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Original article

Sustainability of farms in Contramaestre

Sostenibilidad de fincas en el municipio Contramaestre

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ABSTRACT: The work was carried out in eight farms of producers belonging to the same number of base structures of the ANAP (National Association of Small Farmers), in six popular councils of Contramaestre municipality, in Santiago de Cuba province. The municipality is located at 22º58'4 "North and 82º9'21" West. It has a humid tropical climate with rainfall that exceeds 1500 mm per year, an average annual temperature of 23.9 °C and 80 % relative humidity. 76 % of the area is agricultural land, of which 60 % is cultivable and the rest is used mainly in livestock and forest areas (National Statistics Office). The farms were selected for their high levels of biodiversity, where agroecological techniques are implemented due to their easy access and open availability to participate in the research in the period from January to June 2019, having as the main problem the ignorance of the conditions current economic, ecological and sociocultural dimensions of agro-ecosystems (Farm) that allow determining their sustainability, so it is defined as the objective of our work to evaluate the economic, ecological and socio-cultural dimensions of agro-ecosystems through Participatory Rural Diagnosis (DRP) to determine their sustainability using the principles of participatory-action research (PAR) as a study methodology and was designed from the integration of multi-criteria analysis methods and tools for the study and evaluation of sustainability. Determining a positive trend of the three dimensions evaluated towards sustainability.

Keywords: ecosystems, dimensions, agroecosystems, ecology.

RESUMEN: El trabajo se realizó en ocho fincas de productores perteneciente a igual número de estructuras de base de la Asociación Nacional de Agricultores Pequeños (ANAP), en seis consejos populares del municipio Contramaestre, en la provincia Santiago de Cuba. El municipio se encuentra ubicado a los 22º58'4"Norte y 82º9'21"Oeste. Tiene un clima tropical húmedo con precipitaciones que superan los 1500 mm anuales, una temperatura media anual de 23,9 °C y una humedad relativa del 80 %. El 76 % del área es suelo de fondo agrícola, del cual el 60 % es cultivable y el resto se utiliza, fundamentalmente, en la ganadería y áreas forestales (Oficina Nacional de Estadística). Las fincas fueron seleccionadas por sus altos niveles de biodiversidad, donde se implementan técnicas agroecológicas, por su fácil acceso y abierta a disposición para participar en la investigación en el periodo comprendido de enero-junio del año 2019, teniendo como principal problema el desconocimiento en las condiciones actuales de las dimensiones económicas, ecológicas y socioculturales de los agro ecosistemas (Finca), que permitan determinar su sostenibilidad, por lo que se define como objetivo de nuestro trabajo evaluar las dimensiones económicas, ecológicas y socioculturales de los agroecosistemas, a través del Diagnostico Rural Participativo (DRP), para determinar la sostenibilidad de los mismos, empleando como metodología de estudio los principios de la investigación-acción-participativa (IAP) y se diseñó a partir de la integración de métodos de análisis multicriterio y herramientas para el estudio y la evaluación de la sostenibilidad, determinándose una tendencia positiva de las tres dimensiones evaluadas hacia la sostenibilidad.

Palabras clave: ecosistemas, dimensiones, agroecosistemas, ecología.

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INTRODUCTION

In the historical and difficult task of producing food to supply the diverse needs of human society, numerous development models have been formulated under various conceptual premises, among which modern agriculture, or high-input agriculture, has undoubtedly been the most successful (in quantitative terms) on a global scale. It has been demonstrated that even the current economic order is insufficient to solve the difficulties afflicting society and its impact on the origin and sustainability of the major environmental, economic and socio-political problems facing the human species worldwide, with unpredictable impacts on the economies of developing countries and, at the same time, the impact of the current financial and economic crises that are exacerbating food problems with the rising prices of staple foods. In the last three decades, a special interest has arisen within the world agroecological movement to find methodologies aimed at measuring the sustainability of agroecosystems (1,2).

In Cuba, agroecological principles (such as seeking ecological solutions to pest, disease and weed control, and implementing ecological techniques for tillage and soil conservation) began to be applied in research in the 1970s and were strengthened in the 1980s, but it was not until the period known as the "special period" that various transformations began in the agricultural sector, with a view to converting agriculture into a sustainable activity, due to the need to produce with less inputs in all branches of the national economy (3) .

Cuba has information on various research projects carried out under agroecological principles, both in experimental centers and in peasant, private and cooperative scenarios. These dynamics have encouraged the development of research oriented to the elaboration of study methodologies for a closer approach to sustainable development (4-6).

Agroecosystem sustainability evaluation in Cuba and in our municipality is a great problem because there are no studies in the territory to evaluate them, for this reason it is unknown if the existing ones are sustainable or not in the ecological, economic and sociocultural dimensions. In this sense, the study of the agroecosystem (farms) was determined as the research object, having as main problem the lack of knowledge in the current conditions of the economic, ecological and sociocultural dimensions of the agroecosystems (farm) that allow determining their sustainability, so it is defined as the objective of our work to evaluate the economic, ecological and sociocultural dimensions of agroecosystems through the Participatory Rural Appraisal (PRA) to determine their sustainability using the principles of participatory action-research (PAR) as the methodology of study. In this sense, the following specific objectives were defined: (a) diagnose the economic dimension of the agroecosystem; (b) diagnose the ecological dimension of the agroecosystem; c) to diagnose the socio-cultural dimension of the agroecosystem (7-9).

MATERIALS AND METHODS

An agroecosystem is an ecosystem altered by man for the development of an agricultural exploitation. It is composed of abiotic and biotic elements that interact with each other.

When it is about environmental sustainability, it is referred to the social, economic and environmental balance, so as to ensure, as far as possible, continuity in the future. The participatory action research (PAR) method combines two processes, that of knowing and that of acting, involving in both the population whose reality is being addressed.

In each PRA project, its three components are combined in varying proportions: a) Research consists of a reflective, systematic, controlled and critical procedure aimed at studying some aspect of reality with an expressly practical purpose. b) Action is not only the ultimate purpose of research, but is itself a source of knowledge, while carrying out the study itself is in itself a form of intervention. c) Participation means that not only professional researchers are involved in the process, but also the target community of the project, who are not considered as mere objects of research but as active subjects contributing to the knowledge and transformation of their own reality.

During the research, what is stated in the National Strategy for Environmental Education 2010-2015 was taken into account (10) , which recognizes the following aspects as basic principles for its development and we agree with them in order to achieve a sustainable, prosperous and sustainable development as a goal for a) the educational process: environmental education should be oriented within the social context and in the ecological and cultural reality where the subjects and actors of the educational process are located in order to produce and disseminate the new knowledge that will allow the construction of a new social organization friendly with nature and a rationality in the productive processes based on the potential of ecosystems and cultures. b) Interdisciplinary approach: establishes a form of applied knowledge that is produced at the intersection of knowledge and the transfer of concepts from one field to another. c) Ecosystemic approach: recognizes that human beings, with their cultural diversity, are an integral component of many ecosystems. d) Participatory nature: participation means the creation or adoption of a new methodology, new styles and new techniques, as well as a conviction, a posture and an option before life, so the criteria, interests and knowledge of all those involved must be taken into account, which will allow the commitment of all participants and in turn will achieve the necessary sustainability in the environmental programs and projects carried out. e) Value formation: this is not limited to learning about environmental relations and problems, or to the acquisition of skills for successful environmental management, but rather an integral culture of the people that will guide the actions of individuals. f) Gender perspective: this refers to the male and female gender and the roles, responsibilities and opportunities assigned to

them and the sociocultural relations established between them. The application of a gender perspective should be oriented to the promotion of a sustainable human environmental culture that recognizes in its actions the socio-natural diversity for a change of attitudes and ways of living.

In Cuba in 1959, before the triumph of the Revolution, the following agroecological actions were put into practice, which we must rescue today, to achieve substantive changes in agriculture and live in harmony with the environment: (a) manual weed control; (b) use of wet tobacco stick as a natural insecticide; (c) seed conservation; (d) incorporation of crop residues into the soil and sowing; (e) sowing and planting of crops according to moon phases; f) diversity of animals and crops in each plot, farm or conuco; g) use of animal manure as fertilizer; h) live fences of cardon cactus, tamarind, acacia, vetiver; i) multiple associations of various crops; j) minimum tillage with animal traction.

Three steps were taken into account to develop the work: first step to develop the work was the selection of farms under study being selected a sample of eight at municipal level, for their high levels of biodiversity, where agroecological techniques are implemented. Second step were identified the strengths and weaknesses of each of farms on the methodological basis of participatory rural appraisal (PRA) (11,12), to obtain the necessary information and analysis of the agroecosystem in its economic, ecological and socio-cultural dimensions (3). Third step, the methodological steps for the sustainability evaluation of the eight selected production systems were described in a didactic way, using indicators and descriptors to measure strategic actions, while orienting policies, strategies, actions and decision making in this area.

The indicators that were evaluated in the three dimensions of sustainability, are expressed in different units, depending on the quantified variables (units of weight, length, area, number), so the construction of scales is proposed (2), for this work we proposed the scale 0 to 5, being 0 the least sustainable category and 5 the most sustainable, taking the value 3 as threshold, value from which the tendency to sustainability of the evaluated dimension is determined.

To apply the MESMIS methodology, an evaluation cycle was proposed that included six steps (13,2): 1) definition, description and diagnosis of the systems to be evaluated; 2) identification of significant points within the production, through a meeting between specialists and producers on the farm; 3) selection of diagnostic criteria and indicators; 4) measurement and follow-up of selected indicators; 5) integration of the results: the indicators were grouped within the three pillars of sustainability, admitted by the method (sociocultural, environmental and economic); 6) conclusions and recommendations.

Among the strengths and weaknesses diagnosed in the eight farms selected for the study, the % working age range (18-65 years) was determined. It was diagnosed whether there are problems related to the main social services and quality of life: (a) whether they have access to public health and free education; (b) whether they take advantage of opportunities to raise their schooling level; (c) whether they own their own homes; whether they have drinking water and electricity service; (d) whether they have household appliances; (e) interest in using the diversity of species, for their transformation towards sustainability; f) the predominant soil in the area under evaluation according to the New Version of the Genetic Classification of Soils in Cuba; if they rotate crops, which enhances the self-sufficiency of families and the sale of products in the market; h) if they produce organic fertilizers; i) if they have seedbeds and nurseries; j) if they are favored by organic fertilizers; k) if they produce organic fertilizers; l) if they produce organic fertilizers; m) if they produce organic fertilizers. j) if it is favored by the country's economic situation; k) the farm's possibilities to generate employment; l) if it supports other producers by delivering or selling seeds; m) if it has accounting records.

RESULTS AND DISCUSSION

The present study found weaknesses and scenarios susceptible to improvement that, if addressed, would optimize the sustainability levels of the farms, 56.3 % of the people in the eight agroecosystems studied are within the working age range, the participation of young people stands out at 23 % and women at 18.7 %, and others. Water is obtained through wells, rivers derived from Carlos Manuel de Céspedes dam, considered good quality water for human use due to the treatment it receives. On the other hand, the water used for irrigation comes mainly from subway wells, the river and micro-dams, allowing them to satisfy only 50 % of the irrigation needs, since not all of them have irrigation systems. The other 50 % of farms lack irrigation for their crops, which constitutes a problem for sustainable development. In 100 % of farms evaluated, tropical brown soils predominate, according to the New Version of the Genetic Classification of the Soils of Cuba (14), the topography is slightly flat and the soils are characterized by having an average effective depth of 35-40 cm, this does not constitute a limitation for crops that are established in each of the farms; there was a need to apply conservation measures in 75 % of farms, mostly due to erosive situations.

The traditional soil preparation system predominates, with variants that tend to reduce the number of tillage tasks and preparation time; work with oxen is limited to cultural tasks and the transfer of harvests. The agrobiodiversity managed by the farmers is not so variable since seven of them 87.5 % dedicate their areas to diversified production and only one 12.5 % produces tobacco as main crop, using the rotation of the areas with other crops. It is observed that the most common crops are those directly related to local food needs and income generation, among the fruit trees are mango and guava, among the grains are beans and corn, among the viands are sweet potatoes and cassava, and among the vegetables are eggplant, beans and okra. The economic base of farms studied is designed according to

the management of agrobiodiversity; only 25 % of the livestock modules that are owned meet the requirements, which would enhance the recycling of nutrients, family supply and income. Only 12.5 % of the producers have biogas on their farms, none of them have windmills or solar panels as alternative energies to reduce diesel consumption.

Of the farms evaluated, seven 87.5 % generate jobs for the community, where women predominate. Only one of the farms 12.5 % produces corn and bean seeds in the movement designed for this purpose, however, there are seed exchanges between producers. Only one of the producers 12.5 % has accounting records, which are kept by his son.

Values obtained to determine the tendency to sustainability of the three dimensions evaluated, using the scale 0 to 5, with 0 being the least sustainable category and 5 the most sustainable, taking value 3 as the threshold, from which the tendency to sustainability is determined. As can be seen in Table 1, the values obtained confirm the existence of a certain trend towards sustainability in the agroecosystems evaluated, all exceed the threshold value 3 with an average of 3.52. The highest value was obtained in the sociocultural dimension, which allows us to state that it has the best trend in relation to the rest, followed by the economic dimension with a value of 3.67 and the existence of a certain ecological rationality since this indicator only has a discrete trend towards sustainability of 3.052.

The scope of sustainable development can be conceptually divided into three parts: environmental, economic and social. The social aspect is considered because of the relationship between social welfare with the environment and economic prosperity, which must satisfy the needs of society such as food, clothing, housing and work, because if poverty is common, the world will be headed for catastrophes of various kinds, including ecological ones. Likewise, development and social welfare are limited by the level of technology, environmental resources and the capacity of the environment to absorb the effects of human activity (15).

The strategy of seeking high biodiversity in the agroecosystem coincides with what several agroecologists define as a sustainable practice (2), the three indicators have a tendency to social, economic and environmental improvement in the short, medium and long term, for the benefit of society, without deteriorating the natural resource base. The sustainability values obtained confirm the existence of a certain ecological rationality on the part of farmers.

CONCLUSIONS

1. Taking into account the interaction between the social and ecological environments, it can be concluded that the farms show a tendency towards sustainability, since what is being done is ecologically adequate.
2. Taking into account the interaction between the economic and ecological environments, it can be concluded that the farms tend towards viable economic development for their biodiversity.
3. Taking into account the interaction between the economic and social environment, it can be concluded that the farms have an equitable development, since their source of income is agricultural work.

RECOMMENDATIONS

1. Continue training farmers in ecological knowledge that will increase the productivity of their land, without damaging the environmental benefits offered by agroecosystems, and that these results will be used by producers and decision-makers to draw up improvement plans with a view to projecting strategies in the municipality in the short, medium and long term.

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Table 1. Sustainability values

Dimension	Indicators evaluated	Total descriptor	Scale average value
Sociocultural	7	16	3,85
Ecological	5	21	3,052
Economic	8	27	3,67
total	20	64	3,52

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