Scientific Paper

Evaluation of socioecological resilience in six farms of the Sancti Spiritus province, Cuba

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Abstract

Objective: To evaluate the socioecological resilience of six family farms in the context of a case study in the Sancti Spíritus region, Cuba.

Materials and Methods: For the study of resilience, the methodology for the evaluation of socioecological resilience, which evaluates a set of technological and efficiency criteria, and the perspective of community economies, which considers the needs, interdependence, communication and collective action as essential components, were applied in a combined way.

Results: The results highlighted the importance of mixed methods in the study of socioecological resilience in family agriculture and allowed the involved farmer families to have a contextualized evaluation of their systems. The application of these methods favors decision-making by such families, in order to improve the resilience of their farms, as well as for local decision-makers, who have the possibility of elaborating agrarian policies, to correct the critical points that put the stability and permanence of family agriculture in the region at risk.

Conclusions: When combining the application of the methodology for the evaluation of socioecological resilience and the qualitative analysis of community economies, the evaluation allowed to identify and appraise multiple dimensions that help to conceive strategies to achieve resilience of the studied systems, as well as to make decisions at farm level and in local public policies that support the contextualization and appropriation of adequate technologies for agroecological transition on inclusive and participatory bases.

Keywords: agricultural economy, agricultural exploitations, resilience

Introduction

From the climate point of view, the Caribbean is considered one of the most vulnerable regions of the world (Márquez-Serrano and Funes-Monzote, 2013), due to the high frequency of tropical cyclones and hurricanes. These phenomena affect the ecology and economy of this geographic zone (Stennett-Brown *et al*., 2019), and Cuba is not an exception. In 200 years, 119 hurricanes have hit the country with considerable economic damage, fundamentally in agriculture (ONEI, 2018).

The strong drought, hurricanes and tropical cyclones threaten the socioecological resilience of family agriculture in Cuba, which with the lowest amount of land and little access to inputs and technologies, contributes more than 80 % of most of the foodstuffs that are produced in the Island (Casimiro-Rodríguez, 2016; Nova, 2016; ONEI, 2018).

Resilience is understood as the capacity to persist in the long term through shock buffering, adaptation to change (Darnhofer *et al*., 2016) and transformation. Resilient farmer families have the capacity to carry out adaptive changes in order to overcome any disturbance, stress or change situations, and maintain agricultural production in harmony with the capacity of ecosystems, satisfaction of needs, tradition, identity and social organization, all in an ecologically possible and socially desired context (Casimiro-Rodríguez, 2016).

The concept of socioecological resilience insists on the interdependence and interconnection between social and ecological dynamics (Ploeg, 2012; Darnhofer *et al.,* 2016), both essential to understand family farms. The current trend in studies to evaluate resilience aims at the interconnection of diverse spheres, and comprise the complex processes of adaptation and transformation of socioecological systems to rule the economy-ecology and society interdependence (Darnhofer *et al*., 2016; Gibson-Graham *et al*., 2016).

According to Nicholls-Estrada (2013), social organization strategies (solidarity networks, exchange of food, equipment and inputs, among others) constitute a key characteristic of socioecological resilience, and

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are used by farmers to manage difficult circumstances. That is, the family and farm are linked, coevolve and combine economic, environmental, social and cultural functions (IPC, 2014). It is in the homes of family farms where the relations among the members area created and reproduced, where economy and ecology interact, and are the space where the interdependence among the human, non-human and environmental aspects becomes evident. According to Ploeg (2013), the family farms constitute the link among the past, present and future, for which they create a collective memory through time, crucial in the construction of resilience.

Darnhofer *et al.* (2016) state that for reaching sustainability and creating resilient systems, which can face change and adapt and transform, it is necessary to build the capacity to acknowledge the vulnerability of human beings (interdependence) and of the environment (ecodependence), negotiate their own and other's relations and needs, to create a care sense (Gibson-Graham and Miller, 2015) that can lead to other representations of the system. For such reasons, the objective of this research was to evaluate the socioecological resilience of six family farms in the context of a case study in the Sancti Spíritus region, Cuba.

Materials and Methods

The study was conducted in the Sancti Spíritus province, Cuba, in six family farms located in the municipalities of Cabaiguán (3), Taguasco (1) and Sancti Spíritus (2). The selection of the farms responded to several criteria: 1) that the family lived in the farm, 2) that it followed, mostly, agroecological design and management and 3) that it was heterogeneous, regarding different social objects[1]. The selection criteria were indicated by specialists of the Pastures and Forages Research Station Indio Hatuey (EEPFIH, for its initials in Spanish) and management staff of the National Association of Small Farmers (ANAP, for its initials in Spanish) of the province. Table 1 shows some of the characteristics of the evaluated farms.

These farms are part of the international collaboration project "Biomass as renewable energy source for rural areas (BIOMAS-CUBA), a project led by the EEPFIH, with funding of the Swiss Development and Cooperation Agency (SDC). Such project explores sustainable alternatives in the integrated food and energy production. It also comprises the production and use of biodiesel and biogas, biomass gasification and bioproduct production, from the formulation and implementation of community strategies to develop production on agroecological bases, with appropriate technologies to each context and through a local agricultural innovation model with wide participation of farmers and other actors, for contributing to the development of the different benefitted communities.

The study of the farms that are in different stages of agroecological transition, acknowledged by the province, helps the representativeness of family agriculture in the region, because as they are more advanced than the others in the transition process, the unfavorable elements to be corrected are more

Table 1. General characteristics of the farms object of evaluation.

Farms	Area, ha	Social object	Family members	Workers P/S[¥]		Municipality	Cooperatives (CCS)
Del Medio	10	Milk and meat	5 adults 2 children	1	2	Taguasco	Rolando Reina
Río de Agua Viva	3	Cows and pigs	4 adults 3 children	0	0	Sancti Spíritus	10 de octubre
San José	9	Cows, pigs and tobacco	5 adults 2 children	1	5	Sancti Spíritus	Bernardo Arias
Flor del Cayo	9,6	Cows, pigs and tobacco	2 adults 2 youths	2	10	Cabaiguán	Patria o Muerte
Ingenito	7,2	Cows, pigs and tobacco	6 adults 3 children	1	8	Cabaiguán	Julio Piñero
Las Dos Rosas	13,4	Pigs and tobacco	2 adults 1 youth	4	15	Cabaiguán	Beremundo Paz

[¥] Permanent (P) and seasonal (S) workers

[1]Social object is the production contract each farm has with the State. It can be tobacco, milk and meat or food crops, among others.

evident than in less advanced farms. Thus, the analysis can be valid for the remaining family farms in the territory.

To understand the complexity of socioecological resilience, the methodology for the evaluation of socioecological resilience (MESR) (Casimiro-Rodríguez, 2016), with the purpose of the evaluation of different technological and efficiency criteria (1) (figure 1), and the theoretical framework of community economies (CE) (2) (Gibson-Graham *et al.,* 2013), were combined, in order to enhance the sociocultural analysis and contribute more qualitative data.

This study is based on a participatory approach, which means that the results are part of a negotiation with the participants, to create a learning process (Chambers, 1994; García-Barrios and González-Espinosa, 2017) with the farmer families involved in the research, and for them.

In a first phase, the compilation of quantitative information of each socioecological system was carried out from the diagnosis questionnaires (Casimiro-Rodríguez, 2016), which allowed to obtain the necessary data to make the calculation of four socioecological resilience indexes (SRI), according to Casimiro-Rodríguez (2016): food sovereignty (FS), technological sovereignty (TS), energy sovereignty (ES) and index of economic efficiency (EE), which contribute, equivalently, to the creation of the SRI of the farms (table 2).

In parallel with the compilation of quantitative data, the qualitative information was obtained from the observation during the coexistence with the families and from the semi-structured interviews, formulated from the framework of CEs (Gibson-Graham *et al*., 2013). After processing the compiled information, the results were returned to the family, the critical points that put the resilience of their farms at risk were analyzed in a participatory way, and the collective construction of concrete solutions to the existing problems was searched for.

Results and Discussion

The quantitative results from the MESR methodology are exposed and the qualitative results, obtained from the observation and the interviews defined through the CE theory are described.

The CE theory is based on six ethical coordinates: needs, surplus, meetings, consumption, common goods and investment. These coordinates allow the members of each family farm to negotiate their interdependence (Gibson-Graham *et al.,* 2013) and acknowledge diverse economic realities, beyond money. This research was focused on the first three coordinates: needs, surplus and meetings.

Needs are the starting point of any diagnosis. Examining them constitutes a practice of thinking what is needed to live well and, in this context, what is needed to adapt to the changes and disturbances of the socioecological system. From the needs and considering what is "surplus" and what is necessary for "survival", elements that are interdependent (Gibson-Graham *et al*., 2013), the production and distribution of surplus were also examined. Finally,

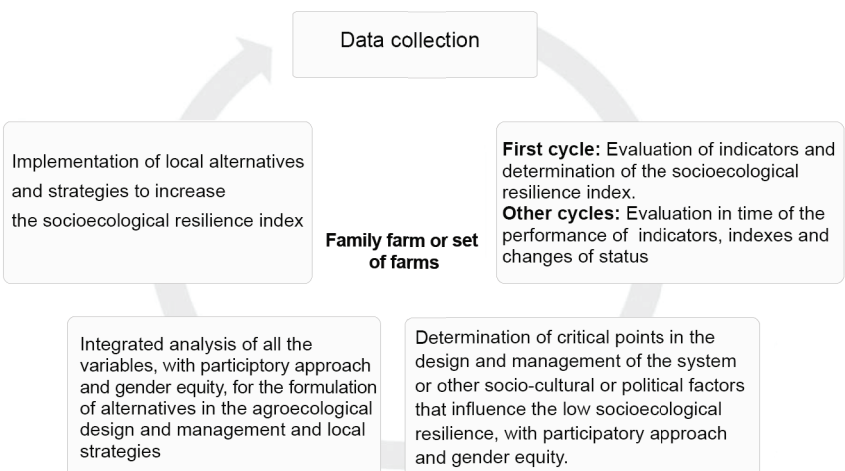

Figure 1. Schematic representation of the practical application of the methodology for the evaluation of socioecological resilience (MESR) of family farms. Casimiro-Rodríguez (2016)

Table 2. Description of the indicators used for obtaining the four indexes for the creation of the SRI[¥].

Indexes	Indicators	Relative bearing	Description
Food sovereignty (FS)	Pp	0,33	Quantity of people fed by protein of animal or plant origin/ha/year.
	Pe	0,01	Quantity of people fed by energy of animal or plant origin/ha/year.
	Af	0,66	Percentage of the feeding of the family who lives in the farm, which is satisfied with its production.
Technological sovereignty (TS)	LUI	0,0054	*Land utilization index*. Necessary hectares for planting in monoculture and obtaining the same yield as in one hectare of polyculture.
	EI	0,2013	Level of non-generated or non-utilized inputs in the farm, which are used in the productive system (%).
	H	0,2814	*Production diversity (Shannon index)*. Includes the total production of each agricultural or animal husbandry product and the total production of the system.
	UIRES	0,4011	Utilization index of the potential of renewable energy sources, associated to appropriate technologies.
	IIF	0,1108	*Innovative intensity of the farm*. Level of execution of the innovation activities that exist in the peasant farm for the agroecological design and management (%).
Food sovereignty (FS)	EE	0,4524	*Energy efficiency*. It is the relation of total megajoules (MJ) produced in the farm (food production, utilization of RES with technologies, labor or draught and production of fertilizers) between the ones imported to the system.
	FS	0,3174	*Energy percentage utilized from the farm (human, animal, RES*). Energy that is utilized in the farm from the resources of the system itself (%).
	EB	0,2265	*Energy balance*. It considers the volume of agricultural production and its energy content, and the energy cost implied by producing that feeding energy with external inputs.
	ECP	0,0037	*Energy cost of protein production*. Total energy cost, which implied producing the food protein with external inputs with regards to the agroecosystem.
Economic efficiency (EE)	CBR	0,1	*Cost/benefit ratio*. It indicates the cost per peso.
	IDEI	0,9	*Index of dependence on external resources*. Relation between the investment on external inputs, related to the total investment (it includes endogenous resources).

[¥]In boldface, the indicator that has higher bearing of each index

the way in which the meetings between humans and between humans and non-humans interact was analyzed, in order to provide the basis for welfare that goes beyond the approach of classic market economy.

From the collection of information and the evaluation of the indicators proposed by MESR, the results shown in table 3 were obtained.

The indicator that had higher bearing in the final calculation of the food sovereignty index (FSI) was the family self-supply (AF), with contribution of 66 %, for which it is the most important indicator of this index. AF provides the information about the percentage of foodstuffs for the family that comes from the farm itself. In general, all the studied farms had a very high FSI, and it means that they have control of their diets and the products that make them up, which agrees with the studies conducted by Ploeg (2013), Santacoloma-Varón (2015) and Casimiro-Rodríguez (2016), and with the precepts of the international farmer path, which state that family agriculture is self-supplied, mostly, with the food produced in their farms.

In the second index, that of technological sovereignty (TSI), farm 1 had the highest value in UIRES (utilization index of the potential of renewable energy sources (RES) 40 %) and, thus, it was also the one that showed the highest value in TSI. This

Table 3. Indicators and indexes of all the farms.

Index			Farm					
			1	2	3	4	5	6
Food sovereignty index	PP		8	56,7	14	10,7	7,94	19,3
	PE		6,11	15,93	8	6,5	5,2	12,3
	AF	%	98	95	95	82	92	70
Technological sovereignty index	LUI		2,74	1,48	1,5	0,9	1,2	1,6
	EI	%	10	88	45	86	89	70
	H		2,15	2,14	2,1	2,2	1,9	1,7
	UIRES	%	83,61	10,15	15	8,9	2,18	15
	IIF	%	95,44	82,6	84,5	71,8	55,6	67,4
Energy sovereignty index	EE		17,26	0,2	1,3	0,5	0,4	0,7
	EF	%	84,94	11,48	20,8	13,72	11,16	5,1
	EB		10,86	0,09	1,02	0,4	0,3	0,7
	ECP		0,58	506,98	95,7	269,3	338	161,4
EEI	CBR		0,34	0,98	0,4	1,2	1,08	0,37
	IDEI		1,81	38,4	57,7	70,8	51,3	86,3
Socioecological resilience indexes	FSI		0,99	0,86	1	0,99	0,99	0,87
	TSI		1	0,52	0,6	0,49	0,41	0,42
	ESI		1	0,52	0,34	0,2	0,2	0,2
	EEI		1	0,74	0,62	0,38	0,56	0,26
Socioecological resilience index			0.99	0,66	0,64	0,51	0,54	0,44

FSI: food sovereignty index, TSI: technological sovereignty index, ESI: energy sovereignty index, EEI: economic efficiency index and SRI: socioecological resilience index

result is based on the use of solar, wind, water and biomass energies with appropriate technologies, which increased considerably energy efficiency and sovereignty and decreased the economic costs in that farm, by decreasing the need to import fossil fuel to the system.

The other farms had moderately acceptable results in this index. It should be highlighted that most have appropriate technologies for the use of RES, as in the case of biodigesters and windmills, introduced in their systems from the collaboration of the project BIOMAS. This emphasizes the effective link of farmers with research centers, in agreement with the report by Vázquez and Martínez (2015) and Casimiro-Rodríguez (2016).

The lowest indexes of TSI were obtained in farms 5 and 6, tobacco producers, and thus, with high demand of energy and external inputs. Shannon index also had a special contribution, which is the one that indicates production diversity, with a relative bearing of 28 %, because it was below 2,0 in both farms. It was observed that the specialty in tobacco, which is a crop that demands much space and energy for the different labors, propitiates lower diversity and, thus, TSI also decreases, with the exception of farm 3. In it a higher TSI was recorded, even than that of farm 2, which does not have tobacco. In farm 3 RES are utilized better, and although it also has dependence on external inputs (EI, 20 %), it is much lower (almost half) than in farm 2, which provides it with higher autonomy and adaptation capacity, because it utilizes the endogenous resources of its system. The fact of having tobacco crop in a farm, does not necessarily mean having low levels of technological sovereignty, because, actually, this index depends on the system design and management, on biodiversity, utilization of spaces and cultural labors based on agroecological principles, among others. Vázquez and Martínez (2015) and Funes-Monzote (2018) have stated that the agricultural systems based on agroecology integrate diversity of species of agricultural crops, animals and trees through complex designs, in fields of different sizes, to favor multifunctions that reduce degrading practices and external inputs, as well as increase ecological services.

Regarding the energy sovereignty index (ESI), the highest relative bearing appeared in the indicators EE and EF, with contribution of 45,0 and 31,0 %, respectively. Except farm 1, all the others showed low efficiency in the development of these indicators, as well as in those related to the energy balance and energy cost of the protein production. These farms still have many opportunities to improve energy sovereignty, mainly, from 3 to 5, with ESI lower than 0,5. Basically, it is most important to reduce the energy demand of the system in them, with the increase of energy from renewable sources, the increase of product diversity and decrease of the demand of external energy, which restricts the capacity of adaptation and, consequently, resilience, coinciding with the studies conducted by Casimiro-Rodríguez (2019; 2020).

In the interpretation of the economic efficiency index it was determined that the farms with higher autonomy in the use of the available resources (farms 1, 2 and 3) were the ones that achieved lower introduction of external inputs for the productive processes, which improved the cost-benefit ratio and allowed a favorable economic efficiency. In the other farms, which import more resources, fundamentally concentrate feeds for animal feeding and chemical-synthetic products to apply on some crops, this index was remarkably affected.

Only farm 1 was cataloged as very resilient. The others varied between resilient and moderately resilient, for which they still have much margin to improve their adaptation capacity and obtain higher indexes. Similar results were obtained by Casimiro-Rodríguez (2019; 2020).

From the analysis of the interviews and observations in the farm, and following the coordinates proposed by the CE theory, the main farmers' needs were defined and, being them negotiable among the members of the family, it was defined how surplus production and distribution are related to such needs. In addition, it was described how the meetings among humans, and between humans and environment, also satisfy the identified needs.

Needs. The central needs identified by the participants of the research were seven (table 4).

Besides the above-mentioned needs, characteristics or capacities to adapt to change and be transformed were also recorded: having an open mind, living in the farm with the family or having the freedom to implement changes, among others. These capacities work as unifying element of the primary needs and underline the interdependence among them and the importance of sovereignty, as fundamental piece for farmers' development. As explained by Gómez-Núñez *et al*. (2019), the farms that can achieve higher advances in agroecological transition are those that can have access to training and to courses that provide them with the necessary instruments to be able to adapt. In addition, for the collective construction of food sovereignty it is essential to design and implement horizontal pedagogical processes, erected from the knowledge of farmer men and women (Gómez-Núñez *et al.,* 2019).

A very important aspect of the analysis of needs is knowing how they are negotiated in the farm. As argued by Villalba *et al.* (2019), it is important to develop instruments that allow to evaluate the negotiation capacity of each family to achieve full sovereignty. Living all together in the farm, negotiation is a continuous process, present all the time. There are diverse negotiation degrees, depending on the farm; but, in general, it could be perceived that the decisions that are related to needs are made

Table 4. Summary of the seven needs identified by the participants of the research (n=24)

Need	Reference to:
Of comfort	Having the necessary space and tools to be able to live and work well.
Of energy	The sources and the use that is made of energy, considering the sustainability of the system.
Of health	People's health (healthy food), as well as the health of the environment in which they live and work (for example, being free of chemicals).
Affective	Having the loved people close, family and family union.
Of relations	The importance of relations with the surroundings and the creation of exchange networks.
Financial	Having sufficient money to buy what is necessary.
Political	Receiving support by agrarian policies and promoting changes in the laws, so that family farms are a viable, desired and valued option.

jointly and, that it is most important that everybody can express and share their ideas. In addition, each family farm has a specific reality, but in all of them there is understanding that the collective or family is more than the sum of its parts, and that to coexist, adapt and transform, decisions must be negotiated jointly (Locke *et al*., 2017).

The identification and interrelation of these needs by the members of the farms and the way in which they are negotiated expose the interdependence among the members of the family farm and between the family and its surroundings, and are the central element to develop the analysis of the other two coordinates (surplus and meetings), which underlines the importance of this interdependence, crucial for the construction of resilience.

Surplus. Surplus is that which remains once the families have covered their needs and, in itself, is a definition of community relations, because if people only took care of themselves there would be no surplus, so that at the moment when this surplus exists and if there is a negotiation of how it is distributed, positive relations can be generated, which are very far from the negative exploitation relations. This is achieved with the creation of support networks that increase the adaptation capacity and, consequently, the resilience of the family system.

From the analysis of the interviews it could be noted that there are practices that aid the creation of this surplus, such as tourism in farm 1, the redesign of that which does not work, feeding and food conservation practices, such as preserves in all the farms and recycling or collaboration among them (Gibson *et al.,* 2018; Rose, 2019). It is important to indicate that the surplus is not always tangible. There is immaterial surplus when taking care of people, like the one that can be found in the farms between grandparents and grandchildren, who take care of each other, and at the same time transmit knowledge of different generations and historical contexts of life (Rose, 2019), and which in turn respond to the meetings between humans.

In the farm surplus inputs and outputs also occur, such as the aid of other relatives, in the form of gifts or exchange, in both directions. In addition, there is a surplus that is produced at larger scale in the cooperative in order to help other members when it is necessary.

Meetings. The results about the meetings refer to how relations among humans, and between humans and the environment, influence the welfare of the members of the family farm. They also refer to the importance of these meetings and how they are promoted to satisfy the needs in both directions in a beneficial way.

It was important to examine how these caring relations influence the resilience of the socioecological system. The meetings among humans in the farm are constant and essential to satisfy the needs (Gibson *et al*., 2018; Rose, 2019). Likewise, the meetings outside the farm with friends, family, other farmers, institutes and associations (Gómez-Núñez *et al.,* 2019), and with people and institutions from other countries, are necessary, to cover the political, financial, relational, affective, health, comfort and energy needs.

Regarding the environment, in a family farm the direct relation with energy sources, resources and technologies is highly evident. Observation and exchange of ideas are essential in the development of the relations with other non-humans to be able to extrapolate the experience and adapt to changes, which improves the resilience of the system (Funes-Monzote, 2017; García-Barrios *et al*., 2017; Gómez-Núñez *et al*., 2019). The participants of the interviews admitted that their welfare depended on the synergy created in these meetings, on the love between humans and love to the land. Analyzing the processes of associativity under the guidelines of subsistence family agriculture is indispensable so that from the collective organization of rurality and under a sustainable development approach a contribution is made to the social, economic, environmental and cultural development of territories (Balanta-Martínez, 2020). These meetings are interconnected with the needs, for example, the exchange of information with other farmers can increase comfort because it opens the possibility of using other methods that decrease work or energy demand, which also influences very directly the relational and affective needs.

From the results obtained with the application of MESR and the analysis of the interviews from the theoretical bases of CE elements that are coordinated stand out:

1) *Food self-supply.* Food sovereignty is defined as a central aspect for the farmers' survival (Boada-Molina, 2014) and to achieve resilience.
2) *Energy self-management*. Energy sovereignty is the engine of the farm. It is related to the way in which the resources of the farm and renewable energy sources can be utilized and distributed, in the system and outside it, to decrease external dependence and increase family autonomy. It is

important to emphasize that all depends on the borders that are defined when a system is analyzed and that community cohesion and cooperation are vital (Márquez-Serrano and Funes-Monzote, 2013) in the construction of resilience.

3) *Innovation*. It is a necessary process to construct resilience. In the TSI there is a proper indicator, which takes into consideration the innovative intensity of the farm, and which considers several aspects: generation of innovations by itself, technological change capacity and flow of external and internal information, among others. This last one has a strong relation with CEs, because if there is external and internal flow of information it means that conversations are taking place and that the negotiation of interdependence can occur and promote this innovation.
4) *Economic efficiency*. It is one of the necessary indexes to create the socioecological resilience index (SRI), which is based on the cost-benefit ratio and the index of external dependence on inputs. Not surprisingly this monetary need appears in the framework of CEs as a prevailing concern and need by the participants. A great predominance of economic aspects when defining development is still perceived. The need to transcend this conception that tends to reduce the human being to a unidimensionally economic being is imperative (Bacon *et al*., 2014).
5) *Good design and management of the system*. It is part of the necessary characteristics to adapt and transform during the resilience construction process. It includes, for example, the diverse forms to deal with a situation (Walker *et al*., 2004), diversity of structures such as of crops or capacity to preserve and improve plant genetic resources. In this element the diverse economies that characterize interdependent relations, including survival and individual and community welfare, are acknowledged, which improves the capacity to build socioecological resilience (Altieri, 2013), because each family has its characteristics, each farm has its structures and a proper way to carry out leadership. In some families it can be observed that if the leader is missing, social clash can occur. However, due to the knowledge transferred through the different generations, "there is exchange between generations and between nature and life, and that is fundamental", for which any conflict can be utilized as space for transformation, which would improve resilience.

It is about learning to live with uncertainty. Resilience should be understood, not with the assumption that future events are expected, but that they can be unexpected (Márquez-Serrano and Funes-Monzote, 2013; Darnhofer, 2014). Thus, it is necessary to develop the qualitative capacity to design systems that can absorb and accommodate future events in any unexpected form they can take (Holling, 1973).

Darnhofer *et al*. (2016) suggest that to be able to understand well socioecological systems it is advisable to evaluate resilience from a perspective of relations, because it allows a stronger interaction of the two perspectives (material/social) and besides, it positions change in the focus. The attempt to construct resilient systems demands that attention is paid to their socioecological nature, and that it is understood that agriculture produces, in turn, social, cultural and ecological landscapes (Cronon, 1996).

From the participatory analysis with each family some strategies could be identified to improve resilience indexes (table 5).

It is important to evaluate the knowledge dialog, as fundamental strategy for collective learning and the promotion of agroecology in the construction of food sovereignty (Anderson *et al*., 2019), not only among Cuban farmers, but with other regions of the world and with other actors of the feeding system.

In the struggle for social change there are diverse ways to understand the world, equally valid. Transformative learning provides a mechanism for the different perspectives to talk among them, without a dominant approach (Martínez-Torres and Rosset, 2014). With the combination of this knowledge and the dialog, social movements can produce important 'outputs' at different scales, based on solidarity, mutual understanding and support, learning and collective action. If the transformation is a desirable process to be produced, it is necessary that there are more experimental and ethically promoted conceptions of the economic-political dynamics, as well as a less utilitarian vision of the economy-ecology interdependence Gibson-Graham *et al.,* 2016). That is why, it is important that the negotiation of this interdependence is central part in the future discourses and strategies about the construction of socioecological resilience.

Conclusions

The theory of CEs has been focused, mainly, on economic resilience. In this study multiple

Table 5. Identified strategies to favor resilience of the studied farms.

Farm	Strategy
Total farms	Contextualization of appropriate technologies to manage energy with RES. Improving irrigation systems to increase efficiency and productive capacity.
Del Medio	Completing the appropriate technologies to manage 100 % of the energy with RES. That is, introducing photovoltaic cells for the use of solar energy. Improving the gravity irrigation systems to reach the largest quantity of area in the farm.
Río de Agua Viva	Fitting out space in the farm to commercialize its productions directly with nearby communities and taking advantage of the fact that it is a farm in urban area of the Sancti Spíritus city.
San José	Enhancing the production and use of organic fertilizers. Substituting conventional inputs in the cultivation of tobacco by others managed at local level.
Flor del Cayo	Utilizing the total solid and liquid waste of the biodigester as organic fertilizer. Redesigning the system with higher representation of cattle husbandry. Enhancing the link with the community for the contextualization of agroecological technologies.
Ingenito	Diversifying production with agroeological designs and practices. Participating in training and sensitization courses for agroecological production.
Las Dos Rosas	Setting up new systems for the biodigestion of animal excreta and obtaining, using and storing biogas. Decreasing the technological package in some conventional crops by agroecological practices and uses with the available resources in the farm.

dimensions of the needs that aid family strategies to satisfy them, as well as the interdependence between needs and strategies, were also identified.

When combining the periodic application of MESR with the theory of CEs, it can be understood that socioecological systems are complex adaptive systems, and that a long-duration stable status is very hard to achieve. The evaluation scale of the MESR indicators and their understanding and interpretation in an integral and participatory way can support the design and implementation of strategies that contribute to the stability and capacity of rural territories.

Recognizing the capacities and opportunities, offered by each system and family member, is very significant to develop improvement strategies from the identified elements; besides the public policies that promote family agriculture from the improvement of livelihoods in rural areas, contextualization and appropriation of adequate technologies, as well as the enhancement of local culture and identity on inclusive and participatory, agroecological bases.

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Conflict of interests

The authors declare that there is no conflict of interests among them.

Authors' contribution

- Maria Borràs-Escayola. Conceptualized the idea of the research, carried out the statistical analysis, data interpretation and manuscript writing; besides, adapted the manuscript according to the reviewers' suggestions.
- Leidy Casimiro-Rodríguez. Contributed to the data analysis and interpretation, as well as to the manuscript writing and revision according to the reviewers' suggestions.
- Jesús Suárez-Hernández. Contributed to data analysis and interpretation.

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