakeholders is increased, those ecosystems can optimize resource allocation and maximize innovation support's effectiveness. This research provides clear evidence for public policies that consider particularities of inland and peripheral regions, whose development challenges differ substantially from those of metropolitan regions. Policies aimed at developing ecosystems must support the creation of structures that facilitate the orchestration and coordination of actors through, thus encouraging collaboration between government, academia, industry and society's needs. By addressing priority barriers in an integrated manner, policies can significantly reduce barriers to the sustainable development of innovation ecosystems. Investment in basic infrastructure such as digital connectivity and transportation is essential to reduce disparities in the innovation potential of those regions, and essential to align their development objectives with national innovation guidelines. This study also raises policy implications, as it seeks to connect theory to practice, when providing actionable insights for stakeholders interested in promoting innovation ecosystems in different geographical settings. By developing policies and practices informed by this evidence, policymakers, managers and researchers can improve innovation ecosystems'

effectiveness in hinterland and peripheral regions, and contribute to a more inclusive and sustainable innovation agenda.

The main point is the need to create and implement municipal innovation laws, to encourage and reward innovative initiatives in cities. Based on the most influential barriers identified, the recommended interventions suggest that managers could benefit from a strategic implementation model, more targeted and aligned with local limitations and with the potential of inland regions. Such places generally do not have the resources and visibility available in large urban centers. This study fills a gap in the literature and has the potential for practical application. It impacts public perception and promotes a better quality of life by strengthening regional economic resilience.

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Supplementary material

The supplementary material for this paper can be found online.

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