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TOWARDS SUSTAINABLE MANAGEMENT IN A RURAL TERRITORY: A MULTIDIMENSIONAL APPROACH ON THE ECUADORIAN COAST

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ABSTRACT

This work proposes to evaluate economic, ecological, and social parameters of a territorial unit that allows for sustainable development strategies. The case study is a territory on the central coast of Ecuador, which includes a reserve zone belonging to the National System of Protected Areas and surrounding populations. We established indicators for each dimension and collected data through semi-structured surey and field measurements. We then performed a normalisation process and scored the results using the Biogram scale. A

separate value was determined for each dimension. The results show that the ecological dimension (0.74) is considered stable. The economic dimension has 0.45 considered as unstable. While the social dimension, with (0.63) shows stable category. The integral valuation of sustainability in the area resulted in 0.61, considered a stable situation. This multidimensional approach provides valuable information to guide future investment actions and government planning.

Keywords: Social surveys; environmental management; land resources; sustainable development; development strategies.

HACIA UNA GESTIÓN SOSTENIBLE EN UN TERRITORIO RURAL: UN ENFOQUE MULTIDIMENSIONAL EN LA COSTA ECUATORIANA

RESUMEN

El trabajo propone evaluar parámetros económicos, ecológicos y sociales de una unidad territorial, que permita estrategias de desarrollo sostenible. El caso de estudio es un territorio de la costa central de Ecuador, que incluye una zona de reserva perteneciente al Sistema Nacional de Áreas Protegidas y poblaciones aledañas. Se establecieron indicadores para cada dimensión y los datos fueron recabados mediante encuestas semiestructuradas y mediciones sobre campo. Posteriormente se realizó una normalización de los datos y los resultados se interpretaron utilizando la escala del Biograma. Se determinó un valor independiente para cada dimensión. Los resultados muestran que la dimensión ecológica (0,74) se considera estable. La dimensión económica, con 0,45, se considera inestable. Mientras que la dimensión social, con (0,63) muestra categoría estable. La valoración integral de la sostenibilidad en la zona dio como resultado 0,61, considerada una situación estable. Este enfoque multidimensional proporciona información valiosa para orientar futuras acciones de inversión y planificación gubernamental

Palabras clave: encuestas sociales; gestión medioambiental; recursos de la tierra; desarrollo sostenible; estrategias de desarrollo.

INTRODUCTION

Globally, there is a war that humans have insisted on fighting for several hundred years; a war against their own habitat (Hawkins, 2020). It could begin in the mid-18th century when the mechanization of production began in order to obtain food faster and in greater quantity.

Its culmination, so far uncertain, could extend to the very end of humanity and become a necessary evil, to say the least.

However, the effects of this growing environmental deterioration could diminish in intensity if there is a radical change in the direction human development has taken, among other aspects.

indiscriminate use of agrochemicals in food production and the disruption this causes to the environment and human health (Suquilanda, 1996); loss

of biodiversity due to the consumption of forest resources and species that could play an important role in the regulation and provision of specific

services within the ecosystem, as well as of micro-organisms useful for maintaining the processes that vitalize the soil, among many other factors that form a cause-effect chain so long that it would be almost impossible to cite.

In this context, it is undeniable that we must remember principles such as using without extinguishing and producing without polluting.

It is under these premises that the concept of sustainable development was proposed some decades ago, which implicitly includes the use of present resources without affecting their future availability (Brundtland, 1987) and has been considered since then as a conciliatory ideal between development and the environment.

Given the importance of this concept and its wide use, it is necessary to analyze all related aspects, from its beginnings to its applications. In this context, the concept of sustainability (as a goal) and sustainable development (as a process) has its beginnings in 1987, when the United Nations Commission on Environment and Development used it for the first time in the Brundtland report.

Since then, this integral and multidimensional vision has served to guide many research projects and to better address the problems between the environment and man.

Since then, the term and the commitment to achieve it have been reaffirmed in international conferences, among which the following can be mentioned: the Rio de Janeiro Summit or United Nations.

Conference on Environment and Development (1992), where Agenda 21 was born, together with the Convention on Climate Change and the Convention on Biological Diversity and the Declaration on Forest Principles; the Copenhagen Summit or World Conference on Social Development (1995); the United Nations Framework Convention on Climate Change (1997); the Millennium Summit in Copenhagen (1997).

The United Nations Framework Convention on Climate Change (1997); the United Nations Framework Convention on Climate Change (1997); and the United Nations Framework Convention on Climate Change (1997); the United Nations Framework Convention on Climate Change (1997); the Millennium Summit in Geneva (2000); the Johannesburg Summit or United Nations Conference on Sustainable Development, Rio +10 (2002); the annual United Nations Conference on Climate Change (1995); among other meetings that have been able to reformulate its definition.

The Rio de Janeiro Summit or UN Conference on Environment and Development held in June 1992 played a pivotal role in reformulating the concept from the original Bruntland Report.

During this influential meeting, the idea was directed towards three fundamental pillars (economic progress, social justice, and environmental preservation). The integration of these pillars was decisive in achieving sustainability.

Across history, sustainable practices have been ingrained in several civilizations, especially those that have effectively maintained their ecological and biological variety.

The indigenous communities' implementation of the 'buen vivir' concept exemplifies a sustainable way of life that effectively harmonizes the preservation of natural resources with the requirements of future generations.

Traditional knowledge is strongly connected to contemporary sustainability principles and offers valuable perspectives on living harmoniously with the environment in a sustainable and gratifying manner. (Sevilla & Holle, 2004; Gudynas, 2011; Sourisseau, 2016)

The significance of family and small-scale farming in sustainable agriculture is of utmost importance in this particular setting.

Although there have been criticisms about the profitability of these farming practices, they are essential for preserving various kinds of ownership, farming systems, and cultural traditions.

These factors contribute to the long-term viability of rural communities (Schneider, 2014; Rincón et al., 2006). Another instance is the Ukrainian agricultural system's village conservation strategy, which seeks to rejuvenate rural life and safeguard the countryside. (Bezdushna et al., 2023)

Europe has also examined the theoretical and practical basis of managing sustainable development in rural regions [3].

In this perspective, public administration plays a significant role in executing strategies and policies for sustainable growth and environmental restructuring (Semenchuk & Postika, 2023).

Implementing green technologies in agriculture is considered a top priority for tackling environmental and socioeconomic issues in rural areas. (Kovalenko et al., 2022)

On the other hand, there are chances for sustainable management in rural regions, such as creating tourist superstructures, which can lead to economic progress and alternate forms of tourism business. (Novichkov et al., 2023)

The deficiencies in understanding sustainable management in rural areas encompass the absence of a comprehensive strategy for rural development, inadequate resources for rural populations, and discrepancies in the execution of pertinent policies.

Implementing a comprehensive strategy for rural development is crucial to attain long-lasting results, although it needs to be improved in numerous regions (Rondinelli, 1979).

This communities frequently encounter resource limitations, which impede their capacity to enact sustainable practices and efficiently oversee their natural resources. (Raya et al., 2022)

Furthermore, these areas suffer from a dearth of all-encompassing policies, as rural development is given minimal importance in prevalent agricultural and cohesion programs. (Wieliczko et al., 2021)

The lack of information and implementation gaps impede the progress toward sustainable development and emphasize the necessity for fair policies and practices that consider local populations' diversity and development potential. (Kurdyukov & Kanurny, 2021)

The assessment of rural sustainability necessitates the examination of social, economic, and environmental aspects. In order to improve policy-making and decision-making, it is crucial to better the design and reporting of studies in this area. (Nelson et al., 2023)

While the term 'sustainability' has been widely adopted, encompassing economic, ecological, and social dimensions, its implementation remains a complex challenge.

In agroecosystems, sustainability is characterized by maintaining consistent performance under diverse conditions, balancing agricultural productivity with environmental conservation.

The transitional period necessary to achieve sustainability, particularly in adopting agroecological practices, frequently compromises this balance.

Despite the broad acceptance of sustainability's three pillars, there is a notable gap in understanding and effectively integrating these dimensions.

This research aims to address this gap by assessing the economic, ecological, and social parameters of sustainability within a territorial unit.

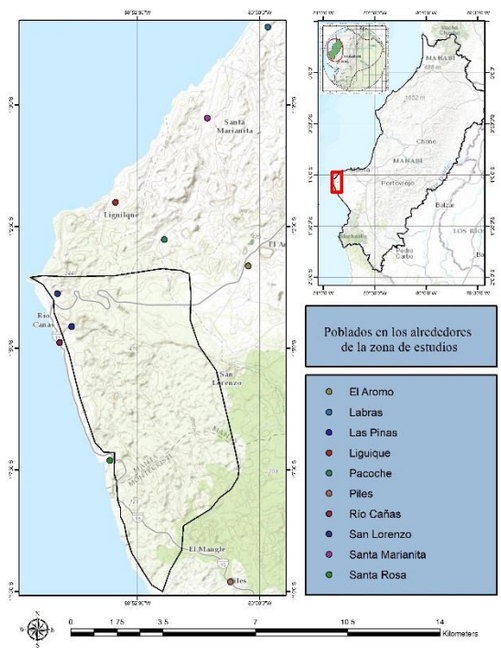
The goal is to provide a quantitative evaluation that can guide the implementation of sustainable development strategies, including investment programs and local government planning.

This approach seeks to enhance the multidimensional and long-term perspective of sustainability, moving beyond mere definitions to practical applications that reconcile human development with environmental integrity.

METHODS

The research was carried out in part of the territory belonging to the Pacoche Coastal Marine Wildlife Refuge (RVSMC-Pacoche), in the province of Manabí, Ecuador (MAE, 2017).

The area has altitudes of up to 363 m and is located in the centre of the Pacific-Ecuadorian coast, formed by the eastern and western slopes of the Pacoche, Los Lugos, Agua Fría and Monte Oscuro hills, which form part of the discontinuous massif of the coastal mountain range in Manabí (Graph 1).



Graph 1. Graphical representation of the indicators for each of the dimensions used in the study.

The terrestrial area of the RVSMC-Pacoche is 5.096,41 ha and hosts at least seven ecosystems with a high number of species that are of great value to the local communities.

This study area was chosen because it has been designated as a protected area, which means that there are already established measures and limits for its preservation.

This situation provides a suitable environment for assessing the effects of conservation in practice.

Additionally, several human populations in this area might significantly affect the conservation goals of the Ecuadorian state through their economic activities, cultural practices, or interactions with the environment.

For this purpose, a variant of the Biogram methodology (Sepúlveda, 2008), created by the Inter-American Institute for Agricultural Cooperation (IICA), was used.

This methodology seeks to explain complex processes in which the simultaneous analysis of several dimensions is required; in this case, three dimensions were determined: the economic dimension, the ecological dimension, and the social dimension, which interact with each other to achieve sustainability. (Drexhage and Murphy, 2010)

The biogram methodology was chosen as it is particularly useful for obtaining a quick and visual understanding of the state of sustainability in rural territories at a broader level, where simplified representation of complex data is crucial for effective decision-making.

For each of these dimensions, indicators were established, which would later be used for the analysis and assessment of sustainability in the area (Table 1).

These indicators, in turn, could be of two types, depending on the relationship (positive or negative) they have with sustainability.

In other words, an increase in the value of the indicator reflects a better or worse situation for the dimension. Thus, if an increase in the indicator value results in an improvement in the system, it is considered to have a positive (+) relationship.

Conversely, if an increase in the value of the indicator worsens the situation, the relationship is inverse or negative (-) (Sepúlveda, 2008).

Table 1. Dimensions used in the study, the indicators for each dimension and their relationship to sustainability.

	Coding	Indicators	Relation
Environmental Dimension	A1	Importance of the forest to your life	+
	A2	Forest clearance	-
	A3	Use of agrochemicals	-
	A4	Carbon stocks in forest	+
Economic Dimension	E1	Financial income (monthly)	+
	E2	Agriculture's contribution to development	+
	E3	Local food production	+
	E4	Training	+
	E5	Satisfaction with current standard of living	+
Social Dimension	S1	Quality of education	+
	S2	Health services	+
	S3	Electricity service provision	+
	S4	Public transport	+
	S5	Institutional support (non-governmental organizations, State, etc.)	+

This methodology presents a great challenge: analyzing indicators with different metrics.

Considering this fact, a type of relativization function was used to standardize the values to the same scale. This function is based on the methodology proposed by the UNDP to calculate the Human Development Index (PNUD, 2006).

In this sense, for the case in which the indicators present a positive relationship, the following formula was adopted:

$$f(x) = \frac{x - m}{M - m}$$

Donde:

x = value of the variable or indicator.

m = minimum value of the variable.

M = maximum level of the variable.

For the case where the indicators have an inverse relationship, the above formula was modified in order to maintain its properties:

$$f(x) = \frac{x - M}{m - M}$$

The data for each indicator were obtained through surveys of the inhabitants of 10 communities located around the reserve area.

The questions contained a scalar option (from 1 to 5, where 1 was the lowest value and 5 was the highest

value) so that the analysis could be carried out considering social perception as the main source of information.

For this purpose, a sample was estimated for finite populations using the demographic data presented by the Ministry of the Environment of Ecuador in 2009 (4952).

For this case, the formula calculated 357 surveys, which indicates that, if 357 people are surveyed, 95% of the time the real data will be in the interval of ± 5% concerning the observed data. Despite the above, and because we wanted to have as much data as possible to reduce the experimental error, a total of 610 surveys were carried out.

The maximum and minimum values required for the formulas were obtained from the same data recorded in the field.

Given that this valuation is given by the indicators selected for each dimension (ecological, social, and economic), it is also possible to obtain it separately for each component, thus determining its contribution to the total valuation of sustainability by exposing the dimension that needs to be potentiated.

Once the relativized value has been obtained, Table 2 will be used to determine the status of each indicator, which was averaged to obtain a single value representing the overall dimension rating (SD).

Table 2. Assessment of calculated sustainable development, identification and significance.

Calculated value	System status
< 0.2	High probability of collapse
De 0,2 a 0,4	Critical situation
De 0,4 a 0,6	Unstable situation
De 0,6 a 0,8	Stable situation
De 0,8 a 1,0	Optimal situation

Source: Sepúlveda (2008).

The integral valuation of sustainability in the study area was determined by weighting the values obtained for each of the dimensions. In this case, similar proportions were considered for each dimension, with the ecological dimension being 34% important, the social dimension 33%, and the economic dimension 33%.

It is important to note at this point that the decision to give weight to each dimension depends very much on the characteristics of the area under study and which dimension has more weight within management.

The data for indicator A4 (carbon stored in forests) were taken from Salas, Alegre and Iglesias (2017), who estimated the carbon stored in the different plant formations present in the area.

RESULTS

The assessment of sustainability in this case study was mainly based on the results obtained through the surveys carried out, considering local perception as a reliable means of gathering information on the real situational state of the study area.

We initially consulted with the key individuals responsible for the study area.

The main objectives of these consultations were twofold: firstly, to determine the significance of the area in terms of its ecosystem services, and secondly, to identify the essential variables that required examination. To achieve these objectives, we employed a multi-criteria analysis approach. The results obtained for each of the dimensions are presented in Table 3 and Graph 2.

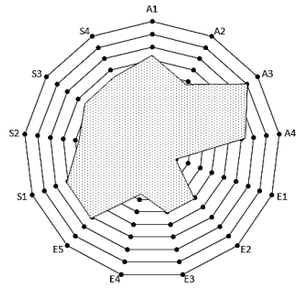
Table 3. Average values calculated for each of the indicators and dimensions used in the study.

	Coding	Indicators	Average	Index by dimension
Environmental Dimension	A1	Importance of the forest to your life	0,73	0,74
	A2	Forest clearance	0,57	
	A3	Use of agrochemicals	0,9	
	A4	Carbon stocks in forest	0,73	
Economic Dimension	E1	Financial income (monthly)	0,2	0,45
	E2	Agriculture's contribution to development	0,51	
	E3	Local food production	0,51	
	E4	Training	0,35	
	E5	Satisfaction with current standard of living	0,71	
Social Dimension	S1	Quality of education	0,71	0,63
	S2	Health services	0,57	
	S3	Electricity service provision	0,63	
	S4	Public transport	0,63	
	S5	Institutional support (non-governmental organizations, State, etc.)	0,6	

The best value was obtained in the ecological dimension (0.74), which could be considered understandable given that the study area is within the protected areas of Ecuador.

This value establishes that in terms of the ecological aspect within sustainability, the area is considered stable.

However, an optimal state could be reached if greater attention were paid to indicator A2 (forest clearing). In this regard, Ecuador Forestal (2007) considers illegal logging and expansion of the agricultural frontier as threats to the conservation of forests in protected areas within the National System of Protected Areas (SNAP), which could affect the structural and functional changes of the forest, collaterally compromising the ability of the ecosystem to act as a carbon sink (0.73 in the calculated value).



Graph 2. Graphical representation of the indicators for each of the dimensions used in the study.

One of the interesting points of the data obtained within the ecological dimension is that indicator A3 (use of agrochemicals) shows favorable behavior, i.e., there is no major use of agrochemicals, basically because of

the strong agricultural activity in the area.

Although there are large areas dedicated to coffee cultivation, these are managed agroecological.

The economic dimension is much lower, with a value of 0.45, considered unstable according to the sustainability index scale. In this respect, although all the indicators reflect neglect, this is most notable in E1 (economic income) and E4 (training), whose improvement could be of vital importance for a better valuation of the economic dimension of the area. (Piao & Managi, 2023)

It should be noted that, given the protected area category, the economic activity of the study area is subject to the regulations imposed by the competent entity.

However, according to the results of the surveys, tourism is a mainstay of the area's economic development, and it is therefore advisable that the State pay special attention to this sector, providing logistics and training to promote tourism.

For the social dimension, the value obtained (0.63) places the area in a stable category. However, it would be advisable to pay attention to indicator S2 (health) to improve the social dimension of the area.

Although indicators S3 and S4 indicate a stable situation, there is room for improvement through the extension of the electricity grids and transport services. Currently, transport services are limited to pick-up trucks with a limited service frequency.

For the integral assessment of sustainability, a value of 0.61 was obtained, which within the sustainability scale determines that the study area is in a stable situation

CONCLUSIONES

In terms of the independent assessment of each dimension, the best value was obtained in the ecological dimension, establishing that in terms of the ecological aspect within sustainability, the area is considered stable.

In the case of the economic dimension, the area is considered unstable, and in the social dimension, the value obtained places the area in a stable category.

The overall assessment of sustainability in the study area within the sustainability rating scale determines that the study area is in a stable situation.

The findings of this research could enrich the debate on rural sustainability and help us to assess the extent to which policies have been

successful in the area studied. By assessing the local context, it may also be feasible to suggest solutions to achieve sustainability goals.

However, one conclusion that emerges from the discrepancy of the ecological dimension (A) with the economic dimension (E, especially E1), is that conservation may not be helping to improve this aspect of the surrounding populations.

This may be caused by: 1) the methodology itself, which does not ask questions about the indirect or unconscious benefits that the population has with the conservation area; 2) they may not really have a direct relationship; and 3) there is a lack of information to establish this relationship.

Therefore, it is very important to improve the studies to establish how conservation can help the development of the populations.

It is necessary to emphasize that the selection of indicators for each of the dimensions should be carefully made on a theoretical, not speculative, basis, clearly reflecting the relationships (positive or negative) that they may have for sustainable development.

It could be recommended to replicate the methodology by including different indicators, trying to take social perception as a primary source of information, and adding in situ measurements of parameters that provide more specific information on the area to be studied.

On the other hand, given that indicators are considered to be in constant change within a system, it would be advisable to try to ensure that there is not a very long time lapse between the collection of information and the obtaining of results since the aim is for the methodology to be easy or quick to apply and for it to reflect the real situation of the area at a given time and in a given space.

This static analysis provides a reference tool to guide actions in a given area, but it is not possible to observe the trajectories of territorial dynamics, i.e., to identify whether the situation is good with a tendency to worsen or bad with a tendency to improve.

Therefore, it is suggested to replicate the analysis in several stages to know the changes that could occur over time.

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