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SUSTAINABILITY INDICATORS, FOR THE DESIGN OF AGROECOLOGICAL TRANSITION ROUTES IN PEASANT COFFEE FARMS

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Abstract: The strengthening of sustainable coffee farming, adapted to climate change, required generating an evaluation using indicators, which allowed obtaining a diagnosis of each farm, thereby identifying the critical points and mitigation actions for the existing risks in each of the productive subsystems, such as: agricultural, livestock and forestry, without forgetting the social component represented by coffee-growing families. This field input that is generated from visits to the farms, achieves the design of agroecological transition routes, for this it is necessary to apply a participatory methodology, which allows between researchers and farmers in a dialogue of knowledge, to generate sustainability strategies for the coffee-growing families and their productive systems.

The general purpose of this research was to propose a methodology that allows the evaluation of sustainability through indicators that are evaluated from 0.0 as the lowest score or smallest scale of sustainability and 5.0 points as the highest scale of sustainability, for the subsequent generation of sustainable routes for farm management, the application of the work was developed in 9 coffee farms in the municipality of Timbio, Cauca, Colombia. The validation of the methodology concludes that by achieving a diagnosis of the farms, in environmental, economic, socio-cultural and technical terms, for the agroecological school farms that have scores less than 3.0, improvement implementation strategies are proposed. and it is possible to formulate a transition plan towards sustainable and resilient agroecological systems in the face of the effects of climate change.

Keywords: coffee growing, tropics, peasantry, characterization, climate change.

INTRODUCTION

In the agroecology component within the framework of the CASAC project "Sustainable agroecological coffee farming for adaptation to climate change" articulated to the Center for Research, Social Innovation and Promotion for the Development of Caucana Cicafícola Coffee Farming, a participatory action research process IAP was developed (Velásquez et al, 2021), where an analysis has been woven with local communities in the municipality of Timbio that reflects the degree of sustainability of the farms through indicators (Alegría Fernández, 2021).

This community proposal claims that there are other ways to relate to nature and in that way validate sustainable models in integrated production systems (Acevedo O & J, 2018). The methodology is divided into four moments: first, the topographic survey, second, the characterization of the productive systems and subsystems, which is covered in a first visit; the third, the state of the sustainability of the farm is determined participatively with the producer through indicators, this participatory exercise, the fourth, proposes the design and implementation plan of a consensual route of agroecological transition with a territorial approach with the producer to its productive unit, in order to move towards a sustainable system, the realization involved 9 farms for a total of 27 field visits (Alegría Fernández, 2021).

Sustainable peasant productive systems can be enhanced as demonstration school farms. In this sense, it is necessary to support the productive and social processes that exist around coffee-producing peasants and the imminent challenge of climate change that requires the generation of strategies. For its mitigation, the work is relevant since social organizations are the support under which it is possible to continue production, based on agroecological and territorial processes

supported by the cultural, political and own economy (Narciso and Toledo, 2008), to achieve this purpose, it is proposed to strengthen the farms that are working with agroecological foundations and that promote sustainability, which will guarantee the permanence of sustainable production (Sarandón, 2021) and as such provide support to local territorial processes.

Just as it is also necessary for farms that do not yet have this agroecological approach to make the transition towards sustainability (Gliessman et al, 2007) and for these places to also become spaces for agroecological demonstration school farms, this document presents the developed methodology, the analysis of the results obtained in the evaluation phase are presented as the central axis of the writing and with them advance in the definition of the farms with the highest score and the strategies to be implemented, to at the end, make some preliminary conclusions, constituting an input to apply in other contexts and continue collecting field information on more farms in different climates, to determine how to face the challenge of producing in the face of climate change.

METHODOLOGY

The field methodology to evaluate the sustainability of coffee systems is composed of 5 dimensions, 22 components, and 56 variables that aim to approximate sustainability, allowing a description of the farms, a management evaluation and validation of agroecological transition routes, its applicability is divided into 4 phases (Fernández, 2022), which are described below.

In phase 1, the topographic survey is carried out, through social cartography the current use of the land is identified, where each coffee-growing family identifies productive zones, conservation zones, boundaries, buildings and distribution of the lots, represented on a freehand map, at the end you are given the current map of your farm.

In phase 2, the characterization of the productive systems and subsystems is carried out, using the characterization guides, that is, the field instrument. Thus, the templates and profiles of each subsystem are prepared, studying each of them in detail, relying on the characterization guide for productive units proposed by Villalba (2022), the general, agricultural, livestock, coffee, and livestock characterization guides. and forestry, identify the percentage of land use with respect to the total area, type/form of production and accompanying systems, among other important factors, allowing recognition of the current state of the productive system and its subsystems, related to the territory, this phase in descriptive and its final product is to define the management of each farm and the strategies implemented against climate change.

In phase 3, sustainability is evaluated, based on the matrix of sustainability indicators: the dimensions are assessed and analyzed: environmental, socio-cultural, technical and economic; with 22 components distributed in each item, with their respective variables, which are estimated from 0 to 5. Zero (0) being the lowest score or lowest sustainability scale and Five (5.0) points being the highest sustainability scale.

In the last phase, number 4, the transition route is prepared, which consists of, once the problems are identified, a proposal and work plan is formulated in a concerted manner, consequently, once sustainability has been diagnosed in each one of the farms, the variables with the lowest and highest qualification, according to the scores, are represented in a traffic light that visually facilitates establishing the critical points in red, to be improved, in green the strengths to be maintained over time and in yellow neutralizing elements,

with these inputs sustainable alternatives or agroecological transition routes are proposed to be implemented according to the edaphoclimatic conditions of the area, the availability of the producer, the application of their cultural practices, use of local resources and incorporation of adapted multifunctional species to the area, and that is consolidated in a short, medium and long term work plan.

For the development of this research, a peasant organization located in the municipality of Timbio, in the department of Cauca-Colombia, called Cafi-ambiente, was selected, which has 9 associates, each of them with a coffee farm, which was visited 3 times, to collect the necessary information in each of the stages, allowing for the diagnosis and generation of strategies, in total 27 field views were made, this article will only focus on the final evaluation for each dimension and whose final results allow defining the farms agroecological demonstration schools and the strategies generated to mitigate climate change.

RESULTS AND DISCUSSION

The description of the farms was made using the field instrument guides and the battery of 56 agroecological indicators, which are divided into 5 dimensions: environmental, economic, sociocultural, agricultural technical and livestock technical, with which it was described and evaluated at the level sustainability of each farm, in terms of agrobiodiversity, the interactions between productive subsystems, cultural management and the economic dynamics that are interwoven in each production system (Cerdá & Khalilova, 2015), which are summarized in table 1.

The evaluation of the nine characterized farms made it possible to measure the current state of the farms, validate and recognize agroecological practices around coffee cultivation, as well as identify alerts of environmental, economic and social deterioration in the productive units.

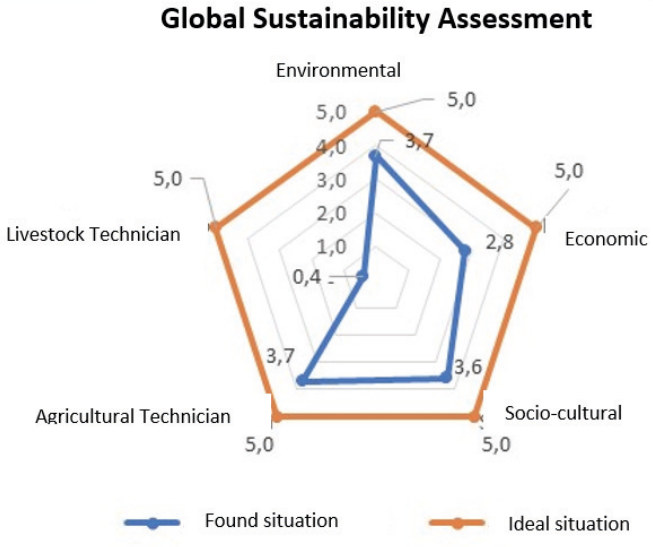
Table 1 represents the farms where it was evaluated: In the economic dimension: the lowest indicator was 2.2 and the highest indicator is 3.5, on average the farms do not maintain a cash flow in the short, medium and long term that allows them to maintain a constant resource throughout the year; for its part, the farm that has the highest indicator is the one that incorporates the livestock component into its production system, increasing the cycle of matter and energy and the interactions between subsystems (Alexandre et al., 2017); in the environmental dimension: the highest average of the farms is 4.2 with the lowest average being 3.1, the farms characterized with the lowest score lack conservation strategies, soils, maintenance of productive diversity and limited forest areas and the highest scores are obtained due to the implementation of biofactories, seed houses, community nurseries and agroecological gardens (Casas, 2019).

In the socio-cultural dimension, it is of great importance to understand and adjust the agroecological transition route (Toledo & Barrera-Bassols, 2020) and whose rating in the highest indicator is 4.3 due to the degree of participation of the farm in processes organizational and attendance at meetings, leadership in the area and management of food processes generated on the farm; the livestock technical dimension: it is one of the deficient ones and in most farms they lack the implementation of this subsystem, this hinders the principle of integration of productive units and increases dependence on external inputs (Martínez López et al, 2021). In the last agricultural technical dimension: the farms have developed processes for recovering their own seeds with ratings higher than 3.0, for the most part, this allows them to lead productive

NAME OF THE PROPERTY	SUSTAINABILITY INDICES					AVERAGE OF SUSTAINABILITY INDICATORS	STATE OF THE ESTATE
	ENVIRONMENTAL	ECONOMIC	CULTURAL PARTNER	AGRICULTURAL TECHNICIAN	LIVESTOCK TECHNICIAN		
El Pensamiento	4,0	3,3	3,9	3,8	0,0	3,8	TRANSITION
La Empalizada	4,2	3,0	4,3	4,5	0,0	4,0	SCHOOL PROPERTY
El Níspero	4,0	3,5	4,2	3,9	0,0	3,9	TRANSITION
EL Imperio 2	4,1	2,5	3,5	3,9	0,0	3,5	TRANSITION
La Sementera	3,5	2,2	3,1	2,9	0,0	2,9	DEFICIENTE
La Granja	3,2	2,9	3,2	3,9	0,0	3,3	TRANSITION
El Arroyo	3,1	2,3	3,3	3,2	0,0	3,0	DEFICIENTE
La Gaviota	3,1	2,7	3,5	3,2	3,4	3,2	TRANSITION
Venencia	4,0	2,8	3,6	3,9	0,0	3,6	TRANSITION

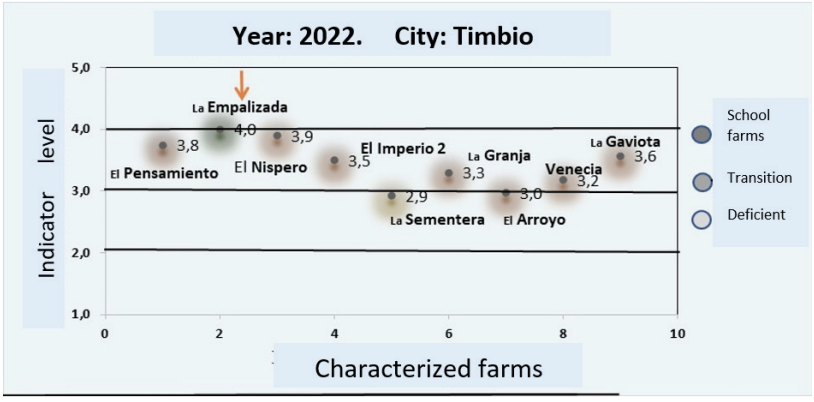
Table 1: consolidated indicators of nine farms

Source: own author of the work



Graph 1: spider web or amoeba diagnoses of the 9 farms

Own source



Graph 2: level of sustainability of the farms

Own source

processes, which strengthen the minerals of the soil, the microorganisms and the organic matter of the themselves, highlighting the management of productive agrobiodiversity to strengthen food sovereignty (Vergara-Romero et al, 2021), as Giraldo states: "on the field side we need to continue strengthening the process of an agroecological peasantry (Val et al., 2018), whose role is to produce food and other non-food goods for all people, while greening the planet" (2022, page 36).

The evaluation by sustainability indicators (Graph 1) allows measuring the current state of the farms, and identifying sustainable practices and alerts of environmental, economic and social deterioration in the productive units CIcafícola (2015).

With the analysis of the information at the farm level, the components to be improved are observed to reach an ideal score situation in the indicators of 5.0. It was determined that only one farm manages the livestock component, being relevant for the rest of the farms. Incorporating this subsystem allows closing cycles of matter and energy (Sevilla Guzmán, 2000) and making the productive system more sustainable. This consolidation allows for the participatory promotion of an agroecological transition route for the design of farms as integrated production systems. Emphasizing coffee, as the main crop at the village level, and based on what has been developed on the demonstration school farms, plans for transitions towards agroecology are advanced, where families from farms with higher levels of sustainability become local agroecological promoters (Tittonell, 2020).

In graph 2, the dark gray color determines the farms that are above the rating of 4.0 points and become the agroecological demonstration school farms of the village, zone or region, due to the high sustainability indexes in each one. of the dimensions evaluated; in pale gray are the farms that are in transition, which must improve some agroecological practices to achieve higher levels of sustainability whose rating ranges from 3.0 to 4.0 points, and in light gray are the farms with a score of less than 3 where Many productive limitations are identified; With these inputs, for each of the farms, together with the peasant families, the design of an agroecological transition route is developed that allows reaching the desired situation a level of sustainability in each farm of rank or level 5 ideal situation that is sought in all the farms. dimensions, Environmental. Economical. Socio-cultural and productive technical, promoting "a civilizational transformation as required, does not mean passively "conserving", but actively transforming and feeding ecosystems so that the reproduction of life becomes more dynamic (Giraldo, 2022, page 16)

CONCLUSIONS

The characterization and evaluation of the sustainability of the farms, based on indicators, allows establishing the current state of the farms and generating strategies in the construction of agroecological transition routes as a powerful tool in the planning process from the farm, the village and the micro basin as a strategy for adaptation to climate change.

The farms with greater productive diversification are those that reduce the use and consumption of inputs that are harmful to nature, which in turn implies less spending on chemical supplies, increasing profitability for coffee-growing families and promoting environmental conservation.

To address climate change, it is essential to implement practices with agroecological principles that promote diversity, in addition to harmoniously integrating the different farm subsystems and promoting self-sufficiency within the productive unit.

Farms with low levels of sustainability must redesign the agroecosystems, based on the structure and functionality of the agroforestry arrangements and multifunctional crops, which promote the farm as a sustainable and profitable productive unit.

Agroecological demonstration school farms play a vital role, by sharing their agroecological experiences with neighbors. This action not only seeks to inform, but also actively involve the community, in the participatory construction of collective action processes. It is a key community strategy in the fight against climate change, allowing the exchange of knowledge and joint collaboration to face this global challenge.

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