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Potential for Frugal Innovation in a Brazilian Regional System: A Study Based on a Multicriteria Approach

Gabriel Gomes Moreira [1], Robério José Rogério dos Santos [1], Victor Diogho Heuer de Carvalho [1,*], Francisco José Peixoto Rosário [2] and Agnaldo José dos Santos [1]

[1] Technologies Axis, Campus do Sertão, Federal University of Alagoas, Delmiro Gouveia 57480-000, Brazil; gabriel.moreira@delmiro.ufal.br (G.G.M.); roberio.santos@delmiro.ufal.br (R.J.R.d.S.); agnaldo@delmiro.ufal.br (A.J.d.S.)

[2] Department of Economics, School of Economics, Business Administration, and Accounting, Federal University of Alagoas, Maceió 57072-970, Brazil; francisco.rosario@feac.ufal.br

* Correspondence: victor.carvalho@delmiro.ufal.br

Abstract: Regional innovation systems (RISs) can stimulate knowledge sharing and collaboration, attracting investments and promoting economic and social progress. This is often linked to what is known as frugal innovation, involving small businesses developing and selling sustainable, low-cost products that meet local needs. This study aims to present and apply a model to measure regional innovation potential, using a multicriteria approach based on the principles of frugal innovation (FI). The analytical hierarchical process (AHP) was used to generate factor weights, enabling score calculation to provide insights into FI potential on a literature-based five-point scale. Data were collected in two stages: (i) from twelve main participants—working in a rural RIS—who responded to a questionnaire, and (ii) from cities through official government channels to collect information about their innovation development initiatives. The results reveal that the RIS analyzed still lacks assistance in the development of public policies to support the development of an innovative culture, indicating the need for appropriate mechanisms to boost innovation actions. The outputs of this study can help cities and regions to analyze their innovation potential, assist public managers in decision-making, support the creation of innovation-stimulating mechanisms, help RISs to address deficiencies, and promote local development.

Keywords: frugal innovation; innovation potential; rural regional innovation systems; multicriteria analysis; analytical hierarchy process (AHP)

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1. Introduction

The National Innovation System (NIS) consists of a collective of entities collaborating towards development, knowledge sharing, and empowering people in favor of innovation [1]. These entities, representing various institutions, contribute mutually, fostering innovative, socioeconomic, and technological advancement within their respective regions and companies [2,3]. Similarly, the regional innovation systems (RISs) apply this concept on a more geographically specific scale, enabling more accurate operations and improved problem perception [4,5].

Innovative potential is characterized as the continuous capacity to convert ideas and knowledge into new processes, systems, and products, benefiting both the company and its stakeholders [6]. Consequently, regional innovation potential (RIP) is understood as a specific region's capacity to evolve by transforming and enhancing existing processes, products, and systems, benefiting the region and all its stakeholders [7], ensuring the creation of policies aimed at the development and economic strengthening of a region, with the generation of jobs and innovative businesses, consequently stimulating competitiveness and product diversification [8].

The establishment of regional innovation systems is crucial for a country's progression. In nations like Brazil, marked by a broad range of regions with diverse socioeconomic disparities and an uneven allocation of innovation resources, the formation of these systems is of the utmost importance [9]. The mission of an innovation system is precisely to understand the joint functioning of elements—as highlighted by Casali et al. [10]—within the region where the system is established and to outline strategies for their development. A well-established innovation ecosystem can convert knowledge into innovation and provide the necessary infrastructure for fostering innovative entrepreneurship within a region [11]. It cultivates an environment where the dynamics of knowledge creation, diffusion, and absorption underpin the rise of innovative entrepreneurship and the propagation of new knowledge [12,13].

With the rise of Industry 4.0 and the significant global changes following the COVID-19 pandemic, frugal innovation (FI) has recently become a hot topic in many studies and discussions [14]. The FI, now part of a new technological paradigm, emphasizes incremental innovation at reduced costs, predominantly seen in economically emerging markets [15] that should be considered when designing oriented business models to attend to low-income consumers [16]. FI was also identified by Ávila-Robinson et al. [17] as one of the growing innovation research trends, describing, together with other topics, a mechanism for creating and transforming social value. Due to its potential to create new markets and business models, and attract and connect customers, coupled with its cost-reduction technique, this approach has been proliferating and evolving not just in emerging markets, but also in developed ones [18].

The main objective of this paper is to develop and put into action a model that can determine the potential for innovation in a rural region. This model, which is based on a multicriteria analysis and follows the principles of FI, can be used not only in the region currently under study but also in other regions. In simpler terms, a five-level scale was suggested and applied to measure the potential for innovation in a region. The analysis uses data from a survey that included 12 key contributors to the innovation ecosystem in the Alagoas State Backlands (in Portuguese, *Sertão de Alagoas*), employing the AHP method to assign weights to innovation factors grounded in FI.

2. Literature Review

This section will provide a theoretical foundation of the concepts related to the study topic. This includes a detailed analysis of the concepts of innovation systems' factors, frugal innovation, and multicriteria decision aid.

2.1. Innovation Systems Factors

Bengt A. Lundvall asserted that the NIS concept was designed to challenge conventional economic theories. This challenge extends not only to the microeconomic aspects of innovation but also to macroeconomic explanations of economic growth. In essence, the NSI concept seeks to provide a more comprehensive and nuanced understanding of economic dynamics [19]. The NIS is closely linked to the concept of a knowledge-based economy, which consists of three main elements (or pillars): the learning economy, the creative economy, and the open knowledge economy [20,21]. The development of NIS is also linked to the development and maintenance of research and development (R&D), and higher education investments, as the creation of innovation policies depends on knowledge-workers being formed in the university as well as the scientific/research initiative to promote solutions to social problems [22].

The RIS approach emerged from the influence of the NIS and territorial innovation models, considering the regional perspective as crucial for containing the clusters and networks of actors working in synergy with research institutions to promote innovation [9]. The whole complex and uncertain environment needs comprehensive metrics and management approaches to support regional economic development, also ensuring knowledge

sharing between the parts involved, to develop competitive capacity considering regional characteristics [23].

Regional systems can be described as areas where business communities and other participants collaborate to perform tasks and share resources, knowledge, and both tangible and intangible assets. This collaboration aims to enhance performance and productivity. It also includes mechanisms for both cooperation and competition among companies to foster mutual growth [5]. There are interactions, in their model, regarding universities, research institutions, the government, and companies, promoting exchanges involving knowledge sharing and transfer, people interactions, funding/financing, product/solutions development, and partnerships [24,25]. In this perspective, the inherent clusters formed by innovation entities have as their main element the collaboration networks acting as conductors for knowledge transfer [26,27].

The study by Snigiriva et al. [28] presents a novel analysis of innovation environment development factors, categorizing them into a trinity known as the *PRIM* index. The first part in this trinity, referring to legal norms (*PR*), consists of a compilation of the main legislative and regulatory documents in the field of science and innovation in the country or region. On the other hand, infrastructure elements (*I*) form a set of facilities that provide the necessary conditions for the execution of innovation and the operation of innovative processes. The methods (*M*) of support for innovative activity consist of a set of governmental actions (regulatory and economic) aimed at promoting innovative activity in the region. The elements considered in each component of Snigiriva et al. [28] trinity, are as follows:

- *PR*—the legal norms regulating innovative activity: the law on industrial policy; the law on the taxation of organizations and enterprises; the law on the regulation of investment activity; the law on science and scientific and technical policy; the law on the development of small and medium enterprises; the law on the development of innovative activity; the law on the protection of intellectual property; the long-term strategy of socio-economic development of the region; programs to support and develop small businesses; programs to improve the investment climate and attract investment and new technologies in the economy of the region;
- *I*—the infrastructure objects of support and development of innovations: center of scientific and technical information; center of research projects; business incubator; techno park; center of innovative development of entrepreneurship; technology transfer center; information and innovation center; center of exhibition and fair activities; center of outsourcing services; fund for the support of small and medium enterprises.
- *M*—the methods to support innovation: subsidizing part of the interest rates on loans attracted by subjects of innovation and development; subsidizing part of leasing payments under lease agreements of subjects of innovation and development; provision of budget investments to subjects of innovation and development; provision of tax benefits; provision of investment tax credit; participation in exhibitions and fairs; venture investment of innovative projects of small businesses; grant support for certain categories of citizens who want to organize their own business; information and consulting support of subjects of id; preferential use of property located in the regional (municipal) property.

According to Garcia and Wolffenbüttel [29], related to the normative (*PR*) perspective, in 2003, the Industrial, Technological, and Foreign Trade Policy (*Política Industrial, Tecnológica e de Comércio Exterior*, PITCE) was launched in Brazil. This policy led to the establishment of several laws and institutions: the Innovation Law and the "new" Computer Law, both enacted in 2004, the Biosafety Law and the Good Law, both from 2005, and the creation of the National Council for Industrial Development and the Brazilian Agency for Industrial Development. The policy underwent a revision due to an international crisis, internal changes within the government, and criticisms of PITCE's sectoral selectivity. In 2007, the Action Plan in Science, Technology, and Innovation was launched. The following year, in 2008, the Productive Development Policy was put into place to stimulate productive

investments in the nation's economy. More recently, in 2015, the Legal Framework for Science, Technology, and Innovation was approved.

According to the Map of the Brazilian Innovation System organized by the National Association for Research and Development of Innovative Companies (*Associação Nacional de Pesquisa e Desenvolvimento das Empresas Inovadoras*, ANPEI), from the infrastructural (*I*) and methodological (*M*) perspectives, Brazil and its regions have a macro flow of interactions between their organizations and public and private agents involving factors such as articulations, knowledge transfer/sharing, tax collection, managerial support processes, the use and transfer of technologies, and the infrastructure availability itself. Among the organizations are public and private science and technology institutions, including universities and research institutes; federal, state, and municipal governments providing regulation and promotion via agencies/foundations; companies of various sizes—including startups—looking for and generating solutions; innovation habitats such as incubators, technological parks, technological innovation centers, consultancies, the "S" system, and the Brazilian Support Service for Micro and Small Businesses (*Serviço Brasileiro de Apoio às Micro e Pequenas Empresas*, SEBRAE); and class entities and investors [30].

2.2. Frugal Innovation

The term "frugal innovation" is relatively new and was first used in *The Economist* magazine, in an article titled "Health in India: Lessons from a Frugal Innovator" [31] published in 2009 [32]. Radjou and Prabhu [15] highlight that FI is about doing more with less, generating social and commercial value. Gupta [33] interprets this as a new management philosophy, focused on the needs of markets at the base of the social pyramid. Looking for a link with the concept of RIS, in Arend et al. [34] it can be found that regionalization to adapt and adhere to the regional profile of customers leading to customization is a practice adopted in the frugal innovation application by companies.

In essence, FI aims to reach the base of the pyramid by restructuring products, services, and business models to reduce complexity and overall costs throughout the lifecycle [5]. This approach combines economic value with environmental and social aspects to generate value for the products [35–38]. Also related to FI, there are frugal productive operations, often based on regional and cultural characteristics that lead to a low-cost process with specific values and practices [39].

Rossetto et al. [40] provide a study on the three capabilities for the development of FI, grounded in their literature review. These capabilities encompass (i) essential functionalities; (ii) cost reduction; and (iii) the shared abilities of sustainable engagement. All of these must be concurrently addressed for the development of IF. Furthermore, it is important to emphasize that an activity is only classified as frugal innovation if it fulfills at least one attribute of each capability.

In the context of emerging/developing economies, frugal innovation (FI) presents itself as a suitable approach to innovation. This is primarily due to the demand for innovative products and services from the lower socioeconomic classes, who cannot afford high-value goods. FI also incorporates the creative economy, with local elements and resources used in the production of sustainable goods. This highlights the cultural, social, and sustainable connections between the produced goods and the technological components involved, which are not necessarily high-tech [41,42]. The main question related to this point is that customers in emerging economies favor cost-effective products with useful features. Embracing frugality can enable companies to make substantial contributions to ensure sustainable conditions for society [43,44], seeking, for example, the reuse of production waste for various purposes, thus contributing to the reduction in pollutants associated with production processes and also describing a line of green innovation [45,46]. Within this perspective, the sharing of knowledge is perceived as a crucial survival strategy for any organization. The presence of inclusive leadership in frugal innovation initiatives plays a pivotal role in fostering creativity among those involved in the conceptualization of frugal

products. This is an indispensable skill when it comes to the development of innovative strategies within organizations [47,48].

2.3. Multicriteria Decision Aid

When dealing with an evaluation with multiple aspects and objectives, as is the case of evaluating the frugal innovation potential, the methods and models provided by the field of multicriteria decision aid (MCDA) prove to be suitable, so that it is possible, for example, to apply ranking, sorting, or selection [49]. These are indeed the three classic decision problematics according to Benard Roy: selection (P.α), sorting (P.β), and ordering/ranking (P.γ), with the later addition of the description problematic (P.δ) [50,51].

MCDA, also known as multiple criteria decision-making (MCDM), is an area of operations research that considers multiple conflicting criteria when making decisions. It is applicable in various fields such as business, government, and medicine. MCDA methods are utilized in complex situations where decision-makers need to choose the best option from many alternatives [52]. These methods aid in structuring and solving decision and planning problems, providing support to decision-makers dealing with such issues [53]. MCDA methods can also be considered as means for eliciting preferences from decision-makers, considering their experiences (tacit knowledge) acquired in previous decision processes and the analysis of the information related to the problems, collected from the involved organizational instances.

The most common multicriteria decision support methods found in the literature are the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), the analytic hierarchy process (AHP), the *Elimination Et Choix Traduisant la Realité* (ELECTRE, which means elimination and choice translating the reality), the *Visekriterijumska Optimizacija I Kompromisno Resenje* (VIKOR, which means multicriteria optimization and compromise solution), the traditional Weighted Sum Method (WSM), the Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE), and the Multi-Attribute Utility Theory (MAUT) [54]. Among the methods most used in studies related to innovation, AHP is very common in the recent literature on innovation elements analysis. This fact is supported by the decision to adopt it as part of the methodology applied in this study.

AHP Applications for Innovation Decision-Related Research

Below, some recent related works using AHP in innovation-related studies are commented on and summarized. In Table 1, there are some key elements of the related works presented in this section: the study's problem, the objectives, and the innovation context of application, also considering the methodological approach applied in the present study for comparison at the end.

The work by Li and Li [55] aimed at understanding the theoretical foundations and dynamic mechanisms behind the ongoing innovation of rural financial products and evaluating the innovative capacity of financial service industry products in a specific region. The Lag Augmented–Vector Autoregression (LA-VAR) model was utilized to account for the market price fluctuations and liquidity factors of supply chain financial inventory products. The study also incorporated some theoretical models to scrutinize the innovative elements and interaction mechanisms of rural financial products. Data from a survey of financial service industry institutions in a certain region were processed using a fuzzy comprehensive evaluation. The weights among each related sub-indicator were determined using the AHP method based on the data obtained from several comparisons of indicators.

Wu and Ye [56] conducted a study on the determinants of innovation and entrepreneurship among college students, looking to understand which factors are significant in cultivating innovative talents. The study employed AHP to obtain the weighting of each determinant, considering them as key factors, thus identifying and analyzing the main influencing factors. They found that self-awareness is the most significant factor influencing students' entrepreneurial intentions. Students tend to decide on entrepreneurship based on their perceived abilities, aligning with common thought and action processes.

Table 1. Comparison between the related works, also considering this study.

Authors	Problem	Objectives	Innovation Application
Li and Li [55]	Rural financial products innovation elements' analysis.	Analyze the innovation elements of rural financial products from the external and internal aspects of innovation and discuss the relationship between the factors.	Innovation of rural financial products.
Wu and Ye [56]	Innovative and entrepreneurial determinants' identification on college students.	Explore relevant factors affecting the willingness of college students to innovate and start a business.	Innovative talent cultivation in the academy.
Filho et al. [57]	Competitiveness assessment.	Propose and apply a measurement tool to verify the competitiveness performance of startups' innovation ecosystems.	Startups innovation ecosystem.
Šūmakaris et al. [58]	Eco-innovation strategies' assessment.	Propose and apply an approach to evaluating eco-innovation strategies from the perspective of strategic green transformation that helps decision-makers to evaluate and select eco-innovation strategies aiming to achieve a competitive advantage.	Eco-innovation.
Puzović et al. [59]	Open innovation partners' selection.	Propose and apply a structured and methodology-supported decision-making process for open innovation partner selection.	Open innovation.
Khue Ngo et al. [60]	Innovation capability assessment.	Propose and apply a new integrated method for the evaluation of innovation capability in banking organizations	Innovation in the banking sector.
This study	Frugal innovation potential assessment.	Propose and apply a model to gauge regional innovation potential, utilizing multicriteria analysis and adhering to the principles of frugal innovation.	Frugal innovation in RIS.

The research by Šūmakaris et al. [58] proposed to assess the competitiveness of startups' innovation ecosystems from the perspective of startup managers. They developed a tool considering findings from a systematic literature review and based on the AHP method, including 6 fundamental points of view and 22 key performance indicators. It was applied to 46 startups, revealing that none achieved a fully competitive index, despite between 59.5% and 72.15% being considered potentially competitive, and 21% of managers rated their ecosystem as excellent. The findings suggest an underutilization of potential and insufficient opportunities for talent development and retention in 79% of the startups.

In their study, Šūmakaris et al. [58] presented a comprehensive method for assessing eco-innovation strategies through the lens of strategic green transformation. The method aims to assist decision-makers in the complex task of evaluating and choosing an eco-innovation strategy. This evaluation considered MCDA by combining AHP to obtain

criteria weights and TOPSIS to create a ranking of the strategies. As the authors make clear, choosing eco-innovation strategies is a crucial and complex task. Although eco-innovation is a significant field, scientific literature has not thoroughly examined eco-innovation strategies and the study presented is the first to look at eco-innovation strategies as a way for a company to go green and gain a competitive advantage.

Puzović et al. [59] outlined a systematic decision-making process for choosing open innovation partners. This process is based on a new hybrid model that uses multiple criteria for decision-making (MCDM). This model is improved with interval type-2 fuzzy sets (IT2F) to handle uncertainty. The model brings together IT2F Delphi (IT2FD), the IT2F analytical hierarchy process (IT2F AHP), and the IT2F Preference Ranking Organization Method for Enrichment of Evaluations (IT2F PROMETHEE). The outputs of the study can support managers in setting up clear strategies, policies, and best practices to enhance teamwork in open innovation projects in an organized way.

Khue Ngo et al. [60] proposed a new combined method for assessing innovation capability in banks, using AHP and the evidential reasoning approach, based on the Dempster–Shafer theory of evidence. According to their research findings, their proposal can give bank managers a tool to obtain a complete view of critical innovation management practices in their institutions, allowing the systematic checking and assessment of these practices. This can help them to enhance their innovation strategies to increase their IC levels and maintain their competitive edge. They verified that banks concentrate on key critical innovation management practices for banking innovation, like strategic management, resource management, and technology management, and that managers can identify which sub-critical practices have conflict among the experts, considering their different backgrounds and experiences influencing their judgments.

3. Methods

The study is descriptive research that seeks to explain the characteristics of a specific population or phenomenon. It analyzes and establishes relationships between variables, using standardized techniques to collect information. The primary goal of this research type is to observe events without any external interference, relying on the gathered sample.

The study by Rossetto et al. [40] suggests that frugal innovation requires the simultaneous application of three capabilities, each with at least one attribute, whether in the creation of new products or organizational practices. These capabilities, which are three sets of criteria that measure frugal innovation, can be applied not only in companies but also in other organizations in the regional context. On the other hand, the study by Snigiriva et al. [28] proposes a new approach to analyze the innovative potential of regions, based on the innovation support mechanisms present in the studied region, known as the "Trinity of Innovation Environment Development Factors."

Russia and Brazil, both members of BRICS and with great cultural diversities, are similar in many aspects. The Russian study, which analyzes regional development factors, is particularly relevant to Brazil and serves as the basis for this research. The "trinity" mentioned in the Russian study represents three key criteria for analysis. Two additional factors relevant to the regional innovation environment, not present in Snigiriva et al. research, are entities for the development of governance and public–private partnerships (PPP). Both were also considered in this research.

The main questions involved in the research developed are as follows:

- RQ1—What concepts and factors related to regional innovation systems can be used to compose a model for evaluating potential frugal innovation?
- RQ2—How can these concepts be used to construct an assessment capable of appropriately describing the frugal innovation potential of a regional system?
- RQ3—How can we appropriately measure this potential?

The study population consisted of 16 individuals, all actors in the innovation ecosystem of the backlands region of Alagoas State (Brazil). The population was not defined through technical or statistical methods, but arbitrarily, based on the respondents' expertise

on the subject. The sample had a total of 12 respondents and was based on the availability of the researched population.

The backlands of Alagoas are characterized as a rural region located in the Brazilian semi-arid ecosystem, being a region marked by a low population density and the presence of small cities, where economic activities revolve around agro-industry, through agriculture, especially for subsistence or to supply local or regional fairs, involving horticulture and fruticulture [61], and animal production with an emphasis on milk and meat [62,63], in addition to beekeeping for honey extraction. Other striking geographical features are the presence of a large river, the São Francisco (the largest entirely located in Brazilian territory), and the characteristic biome of the *caatinga*.

There is also an inclination towards peasant production from the "Landless" movements (in Portuguese, *Movimento Sem-Terra*), quite typical in rural regions in Brazil, which have as their characteristics the productive backyard, experiences of coexistence with the semi-arid ecosystem, peasant production in agroecological farms, organization on a daily scale, as well as others such as the struggles shared by social movements and organizations and learning from collective experiences [64]. In this context, family farming is also striking, highlighting that production is sometimes aimed at subsistence and sometimes directed for sale in markets in nearby cities, in addition to marking the formation of agricultural cooperatives among local producers [62].

Therefore, the context of the backlands region in this study is characterized by target cities whose main production comes from rural enterprises that function as sources of supply either for products considered "traditional", that is those that have always been present in the daily life of local markets, or products from enterprises with an emphasis on frugal innovation, also using inputs of rural origin, for sale in the cities' markets. In the region, in addition to subsistence agriculture and animal production, there are also economic vocations for sustainable agroecological tourism and the creative economy, in the latter case, also having as its main base materials characteristic products extracted from the semi-arid rural environment.

3.1. Data Collection Instrument and Reliability Measurement

For the data collection of the research, an online survey form was used which, according to Fowler [65], is a type of investigation whose purpose is to provide statistical descriptions of people through questions, usually applied to a sample. In this study, the sample was collected using the Google Forms tool and the questionnaire was made available through the WhatsApp application, where it was ensured that the form accepted only one response per individual through the collection of the email of each of the respondents, to prevent the distortion of the results obtained in addition to possible biases. The collection period lasted 30 days between September and October 2023.

After being collected via questionnaire, the data were compiled in a spreadsheet using Microsoft Excel software, for further processing in IBM SPSS Statistics software. The Cronbach's alpha coefficient in Equation (1) was calculated to assess the internal consistency of the questionnaire based on the standardized items of the questionnaire.

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i=1}^{k} S_i^2}{S_t^2}\right) \quad (1)$$

where k is the number of items (or questions), S_i^2 is the variance of each item, and S_t^2 is the total variance of the questionnaire. According to the α computed, Table 2 brings the reference values to determine the reliability level of the data collection instrument.

Table 2. Reference values for the Cronbach's alpha test.

Reliability Level	α-Value
Very low	$\alpha \leq 0.30$
Low	$0.30 \leq \alpha \leq 0.60$
Moderate	$0.60 \leq \alpha \leq 0.75$
High	$0.75 \leq \alpha \leq 0.90$
Very high	$\alpha > 0.90$

3.2. Data Processing with AHP

The modeling of the elements of the regional innovation environment was a key component for the success of the study. We selected the most effective evaluation criteria for the regional environment, focusing on frugal innovation. After identifying these criteria, we conducted extensive research on various platforms to find each of these elements in the cities of the backlands in Alagoas State. Finally, with the support of the AHP method, the ranking of the cities according to their innovative potential was created. Below, we describe the mathematical base of the AHP method.

AHP Methodological Details

When assessing intricate information or qualitative criteria that cannot be quantified, the involvement of a decision-maker becomes essential. In such instances, it is typical to utilize approaches such as the one suggested by Saaty [66] to articulate verbal preference judgments. Table 3 presents Saaty's scale, and the related AHP definitions explained in the sequence are based on [67].

Table 3. Saaty's scale and numerical points definitions.

Numerical Scale	Definition
1	Of equal significance—both criteria equally influence the objective.
3	Slightly more important—based on analysis or experience, criterion i holds slightly more importance than j.
5	Much more important—analysis or experience indicates that criterion i is considerably more important than j.
7	Very much more Important—analysis or experience shows that one criterion i is very much more important than j.
9	Extremely more important—analysis or experience reveals that criterion i holds extreme importance over j.
2, 4, 6, 8	Values that fall between the scales.
Reciprocal values	If criterion *i* is assigned a specific value in comparison to criterion *j*, then *j* will have a reciprocal value when compared to *i*.

Parting from Saaty's scale, a judgment square (n x n) matrix, is established. Subsequently, the elements in each column are added together to create a vector w_n. Table 4 represents this matrix.

Table 4. Judgment matrix.

	Criterion 1	Criterion 2	...	Criterion n
Criterion 1	1	a_{12}	...	a_{1n}
Criterion 2	$\frac{1}{a_{21}}$	1	...	a_{2n}
⋮	⋮	⋮	⋱	⋮
Criterion n	$\frac{1}{a_{n1}}$	$\frac{1}{a_{n2}}$	...	1
Sum	S_1	S_2	...	S_n

Subsequently, the normalization process for the judgment matrix values is executed. In this process, each value is divided by the sum of its respective column. Furthermore, the sum of each row is calculated to determine the relative priority or weight of each criterion. It is important to note that the sum of each column should equal one; if it does not, the matrix has not been correctly normalized. The subsequent phase involves assessing consistency via the consistency ratio (CR). If the CR ≤ 0.1, the judgments are deemed to be consistent. To execute this calculation, it is necessary to determine the value of λ_{max}, which is essentially the highest eigenvalue of the judgment matrix A. The equation to derive this value employs the following formula: $Aw = \lambda_{max} \times w$. The calculation process is represented in Equation (2).

$$\begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{21}} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{1}{a_{n1}} & \frac{1}{a_{n2}} & \cdots & 1 \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = \lambda_{max} \times \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} \quad (2)$$

Once λ_{max} is computed, the subsequent step involves calculating the consistency index (CI), which is derived from Equation (3).

$$CI = \frac{(\lambda_{max} - n)}{n - 1} \quad (3)$$

The CR is then ascertained using Equation (4), where RI is a random index found in Table 5.

$$CR = \frac{CI}{RI} \quad (4)$$

Table 5. RI values according to matrix order (n).

Matrix Order (n)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

In the last part of the process, once the matrix consistency is confirmed, the next step is to build the pairwise comparison matrix for evaluating the alternatives, as shown in Table 6.

Table 6. Comparison matrix.

	Criterion 1	**Criterion 2**	...	**Criterion n**
Alternative 1	x_{11}	x_{12}	...	x_{1n}
Alternative 2	x_{21}	x_{22}	...	x_{2n}
⋮	⋮	⋮	⋱	⋮
Alternative m	x_{m1}	x_{m2}	...	x_{mn}

Once the matrix is constructed, its values are multiplied by the weights w_n, as depicted in the matrixial form according to Equation (5).

$$\begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \begin{bmatrix} w_1 & w_2 & \ldots & w_n \end{bmatrix} = \begin{bmatrix} x_{11}w_1 & x_{12}w_2 & \cdots & x_{1n}w_n \\ x_{21}w_1 & x_{22}w_2 & \cdots & x_{2n}w_n \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1}w_1 & x_{m2}w_2 & \cdots & x_{mn}w_n \end{bmatrix} \quad (5)$$

Finishing, the results will be given by the sum for each alternative according to Equation (6).

$$v(a_m) = \sum_{i=1}^{m,n} x_{mn} w_n \quad (6)$$

where $v(a_m)$ is the final aggregated value related to the alternative m (a_m), used to obtain the ranking of the alternatives.

In the methodological process involved, data collection is the most challenging phase, as the method uses the MCDA approach and it depends fundamentally on preference; in other words, it requires direct contact with people (the decision-makers) to collect their judgments to be used and create the outputs (weights, alternative value scores, and the ranking of the alternatives). Data collection should be structured to ensure the consistency of the AHP results—as can be seen, the method introduces a measure for consistency (the CR) as a step within the analytical process.

4. Results and Discussion

This section will present an analysis and compilation of the results garnered from the study, appropriately divided into the following topics: sample descriptive analysis; modeling the factors of the regional innovation environment; analysis of the factors in each city of the Alagoas State Backlands; multicriteria analysis; and determination of the potential for frugal innovation.

4.1. Sample Descriptive Analysis

To complement the criteria of the study by Snigiriva et al. [28] with FI, a questionnaire was employed. This questionnaire was specifically designed for the primary and most dynamic participants of the Innovation Ecosystem in the Alagoas Backlands. In this way, this questionnaire correlated the factors of the regional innovation environment of the Russian study, with the capabilities of frugal innovation. The questionnaire was launched to a total audience of 16 (sixteen) people and had a total of 12 (twelve) responses. Thus, the margin of error of this sample is 12.22% (this means that the variation index of the results of this research can vary up to approximately 13 percentage points more or less) considering a confidence level of 90%.

With the help of IBM SPSS Statistics Software, the Cronbach's alpha coefficient was calculated based on the standardized items of the questionnaire, and the results are presented in Table 7.

Table 7. Cronbach's alpha test results.

Cronbach's Alpha	Cronbach's Alpha (Standardized Items)	Num. of Items
0.974	0.975	32

The value of 0.975 indicates an extremely high internal consistency for this questionnaire, reinforcing its reliability.

4.2. Modeling the Factors of the Regional Innovation Environment

To eliminate the factors of the innovation environment that do not align with the capabilities of frugal innovation and recognize that it is practically impossible for these factors to simultaneously meet the three capabilities of FI (a quantity that according to the research by Rossetto et al. [40], an activity must meet to be considered FI), it was then considered necessary to develop an alternative analysis metric.

In the first step of this analysis, only the FI attributes that were voted by more than 50% of the respondents in each of the regional environmental factors were considered. This was performed to select the best FI criteria in a way that would meet most of the experts. The study required at least seven votes per alternative for validation; attributes with six or

fewer votes are excluded. In the second step, factors not meeting at least two FI capabilities were excluded. In this way, a total of nine factors were removed from the study, Table 8 shows the factors excluded from the study along with the number of attributes and FI capabilities that each one met.

Table 8. Regional innovation environment excluded factors.

Factors	Capabilities	Attributes
Techno Park	0	0
Center for Innovative Entrepreneurship Development	1	1
Support funds for individual entrepreneurs and micro, small, and medium companies	1	2
Lease payment assistance under innovation and development constituent entity contracts	1	1
Provision of budgetary investments for innovation and development entities	1	1
Participation in exhibitions and fairs	0	0
Risk investment in innovative small business projects	1	3
Granting support to certain categories of citizens who intend to create their own business	1	2
Preferential use of municipal property	1	1
Informational and consultative support for innovation and development subjects	1	1

In addition, Table 9 presents the most important factors in the innovation environment based on the following criteria: firstly, the number of capabilities met by each factor, secondly the number of attributes met, and thirdly the scores based on the average number of votes that each factor received.

Table 9. Main factors of the regional innovation environment.

Factors	Capabilities	Attributes	Score
Long-term regional development strategy	2	5	8.80
Scientific and Technical Information Center	2	2	8.50
Business incubator	2	2	8.50
Information and Innovation Center	2	2	8.50
Law on taxation of organizations and companies	2	3	8.33
Entities for the development of the governance process	2	3	8.33
Law on the development of innovative activities	2	4	8.25
Program to improve the investment climate and attract investments and new technologies in the region's economy	2	4	8.25
Law on industrial policy	3	5	8.20
Technology Transfer Center	3	3	8.00
Law on the regulation of investment activities	2	3	8.00
Outsourced Service Center	2	2	8.00
Legislation protecting intellectual property	2	2	7.50
Center for exhibition and fair activities	3	5	7.40
Law on science and scientific and technological policy	2	3	7.33
Subsidy of part of the interest rates on loans raised by innovation and development entities	2	3	7.33
Granting tax benefits/incentives	2	3	7.33
Law on the development of small, medium-sized enterprises and individual entrepreneurs	2	4	7.25
Public–private partnerships (PPP)	2	4	7.25
Research Project Center	3	6	7.17
Support and development programs for individual entrepreneurs and micro, small, and medium-sized companies	2	4	7.00
Granting investment tax credit	2	2	7.00

With Table 9 of the main factors of the RIS, and with the defined criteria, it is now possible to create a scoring system to later be able to rank the cities as they meet each of the factors.

4.3. Analysis of the Factors in Each City of the Alagoas State Backlands

An analysis of regional innovation environment factors was conducted using various sources, including the Transparency Portal of each studied municipality (Canapi, Olho D'água do Casado, Água Branca, Pariconha, and Delmiro Gouveia) and attempted communication with local entities. Despite numerous attempts via email, calls, and instant messages, many inquiries remained unanswered. E-mails were also sent to the State Secretariat for Science, Technology, and Innovation of Alagoas (*Secretaria de Estado da Ciência, da Tecnologia e da Inovação de Alagoas*, SECTI), and the Alagoas State Research Support Foundation (*Fundação de Amparo à Pesquisa do Estado de Alagoas*, FAPEAL), to discover the actions that these entities were carrying out in the region.

Communication was established with members of the city halls of Piranhas and Pariconha to gather data on potential initiatives, strategies, resources, and applicable municipal regulations. Online research was also conducted using the Google platform and Google Maps to identify infrastructures intended to foster innovation in these municipalities. Only entities related to commercial classes and their development are considered for the development of governance processes. Associations of parents, teachers, residents, etc., and common federal and state laws, programs, and actions are not included in this study. The results are registered in the Supplementary Materials (Tables S1–S4).

The data collection results indicated there are still many structures failing to support innovative activities throughout the Alagoas State Backlands. This is largely due to it being a region with a low population density, where the existence of large structures such as more Research Project Centers may not make much sense. However, we think that it is indeed feasible for there to be Technology Transfer Centers in the cities where the Research Project Centers are located, at least one Business Incubator, Exhibition, and Fair Activity Center (even if small, adapted to the realities of each municipality), more Information and Innovation Centers, more entities for the development of governance processes, at least one commercial association or a chamber of store managers in each municipality, and at least one Outsourced Services Center. Scientific and Technological Information Centers are a national problem; there are very few throughout the country, so it would be almost unimaginable to have such a structure in the region studied.

There are also many municipal laws failing to support and promote innovation and entrepreneurship; even though there are state and federal laws aimed at supporting these activities, municipalities must be able to adapt these laws to their respective realities. We can see examples of this in the study itself, such as the Municipal General Law of the Microenterprise, the Small Business, and the Individual Microentrepreneur of the municipality of Piranhas, which regulates the differentiated and favored legal treatment of companies of the sizes mentioned above by federal law n° 123/2006. It alone covers a wide range of very important laws for determining the city's innovative potential.

Federal law Nº 123/2006 also influenced two other laws from two municipalities, which are the Municipal Public Purchasing Program of Água Branca, and the Municipal Science, Technology, and Innovation Policy of Delmiro Gouveia. It is worth noting that the lack of industrial policy laws in most of these municipalities can deter potential enterprises that want to be located in the region.

There is still a shortage in these locations when we talk about methods to support innovation. The most important of them, according to experts, are public–private partnerships. There are only two partnerships of this type throughout the region, one of which is common to all municipalities, which is the entrepreneur's room/house, which is a partnership between the city halls and the SEBRAE, and represents facilities operated by municipal administrations, aimed at simplifying the procedures for creating, regularizing, and closing companies, in addition to offering exclusive services aimed at individual mi-

croentrepreneurs. The other PPP operates only in the municipality of Piranhas, through *Hub Xingó*. The latter works for the development of solutions in innovation for municipal administrations. In this way, we realize that there are few partnerships for the number of opportunities and advantages that this type of partnership can offer to municipalities.

Another stimulus that could not be computed in any of these factors but that is worth mentioning is the "*Desenvolve Alagoas*" (Developing Alagoas) program, which until the time of delivery of this work offers three kinds of credit lines for companies in the tourism area, from individual microentrepreneurs to small-sized companies and limited liability companies.

It is also worth noting that there are ongoing projects for several municipal development plans, which will have the participation of the Federal University of Alagoas (*Universidade Federal de Alagoas*, UFAL) and the University Foundation for Extension and Research Development (*Fundação Universitária de Desenvolvimento de Extensão e Pesquisa*, FUNDEPES). According to Fischer et al. [68], universities need to foster internal collaboration for FI and ease bureaucratic hurdles for external interactions. Incentives rewarding frugal innovation engagement are vital. Despite its emergence, FI is yet to be fully recognized within universities' traditional structures.

Despite all the problems, the scenario is one of great evolution. Until recently, many of these laws, entities, and centers did not even exist. SEBRAE appears as a key figure in this development when we talk about innovative initiatives in the high backlands. Actions range from the creation and implementation of the Backlands Innovation Ecosystem to the promotion of the game Entrepreneurial Cities, which generates healthy rivalry among the municipalities in the region and promotes economic, scientific, and technological growth.

In this context, the participation of the Alagoas State Backlands Innovation Ecosystem brings a significant positive point to the entire region. They coordinate and monitor actions to promote innovation that is carried out throughout the territory of the Alagoas Backlands.

4.4. Multicriteria Analysis

The AHP method enabled the classification of criteria based on their relevance, resulting in the creation of a set of weights used in the evaluation of the established criteria. Consequently, this method was chosen to develop the scoring system in this study, where the weights will be used to determine the innovation potential of each municipality in the Alagoas State Backlands. Therefore, the first step is to prioritize the criteria through the judgment matrix. After defining this, the next step is to calculate the weights generated through the matrix according to Tables 10 and 11, the last containing the normalized judgments.

Table 10. Judgments matrix for the criteria.

	Capabilities	**Attributes**	**Score (Votes) Average)**
Capabilities	1.000	6.000	9.000
Attributes	0.167	1.000	4.000
Score (votes average)	0.111	0.250	1.000
Sum	1.278	7.250	14.000

Using the procedure to calculate the consistency ratio according to Equations (2)–(4), the following are obtained: $\lambda_{max} \cong 3.112$, CI = 0.056, and CR = 0.09. The result of *RC* implies that the relative priorities of the example are consistent, so we should then proceed with the calculations by constructing the comparison matrix, as per the model presented in Table 6. Thus, in Table 12, the comparison matrix is presented, which is nothing more than the multiplication of the results shown in Table 9, by the weight of each criterion in Table 11, according to Equation (5).

Table 11. Normalized judgments matrix for the criteria.

	Capabilities	Attributes	Score (Votes Average)	Weights
Capabilities	0.783	0.828	0.643	0.751
Attributes	0.130	0.138	0.286	0.185
Score (votes average)	0.087	0.034	0.071	0.064
Sum	1.000	1.000	1.000	1.000

Table 12. Comparison matrix.

Factors	Capabilities	Attributes	Score (Votes Average)	Total Weight
Research Project Center	2.2530520	1.1081602	0.4600000	3.8219520
Law on industrial policy	2.2530520	0.9234668	0.5300000	3.7036910
Center for Exhibition and Fair Activities	2.2530520	0.9234668	0.4800000	3.6522600
Technology Transfer Center	2.2530520	0.5540801	0.5100000	3.3214460
Long-term regional development strategy	1.5020347	0.9234668	0.5700000	2.9912470
Law on the development of innovative activities	1.5020347	0.7387735	0.5300000	2.7711950
Program to improve the investment climate and attract investments and new technologies in the region's economy	1.5020347	0.7387735	0.5300000	2.7711950
Law on the development of small or medium-sized enterprises and individual entrepreneurs	1.5020347	0.7387735	0.4700000	2.7069050
Public–private partnerships (PPP)	1.5020347	0.7387735	0.4700000	2.7069050
Support and development programs for individual entrepreneurs and micro, small, and medium-sized companies	1.5020347	0.7387735	0.4500000	2.6908330
Law on taxation of organizations and companies	1.5020347	0.5540801	0.5400000	2.5918590
Entities for the development of the governance process	1.5020347	0.5540801	0.5400000	2.5918590
Law on the regulation of investment activities	1.5020347	0.5540801	0.5100000	2.5704290
Law on science and scientific and technological policy	1.5020347	0.5540801	0.4700000	2.5275700
Subsidy of part of the interest rates on loans raised by innovation and development entities	1.5020347	0.5540801	0.4700000	2.5275700
Granting tax benefits/incentives	1.5020347	0.5540801	0.4700000	2.5275700
Scientific and Technical Information Center	1.5020347	0.3693867	0.5500000	2.4178800
Business incubator	1.5020347	0.3693867	0.5500000	2.4178800
Information and Innovation Center	1.5020347	0.3693867	0.5500000	2.4178800
Outsourced Service Center	1.5020347	0.3693867	0.5100000	2.3857360
Legislation protecting intellectual property	1.5020347	0.3693867	0.4800000	2.3535910
Granting investment tax credit	1.5020347	0.3693867	0.4500000	2.3214460

In Table 12, the "Total Weight" column represents the weight corresponding to each factor of the regional innovation environment, allowing their ranking, for instance, in descending order (higher to lower weight values).

4.5. Determination of the Potential for Frugal Innovation

After establishing the total weights and assigning quantitative values to all the elements that make up the regional innovation environment, the subsequent step involves combining the data from Section 4.3 of this article with the values found in Table 13.

these values were calculated by multiplication, where each value of "Total Weight" was multiplied by the number of factors that each municipality met, using Equation (6).

Table 13. Cities ranking according to their innovative potential.

City	Innovative Potential
Delmiro Gouveia	49.595
Piranhas	43.547
Água Branca	26.358
Canapi	8.116
Inhapi	8.116
Mata Grande	8.116
Olho d'Água do Casado	8.116
Pariconha	8.116

It can be observed that the municipality of Delmiro Gouveia is ahead of the others in its region, closely followed by Piranhas, which is well ahead of the third place, Água Branca. Delmiro's position was expected, as it is the hub municipality of the region, but what is impressive is Piranhas, which, despite having a population more than 50% smaller, as shown by the 2022 Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, IBGE) data, achieved a performance very similar to that of Delmiro Gouveia. This is largely due to "Piranhas 150," an innovative event where the population is invited to draw up city development plans together with the public power, in addition to the PPP with the private company Hub Xingó.

What made the difference for Delmiro was the difference in the number of entities for the development of governance processes. The tie between the other listed cities is due to the lack of several factors, especially the entities for the development of governance processes, which are six in Água Branca, seven in Delmiro Gouveia, and four in Piranhas.

Using the data from this study, a scale proposal can also be presented to classify the innovative potential of the municipality, according to the scores obtained for innovative potential. The basis used for the scale comes from maturity models such as the Capability Maturity Model Integration (CMMI), whose objective is to evaluate and improve organizational processes in the production of information systems/software [69]. Other references such as the model applied by Ouazzani-Chahidi et al. [70] and the concepts presented by Jugdev and Thomas [71] also supported the definition of the concepts presented in Table 14.

Table 14. Scale for the innovative potential.

Level	Concept	Range
Initial	The location still has an incipient level of innovation initiatives, although there may already be some initiatives in development, but at a very initial level and without generating measurable and significant results.	$0 \leq x < 20$
Planned	The location already has a planned vision of innovation initiatives, compared to the previous stage, managing to adopt some associated methodological practices to help promote these initiatives. It is now possible to carry out some more basic measurements, such as the number of initiatives and entities involved.	$20 \leq x < 40$
Defined	The location can clearly define its innovation objectives, also having some entities working towards the development of innovation initiatives. Local regulations are in the process of being defined as well as initial infrastructure being established.	$40 \leq x < 60$

Table 14. *Cont.*

Level	Concept	Range
Managed	The location can manage and control the components of innovation initiatives, with a network of interactions being consolidated to strengthen the ecosystem. Control implies more advanced measurability, making it possible to correlate the effects that the environment presents with the actions of the agents and entities involved.	$60 \leq x < 80$
Advanced	The location can optimally manage and control the actions of innovation initiatives, ensuring strong integration between agents and entities to strengthen the ecosystem, understanding well which are the indicators that allow quantification of the level of success achieved, making predictions for replanning and updates on managed elements.	Equal to or above 80

On the proposed scale, numerically the lower limit for the value of innovative potential is zero (0), which indicates an initial potential; the more factors of the regional environment each municipality or region has, the greater its innovative potential. Through the scores in Table 13 and the ranges in Table 14, it can be considered that the innovative potentials of Delmiro Gouveia and Piranhas are intermediate and that Água Branca is at the beginner level. For the other municipalities, there is insufficient innovation potential.

The total potential for frugal innovation in the region is the average of the innovation of each municipality, given by the traditional mean formula: $\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n}$. For the Alagoas State Backlands RIS, a score of 20.01 was computed.

Therefore, considering all the cities analyzed in this study, the region is at a beginner stage in terms of innovation potential. This result is largely influenced by the municipalities of Canapi, Inhapi, Mata Grande, Olho d'Água do Casado, and Pariconha (highlighted in gray in Table 13), which together represent 62.5% of the sample of cities surveyed and have a significant influence in reducing this indicator.

4.6. Theoretical Implications

Despite its increasing prominence, frugal innovation remains under-studied in Brazil. This research serves as a pioneering effort in this critical subject, which holds significant importance for the advancement of numerous regions, particularly the northeastern part of the country that grapples with financial resource constraints in its states and cities. These challenges amplify in the backlands of Alagoas State, where these issues are starkly apparent.

This study's methodological approach offers a distinct viewpoint in the examination of regional innovation potential. By integrating the principles of multicriteria methods, decision theory, and transforming qualitative criteria into quantitative ones, this research facilitates a more objective evaluation of innovation potential. The outcome is the creation of indicators that could prove invaluable for future explorations on the topic, aiding in a more precise and substantiated analysis, supporting a learning perspective for the organizations and actors involved by providing insights on what action needs to be taken to improve the conditions of the system in which they are inserted [72]. Moreover, there are limited studies that consider frugal innovation as a crucial component of RIS, despite its role in fostering a more inclusive form of innovation, particularly vital for emerging nations like Brazil. Consequently, this research delivers fresh insights and findings that enhance the comprehension of how frugal innovation transpires and how it can be cultivated within a regional context.

4.7. Practical Implications

This research holds the potential to guide how the government, the NIS, states, regional innovation systems, municipalities, and organizations like SEBRAE can strategize and allocate their resources for the advancement of various cities and regions via the facets of frugal innovation.

By leveraging the ranking of the most crucial factors in the RIS, it is feasible to devise plans, enact laws, construct infrastructures deemed vital for municipal and regional development, and train people to lead the ecosystem in a manner consistent with an innovative and entrepreneurial mentality. This lends considerable significance to this research in terms of regional economic growth. Moreover, this study could act as a catalyst for municipalities, particularly those with lower rankings in the list, potentially fostering a healthy competitive atmosphere among cities, thereby promoting the progress of these regions, akin to the game "Entrepreneurial Cities."

These implications meet the findings by Silva et al. [73], which emphasize the challenges of implementing a standalone RIS, the need for a quality-focused education system, the importance of human resource development, and the role of R&D in high-tech employment and innovation. It also highlights the necessity of additional policies to address RIS limitations.

The methodology utilized in this research lays a foundational structure that could serve as the groundwork for developing specialized software intended to aid in assessing the innovation potential of municipalities and regions. This software would be anchored in the principles of innovation management, frugal innovation, and decision theory, offering insights and guiding the actions of the relevant authorities.

We also note that it is necessary to emphasize that the technique used, and the result obtained, is an instrument so that the mayor and council of the municipality can better structure the resources and capabilities of the locality to increase public policies for the citizens, serving as a case study for municipal management.

5. Conclusions

The Alagoas State Backlands still lacks key elements necessary for its development in terms of infrastructure and actions that promote innovation. Numerous municipalities continue to overlook innovative activities, consequently lagging in the developmental race. This study has managed to underscore the disparity among the municipalities within the Alagoas State Backlands.

Consequently, the Backlands Innovation Ecosystem, the Backlands Territorial Council, and entities promoting innovation such as SEBRAE, SECTI, and FAPEAL should intensify their focus and efforts in these municipalities to enhance their participation in the RIS. The study is constrained by the absence of substantial municipal data, primarily due to the challenging communication with representatives from the municipalities of the Alagoas State Backlands.

Numerous contact attempts with these municipalities' secretariats remained unanswered, potentially leading to discrepancies in the data obtained and presented in Section 4.5. There might be municipal actions and laws that were not discovered on search sites or the Transparency Portal of these municipalities but could be in effect. Another limitation worth noting is the number of respondents in this study.

A margin of error of 12.22% is considerably high, given a 90% confidence level. This suggests a significant likelihood that many of the factors listed in Table 9 may not conform. For future research, it would be insightful to understand the efficacy of the actions undertaken by these municipalities. This is a significant bottleneck when evaluating innovation potential since it is challenging to ascertain if the actions implemented are genuinely generating a tangible impact. To achieve this, closer monitoring of the municipalities through visits and unrestricted access to information would be necessary.

By its nature, the results of the study reported in this article are limited to the RIS of the Alagoas State Backlands region; however, the multicriteria analysis involved in the

methodological approach, combined with the factors extracted from literature, can be used to assess another RIS. The results also represent a picture of the status of the Alagoas State Backlands RIS, and considering the evolution of policies, laws, and involved organizations, this is not assumed to be static. Thus, this kind of assessment should be applied periodically to support constructing a historical database, for instance, to support information systems dedicated to entrepreneurship and innovation initiatives.

The study had to deal with several challenges, difficulties, and limitations, but among them, the most remarkable were (i) the difficulty in accessing open data on the municipalities-related websites, as there is still a culture of bureaucracy, involving asking to access this information for the management agencies; (ii) the difficulty in contacting some public managers and when contacted, the delay in receiving the replies; (iii) the difficulty in contacting entrepreneurs and local agents involved in promoting the RIS; (iv) the limited data available, for instance, missing important descriptive details to ensure understanding a timeline of the innovation and entrepreneurship initiatives evolution; (v) the lack of a unified platform, managed by the state, to aggregate important information on the innovation and entrepreneurship initiatives.

For future research, continuing the reported method, some other multicriteria models/methods can be tested, for instance, combining both sorting (P.β), and ordering/ranking (P.γ) problematics or even applying a stepwise process involving structuring the problem combining the description problematic (P.δ) with the aforementioned. The data collection can also be expanded to support building a database containing both structured and unstructured (textual) data, to support developing information systems dedicated to innovation and entrepreneurship to analyze information from cities related to an RIS.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/soc14060095/s1, Table S1: Factors in the Água Branca and Canapi Innovation Environments; Table S2: Factors in the Delmiro Gouveia and Inhapi Innovation Environments; Table S3: Factors in the Mata Grande and Olho d'Água do Casado Innovation Environments; Table S4: Factors in the Pariconha and Piranhas Innovation Environments.

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