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Original article

Transformation to a management model of value chain in agricultural entities dedicated to growing oilseeds

Transformación hacia modelo de gestión de cadena de valor en entidades agrarias dedicadas a cultivar oleaginosas

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ABSTRACT: This article presents a participatory research-innovation exercise to characterize a management model of production chain in agricultural entities producing oilseed plants and to transform this model into one with a value chain approach. In eight entities in two provinces, the production chain of management model was diagnosed according to technical-productive, organizational, economic, environmental and social dimensions. The baseline was defined in these dimensions, supported by a group of experts and using workshops, a SWOT matrix and analysis with producers. The diagnosis revealed low productivity, few agroecological practices, and losses in economic activity, low female participation and training, as well as weak interaction with partner entities in parts of the production process. A management model with a value chain approach was selected and was applied, taking into account the dimensions described above. In its implementation, nine scientific results, six technological improvements and four innovations were introduced in co-innovation processes, and production increases were achieved that contributed to local self-sufficiency. The territorial agri-food systems benefited from the organizational, social and productive contribution of this new management model, which favored the application of agroecological practices.

Key words: environment, economy, efficiency, diagnosis, productivity.

RESUMEN: El presente artículo expone un ejercicio de investigación-innovación participativa, para caracterizar un modelo de gestión de cadena productiva en entidades agrarias productoras de plantas oleaginosas y transformar este modelo, a uno con enfoque de cadena de valor. En ocho entidades, de dos provincias, se diagnosticó el modelo de gestión de cadena productiva según dimensiones técnico-productiva, organizacional, económica, medioambiental y social. Se definió la línea base, en esas dimensiones, apoyados en grupo de expertos y utilizando talleres, matriz DAFO y análisis con productores. El diagnóstico tributó baja productividad, pocas prácticas agroecológicas, pérdidas en la actividad económica, poca participación femenina y capacitación, así como débil interacción con entidades asociadas en partes del proceso productivo. Fue seleccionado y aplicado un modelo de gestión con enfoque de cadena de valor, teniendo en cuenta las dimensiones descritas. En la implementación del mismo, fueron introducidos nueve resultados científicos, seis mejoras tecnológicas y cuatro innovaciones, en procesos de coinnovación, se lograron incrementos productivos que tributaron al autoabastecimiento local. Los sistemas agroalimentarios territoriales, se vieron beneficiados por la contribución organizacional, social y productiva de este nuevo modelo de gestión, que favoreció la aplicación de prácticas agroecológicas.

Palabras clave: ambiente, economía, eficiencia, diagnóstico, productividad.

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INTRODUCTION

An agriculture oriented towards differentiated products, with benefit, specialized products for niche markets, requires intense and conscious coordination in the activity.

A value chain describes activities required to take a product or service from its conception, through the intermediate stages of production, final disposal for marketing, delivery to consumers and destination of waste after use. The activities that make up a value chain may be contained in one company, or several; in one geographical location or distributed over several larger geographical areas (1).

At the international level, a new configuration of food systems is emerging as responsible, sustainable and territorial food systems, based on local networks of agricultural, agri-food and service enterprises operating in a close geographical environment (2).

These processes also bring opportunities to reduce poverty among small rural producers and contribute to food security at the local level (3) and have become the most widely used tool in the analysis of value creation in local economies (4).

The Cuban agricultural sector needs transformations adapted to its national context. Since 1997, Valdés has identified that the demands of agriculture on local resources and the impact of its development on the community, raised the need for a closer relationship between local authorities and agricultural activities (5).

In the diagnosis carried out by the Ministry of Agriculture of Cuba in 2012, it was pointed out that the management model of production chains in agricultural entities has not fully met its objectives. There is economic and productive inefficiency over the years, resources invested without proportional support with the results, little progress in local agricultural development and, in general, municipal self-sufficiency plans are not fulfilled. All of this has led to a high level of food dependence on foreign imports (6).

Here, there are no local innovation systems or a risk management culture, which articulates all stakeholders (7). Since 2008, food security has been declared as a national security priority by the top leadership of the Communist Party of Cuba (PCC) and its government (8) and, recently, in 2020, the Cuban Food Sovereignty and Nutrition Education Plan was approved, with a solid foundation in Local Food Systems (SAL) (9).

In this renewed context, the various actors involved must contribute to achieving the proposed economic and social objectives, where traditional tools may be insufficient. It is necessary to implement new policies and strategies, a new economic management model with a systemic approach, with higher levels of integration, organization and adaptability from a local perspective, reinforcing municipal food self-sufficiency (10, 11).

The definition of the problem situation of a set of entities can constitute the baseline for the application of management models with a value chain approach (12), for which it is important to define indicators to be measured and their results.

The objective of this study was to demonstrate the validity of a management model with a value chain approach in agricultural entities producing oilseeds.

MATERIALS AND METHODS

The work was based on a participatory research-innovation exercise, based on the observation of production chains and the management systems of agricultural entities studied, dedicated to the cultivation of oilseeds. On the one hand, and on the other, on the selection and implementation of a management model focused on the value chain, applied in the entities and evaluated in depth in a case study.

Characterization of the entities

To analyze and diagnose the problematic situation of each entity, the research techniques used to obtain information included a bibliographic review, the creation of a group of experts and documentary analysis, and to process the information, prospective analysis, qualitative techniques, figures and tables were used.

The characterization studies were developed in the period from 2013 to 2014, and those of transformation and evaluation of the new management model applied, from 2015 to 2018.

For the diagnosis, the Group of Experts was created in the entities, considering the demonstrated wisdom and experience possessed by the members in the subject under analysis.

This instrument is valued by several authors as indicated, especially for exploratory studies (13, 14), where quantitative techniques hardly achieve the required information.

To create the Group of Experts, 20 specialists from 18 international and national institutions, organizations and actors were initially identified, whose competencies, advocacy and decision-making capacities, as well as recognition in the field, would guarantee the functions of this instrument.

The following scientific institutions were represented: The Institute of Fundamental Research in Tropical Agriculture (INIFAT), the Institute of Tropical Fruit Growing Research (IIFT), Soil Institute (IS), the Institute of Plant Health Research (INISAV), the Institute of Agroforestry Research (IAF) and the Center for Apiculture Research (CIAPI), which belong to MINAG. In addition; National Institute of Agricultural Sciences (INCA) and the Experimental Station of Pastures and Forage "Indio Hatuey" (EEPFIH), which belong to the MES, and the National Institute of Sugarcane Research (INICA), which belongs to AZCUBA.

By the directorates of the Ministry of Agriculture: Directorate of Various Crops, Directorate of Urban, Suburban and Family Agriculture, (currently State Management Body within the Ministry of Agriculture,

according to Resolution 50 of 2018) and National Center for Plant Health.

For Cuban civil society organizations: Cuban Association of Agricultural and Forestry Technicians (ACTAF), National Association of Small Farmers (ANAP), Cuban Association of Animal Production (ACPA) and National Association of Economists of Cuba (ANEC).

International Organizations: Humanist Institute for Cooperation with Developing Countries (HIVOS) and Swiss Agency for Development and Cooperation (COSUDE).

The Delphi Method (12) and the phases of preparation, consultation and consensus were used to systematize the work procedure.

The documents and consultation channels were carried out in the preparation phase. In the consultation phase, the rounds were conducted, which indicated the statistical descriptors used (Kendall's W or Kronbach's Alpha of SPSS version 15.0), including the necessary feedback on the results of the analysis and the construction of consensus, based on these results.

For the selection of the experts who were members of the Group, the respective competence coefficients (K) were calculated (14-16) having a special value for acceptance, the self-evaluation criteria of each specialist (17), in the formula K=0.5 (Kc+Ka). Kc: knowledge coefficient and it is self-evaluated from 0.10 to 1.00, and Ka: argumentation coefficient, which is self-evaluated from high, medium and low, according to theoretical and experimental research related to the subject and experience in their professional activity (including teaching). Besides analysis of specialized literature of foreign and national authors, knowledge of the current state of the problem in Cuba and in the world and intuition.

Once the Group of Experts was created, its mission was to analyze documents that would justify the relevance of defining the problem situation of production chains in agricultural entities growing oilseed crops and to define the entities in which there were better conditions for analyzing and characterizing their problems.

These entities are subprograms of the Urban, Suburban and Family Agriculture Movement. They have little recognition and visibility, but are of importance for local development, the energy contribution in the diet of the population, as well as their contribution to animal feed.

Estas entidades son subprograma del Movimiento de la Agricultura Urbana, Suburbana y Familiar. Tienen poco reconocimiento y visibilidad, pero son de importancia para el desarrollo local, el aporte energético en la dieta de la población, así como su contribución a la alimentación animal.

The entities in which work was carried out were initially suggested by Dr. Adolfo Rodríguez Nodal, INIFAT's director at the time, and approved by the group of experts, taking into account the effort made by their leaders and the progress they had made with low technological level.

Work was carried out in eight entities: four Credit and Service Cooperatives (CCS) and four Basic Units of Cooperative Production (UBPC), of the 47 that exist in the country, dedicated to the cultivation of oilseeds, belonging to four municipalities, in two provinces. They are, located in two regions, with very different soil and climatic conditions (center and east), for which the type of soil, the source of water supply for irrigation, the temperatures and average annual rainfall of each one were characterized.

Once the intervention entities were selected (Table 1), the diagnosis was made, which consisted of characterizing the productive forms and determining their potential and bottlenecks.

Table 1. Productive entities selected for the diagnostic study

Entity	Municipality and Province
UBPC Victoria de Girón	Abreus, Cienfuegos
UBPC La Victoria	Abreus, Cienfuegos
UBPC Che Guevara	Abreus, Cienfuegos
UBPC Cuba Libre	Abreus, Cienfuegos
CCS Antonio Maceo	Abreus, Cienfuegos
CCS Rafael Pérez Pérez	Calixto García, Holguín
CCS Julito Díaz	Gibara, Holguín
CCS José A. Echeverría	Holguín, Holguín

Three of the four tools most commonly used in rural appraisals were used in the appraisal: rapid rural appraisal (RRA-SWOT), baseline and stakeholder mapping (18, 19). The SWOT matrix analysis technique was used to evaluate the background and characterization of the entities; a general diagnosis was made of the environment and possible markets, analyzing the external and internal context to identify opportunities and threats, as well as existing internal conditions with respect to these productions, in order to identify strengths and weaknesses (20,21).

The matrices were structured to include five dimensions: technical-productive, organizational, economic, social and environmental (22). These last two were not included in previous studies (6).

For the evaluation of the relationship between the components of the SWOT matrices, values 1, 2 and 3 were assigned, according to the Likert scale, for moderate, strong and very strong relationships, respectively. A value of 0 was used for those cases where no relationship was considered to exist, following the working procedures of the Group of Experts, as described above.

Based on the identification of the positive or negative impact factors, the indicators that would make it possible to establish the baseline for each scenario under study were defined based on a participatory diagnosis, based on the indicators pre-established by dimension.

Indicators of the technical-productive dimension: Total annual production (t); productive area (ha), food production (t ha^{-1}), application of agroecological practices (rating from 1 to 3, where 1: agroecological practices are not applied; 2: some agroecological practices are applied; 3: many agroecological practices are applied); area under irrigation; type of fertilization (Q: chemical

fertilizers are applied. O: only organic fertilizers are applied; Q- O: chemical and organic fertilizers are applied); method used in pest control (pest and disease control is done with: Q chemicals; B: biological means; IPM: integrated pest management); average annual productivity of the farm.

Organizational dimension indicators: Type of organizational management (PC: production chain or VC: value chain); existence of a development program (YES or NO); links with research centers (YES or NO); innovations applied (1: no innovations; 2: some innovations; 3: innovations).

Indicators of the economic dimension: Economic results (loss (P) or profit (G); mode of sale (Wholesale (M), retail (m), both (M, m); type of product marketed: Fresh (F), Processed (P), Both (A); average annual income per worker ($).

Social dimension indicators: Training received; contribution to local development (defined as 1: no contribution; 2: low contribution; 3: medium contribution to local development); number of producers on the farm (number of men (M) and women (W)).

Indicators of the environmental dimension: Existence of mono or polyculture on the farm (M or P), application of soil conservation measures (1: no soil conservation measures are applied; 2: some soil conservation measures are applied; 3: several soil conservation measures are applied); management of waste from the production process (YES or NO); use of renewable energy (YES or NO).

The results of the baselines were validated in workshops held in each municipality, with the participation of producers and local authorities. The workshops were organized according to the procedure developed by the PAAS project, based on the Inter-American Institute for Cooperation on Agriculture's Methodology for the Evaluation of Agrifood Chains, for the identification of problems and projects (23).

Transformation of the management model

The selection of the value chain model began with the study of the five generic models referred to by various authors (24-27, 10), and the steps defined in the value chain approach were taken into account, with emphasis on the elements that favor local food self-sufficiency, applied to the Cuban socioeconomic context, as other authors have done (28).

The group of experts selected the value chain model to be used in the study, and once its organizational form was defined, it was applied in the eight entities.

The three existing organizational forms of agrifood value chains were analyzed: 1) producer-driven, 2) market-driven and 3) intermediary-driven, as described above (29).

Based on the situation identified for each agricultural entity in the diagnostic tools, the links to be strengthened with scientific results, technological improvements or innovations to be applied were proposed, as well as the training processes required to assimilate the technologies and innovations to be introduced.

All of the above was validated by the stakeholders through workshops in each municipality, with the participation of the Group of Experts and the producers involved.

Finally, a national workshop was held with representatives of the State Directorates of the Ministries of Agriculture and Foreign Trade to socialize the results of the municipal workshops and identify common actions for the different municipalities and their compatibility with the Economy Plan, in the case of investments.

Once consensus was reached on the actions to be carried out, the process of implementing the investments and the actions for the introduction of scientific-technical results, technological improvements and innovations was developed.

Technological improvements were considered to be the adoption of established technologies and processes to benefit the existing infrastructure and technology, and innovation was considered to be the different types of innovation, whether technological (changes introduced in products and processes); commercial (related to competencies and market knowledge) and organizational or managerial (covering the financial, commercial and organizational spheres).

The indicators selected to measure the impact of the transformations to be carried out were yield, quality and safety. The quantitative or qualitative evaluation of these indicators makes it possible to corroborate how each link adds value to the next, an important characteristic in a value chain.

In one entity, the protein contribution of flours resulting from oil extraction was evaluated by means of a near infrared spectrometry equipment (NIRS DS 2500) in the CCS José Antonio Echeverría de Holguín, together with the Science, Technology and Innovation Entity "Sierra Maestra", with the objective of specifying its importance for animal feeding.

According to the synthesis method used, the impacts of the value chains and their contributions to territorial self-sufficiency were integrated and were validated as a whole. Comparative values were obtained, after applying the management system in the eight entities, although the CCS "José Antonio Echeverría", in Holguín province, was selected as a case study, given that its leading producers better mastered the process of transformation from productive chain to value chain.

The results obtained in 2018, after the implementation of the value chain, were compared with those of the baseline surveyed in 2013.

Contributions to local food self-sufficiency were identified, applying the LEADER Methodology as described (30).

RESULTS

Characterization of the entities

Because of the selection process of the Group of Experts, proposals were made from 18 institutions and individuals were selected from 16 of them. Out of 20 specialists, 17 experts were selected.

The analyses carried out corroborated the relevance of the experts' competencies (Table 2), similar to that reported by other authors (15, 31) as they were in the range of competencies between 0.9-1 with the maximum Kendall's W values.

Regarding meteorological variables, the historical records of minimum and maximum temperatures are in the range of 17 to 33 ºC, but rainfall (Table 3) was very different in the two regions, as well as, in two of the cases, the sources of water for irrigation.

For the interpretation of the results of the SWOT matrix analysis (Table 4) and baselines in the selected entities, the Kronbach's Alpha coefficient reflected the internal consistency in the average of the correlations and demonstrated the reliability of the evaluation carried out, with high values obtained (0.85-0.87).

It was observed that the situation was favorable for assuming future offensive strategies, which are managed by trying to enhance the strengths to make the most of the opportunities. When opportunities and strengths were evaluated as a whole (Maxi-Maxi Strategy or Optimization Factor), (21), the capacity of the entities to protect themselves or mitigate the effects of weaknesses was evidenced.

Table 2. Selected group of experts and their competencies

No	Expert Group	Organization	Specialty	Academic Degree	Competency coefficient (K)
1	Michely Vega León	INIFAT	Agronomist Eng	PhD. C.	0.90
2	María Eugenia García Álvarez	IIFT	B. Sc. in Biology	PhD. C.	0.95
3	Walfredo Torres de la Noval	INCA	B.Sc. Chemistry	PhD. C.	1.00
4	María C. Pérez Hernández	INCA	Biology	PhD. Cs.	1.00
5	Giraldo Martín Martín	EEPFIH	Agronomist Engineer	PhD. C.	1.00
6	Esteban Pita Padrón	II Suelos	Agronomist Eng.	PhD. C.	0.90
7	Emilio Fernández González	INISAV	Agronomist Eng.	PhD. C.	0.95
8	Emilio Farrés Armenteros	Cultivos Varios	Agronomist Eng.	M. Sc.	1.00
9	Adolfo Rodríguez Nodal	AUS y F	Agronomist Eng.	PhD. C.	1.00
10	Luis Pérez Vicente	CNSV	Agronomist Eng.	PhD. C.	0.95
11	Roberto Caballero Grande	ACTAF	Agronomist Eng.	PhD. C.	1.00
12	Félix González Viego	ANAP	Agronomist	Engineer	1.00
13	Elio Perón Mirabal	ACPA	PhD. M.V.Z.	M. Sc.	1.00
14	Pablo Álvarez Olea	HIVOS	B.Sc. Economics	M. Sc.	1.00
15	Rodolfo Hernández Hernández	COSUDE	Industrial Engineer	Engineer	1.00
16	Adolfo Pérez Piñeiro	CIAPI	B.Sc. Biology	PhD. C.	1.00
17	Tirso de Jesús Sáenz Coopat	ANEC	B.Sc. Economics	Bachelor´s degree	1.00

K=0.5 (Kc+Ka), where: Kc: knowledge coefficient, Ka: argumentation coefficient. Kc is self-evaluated from 0.10 to 1.00. Ka self-evaluates from high, medium and low, according to the sources of argumentation explained.

Table 3. Edaphoclimatic characteristics of the eight entities

No	Productive Entities	Prov.	Municipality	Soil classification*	Source of water supply for irrigation	Min and Max temperature (° C)	Average annual rainfall (mm)
1.	UBPC Victoria de Girón	Cienfuegos	Abreus	Ferrallitic Red, Yellowish	Groundwater	17-33	1269
2.	UBPC La Victoria		Abreus	Ferrallitic Red, Yellowish	Groundwater	17-33	1269
3.	UBPC Che Guevara		Abreus	Ferrallitic Red, Yellowish	Groundwater	17-33	1269
4.	UBPC Cuba Libre		Abreus	Ferrallitic Red, Yellowish	Groundwater	17-33	1269
5.	CCS Antonio Maceo		Abreus	Ferrallitic Red, Yellowish	Groundwater	17-33	1269
6.	CCS Rafael Pérez	Holguín	Calixto García	Reddish-brown	Dawn	19-33	974
7.	CCS Julito Díaz		Gibara	Soils Humic, Sialytic red rendzina skeletal type	Dawn	21-32	976
8.	CCS José Antonio Echeverría		Holguín	Fersialytic brownish red ferromagnesian	Groundwater	19-33	979

*Classification (32)

Table 4. Results of the SWOT Matrix in the diagnostic process

		Threats					Opportunities					
		A1	**A2**	**A3**	**A4**	**Sum**	**O1**	**O2**	**O3**	**O4**	**O5**	**Sum**
	Strengths											
Positives	F1	1	1	0	1	3	3	1	3	3	3	13
	F2	0	0	0	0	0	2	0	1	2	2	7
	F3	0	0	0	1	1	3	2	1	3	3	12
	F4	1	0	0	2	3	3	3	2	2	2	12
	F5	0	2	3	1	6	3	1	2	2	3	11
	Total	2	3	3	5	**13**	14	7	9	12	13	**55**
	Weaknesses											
Negatives	D1	2	3	2	3	10	3	2	2	3	2	12
	D2	0	0	3	0	3	0	0	2	1	1	4
	D3	0	2	3	2	7	3	0	2	1	2	8
	D4	1	2	0	1	4	2	2	0	3	1	8
	D5	0	1	3	0	4	1	1	0	1	0	3
	D6	0	3	3	3	9	2	3	1	2	1	9
	Total	3	11	14	9	**37**	11	8	7	11	7	**44**

0 no influence, 1 has little influence, 2 has great influence, 3 has a decisive influence

Threats: A1 Underestimation of the activity by managers. A2 Activity not prioritized in national agricultural programs. A3 Instability in scientific attention to oilseed plants. A4 Few centers for industrial processing.

Opportunities: O1 High demand for product derivatives. O2 Unsatisfied market. O3 Experiences exist in the region. O4 Alternative to substitute imports. O5 Political will to achieve national feed and develop small livestock.

Strengths: F1 Knowledgeable and stable work force. F2 Favorable soil and climatic conditions. F3 Market demand. F4 High income. F5 Use of promising germplasm.

Weaknesses: D1 Little agricultural technological development, small industry. D2 High use of chemicals, negative environmental impact. D3 Seed quality. D4 Insufficient agricultural inputs. D5 Low production and use of agroecological products. D6 Good production practices are not applied in the few industrial facilities and have little link with the market.

The result of the analysis of the SWOT matrix was a favorable condition for the development of the research. The technological culture of the producers, the existing scientific results, the high demands of the products were recognized as strengths; all related to opportunities provided by the diversification needs and the existence of specialized scientific centers to collaborate in the strategic actions derived, situation described previously (20).

Technological obsolescence, lack of inputs and low yields were reiterated as weaknesses.

It was evidenced that the existing organizational management did not allow the integration and empowerment of actors for the solution of identified problems. It did not contribute to mitigate the effects of the common threats of the environment, such as the low industrialization, the reduced possibilities of processing, benefit and commercialization to reduce losses and the low availability of financial resources.

Correcting weaknesses, confronting threats, maintaining strengths and exploiting opportunities would still be insufficient if the management model is maintained. However, it must be taken into account that the capabilities of an organization or competitive company are important for the adoption of a new strategy (24); however, with an offensive strategy, weaknesses can be minimized.

The results ratify the possibilities of substituting imports in these entities, increasing their contribution to municipal self-sufficiency, and increasing the linkage of producers with other local industries. Another contribution, valued as an opportunity, is the use of by-products for animal feed, as a way to support the recent "Small Cattle Movement" to guarantee 5 pounds (2.27 kg) per capita, promoted by the President of the Republic, Miguel Díaz-Canel Bermúdez.

The use of by-products in animal feed also corroborates the opportunity to be part of a circular economy process.

One of the main organizational weaknesses was identified: the existing management model of the production chain did not allow the main objectives of the production system to be met (33).

The dimensions studied are important for making a diagnosis based on the SWOT matrix (21). The analysis of the social and environmental dimensions is a contribution of this work and has an important weight in studies related to local development, and coincides with the definition that institutional innovation is capable of mobilizing the elements of the five dimensions of the strategic approach (22). The strategic importance of the economic, social and environmental dimensions in rural development has also been proposed (34).

Based on the indicators described above, baselines were defined for each of the eight agricultural entities under study, and the individual surveys for each entity showed a high degree of confidence, according to Kendall's average of 0.86 W. The baseline for seven entities showed a high degree of confidence, according to Kendall's average of 0.86 W. The baseline for seven entities showed a high

degree of confidence, according to Kendall's average of 0.86.

The baseline for seven entities is shown in Table V, which compares the results of 2018 with those of 2013, with the value chain already applied. The CCS José Antonio Echeverría was studied in more detail and its results are analyzed independently.

The baseline of the seven entities exposed evidenced the influence of the organizational dimension with the management model of production chain, without strong interrelationships between its links, or with scientific, productive or service entities in the territory, with low application of innovations. None of the entities had strategic development programs.

There is little or no innovation, obsolescence of technologies, lack of knowledge about new advances in science, in their activity to generate new products and higher income.

In the technical-productive dimension, the lack of irrigation was identified, which contributed to low yields and low productivity.

The use of organized agroecological practices was low, taking into account what has been described (35). They used chemical fertilization and pest control was predominantly carried out with chemical pesticides; they did not have animal traction for agricultural work, and did not use rotation or polycultures.

There was no coherent agroecological culture on a lasting basis, and training activities were scarce.

It is suggested that rural agricultural entities have comparative advantages over large production centers with respect to the application of agroecological practices; however, it is necessary to generate strategies that make them sustainable and design distinctive characteristics, green seals or access to specialized markets, as an option for greater benefits (36).

In the economic dimension, they operated at a loss. Wholesale sales of their products predominated, annual income per worker was low and few productions were produced locally.

In the social dimension, there were very few women linked to these entities: in four of them there was no female participation. The workers interviewed reported having received some training. The perception of their contribution to local development was low.

The low female participation in these structures coincides with the percentages reported for agricultural workers worldwide (37), even though it is recognized that there are no significant differences in productivity between male and female farmers (38), which is why the feminization of agriculture is considered a driving force in the sector (39). In the environmental dimension, it is reiterated that monoculture predominates, soil conservation measures are not applied, production process residues are not managed and the use of renewable energy is null.

The management models in these entities result in low production and, at best, a subsistence economy. In all the entities analyzed, their performance was very similar.

It is recognized that agricultural producers must capture and generate knowledge, (40) and the management system of the agricultural entities must favor this.

Transformation of the management model

From the five options of value chain models studied, the Group of experts selected, the model (10) adapted to agrifood value chains (Figure 1), with a W Kendall coefficient of 0.92, after performing the corresponding Delphi procedure.

De las cinco opciones de modelos de cadenas de valor estudiados, el Grupo de expertos seleccionó el modelo propuesto por Vinci, *et al*. (2014), adaptado a cadenas de valor agroalimentarias (figura 1), con un coeficiente de W Kendall de 0,92, luego de realizarse el procedimiento Delphi correspondiente.

From the organizational point of view, according to the classification of the management model of value chain (29), the model designed in this study falls into the producer-driven model (Figure 2). The priority was focused on the study of each of the links, with emphasis on the potential for increasing agricultural production, its quality and safety, on

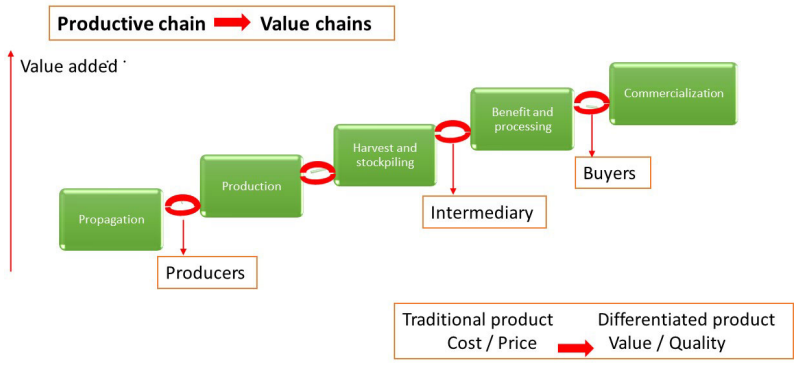


Figure 1. Overview of the transformation of production chains into value chains

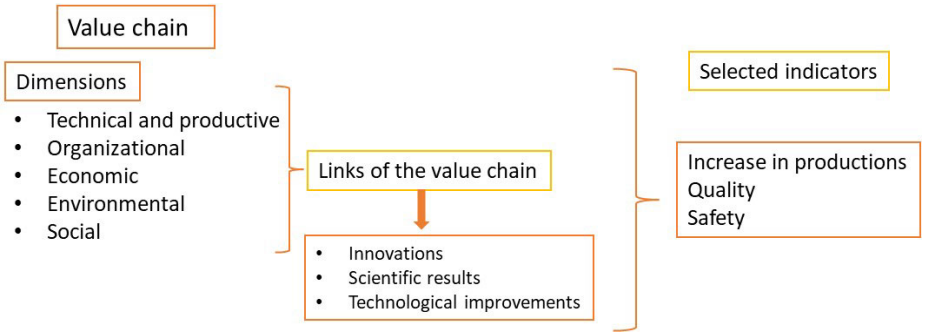


Figure 2. Organizational innovation: The applied Value Chain

assessing its possible impact on local food self-sufficiency and on the possibilities of introducing scientific results, technological improvements and innovations, as appropriate (Figure 2).

Table 5 shows the results of the baselines (2013) of seven entities, compared with those of 2018, after the transformation of the management model.

As can be seen, the results of the technical productive indicators improved, except for productivity in some entities, in which it remained in the same order in four of them; fertilization, in all entities, went from using chemical products to a combination of chemical and organic products and pest control the same, from only chemical, became integrated pest management.

In the organizational dimension, the management model of value chain strengthened interactions, development programs were developed, innovations were applied, and links with research centers were increased.

In the economic dimension, there were gains in all the entities, income per worker improved, and except for two of them, they marketed products at the retail and wholesale levels, and marketed fresh and processed products, i.e., with added value.

The social dimension was characterized by greater participation of women, increased training, improved contribution to local development, and in the environmental dimension, agroecological practices were massively used, resulting in benefits for the final product, there was a shift from monoculture to polyculture, waste was managed, and in three of the entities renewable energy sources were used.

Substantial improvements were observed in the seven entities described.

Case: CCS José Antonio Echeverría

The application of the management model with a value chain approach was used as a case study in the José Antonio Echeverría CCS. The chain was organized at the local level, with producers grouped into cooperatives for production, product processing, transportation and marketing, which made it possible to add value.

In the process, the entity increased the interactions between the links and, in turn, the network of actors involved in supply, which can be seen in the value chain graph applied in this CCS (Figure 3). Some of the results compared to the baseline are shown in Figure 4.

In the technical-productive dimension, there was an increase in production of 18.5 t, in yields by 1.5 t ha^{-1}, and in productivity by 1.5 t per worker, when comparing the information provided in 2018 compared to 2013. In these increases, the introduction of high quality seeds, guaranteed by the seed banks of INIFAT and the Grain Research Institute, has a valuable incidence. In addition to the application of the new management model, these results were based on the introduction of irrigation systems on 15 ha, integrated pest and disease management, and the application of efficient microorganism formulations.

The grain harvesting and threshing processes were favored by the introduction of a combine harvester-thresher machine for oilseed plants, which made it possible to humanize the activities that were carried out manually.

Due to innovation in the process of improving oil extraction, a higher quality product was obtained through the application of good manufacturing practices, which favored obtaining INHEM and sanitary registrations for the processing facilities.

The increase in oilseed grain production in turn led to an increase in residual cakes containing protein meal. New formulations were developed for the production of animal feed, in conjunction with the Holguín Agricultural Extension, Research and Training Unit (UEICA), and were used in the feeding of pigs, poultry, sheep, and goats, which improved meat production, the feeding of producers and their families, and the surpluses were sold in local markets.

With respect to the characterization of the by-products derived from the oil extraction process for the formulation of animal feed, the values of the meals obtained in the elaboration process are shown (Table 6).

The above is in accordance with what was raised by the President of the Republic of Cuba, Miguel Díaz-Canel Bermúdez, when in 2018, he indicated to reinforce the municipal self-sufficiency program with a subprogram for the production of 5 kilograms per capita of small livestock meat (41).

The organizational dimension was characterized by an important link with scientific institutions: INIFAT, IIG and UEICA, when initially no relations with any research center were recorded. This new support led to the design of a development program, with a high level of application of

Table 5. Comparison of baseline and results obtained in 2018 for seven entities

	Indicatorss	UBPC Victoria de Girón		UBPC La Victoria		UBPC Che Guevara		UBPC Cuba Libre		CCS Antonio Maceo		CCS Rafael Pérez Pérez		CCS Julito Díaz	
		2013	2018	2013	2018	2013	2018	2013	2018	2013	2018	2013	2018	2013	2018
Tech-prod	Total annual production (t)	17	34	15	22.5	9	21	8	23.4	7	36.67	27.6	36.54	17.9	52.6
	Productive area (ha)	10	20	10	15	10	14	10	13	9.8	19.3	32.4	17.4	20.6	21.9
	Food production (t ha-1)	1.7	1.7	1.5	1.5	0.9	1.5	0.8	1.8	0.7	1.9	0.85	2.1	0.8	2.4
	Area under irrigation	10	20	10	20	10	14	8	13	7	19.3	0	16	0	18
	Average annual productivity.	2.4	2.1	1.8	1.25	1.2	1.3	1.0	1.7	1.4	1.6	3.4	1.7	2.5	2.3
Org.	Innovations applied (1. 2. 3) a	1	3	1	3	1	3	1	3	1	3	1	3	1	3
Economical.	Sales modality: Wholesale (M). retail (m) both (Mm)	M	Mm	M	Mm	M	M	M	M	M	Mm	M	Mm	M	Mm
	Average annual income per worker (Thousands $)	3.5	13.5	3.6	12.1	3.6	10. 6	3.5	12.5	4.0	13.3	4.2	12.2	4.0	12.6
Social	Contribution to local development (Values from 1 to 3) b	1	3	1	2	1	2	1	2	1	3	1	2	1	2
	Number of male (M) and female (W) producers on the farm (M)	H7 (1M)	H10 (6M)	H8 (3M)	H 13 (5M)	H7 (0M)	H 14 (2M)	H8 (2M)	H 15 (5M)	H5 (0M)	H12 (M10)	H8 (1M)	H15 (6M)	H7 (0M)	H18 (M5)
Environment.	Application of agroecological practices (1 to 3) c	1	3	1	3	1	2	1	3	1	3	1	3	1	3

a) Innovations applied (Rating 1: No innovations are made; 2: Some innovations are carried out. 3: Innovations are carried out, b) Contribution to local development (Valuation 1: No contribution to local development; 2: Low contribution to local development; 3: Medium contribution to local development. c) Application of agroecological practices (Valuation 1: No agroecological practices are applied. 2: Some agroecological practices are applied. 3: Many agroecological practices are applied

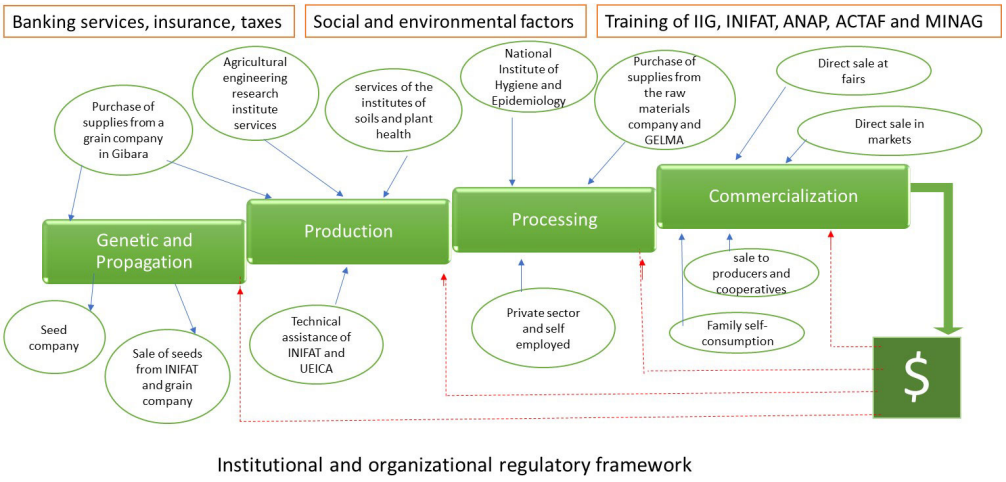


Figure 3. Interaction of the value chains of CCS José A. Echeverría Holguín municipality

innovations, the main one being the processing of oilseeds to obtain oils for human consumption and flours for animal feed.

Changes in the economic dimension are related to the development of the industrial process, for oils and flours, and their use, one part for family self-consumption and the other for sale in the retail market. The operations taxed profits that eliminated the losses recorded in 2013 and generated salary increases of 9800 pesos per worker in the year.

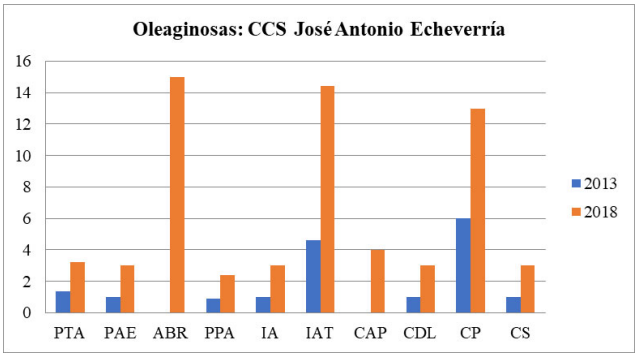
The social dimension with the new value chain model in this entity varied with the incorporation of seven new jobs, of which women occupied 57 %.

The improvement of human resources marked notable progress. At the beginning of this research, the entity did not have any training, but by the end of it, two specialized scientific institutes had carried out four activities. The assimilation of new knowledge on the reproduction of seeds from certified material was very valuable.

The environmental dimension was marked by the transition from monoculture to polyculture, the use of environmentally friendly agricultural practices, such as the use of living barriers, and the design and construction of a center for the production of efficient microorganisms.

In valuing the contribution to local development, this entity, with the commercialization of its oil products and meals as by-products, favored the feeding of pigs and poultry and, therefore, the availability of these items so demanded by the population.

Local development received the main contributions from innovations in the five dimensions, with emphasis on the social and environmental dimensions. More than 30,000 people are recognized as indirect beneficiaries of the products marketed.



PTA: Total annual production (t x 10) PAA: Annual food production (t) PAE: Application of agroecological practices ABR: Area under irrigation (ha) PPA: Average annual productivity IA: Innovations applied IAT: Average annual income per worker (x 1000 $) CAP: Training CDL: Contribution to local development CP: Number of producers CS: Application of soil conservation measures

Figure 4. Comparison of 2018 with 2013 results in the José Antonio Echeverria CCS

In the development of the value chains of the eight selected agricultural entities, nine scientific results, six technological improvements and four innovations were introduced (Table 7), achieved through linkages with INIFAT, IIG and the UEICA of Holguín.

In the eight entities, in addition to direct training of 120 people (44 % women) the training was enriched with

Table 6. Characterization of the flours from cakes obtained from the extraction, elaborated at the CCS José Antonio Echeverría (all variables expressed in %)

Products	Protein	Humidity	Fat	Fiber	Ash	Starch
Peanut cake	48.90	10.00	5.31	4.90	6.10	2.04
Soybean cake	43.97	9.43	7.19	3.71	5.18	2.71
Sesame cake	40.44	10.92	11.67	5.10	9.17	4.37

Source: Authors' own elaboration

Table 7. Scientific and technical results, technological improvements and innovations applied in oilseed value chains

Links	Scientific-Technical Results	Technological Improvements	Innovations
Propagation	§ Introduction of new certified propagation materials	§ Multiplication of quality seeds in the municipalities	
	§ Technologies for the use of rice charcoal in production		
Agricultural production	§ Introduction of new small- and medium-scale planting technologies	§ Portable sprinkler irrigation systems	§ Design of installation and equipment for the production of efficient microorganisms
	§ Application of new agroecological practices	§ Agricultural tools and equipment for cultural care.	
	§ Use of efficient microorganisms in fertilization	§ Integrated pest and disease management technologies.	
	§ Technologies for the use of charcoal in peanut cultivation		
Harvesting and storing	§ Technologies for harvesting and storage of oilseed plants		
Processing and Benefits	§ Characterization of oilseed plant meals	§ Facilities and equipment for processing and processing oilseeds	§ Technologies for oilseed processing, oilseed processing and oil packaging.
			§ Design and manufacture of peanut shelling machines
			§ New formulations of animal feed, with the flours obtained in the industrial processing of oilseeds
Distribution and Marketing	§ Transportation logistics	§ Brand creation and registration	

materials prepared for producers and decision-makers, including several manuals and informative books. Tittles as Good Practices in Agroecological-Organic Production; Manual on Production and Post Production of Oilseed Grains; Manual on the Participatory System of Guarantees in Cuba; Methodological Manual on steps in the investment process in value chains and materials on agroecological practices introduced in value chains for urban, suburban and family agriculture were presented.

The creation of the registered trademark made it possible to provide these products with an added and distinctive qualitative value, both within and outside their place of origin, as one of the market's competitiveness requirements.

There is a successful model of a large-scale oilseed value chain in Brazil, which introduced into production practice the results of research on soil management, pest control and reduction of nitrogen fertilization using biofertilizers, to the benefit of the safety of the final products. Improvements in production and cost reductions increased the sector's competitiveness (42).

Global agricultural value chains and the historical genesis of the agrifood value chain have comparatively high levels of employment, labor and raw materials (43), which are aspects of great importance today.

Oilseed plants are significant, for example, in Argentina, (44) soybean, sunflower, peanut and rapeseed plants occupy, in that order, the productive places, and in particular, soybean was cultivated in almost 50 % by small producers who did not exceed 150 t per year.

It is important in a food supply system, such as the one being considered, to analyze the "territory" as a space where productive and social activities converge (45,46) and to design neutral policies that encourage the increase of productive efficiency and the volume of agricultural and agroindustrial production, in general (47).

In Cuba, food production is a key issue in any national debate on food security. Generally, decision-makers and actors in the Cuban agrifood chain relate the issue to the need to make material investments for food production, without stopping to reflect on the impact of the disarticulation of technological innovation processes and the research-production-processing-distribution-access chain.

These aspects call for a paradigm shift in the face of the new challenges of the Cuban agricultural scenario, where decentralization and self-management processes are even more highly valued (48). This requires managing value chains and taking into account the co-innovation approach, as defined in the Economic and Social Policy Guidelines (PCC, 2016), the Social Economic Development Strategy until 2030, the SAN Plan and, recently, the 63 Measures to energize Cuban Agriculture (49).

The present study contributes to validate its usefulness with a systemic, territorial, demand- or market-oriented approach, driven by the producers of the Cuban agri-food sector, from the local perspective.

The innovations applied, when changing the management model to value chains, were technological innovations, applied in the different production and processing links, and commercial innovations, in the marketing networks created, which respond to productive linkages through co-innovation processes (50-54).

The technical and productive dimension was strengthened through interventions mainly involving agroecological actions and technological improvements, which were aspects to be improved in the baselines of each intervention scenario (55), the value chains and the productive and economic linkages systematically improved the value added to the final product.

Organizational change, supported by the application of science, favored community culture, as has also been described (56).

A study in the agrifood sector in Ecuador, with the objective of applying a value chain approach in rural areas of Chimborazo province (34), had similar results to those of the present study. It related to some of the critical factors identified, mainly in the technical-productive dimension, regarding the lack of irrigation, disarticulation of production chains, marketing channels and weak local management.

The principles of changes in management and contributions to local development were also insufficiencies found in a study on food security at the municipal level (56).

It has been confirmed that achieving an agricultural innovation system implies involving knowledge and information systems conveyed through research institutions, Technical Assistance and Rural Extension institutions, teaching institutions with services to farmers, but, above all, to the farmers themselves (57).

All the actors and processes, previously assessed, were articulated in the conformation of the value chains of the present work, which allowed the transformation of the problems identified in the baselines of the entities, for the five dimensions studied.

The training of actors and integration were issues that were considered fundamental in the workshops held to improve the efficiency of workers in their contribution to increasing productivity indexes. Equally essential is the ability to anticipate responses to the challenges of the environment, as described (58).

Failure to provide sufficient training is one of the causes of failure in the application of value chains (14). Trust and learning are key elements in the development of value chains and do not emerge immediately; they are the result of a process of preparation (59).

Integration is considered indispensable for achieving the objective of contributing to local development at the municipal level.

The aforementioned authors studied Porter's (1985) value chain model in the Guardaña Basin, Department of Oruro, Bolivia, for the transformation of the vegetable agricultural production system, and found that success is related to the development of strategies in each link of the value chain, which coincides with the results of the present study.

There are features in the work that are shared with those stated by other authors (49), such as the need to support this transformation with investment resources (56); or substantial subsidies for long-term production, given the current circumstances of the pandemic (60). In addition to favoring the development of links with scientific centers helping small producers to link up with other types of markets or promoting their efficient integration into the wholesale trade.

Training producers on the environmental and social standards of the target markets of their productions. Also supporting the development of innovative capacities, which are growing every day, are also considered by other authors (61).

CONCLUSIONS

- The diagnosis of the selected agricultural entities revealed the disarticulation of the actors in the phases of the production process, as well as the lack of integrality of the agroecological practices employed, which is an expression of the inefficiency of the management model of production chain used so far.
- As a scientific novelty, the inclusion of the environmental and social dimensions as components of the characterization and diagnosis of an agricultural entity enables a holistic approach.
- The application of the management model with a value chain approach had a favorable impact on the technical-productive, organizational, economic, environmental and social dimensions of the value chains studied.
- Local development was strengthened by the application of value chain management models in products that contribute to municipal food self-sufficiency and national balance, in line with the country's Economic and Social Development Model.
- The application of innovative processes and training of the different stakeholders and decision-makers, accompanied by scientific centers, were key elements in the impacts obtained.
- In practical terms, the results of this work constitute a useful document for the formulation of public policies.

RECOMMENDATIONS

- To evaluate the indicators used in baselines of the entities studied and to apply a management model with a value chain approach as a possibility. Besides, characterize the indicators over time, which is consistent with the document on "Updating the Guidelines of the Economic and Social Policy of the Party and the Revolution for the period 2016-2021".
- Propose the generalization of the management model with a focus on value chains in the agricultural sector, as a new form of more inclusive and efficient management, which is in accordance with the document on the "Update of the Guidelines of the Economic and Social Policy of the Party and the Revolution, for the period 2016-2021".
- To use the results of this document in the training of actors and decision makers to contribute to its implementation in the productive practice, as well as in undergraduate and graduate teaching.

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