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Environmental Sustainability Index of Rural Properties in the Federal District, Brazil

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Abstract: The objective of this work was to build and apply environmental indicators to verify the environmental performance and diagnose the sustainability levels of the rural properties from Federal District, Brazil. Data analysis was performed based on the information required and declared to public administration. Exploratory sampling was applied, obtaining a sample population of 169 properties. It was decided to use the factor analysis methodology in order to verify the environmental performance and diagnose the sustainability levels of the rural properties. The results achieved allow us to state that most of the properties (91.49%) are in a state of severe unsustainability. The results also show that the remnants of native vegetation, when they exist, are not in sufficient proportion to the total size of the property according to what the legislation requires. The proposed model and the environmental indicators built from the environmental legislation proved to be an efficient, practical and low-cost tool for a satisfactory diagnosis about the measurement of the sustainability of Brazilian rural properties and in the identification of positive management situations in relation to the suitability for environmental laws.

Keywords: rural development; sustainability indicators; environmental legislation

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Citation: Souza, R.M.; Angelo, H.; Almeida, A.N.d.; Gaspar, R.d.O.; Paula, M.F.d. Environmental Sustainability Index of Rural Properties in the Federal District, Brazil. *Sustainability* **2022**, *14*, 16738. https://doi.org/10.3390/su142416738

Academic Editors: Margarita Maria Brugarolas Molla-Bauza and Laura Martinez-Carrasco

Received: 18 October 2022
Accepted: 6 December 2022
Published: 14 December 2022

1. Introduction

The environmental sustainability of rural properties, in the context of the new forest code—Law 12.651/2012, which sanctions the Native Vegetation Protection legislation (LPVN)—assumes that with the farmer's participation, it will be possible to restore forest environments, exercise sustainable agriculture and, consequently, rationally use natural resources [1]. To comply with the LPVN guidelines and to facilitate the monitoring by competent environmental agencies, two legal instruments were established under the National Environmental Information System (SINIMA): the Rural Environmental Registry (CAR), a public and electronic registry in which all rural properties in the national territory are required to participate, and the Environmental Regularization Program (PRA).

The CAR was regulated by Decree No. 7.830/2012; its purpose was to integrate environmental information from rural properties and possessions, construct a database to control, monitor, and combat deforestation, and for environmental and economic planning [2]. The CAR covers data from the owners, possessors or person responsible for the rural property, the georeferenced plant within the boundaries of the property, the areas of social interest, areas of public utility, locations of the remnants of native vegetation and consolidated areas, and Areas of Permanent Preservation (APP), Restricted Use, and Legal Reserves (RL).

The legislation has created the need to identify and characterize rural properties, making it extremely important to diagnose the environmental regularities and irregularities of such properties in terms of cost and efficiency. Moreover, proposing appropriate methodologies for the diagnosed reality is an incipient initiative. It is particularly important, in terms of regularizing these properties according to environmental legislation, to recognize the importance of the remaining natural formations in private areas, balancing the property right with the preserved environment collective right, both constitutionally determined in Brazil.

Therefore, based on such assumptions, the legislation is a legal instrument for preventing environmental damage and driving people and states to adopt more environmentally sustainable practices [3]. Greater public investment is needed with a focus on sustainable rural production in Brazil, incorporating economic, social and environmental bases.

The free market, in many cases, does not incorporate environmental externalities in the price formation of goods, leading to irrational decisions of society regarding the environment preservation. Furthermore, information asymmetries and concentrated market structures, present in the free market, can lead to a short-term economic rationality, denying the right to a balanced environment for future generations. These contingencies justify state intervention, enabling social, environmental and economic benefits.

Feistauer et al. highlight the need to consider agricultural and land use models focused on the sustainability of the agro-ecosystem, reconciling with what environmental legislations allow and require [3]. However, few areas are managed from a sustainable perspective. The difficulty of interpreting and understanding the environmental legislation, especially in the absence of specialized technical advice that helps producers strategically manage and handle rural properties, has raised doubts about the adequacy of such legislation, which is one of the main causes of this scenario [4]. The observation by Meireles [3] is based on the complexity and instability of environmental legislation in Brazil, as well as the difficulty of surveillance due to the size of the country and insufficient public resources.

The changes in understanding the role that the countryside plays in the conservation and preservation of natural resources are recent. In response to the growing demand for products and goods from the rural environment, the farmer has become the main character in driving integrated, complex, diversified, interdependent and, above all, sustainable production systems. Aggregate economic efficiency with regards to social responsibility and the protection of natural heritage, articulating the availability of ecosystem services to society, has become paramount for the producer to continue the business.

Ferreira et al. highlight the need to articulate managerial and educational processes through tools that assist in measuring and analyzing the environmental performance of rural properties with a focus on decision-making [5]. This holistic view between environmental conservation, production systems, and consequent compliance with environmental legislation implies greater complexity in managing rural properties.

Currently, Sustainability Indicators are one of the most widely used tools for this type of measurement and the analysis of the environmental performance of rural properties. Some existing methodologies are appropriate to their intended reality, and there is the possibility of building indicators based on what is intended to be analyzed.

According to Van Bellen, the main purpose of indicators is to aggregate and quantify information so that their significance becomes more apparent [6]. To be a relevant and important tool for environmental management, indicators must compile, in the simplest way possible, relevant information about what is being analyzed. There are some specific functions intrinsic to indicators as follows [7]:

- Assess conditions and trends;
- Make a comparison between places and situations;
- Assess conditions and trends in relation to goals and objectives;
- Provide warning information;
- Anticipate future conditions and trends.

Creating these or any other kind of indicators requires working with a unit that makes it possible to describe and represent a phenomenon. This unit should encompass a range of factors related to sustainability, such as ecological, economic, and social factors. It is necessary to have a look at the total rural enterprise, aim at the sustainability of the property, and allow to create indicators that portray the reality to be analyzed.

With regard to the proposal of this work, creating indicators based on the legal requirements imposed by the Brazilian State can facilitate the process of raising awareness among landowners about regularizing their properties, as provided in Brazilian environmental law. It is not only about complying with the legislation but also understanding the importance of preserving and, when necessary, recovering natural areas, as well as understanding the benefits of not only complying with legal obligations but also the environmental benefits and the potential ecological services resulting from re-establishing balanced ecosystems.

It is also important to understand the consequences of this type of analysis, arising from changes in environmental legislation and even the possible benefits related to the preservation and diagnosis of sustainability that the information obtained from the enforced forest code allows. The variety of information required from landowners for the CAR to proceed with regularizing their properties indicates their minimum conservation status and, consequently, allows diagnoses that can lead to more accurate decision-making. By crossing information on the environmental sustainability of rural properties with the resilience and environmental importance in a given area, the Brazilian environmental agency can act in proposing more or less restrictive policies in the use of natural resources.

To this end, this study addresses the use of indicators based on Brazilian environmental legislation, especially with regard to issues of the environmental landscape of rural properties in the light of the LPVN, to analyze rural properties. In particular, we sought to (a) determine the degree of sustainability of the rural properties studied, (b) identify the determinants of environmental sustainability based on the LPVN, (c) verify whether the properties studied are in line with the legislation, and (d) contribute to decision makers in constructing solutions to environmental problems in the rural environment.

There are several studies on the environmental sustainability index, but most of them address the urban area [8,9] increasing the contribution of this research in the countryside, such as Hashemi [10] motivation. In addition, Brazil's relevance in food production and the great environmental impact from rural area also justify this study.

2. Literature Review

The word "indicator" has the meaning of discovering, pointing out, announcing and estimating something. When they seek to reach a certain goal, the indicators show, communicate, inform about the progress towards that goal, such as the achievement of sustainable development. According to Hammond [11], indicators can be understood as a resource that makes noticeable a trend or phenomenon that is not readily detectable.

Regarding environmental indicators, these are tools used to monitor environmental sustainability and their main function is to provide information about the status of the various dimensions [12]. Through sustainability indicators, it is possible to generate data and information that serve as a basis for environmental planning and territorial development.

The first compilation of environmental indicators arose from the need to seek sustainable development and transform it into a global goal. The objective to be achieved when working with these indicators is basically to explain the reality under analysis through its control. In addition, it should be possible to transform qualitative and subjective data into quantitative and objective analysis, in order to facilitate understanding and allow the measurement of categories within the object of analysis [13].

For Pereira et al. [13], "in order to build an indicator, it is necessary to keep in mind what you want to achieve with it, to also choose correctly which data should be collected and (...) whether the essential data are measurable." The data collected must be correlated with the dimensions that are proposed to be detailed in order to reach the defined objectives [14].

A review of current studies about environmental sustainability indicators can be found at Silva and Garneiro [15] and Gani et al. [16]. The use of this tool to measure sustainability in rural properties is presented by Silva and Rosa [17]. According to the authors [17], through a set of indicators it is possible to analyze and monitor the property, identify environmental problems, understand the advances or setbacks of the system and consolidate strategies for managerial decision-making.

In addition to Silva and Rosa [17], the application of sustainability index in rural areas can be highlighted in studies by Rasul and Thapa [18]; Parra-López [19]; Trindade and Silva [20]; Di Domenico et al. [21] and Santana et al. [22]. Among these studies, those that compare conventional and ecological agricultural systems stand out, Rasul and Thapa [18] in Bangladesh and Parra-López [19] in Spain. Other studies have analyzed isolated rural activities, such as milk production [20,21] and agroextractivist activities [22] in Brazil. In general, the results of studies carried out in Brazil have shown a low level of rural activities sustainability.

3. Materials and Methods

3.1. Characterization of the Study Area

The research was conducted in rural properties in the Federal District (DF). The DF was selected by considering the number of rural properties registered in the region, according to data from the Brazilian Institute of Geography and Statistics (IBGE) and data from the CAR. The Environmental Brasilia Institute's (IBRAM) information, from the first half of 2019, states that about 94% of rural properties in the DF have joined the CAR.

To define the most appropriate area to select properties for this study, we considered regions where most properties had joined the CAR; the sizes of these properties would not create a very heterogeneous dataset and generate a good amount of information. The characteristics of large rural properties are different from small and medium ones, aggregating all rural properties in a single indicator would reduce their selectivity, validity and comparability. Based on the information obtained by the EMATER, the IBRAM, and the Brazilian Forestry Service, the chosen properties were at the Rural Core of Pipiripau.

The region was chosen because it is a representative area in the DF with respect to agricultural production, greater production diversity, and generating a large amount of information about the use and occupation of land in this locality. The Ribeirão Pipiripau basin is located in the northeast region of the DF on the border with the municipality of Formosa/GO; most of the basin area is located in the DF (90.3%), 55 km from the center of Brasilia where there are about 591 rural properties.

The Basin is divided into four nuclei (Figure 1): Pipiripau 1, Pipiripau 2, Taquara, and Santos Dummont. For this study, 169 properties of the Rural Nucleus Pipiripau 1, which are part of the CAR, were selected.

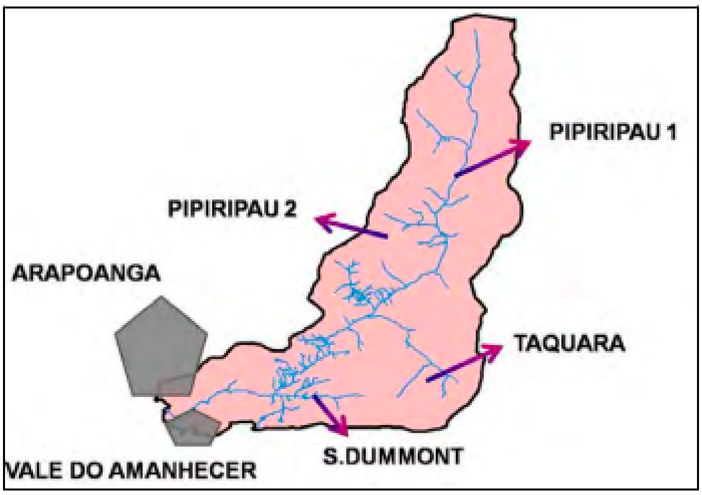

Figure 1. Location of urban centers in the Ribeirão Pipiripau basin (Source: Diagnostic Report of the Water Producer Program—Pipiripau).

3.2. Variables

The methodology, adjusted to the purpose of the present study, comprises the information regarding the various environmental parameters and the use and coverage of the soil inside the analyzed rural properties, according to the required guidelines in the environmental legislation regarding the regularization of rural properties.

After choosing the area, a survey of the data from the IBRAM government platform, which is responsible for rural regularization of the DF, was carried out regarding the data declared in the CAR of each property. There is a huge variety of data available from rural landowners who have registered to the CAR; the data were further filtered for environmental information.

After collecting the data, the relevant information was analyzed with regards to the following aspects: Property Area, Consolidated Area, Remaining Native Vegetation, Proposed Legal Reserve Area, APP Area to be recovered, Existing APP on the property, APP of Springs or Perennial Water Eyes, APP of Rivers up to 10 m, APP of Veredas, Total APP, APP of Perennial Springs or Eyes of water to be Restored, APP to be restored of Footpaths, Minimum RL required by Law, RL Surplus or Liability, Overlap with Conservation Unit, Anthropized Area, Native Vegetation in Legal Reserve, Area to be Restored in the Legal Reserve, Native Vegetation in APPs, Area of Legal Reserve inside APP.

3.3. Factor Analysis

According to Andrade et al. [23] and Trindade and Silva [20], Factor Analysis was used to obtain the weights of each variable in the calculation of the Sustainability Index. The construction of any indicator requires the choice of variables that will compose the index and the weight that each variable will contribute in this composition.

In Factor Analysis each of the n variables composes a linear arrangement of m common factors and one specific factor, and it is important to emphasize that the number of common factors should be less than the number of variables. For data analysis, the R program (R i386 3.6.1) was used.

The first analysis developed was of the interdependence between variables, that is, to verify if the set of variables were suitable for the statistical procedure. First, a simple histogram was prepared to observe the frequency of data; then, the Shapiro-Wilk normality test was performed to diagnose whether the variables had a normal distribution, showing if the data were parametric.

Subsequently, the correlation analysis was performed in order to observe the behavior of the components of the correlation matrix (matrix of variances and covariances) external to the main diagonal. This analysis allowed to verify the interdependence between the variables that, according to Johnson and Wichern in the case of dealing with elements of reduced amplitude, are not related; therefore, the factor analysis should not be performed [24].

To determine the correlation between variables, Bartlett's test of sphericity [25] was used to verify the hypothesis that the correlation matrix, R, is an identity matrix, I, (which means that the elements of the main diagonal of the matrix are equal to 1, and the elements outside the diagonal are equal to 0). If this hypothesis is true, there is no correlation between the variables, and if there is no correlation, the variables cannot be grouped into factors, making factor analysis unfeasible.

The variables that make up a given factor should be highly correlated; thus, there was a need for correlation analysis. The congruence of these analyses, as to the information exposed with respect to the overall consistency of the data, was verified through the Kaiser Mayer Olkim (KMO) test, performed to ascertain whether the factor analysis model is adequate and adjusted to the data, indicating that the analysis is appropriate.

3.4. Sample

Multivariate analysis was used to calculate the sample size. Thus, in the case of factor analysis, the sample size has to weigh with the number of variables in the analysis. Hair et al. suggests a minimum ratio of five cases per variable as an acceptable situation [26]. Figueiredo Filho et al. suggest that the larger the sample, the better [27].

The sample size was 169 rural properties representing 35% of the Rural Nucleus Pipiripau population approximately, which are configured as small and medium-sized properties. Small properties, according to the LPVN, have up to 4 fiscal modules, and medium-sized properties, according to the reality of the properties analyzed in this study, have 5 to 20 fiscal modules; a fiscal module at the level of the DF is equivalent to 4 hectares. The properties with more than 20 fiscal modules, which are equivalent to 80 hectares of total area or more, were eliminated for not being representative of the region and for having the possibility of biasing the sample.

For the present study, the properties were classified according to Table 1.

Table 1. Sample size according to the area size.

Area	Sample Size
Less than 16 hectares	137
Between 16 and 80 hectares	32
Greater than 80 hectares	0
Total	169

3.5. Calculation of the Sustainability Index

The sustainability index (SI) is calculated by the sum of the product between the score of each variable (V) (Table 2) in each production unit and its respective weight (W) (Equation (1)).

$$\mathrm{SI} = \mathrm{V}_1\mathrm{W}_1 + \mathrm{V}_2\mathrm{W}_2 + \mathrm{V}_3\mathrm{W}_3 + \ldots\ldots\ldots\ldots + \mathrm{V}_\mathrm{i}W_i \quad (1)$$

Table 2. Variables used in the sustainability index.

Variables			
Property Area	APP existing on the property	APP of Veredas to be Restored	Native Vegetation in Legal Reserve
Consolidated Area	APP of Rivers up to 10 m	Minimum RL required by Law	Area to Recompose in Legal Reserve
Remnant of Native Vegetation	APP of Veredas	Overlap with Conservation Unit	Native Vegetation in APP
Proposed Legal Reserve Area	Total APP	Anthropized Area	Legal Reserve area within APP

The weight for each variable (W) is obtained through Equation (2), where the parameters "E" (eigenvalues) and "L" (loadings) are obtained from the Factor Analysis results. The factorial solution, after applying the Varimax rotation and using the principal components method, extracted three factors, therefore three eigenvalues (E_1, E_2 and E_3).

$$W_i = \frac{(E_1 L_i) + (E_2 L_i) + (E_3 L_i)}{(E_1 \sum_1^n L_i) + (E_2 \sum_1^n L_i) + (E_3 \sum_1^n L_i)} \quad (2)$$

The weights of the variables were used to determine the Sustainability Index (SI). The value of the weight given to each variable was measured in relation to the characteristic root to the component eigenvalue. According to Barreto et al. [28], the component eigenvalue is associated to justify each variable in relation to the extracted principal component. Each admitted eigenvalue demonstrated the suitability of the factors according to the different levels of the variances of each variable [23].

With regard to the proposed SI of the properties that joined the CAR, it was elaborated from the sum between the score of each variable attributed to each analyzed property and the weighting term of the indicators in the index. After determining the SI, the comparative classification between the analyzed properties of the Rural Nucleus Pipiripau was conducted according to their size and the consolidated and remaining areas of native vegetation.

This index portrays not only the conditions of environmental sustainability of the studied units but also the legal provisions imposed on rural landowners that have an impact on this sustainability. Regarding the proposed SI of the properties that joined the CAR of the Rural Nucleus Pipiripau, it was elaborated from the sum between the score of each variable attributed to each analyzed property and the term of the weighting of the indicators in the index.

After ascertaining the SI, the analyzed properties were comparatively classified according to their size and with the consolidated areas and native vegetation remnants as established in the indicators. Considering the database standardization process, the stipulated index can vary between 0 and 1; the applied category considered the five following intervals to indicate the sustainability level of the studied properties as suggested by Melo [29]:

1. Sustainable: SI > 0.8;
2. Sustainability in a state of threat: $0.6 < SI \leq 0.8$;
3. Sustainability compromised: $0.4 < SI \leq 0.6$;
4. Unsustainable: $0.2 < SI \leq 0.4$;
5. Seriously unsustainable: $SI \leq 0.2$.

4. Results

With the standardized data, the findings showed that the variables correlated significantly, explaining why none of them was excluded. In addition to analyzing the correlation matrix, to verify the appropriateness of using factor analysis, Bartlett's test of sphericity and the KMO test were performed. The former generated statistically significant results at $p < 0.05$, proving the adequacy of the database, which was also indicated by the latter's score of 0.5 considered acceptable by researchers such as Silveira and Andrade [30], showing that it is possible to proceed with the PA.

By applying the established method, three principal components were obtained with characteristic roots higher than the unit (eigenvalues), with the cumulative variance explaining 71% of the total variance of the selected variables. Then, the orthogonal rotation by the Varimax criterion was performed, which better established the correlation between factors and variables. The rotation does not affect the communalities and the percentage of explained variance; the latter, however, can be explained by each differing factor that is being redistributed by the rotation.

Varimax rotation was chosen to obtain factors with the greatest possible orthogonality, and the purpose was to measure the components that present greater influence in the sample. Ribeiro and Veiga used a similar procedure to propose a sustainable consumption scale for Brazilian federal university students [31].

The variables that expressed the highest correlation with the factors are highlighted in Table 3. They, thus, define an understanding of this factor, that is, finding which aspect it best translates. Those variables that presented low communality (<0.50) were removed from the total set of variables.

The selected variables had a communality greater than 0.69, demonstrating that the corresponding factor in question is significant.

Table 3. Factorial loading matrix—Rural property Pipiripau, Federal District, 2020.

N°	Variables	Components or Factors			
		1	2	3	C
1	Property Area	0.62	**0.74**	0.18	0.97
2	Consolidated Area	0.47	**0.75**	0.18	0.83
3	Remnant of Native Vegetation	**0.89**	0.10	0.13	0.82
4	Proposed Legal Reserve Area	0.61	**0.68**	0.31	0.93
5	APP existing on the property	0.53	0.23	**0.77**	0.93
6	APP of Rivers up to 10 m	**0.77**	0.40	0.15	0.77
7	APP of Veredas	0.12	0.02	**0.93**	0.87
8	Total APP	0.58	0.17	**0.75**	0.92
9	APP of Veredas to be Restored	0.01	0.11	**0.89**	0.80
10	Minimum RL required by Law	0.62	**0.74**	0.18	0.97
11	Overlap with Conservation Unit	0.62	**0.74**	0.18	0.97
12	Anthropized Area	−0.13	**0.82**	−0.04	0.69
13	Native Vegetation in Legal Reserve	**0.85**	0.06	0.31	0.83
14	Area to Recompose in Legal Reserve	−0.06	**0.90**	0.14	0.83
15	Native Vegetation in APP	**0.70**	0.04	0.64	0.90
16	Legal Reserve area within APP	0.27	0.35	**0.79**	0.82
	SS loadings	5.66	4.92	4.63	
	Variance	0.27	0.23	0.22	
	Cumulative variance	0.27	0.5	0.72	

C: Communality—when higher than 0.5 means that the corresponding factor reproduces more than half of the variance of the corresponding variable.

Estimation of Sustainability Indices

The obtained sustainability indices (SIs) ranged from 7.34 to −0.26. The lower values mean lower levels of sustainability, while higher values mean more sustainable levels. The highest coefficients of the SIs are associated with the variables that obtained the highest weight related to the factors estimated in the analysis.

The overall average of sustainability among the analyzed properties is around 0.16, indicating a result that tends more towards unsustainability. It is relevant that such measures revolve around established limits, classifying the indices in intervals that can be more or less sustainable, as proposed by Melo [29] in the estimation of sustainable agriculture index: the case of irrigated agriculture in the São Francisco valley is an example.

Table 4 presents the results of the aggregation of indices estimated according to the model proposed in this work in sub-item 3.5.

Table 4. Classification of rural properties in relation to sustainability.

Classification	Number of PROPERTIES	Proportion
Sustainable	0	0.00
Sustainability Threatened	4	2.37
Sustainability Committed	5	2.96
Unsustainable	7	4.14
Seriously Unsustainable	153	90.53
Total	169	100.00

From the assumed classification, none of the properties studied is in a situation of relatively optimal or balanced sustainability. A smaller percentage of properties (2.37%) can be considered sustainable; however, their sustainability is threatened. Another small percentage of sustainable properties (2.66%) is under a state of compromised sustainability. Excluding the classifications considered sustainable, the percentage of unsustainable properties was 4.14%, which raised a certain degree of concern.

The remaining 90.53% of the analyzed properties are critically in danger of becoming seriously unsustainable and, consequently, not complying with the LPVN in full with respect to land use and occupation. This situation is related to the factors used for calculating the SIs, which contained large assumed loads of variables related to the areas of RL and APP to recompose in relation to the proportion of the total area of the properties. This situation is probably related a lack of caring by farmers in the region of the forest plots in APPs and RLs, in which there is little evidence of productive management in the form of preservationist systems.

The parameters for the construction of the sustainability index used aspects of the land use law in Brazil. It is important to highlight that compared to other countries the legislation that regulates land use in Brazil is more restrictive. In general, protected natural areas are defined in a higher percentage and the resources of economic compensation and public financial incentives for rural producers are lower. Compliance with environmental legislation in the country is difficult, aggravated by the lack of public resources for surveillance compatible with the large size of Brazil.

5. Conclusions

The proposed model for creating the environmental SI proved to be appropriate, adjusting well to the suggested indicators. It presented an expected performance; the results obtained, once the methodological basis was developed and applied, can be widely employed in works with similar objectives. The causal relationship measured between the conditioning factors and the explained variables evidenced relevant aspects for obtaining the final result of the analyses. However, the SI estimated for the properties of the rural nucleus Pipiripau presented a worrying situation.

The results show a weakened condition of sustainability; in the vast majority of cases, the properties were classified as unsustainable. However, considering the engagement of the landowners and the deadline that the legislation itself determines for regularizing rural properties, this may be a reversible situation. Sustainable management projects for protected areas within the properties and projects for the recovery of degraded areas, even those required by law, may facilitate the process of regularizing properties and, consequently, raise their levels of sustainability in accordance with the legal parameters.

The causal relationship estimated between the conditioning factors and the explained variables demonstrated, among others, the following relevant aspects:

1. There are areas with remnants of native vegetation within most of the properties analyzed; however, this does not mean that they occur to the extent required by Brazilian environmental law.
2. Of the total existing vegetation areas, a large portion of them was declared as part of the minimum RL required by law. However, even so, the areas to be recovered in RL are significant, allowing the conclusion that even the minimum has not been achieved.
3. With regard to the APPs, the proportion to be restored is also significant, and a large part of it refers to the recovery of wetlands. This type of situation shows that most of the properties, which have some type of watercourse, do not have an adequate APP associated with them.
4. When analyzing the environmental sustainability from the perspective of land use, more specifically, forest conservation, it was found that a considerable part of the variables, which weighed on the factors considered for estimating the index, relates to the proportion of areas of RL and APP, including wetlands amenable to restoration, assigning unsustainable degree to most properties.

Conclusively, it is possible to state that the use of the forest code as a source of environmental indicators to estimate the sustainability of rural properties has proved to be an efficient, practical, and low-cost tool. This type of instrument, in addition to encouraging compliance with the legislation, helps technicians and landowners to understand the level of conservation of the properties, what needs to be done, what needs to be changed, and what needs to be maintained. It also helps to identify favorable management situations in relation to compliance with environmental legislation.

The comparison between of this paper and similar studies in other countries differs by method. While this paper analyzes rural properties through compliance with land use Brazilian legislation, in other countries the indicators are related to technical parameters about pollution, energy efficiency, biodiversity, landscape quality, water and land use. The results are not directly comparable, as legislation about land use in Brazil is more restrictive than in most countries of the world.

Author Contributions: Conceptualization, R.M.S. and H.A.; methodology, R.M.S. and A.N.d.A.; software, R.M.S.; validation, A.N.d.A., R.d.O.G. and M.F.d.P.; formal analysis, R.M.S.; investigation, R.M.S.; resources, H.A.; data curation, R.M.S.; writing—original draft preparation, R.M.S. and H.A.; writing—review and editing, A.N.d.A., R.d.O.G. and M.F.d.P.; visualization, A.N.d.A.; supervision, A.N.d.A.; project administration, H.A.; funding acquisition, H.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by CAPES/BRAZIL, grant number 001.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data supporting reported results can be found at https://www.car.gov.br/#/ (accessed on 10 May 2022).

Acknowledgments: The author is very grateful to UnB and CAPES.

Conflicts of Interest: The authors declare no conflict of interest.

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