Original Research Article

Methodological Strategy for the Conservation of Ecosystem Services

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ABSTRACT

Ecosystem services (ES) are the benefits that human beings receive from nature and that contribute to improving the quality of life. However, at present, precisely the human activities through which ES are used are generating negative impacts on ecosystems that hinder their provision. It is a vicious circle that needs to be corrected. To do so, this article, the result of postdoctoral research, proposes an ES sustainability strategy that includes a methodology to assess its status and generates actions to follow in order to contribute to the recovery and conservation of natural resources. The methodology implies identifying the ES of the place of interest, measuring a series of indicators constructed to be applied at home or in the community by the inhabitants of the territory, making an evaluation of them and, according to the results, actions to be followed are generated. In addition, an application is presented to Tocotá, a village in the municipality of Dagua in Valle del Cauca (Colombia) that is characterized by the visit of tourists attracted by the biodiversity of the place, but whose natural resources are being compromised by the activity that it has become the main economic resource of the community. The application of the methodological strategy indicates that the state of the ecosystem services in Tocotá is acceptable, although it is not in bad conditions, actions are suggested for its improvement. This methodological strategy allows identifying the state of ecosystem services in Tocotá, but it is replicable to hydrographic basins with similar conditions.

Keywords: ecosystem services, sustainability, rural area, Colombia

1. INTRODUCTION

Anthropic activities are generating negative impacts on ecosystem services (ES), which is striking, because by definition ES are benefits that generate well-being for human beings, without forgetting that the survival of other species also depends on their state and the very possibility of continuing to contribute to a better quality of life for people [1]. However, these human activities, through which ES are used, are generating adverse impacts on biodiversity [2].

ES are benefits, direct or indirect, that the population can obtain from ecosystems [3 - 6] and that result from the interaction between the different components, structures and functions that constitute ecosystems. The biodiversity are contributions that ecosystems make to human well-being, that is, they are those services that result from ecosystems (naturally, semi-naturally, or modified) and directly affect the level of well-being of people [7 - 9], but in addition to being studied from the economic and ecological sciences, they must also involve the role of cultural contexts and traditional knowledge to address the benefits of nature from a more comprehensive view [10 - 12], so they are a contribution to society [13]. Consequently, ecosystem services are indispensable to improve the quality of life of people, since in addition to providing basic needs, changes in their flow affect livelihoods, income, local migration, and political conflict, so the resulting impacts, in terms of economic and

physical security, freedom, choice, and social relationships have impacts on well-being and health [14]. Due to the importance of ES, they have been classified into provision, regulation and cultural services as those that directly affect people, in addition to support services that maintain other services [15]. Among the ES that stand out the most are water regulation and quality services, biodiversity conservation services, the reduction and capture of greenhouse gases and, currently with greater interest, cultural, spiritual and recreation services [16]. It is estimated that most of the research in relation to ES focuses on biophysical and regulatory contributions (76%), while it has lagged behind in those services related to sociocultural aspects (14%) [17 - 18], that is, in those services that provide well-being to the population in terms of enjoying the landscape, relaxation, recreation, and other activities related to rest, leisure, and recharging energy for the people.

However, these services are being altered by human activities. It is estimated that, since approximately 1950, humans have transformed ecosystems more rapidly and extensively than in any other period of time in human history, due to the constant growth in demand for natural resources, such as food, fresh water, wood, fibers, and fuels, among others [19]. This means the development of lifestyles that negatively impact ecosystems and that have caused such an environmental imbalance that hydrological cycles, soil regulation and climate, among others, are being affected. In turn, it implies the deterioration of natural resources, the loss and transformation of biodiversity and ecosystem services [20]. Consequently, and as a vicious circle, the impact on ecosystems translates into a lower possibility of offering ES and, therefore, a decrease in people's well-being. Environmental deterioration, in many cases, occurs severely and irreversibly [21]. The activities that cause the most consequences in ecosystem services are agriculture, livestock, forestry, and more recently, tourism. Although they generate positive impacts on the satisfaction of people's basic needs (food and income generation, mainly), they are activities that cause negative effects on ecosystems, such as the incorporation of pesticides in ecosystems, the homogenization of the landscape with crops, deforestation, increased flooding, water, soil, and air pollution, destabilization of communities of aquatic species by fishing, among others [22]. The case of tourist activity has recently drawn attention, since the presence of tourists in sites of high ecosystem value is devastating them. The organization Tourism World indicated that, in 2021, tourism generated 700,000 million dollars in export revenue, and although before the pandemic this value reached 1.7 trillion dollars, the recovery of the sector is going at a good pace [23], and natural resources are key to most tourism activities [24]. However, the increase in people in tourist places is generating water pollution, affectation due to the increase in solid waste, noise pollution and, in general, it is affecting the carrying capacity of ecosystems [25]. All these are reasons why it is necessary to guarantee the provision of ES, through the support and maintenance of ecosystem functions and the protection of biodiversity [26], through the development of sustainable activities with which progress is made towards SE conservation through economic activity that generates income for the population.

Tourism activity is closely related to cultural ecosystem services, but it also involves the ecosystem services of greatest demand (supply and regulation), which means that it is an activity that generates income for its providers and improves the well-being of those who consume it, but it is also associated with various problems that are reflected in the provision of ES. In other words, tourism depends on ecosystems providing their services, but it is also one of the activities that is degrading them.

In this sense, it is necessary to evaluate the state of ES and generate actions to counteract their degradation. Therefore, this article shows a methodology to identify the status of ES in a given place and, according to the result, suggests actions to be implemented for their recovery or conservation. This is a methodology that can be implemented by the

communities themselves, it can be used at the household level or at the community level. The suggested actions are easy to implement by anyone interested in contributing to the recovery and conservation of ES. In addition, the application of the methodology in Tocotá is presented, a site that has become in the last 10 years a tourist destination for the inhabitants of Cali (Valle del Cauca) thanks to its environmental characteristics, which make it attractive for tourism, but which is suffering the effects of the influx of people seeking rest.

2. MATERIAL AND METHODS

This research focuses on the Tocotá village, which has become a tourist destination for the inhabitants of Cali, since the journey to the area is easy and relatively short. What draws the attention of tourists in the village are the services offered by the ecosystems, mainly related to the cool climate, the possibilities for recreation and, in general, the ease of close contact with nature; however, the influx of tourists is generating environmental deterioration. In this sense, this article identifies the ES that Tocotá offers, makes an evaluation of them and generates actions for their recovery and conservation.

The conceptualization in relation to ecosystem services was carried out based on a review of scientific literature. For this, databases of magazines with academic articles and theses were used, in addition to literature produced by widely recognized institutions in the environmental sector on the subject. The literature search was done through the internet. For the characterization of the study area and the identification of ecosystem services in Tocotá, it was necessary to carry out reconnaissance tours and interviews with officials from the institutions with jurisdiction in the area and representatives of the community that live in the locality. The reconnaissance visits were carried out with the accompaniment of an interdisciplinary group of professionals and community leaders, who are people who know the place well and told about the characteristics of the area and the changes it has had over time. The visits were made to places of reference for tourists and locals. In addition, appointments were made to interview community leaders who work for Tocotá, such as representatives of the Community Action Board, the organization that manages the supply system, the area's educational institution, as well as people who work in environmental committees of the sector and farmers and tourism promoters, who have lived in Tocotá for years and know how the activities work, how the area has changed, what difficulties arise and, mainly, are capable of recognizing the ES that can be found and which are the most consumed. The interviews were conducted using a format with guiding questions, but the conversation was motivated in which, in addition to knowledge, various experiences and opinions were exchanged. Interviews were conducted independently with each person. The results of the interviews were processed in an Excel spreadsheet, which made it possible to determine the coincident and divergent points between the interviewees and facilitated the calculation of averages in aspects such as the number of people living in the area, the number of regular tourists, the number of houses of recreation, and number of dwellings in total, among others. Additionally, information was obtained from the documents such as the Development Plan for the period 2020-2023, the Basic Territorial Planning Plan, the Sisbén survey (which is a State tool to classify the population according to their living conditions and income), and other studies carried out in the locality. For the construction of the methodology for evaluating the sustainability of ES, experts in environmental areas were consulted, with whom, in periodic meetings, indicators were constructed to evaluate the state of the ecosystems that provide services to the community and visitors and they were designed the actions that the communities can follow according to the state of the ecosystems. The actions carried out in favor of the recovery and conservation of ecosystems are reflected in the improvement of the services they provide. Both the indicators and the actions were built with the objective that they can be evaluated and carried out with the resources of the

communities and their visitors, that is, they are indicators of community evaluation in accordance with the knowledge that the inhabitants have, and actions can be developed at home and community level without necessarily requiring institutional interventions. Once the indicators were built and the actions to be followed were generated, an Excel file was built that allows selecting between the response options and, according to the qualification obtained, throws the actions to be followed, in such a way that it is easy to use for those interested in the evaluation of the ES.

2.1 Local context

Tocotá is part of the town of San Bernardo, in the municipality of Dagua, just 9 km from the limit of the city of Cali by the exit to the sea (western limit). The dry climate prevails in the village with an average annual rainfall between 1,500 and 2,000 mm and an average annual temperature between 12 and 20°C [27]. This locality is characterized for being the area of expansion of the municipality with the highest growth of country houses for the inhabitants of Cali. It is estimated that 271 people permanently reside in Tocotá, however, of the 420 homes in the area, at least 67% are recreational houses with occasional visitors that can reach 3,000 people. By municipal instruction, the plots in the community cannot be smaller than 3,000 m^2 [28]. The people of the area are mainly dedicated to work related to tourism: farm maintenance, gardening, pool care, food sales, hardware stores to attend to the construction of new farms, and a few still maintain the activities that were traditional in the area: agriculture and livestock. In the town there is a wide range of country houses for rent, there are recreational sites with natural pools and fishing lakes, horse and four wheel motorcycles tours are offered, and walks and bicycle tours are also facilitated. In addition, you can go bird watching. Due to the orographic characteristics of the town, many of the recreational houses have a beautiful view towards the Colombian Pacific. Another tourist attraction of Tocotá is related to the weather, during the day the temperature is pleasant to carry out various activities, and at night, the cold allows you to enjoy the change with respect to the heat of Cali and other nearby cities. The town is crossed by the Dagua River, which gathers the waters of various tributaries as it passes.

According to community leaders, the population of Tocota has a water supply service through Asotocotá, a community based organization that provides untreated water service, but is running out of technical capacity to serve a growing population. There is no collection or collective treatment of wastewater, so the owners are instructed to build individual systems, but this is not fully complied with. Solid waste is collected once a week, and this insufficiency leads to burning, improper accumulation or being left on the streets. In addition, there is electricity service, while gas service is through the use of propane gas pipes. The town has 3 access roads with public transport, basic primary and secondary schools with an agroecological emphasis.

The decline in agricultural activity was mainly due to the deterioration of the soil, which led to the division of land for the construction of recreational houses. According to community leaders and representatives of the environmental authority of the department, with this change, the agricultural vocation was lost, but a diverse source of income appeared that, in addition, has allowed the recovery of the soil and natural revegetation in the area, which in turn has attracted a diversity of birds and other wild animals. However, the increase in tourists is generating water pollution through the increase in sewage, solid waste contamination that spreads along the roads and high noise levels on weekends, among others.

3. RESULTS AND DISCUSSION

Methodology to assess sustainability

Considering that ES are essential for human life and other species, it is necessary to generate strategies that promote their recovery and conservation for the present and future generations. In this sense, a methodology has been generated to determine the level of sustainability of ecosystem services, which generates actions to be implemented at the community level for their recovery and conservation, and an application is presented in the village of Tocotá, municipality of Dagua (Valle del Cauca, Colombia).

This methodology is a guide for evaluators of ES, through a step by step, to determine the level of sustainability of ecosystem services in a given place and, according to the result, actions are generated to follow that would allow progress towards its sustainability. The methodology is designed to be applied at the household level, but also at the community level and, mainly, to be applied with basic information that the people of the territory have, without the need to carry out technical studies or laboratory analysis, for example. The methodology includes five steps (Figure 1) which are described below:

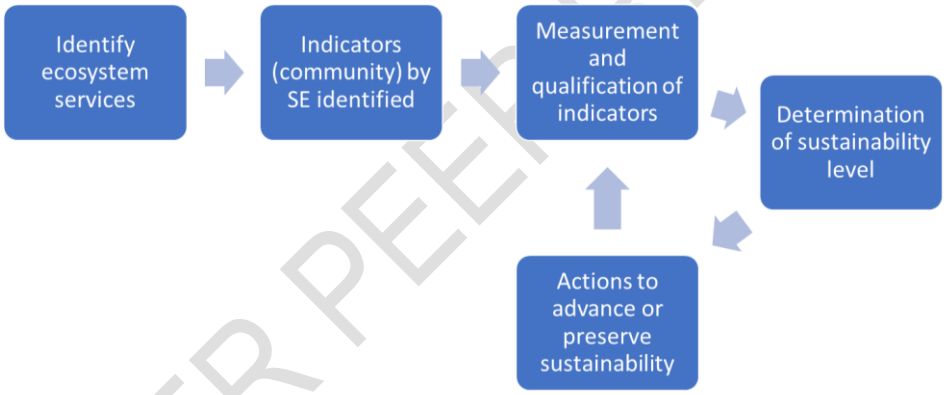

Figure 1. Step by step to assess the sustainability of ecosystem services

1. Identification of ES: all the ES of the place where the evaluation is to be made must be recognized and listed. If it is not possible to identify all of them, at least the most used ones. Figure 2 shows the ecosystem services identified in Tocotá.

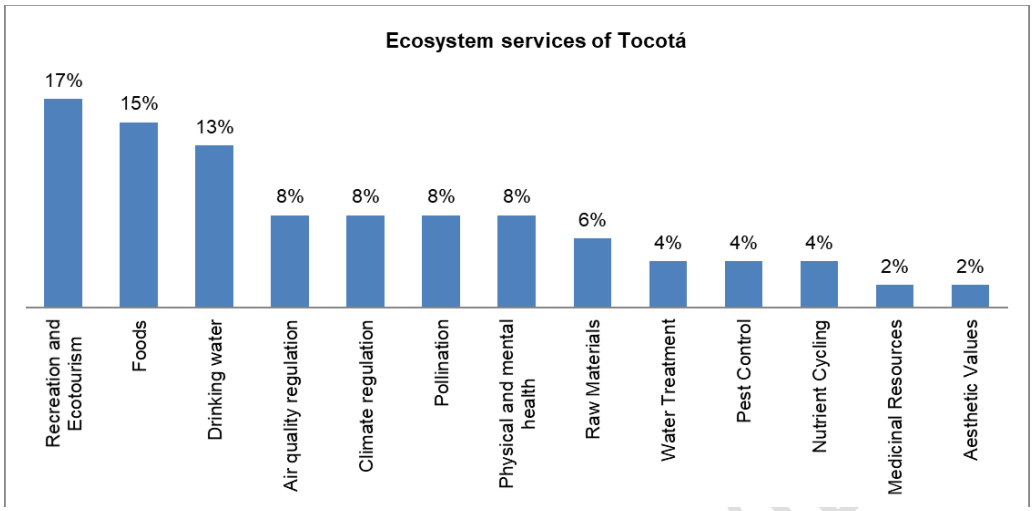

Figure 2. Ecosystem services identified in Tocotá

2. Indicators of ES: a list of indicators has been generated to measure the state of ES. These indicators can be measured at the community level with the information available in the territory and are associated with human practices in the ecosystems that affect the availability of ES, so each one is associated with one or more ES. Each indicator consists of an easy-to-answer question, such as, Are there burnings in the area? Answer options: Yes, No, Sometimes.

3. Measurement and qualification of indicators: according to the answers given to the indicators, an equivalent qualification is obtained, such as Yes = 10, No = 0, Sometimes = 5. Table 1 shows the indicators, with their respective form of evaluation. and rating (in parentheses the rating given according to the response) and association with the ES, built for the case of Tocotá.

Table 1. Indicators to evaluate the sustainability of ecosystem services in Tocotá

Indicator	Associated Ecosystem Service*	Qualification Form	Qualification
Sowing of native species	RCA, RC, MEE	Are there regular plantings of native species adapted to the soil and climate conditions of the area?	Yes (10), Sometimes (5), No (0)
Diversity of bird species	CPE, P, RE	Is there diversity of bird species?	Yes (10), Some (5), No (0)
Wild animal hunting	CPE, P, RE	Is there hunting of wild animals (squirrels, possums, snakes, and so on)?	Yes (10), Sometimes (5), No (0)
Variety of wild animal species	CPE, P, RE	Does it identify if wild species have increased or decreased in the last 10 years?	They have increased (10), It is the same (5), They have decreased (0)
Reduction of polluting emissions into the air	RCA, RC, RE	Are there burnings in the area?	Yes (10), Sometimes (5), No (0)

Indicator	Associated Ecosystem Service*	Qualification Form	Qualification
Reduction of polluting emissions due to noise	RCA, RC, RE	How often is excess noise generated?	Never (10), Weekends (5), Every day (0)
Efficient use of water	AA, RPATR	Is water used efficiently?	Yes (10), Sometimes (5), No (0)
Decrease in contamination due to wastewater discharge	AA, RPATR, RE	Is there pollution control through wastewater treatment systems?	Yes (10), Sometimes (5), No (0)
Decrease in contamination due to wastewater treatment	AA, RPATR, RE	Is periodic maintenance performed on existing treatment systems?	Yes (10), Sometimes (5), No (0)
Decrease in contamination of water sources	AA, RPATR, RE	Does the water from the local fountains have bad odours?	Yes (10), Sometimes (5), No (0)
Decrease in pollution from solid waste collection	RE, AA	Is garbage collection once a week enough?	Yes (10), No (5), No service (0)
Decrease in contamination due to solid waste disposal	RE, AA	Is there education on solid waste disposal?	Yes (10), Occasionally (5), No (0)
Decrease in pollution due to treatment at the source of residential organic waste	RCA, RC, RE, AA	How is the organic waste of the house disposed of?	They compost (10), They bury (10), They have a time and place for a collection car (5), They dump in a public area (3), They burn (0)
Reduction of contamination by treatment at the source of agricultural organic waste	RCA, RC, RE, AA	How is grass cutting waste disposed of?	They compost (10), They dump in public areas (5), They burn (0)
Reduction of contamination by recyclable solid waste	RCA, RC, RE, AA	How is recyclable solid waste (plastics, paper, glass) disposed of?	They reuse (10), They recycle (7.5), They have a time and place for a garbage truck (5), They bury (2.5), They dump in a public area (1), They burn (0)
Reduction of contamination due to the disposal of unusable solid waste	RCA, RC, RE, AA	How is unusable solid waste disposed of?	They have a time and place for a collection car (10), They bury (5), They dump in a public area (1), They burn (0)

Indicator	Associated Ecosystem Service*	Qualification Form	Qualification
recycling programs	RE, AA	Are there recycling programs in the area?	Yes (10), It exists but it doesn't work (5), No (0)
Creation and strengthening of environmental groups	RE, AA, A, RCA, RC	Are there environmental protection groups in the area?	Yes (10), It exists but it doesn't work (5), No (0)
Environmental protection activities in the area	RE, AA, A, RCA, RC	Are periodic environmental care activities carried out?	Yes (10), Occasionally (5), No (0)
Participation of the community in the area in environmental care activities	RE, AA, A, RCA, RC	Do people participate in environmental protection activities?	Yes (10), Sometimes (5), No (0)
Pollution generated by ecotourism services in the area	RE, AA, RPATR	Is tourism affecting the carrying capacity of ecosystems (ability to self-recover from negative impacts)?	No (10), Partly (5), Yes (0)
Existence of activities promoting ecotourism services in the area	RE	Are there adventure recreation activities in the area (mountain biking, motocross, horseback riding, 4x4 tours, walks, hiking)?	Yes (10), Some (5), No (0)
Existence of rest houses, change of vocation of land use in the area	RE	Have recreational houses and/or vacation farms increased or decreased?	Increased (10), Same (5), Decreased (0)
Existence of places for tourist accommodation	RE	Are there lodging places for country tourists (Farms, camping areas, glamping sites, and so on)?	Yes (10), Few (5), No (0)
Agricultural production (quantification)	A	How has agricultural production in the area evolved in the last 10 years (crops, poultry, livestock, fish farming, and so on.)	Increased (10), Remained the same (5), Decreased (0)
Agricultural production (livelihood)	A	Do you consider that agricultural production in the area generates profits for the livelihood of producers?	Yes (10), Insufficient (5), No (0)
Agricultural production (self-consumption)	A	Is the agricultural production of the area used for self-consumption (bread, milk, eggs, and so on)?	Yes (10), Sometimes (5), No (0)

*RCA: Air Quality Regulation; RC: climate regulation; MEE: Moderation of extreme events; CPE: Pest and disease control; P: Pollination; RE: Recreation and ecotourism; AA: Water supply; RPATR: Regulation, water purification and waste treatment; A: Food.

4. Determination of the level of sustainability: according to the rating obtained for each indicator, it can be determined whether the sustainability of that indicator is high, medium or low, and averaging the sum of responses, a general level of sustainability is obtained. The general rating, which groups all the indicators, is given in percentage terms: less than 45% is low, between 45 and 75% is medium, and more than 75% is high. For the qualification, an Excel file is used in which the information

is entered and it is programmed to show the results and actions automatically. Table 2 shows an example of the rating obtained for some of the indicators in Tocotá, in addition to the general result grouped according to the results of all the indicators.

Table 2. Application of sustainability analysis methodology in Tocotá

Sustainability analysis methodology for ecosystem services					
Overall Ecosystem Service Sustainability Rating:				53	**Half**
indicator	**Associated Ecosystem Service**	**Qualification Form**	**Range of sustainability results**	**Rating according to Result**	
Sowing of native species	RCA	Are there regular plantings of native species adapted to the soil and climate conditions of the area?	Yes = 10	6,67	Acceptable
	RC		Sometimes = 5		
	MEE		Not = 0		
Diversity of bird species	CPE	Is there diversity of bird species?	Yes = 10	8,33	High
	P		Some = 5		
	RE		Not = 0		
Wild animal hunting	CPE	Is there hunting of wild animals (squirrels, possums, snakes, and so on)?	Not = 10	5	Acceptable
	P		Sometimes = 5		
	RE		Yes = 0		

5. Actions for sustainability: according to the result obtained for each indicator, actions are proposed to be followed (easy to apply at the community level) to improve its state of sustainability. Even when the rating is good, actions are proposed to contribute to the conservation of ecosystem services. Table 3 shows examples of the actions that are suggested for some of the indicators according to the rating obtained, in addition to some transversal actions that should be applied to any result and regardless of the indicators evaluated. This exercise shows the average of the results obtained from the application of the methodology with members of the Community Action Board, community leaders and representatives of an environmental group in Tocotá.

Table 3. Suggested sustainability actions for Tocotá according to its sustainability results

Actions for sustainability

Transversal actions for sustainability:

- Strengthen the capacities of communities and visitors to promote sustainable activities: sustainable tourism, sustainable agricultural production.

- Make the population aware of the importance of reducing the negative impacts generated by human activities: reducing the consumption of products that generate polluting waste, promoting recycling and reuse.

- Disseminate knowledge to undertake sustainable activities.

Indicator and associated sustainability action	Score Obtained	Result
Sowing of native species Are there regular plantings of native species adapted to the soil and climate conditions of the area?	6.67 out of 10	**Acceptable**
Sustainability actions: - Apply organic products to control pests and weeds. - Use natural fertilizers for crops. - Promote seedbeds of species typical of the region. - Plant live fences with native species.		
Diversity of bird species Is there diversity of bird species?	8.33 of 10	**High**
Sustainability actions: - Allocate part of the production of fruit trees to feed the birds. Promote natural spaces for their reproduction. - Promote bird watching ecotourism.		
Wild animal hunting Is there hunting of wild animals (squirrels, possums, snakes, and so on)?	5 out of 10	Acceptable
Sustainability actions: - Promote knowledge of wild animals and their participation in environmental regulation - Take the children to a reconnaissance of sites with wild animals		

Currently, a wide variety of models can be found that allow the impact of anthropic activities to be assessed through different tools that, in most cases, are disciplinary, and a few, consider the vision of different disciplines to give an understanding from the ecological, economic, and social dimensions of ES [29]. There are models that value ES through their particular characteristics, analyzed from biology and ecology [30 - 32]; many others, who tend to be the majority, use technological tools to simulate the behavior of ecosystems

according to interactions with human beings [33 - 39]; some others who make an assessment based on economic and econometric models in which a market is assigned to natural resources [40 - 44]; and others that promote changes in ES policy and usage patterns [45 - 48]. Some others, but in smaller numbers, include an interdisciplinary look at the evaluation of ES [49]. The models to value ES should contemplate the integrity of the ecological, economic and social dimensions and consider measures so that the interaction of human beings with biodiversity does not deteriorate the environmental offer, but also allows the generation of income in a stable and sustainable manner. that social actors reach an acceptable degree of generation of their needs [50 - 51]. On the other hand, most models identify the causes of degradation and the level of impact generated in ecosystems, and express the importance of moving towards their recovery and/or conservation, but do not propose actions to be followed to achieve it.

It is necessary to further promote an interdisciplinary approach and, above all, the participation of communities in the assessment of the ES that are provided and used in their localities, to include in the assessment the impact of local activities on the socio-ecological system that surrounds them [52]. However, the assessments continue to be in the hands of technicians from different disciplines, restricted by an institutional and budgetary framework, without promoting continuous assessment from the communities themselves, with the resources, mainly knowledge, that they have. In this sense, the methodology presented in this article advances in two dimensions with respect to others, first in the promotion of actions to follow in accordance with the identified state of the ES once the qualification of the proposed indicators is applied; and second, to promote assessment from the communities, from the homes themselves, with their available information and resources, without depending on institutional support, but recognizing the importance of the participation of different organizations to improve the level of sustainability of ES. It is a bet for the communities to make decisions that improve their quality of life and the integrity of the ES in their region.

For the particular case of Tocotá, there are no previous studies in which indicators have been applied to assess ecosystem services. However, there are studies in the area that show environmental aspects of the locality and that coincide with the results obtained with the application of this methodological strategy. The environmental authority of Valle del Cauca has identified that one of the biggest problems in Tocotá is the inadequate management of liquid and solid waste, due to the non-existence of community sanitation systems, and the individual systems do not work correctly, as well as the disposal inadequate use of solid waste in the streets, due to insufficient collection, in addition to the inefficient use of water; and proposes as solutions the construction of wastewater treatment plants in populated centers, the increase in environmental education and the creation of biodigesters [53]. Similarly, the Dagua Development Plan 2020-2023 shows impacts on natural resources resulting from human activities [54]. Likewise, research has shown the presence of protective forest crops and the change in productive practices of the inhabitants of Tocotá, from agricultural activities to tourism [55]. This agrees with the results of the analysis of indicators built in this research, particularly those related to pollution control through wastewater treatment and the correct disposal of solid waste or its use indicated a bad state for wastewater and acceptable for solid waste management. Also, in the indicators related to food production, it is identified that the food that is consumed there is not produced in the locality, because agriculture is not the main economic activity. In general, the results of the application of the developed methodological strategy indicate the need to carry out actions to improve the situation of the ecosystems that generate ecosystem services in Tocotá, as suggested by the institutions that have an impact on the area.

4. CONCLUSION

The provision of services for people by ecosystems will always be a benefit to society in general, even more so when, in addition to support, regulation and provisioning services, people can enjoy services that promote emotional well-being and spiritual of the people. However, this use of ES can generate impacts that undermine its sustainability over time, affecting the communities where they are generated and that enjoy them, and future generations.

Activities that take advantage of the cultural services of ecosystems, such as tourism, not only affect the possibilities of taking advantage of these same services by other people, but also have implications for the quality and quantity of other ES that can be generated in a locality. In the case of Tocotá, the consumption of services for recreation and tourism is generating pollution of different kinds: by solid waste, from water sources, from the air and reducing the possibilities of providing food and livelihoods for the population. mainly local. According to this methodological proposal for the evaluation of the sustainability of ecosystem services, the state of the ecosystem services evaluated in Tocotá is Medium, which means that the ecosystems are in acceptable conditions, but that they have some degree of deterioration that needs to be recovered. and move towards conservation.

To evaluate the sustainability of ecosystems and their services, it is necessary to identify them, which allows knowing the uses that are given to ecosystems. It is good to identify them all, but if not possible, at least the most significant in terms of greatest demand and worst impact. It is also important to characterize the SE identified: determine their quantity, quality, location, status, demand, and other factors that can be measured for each service. Subsequently, it is urgent to implement actions to contribute to the sustainability of the ES, depending on the evaluation of the state that is made of them. If the SE status identified is bad, take action to improve it, but if the status is good, also take steps to continue or improve it even more.

The evaluation of ecosystem services must contemplate the communities. In fact, it can also be done by members of the community. The people who know a territory best are those who inhabit it or are close to it. Likewise, the actions to be taken can be of a community nature, with the resources and knowledge that exist in the territory. Just as technical measures are important, so are actions related to knowledge management and education. The environment must be protected by state actions and the resources that the state must provide are fundamental for its conservation, however, actions can be taken from the communities for its care and protection, but it is necessary to give them the tools to do so.

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