Reflection and analysis

Supportability of productive systems in Cuba from a multifactorial approach

Katerine Oropesa-Casanova *https://orcid.org/0000-0002-4310-5019*, Hilda Beatriz Wencomo-Cárdenas *https://orcid.org/0000-0002-1450-5611* Taymer Miranda-Tortoló *https://orcid.org/0000-0001-8603-7725* and Juan Carlos Lezcano-Fleires *https://orcid.org/0000-0002-8718-1523*

Estación Experimental de Pastos y Forrajes Indio Hatuey, Universidad de Matanzas, Ministerio de Educación Superior. Central España Republicana CP 44280. Matanzas, Cuba.

E-mail: katerine.oropesa@ihatuey.cu, wencomo@ihatuey.cu, miranda@ihatuey.cu, lezcano@ihatuey.cu

Abstract

Objective: To reflect about the importance of the supportability of agroproductive systems and of their contribution to local development in Cuba, from an economic, ecological and sociocultural approach.

Materials and Methods: This study, of exploratory, analytical and descriptive type, is based on the bibliographic review of the concepts sustainable and supportable systems, bioeconomy, agroecology and development programs in local contexts. For such purpose, different information sources, scientific papers published about the topic and literature produced by national and international organisms, were consulted and analyzed, in order to know about the state-of-the-art of the object of study and to concrete necessary definitions and strategies for the implementation of supportable systems in the framework of agricultural programs.

Results: It was corroborated that supportability is a way of living and producing in harmony with the environment, to guarantee that future generations can satisfy their needs. From its multifunctionality, supportability can be a tool in supportable local development, from the commitment to agrifood models based on agroecology, bioeconomy and food sovereignty.

Conclusions: In Cuba it would be pertinent to establish local strategies to improve people's quality of life and preserve the environment, from an agroecological and supportable approach.

Keywords: community development, sustainability

Introduction

In order to find methodologies aimed at evaluating production systems, the supportability of agroproductive systems has been a highly debated topic by the world agroecological movement in the last decades (Leyva-Galán, and Lores-Pérez, 2012; Sarandón and Flores, 2019; Flores and Sarandón, 2015). Nevertheless, the search for the approach to supportable agricultural development shows restrictions, inherent to the multidimensionality of the concept (economic, ecological and sociocultural).

Supportable systems could also contribute to overcome some of the limitations related to rural development, from the commitment to agrifood models based on agroecology and food sovereignty. According to the development theories defended by Shejtman and Berdegué (2004) and Alburquerque-Tur (2016), supportable (rural, local and territorial) development is a process of productive and institutional transformation in a certain rural space, whose purpose is to reduce rural poverty, and in which productive transformation allows to articulate, competitively and supportably, the economy of the territory, to dynamic markets.

From the above-explained facts, the objective of this work was to reflect about the importance of the supportability of agroproductive systems and of their contribution to

local development in Cuba, from an economic, ecological and sociocultural approach..

Materials and Methods

This study is exploratory, analytical and descriptive. Specialized literature on sustainable systems, agroecology and development programs in local contexts, was consulted and analyzed, in order to know about the state-of-the-art of the object of study, and to indicate necessary definitions and

Received: December 18, 2020
Accepted: March 11, 2021

How to cite a paper: Oropesa-Casanova, Katerine; Wencomo-Cárdenas, Hilda Beatriz & Miranda-Tortoló, Taymer. Supportability of productive systems in Cuba from a multifactorial approach. *Pastos y Forrajes*. 44:eI08, 2021.

strategies to implement sustainable systems in the framework of agricultural programs.

Sustainable and supportable systems

The terms sustainable and supportable, *desarrollo sostenible* (sustainable development) and *desarrollo sustentable* (supportable development) or *sostenibilidad* (sustainability) and *sustentabilidad* (supportability) are indistinctly used, from the English term sustainability. Scientific papers can be found that translate sustainability as *sostenibilidad* and, in turn, others that translate it as *sustentabilidad*, even when the cited reference is the same. Méndez (2012) states that *sostenibilidad* as well as *sustentabilidad* does not show higher differentiation with regards to their application to development. According to Cortés-Mura and Peña-Reyes (2015), the difference between these two terms is a question that obeys lexicon or geographical location.

The Dictionary of the Spanish Language, reference work of the Royal Spanish Academy, defines the adjective *sustentable* as "that which can be sustained or defended with reasons". Of *sostenible* it says: 1) "that can be sustained", 2) "especially in ecology and economy, that can be maintained during a long time without depleting the resources or causing serious damage to the environment". The words sostenible and sustentable are verbal adjectives, which are derived from respective verbs (sostener (sustain) and sustentar (support)), and also understands that they are synonyms (RAE, 2014).

Nevertheless, these concepts have been much argued. It could be even said that in the seventies this discussion started from the concept of human development, and from its relation to the economic, productive and consumption aspects and, especially, from the antagonist link of economic growth and use of natural resources, topics debated in the preparatory meetings of the United Nations Conference on Human Environment (UNCHE), carried out in Stockholm, Sweden, in 1972.

In 1980, the world strategy for conservation, prepared by the Union for the Conservation of Nature and Natural Resources (IUCN), identifies demographic pressure, social inequity and the terms of trade as the main causes of poverty and habitat destruction. This organization calls for a new international development strategy to readjust inequities through the application of a more dynamic and stable economy at international level, which stimulates economic growth and is opposed to the worst impacts of poverty. This conservation strategy stated sustainability in ecological terms, but with very little emphasis on economic development, and contemplated three priorities: maintenance of ecological processes, sustainable use of resources and preservation of genetic diversity.

Afterwards, in 1983, the UN created the World Commission on Environment and Development. The work group created for such purpose, known as Brundtland Commission[1], started diverse studies, debates and public hearings in the five continents during almost three years. These events ended in April, 1987, with the publication of the document titled Our Common Future or Brundtland Report (Boada and Toledo, 2003; López-Pardo, 2015).

This report indicates a definition of sustainable development that is maybe more widespread and accepted. It conceptualizes it as the development that satisfies the current needs, without compromising the possibilities of the future generations to tend to its own needs (López-Ricalde *et al.,* 2005). In this regard, Martínez-Castillo and Martínez-Chaves (2016), as criticism, reconsider some aspects of this concept:

- It proposes to maintain the economic growth model "adjusting" the parameters to allow its continuity in time, but it leaves intact and out of discussion the main bases of the predator production model that, it acknowledges, leads the planet to collapse. That is, it detects a problem, but does not understand it (cause-effect relation).
- In turn, it evades the debate about the socioeconomic aspects and consequences of this economic model, such as the increasing generation of the gap between the rich and the poor.

The indiscriminate use of the term sustainable has also generated a depletion of its initial definition. Today, with the influence of futuristic marketing, everything is sustainable, for which this term has good social acceptance, and is very closely related to all that lasts in time. Meanwhile, the term supportable has become a worldwide accepted concept to guide the interactions between nature and society, in order to dominate the local and global variations, such as climate change, social inequity, poverty, biodiversity loss, overpopulation and lack of resources. In this sense, a call is made to modify this paradigm at all levels (Disterheft *et al.,* 2013; Zarta-Ávila, 2018).

[1]Led by Mistress Gro Brundtland, who was Prime Minister of Norway

Supportability can be understood as a paradigm to think of a future in which environmental, social and economic considerations are balanced in the search for development and a better quality of life. Cortés-Mura and Peña-Reyes (2015) emphasize the fact that the concept of supportable development should have ethic bases, such as justice and intergenerational equity or the ecocentric concern for the preservation of biological diversity.

At present, strategies are developed to move towards a sustainable production model, based on the utilization of biodiversity and the decrease of the carbon footprint. In this sense, bioeconomy could contribute to the transition from a model based on the intensive use of fossil fuels to another one that gives priority to the economic activities around biodiversity, that is, to the production of efficient and sustainable goods and services, from the biological and genetic resources with high added value (CEPAL, 2015; Mercado-Ramos, 2017; Lombeyda-Miño, 2020).

Bioeconomy

Bioeconomy provides the bases to achieve production systems and utilization of natural resources in a more sustainable way. Initially, Georgescu-Roegen (1975) conceptualized this term to highlight the biological origin of economic processes and, from it, to stress the problems posed by mankind, depending on a limited quantity of utilizable resources, which are unequally distributed.

Bioeconomy is defined as the production, utilization and conservation of biological resources, including the knowledge, science, technology and innovation, related among them to provide information, products, processes and services in all the economic sectors, in order to advance towards sustainable economy (Rodríguez *et al.,* 2019). That is why it is understood as a dynamic and complex social transformation process, which demands a perspective of long-term policy. Each country can define its bioeconomy depending on its realities, its national capacities and its programmatic elements.

There are several definitions of bioeconomy, depending on each country or region. In the European Union (EU) it is defined as the production of renewable biological resources and the conversion of these resources and residue flows in products of added value, such as feedstuffs, concentrate feds, products of biological basis and bioenergy (European Comission, 2012). The UE was the first to promote this term as an opportunity to develop biotechnology and to replace the use of fossil derivatives for resources of biological basis (Birner, 2018).

Since the Global Bioeconomy Summit (GBS) in 2015, this term has become more common in the documents of policies and strategies worldwide, but with different definitions (Rodríguez *et al*., 2019).

At the same time, new terms and broader concepts emerge. In the EU, the synergies between the concepts of bioeconomy and circular economy are being explored. Several documents about bioeconomy policies of the European countries refer to sustainable and circular bioeconomy. In Anglo-Saxon countries, they relate bioeconomy with the concepts of high technology innovation, such as synthetic biology, digitalization and advanced manufacture. Meanwhile, in the United States, reference is made to the industrialization of biology, and in Germany biologization of economy or biological transformation of the industry emerges in key documents about innovation policies.

Bioeconomy also has certain relation to the decrease theory[2] as basis for balanced production in a world where resources are finite and the economic processes are entropic. That is, where neither materials nor energy are created or consumed, but transformed (Georgescu-Roegen, 1971).

The similarity between the bioeconomy concept described by Georgescu-Roegen (1975) and the Agenda 2030 for Sustainable Development is remarkable, for which it could be stated that the latter comprises the essence of such concept and, thus, it is intrinsically bioeconomic (table 1).

One of the pillars for the development of bioeconomy is agriculture and, thus, it should be aimed at improving agricultural production to optimize the supply of food destined to the people with scarce resources and, at the same time, enhance food security from rural zones (Trigo *et al.,* 2014). Agroecological practices fulfill that objective, by providing healthy foodstuffs ecologically balanced with the environment.

Agroecology

According to criteria expressed by Roque-Jaime *et al.* (2016), agreocology is a millenary practice that defends producing in harmony with nature, with the rescue of traditional practices and farmer wisdom.

[2]This trend of economic thought questions the limits of economic growth, because unlimited growth is a phantasy, an absurd. The planet cannot stand the duplication of the GDP, because the regeneration capacity of the biosphere has been exceeded by 50 % (Latouche, 2010).

Table 1. Relation between the Minimum Bioeconomic Program proposed by Geogescu-Roegen and the Agenda 2030 for Sustainable Development.

Minimum Bioeconomic Program proposed by Geogescu-Roegen (1975)	Goals of the Agenda 2030 for Sustainable Development (2015)
First, the production of all war instruments, not only war itself, should be completely forbidden.	SDG 16: Promote just, peaceful and inclusive societies SDG 17: Revitalize the Global Partnership for Sustainable Development.
Second, through the use of the resources associated to the war that are released, as well as through well-planned and well-intended additional measures, developing countries should be helped to arrive as quickly as possible to a good life (not luxury).	SDG 1: End poverty in all its forms everywhere. SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture. SDG 3: Ensure healthy lives and promote well-being for all at all ages. SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. SDG 6: Ensure availability and sustainable management of water and sanitation for all. SDG 17: Revitalize the Global Partnership for Sustainable Development.
Third, mankind should gradually reduce its population to a level that could be adequately fed only by organic agriculture. Fourth, until the direct use of solar energy becomes a general convenience or controlled fusion is achieved, energy waste –due to overheating, excessive cooling, speed excess, light excess, etc.- should be strictly avoided, and if necessary, strictly regulated.	SDG 7: Ensure Access to affordable, reliable, sustainable and modern energy for all.
Fifth, we must be healed from the morbid desire of extravagant equipment. Six, we must also get rid of fashion.	SDG 12: Ensure sustainable consumption and production patterns.
Seventh, it is necessary that lasting goods are manufactured to last even more, by being designed so that they can be repaired.	SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation. SDG 12: Ensure sustainable consumption and production patterns.
Eighth, we must realize that an important prerequisite for a good life is a substantial amount of spare time, which can be used in an intelligent way.	SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

Source: Rodríguez *et al.* (2017)

Thus, the main function in agricultural production is returned to the farmer, which guarantees the sustainability of agricultural systems.

For Altieri *et al.* (2009),agroecology goes beyond a unidimensional glance of agroecosystems, of their genetics, agronomy, edaphology and others. It comprises an understanding of the ecological and social levels of the coevolution, structure and functioning of agroecosystems. Likewise, these authors refer that such systems are healthy and productive when balance and good growth prevail, when cultivated plants are capable of tolerating stress and adversity.

Vázquez-Moreno (2015) indicates that agroecology delivers the guidelines for a careful management of agroecosystems, without causing unnecessary or irreparable damage, simultaneously with the effort to counteract pests, diseases or soil deficiencies. The agroecologist struggles to return to the agroecosystem its elasticity and strength through innovation processes, based on the agroecological principles (Altieri and Nicholls, 2013; Nicholls *et al*., 2017a; 2017b), which allows to achieve contextual technological forms that contribute to sustainable agricultural production,

sovereignty and resilience against extreme events (Santiago-Vera *et al*., 2018).

In spite of the above-stated facts, as asserted by Funes-Monzote (2018), the social complement that is related to them is highly important, as real warrant of the development of agroecological family farms and the continuity of a culture that can be acquired, maintained and enriched in them (Casimiro, 2016a).

Agroecology, as scientific speech or as application to development models, links the ecological aspect to the life forms, which necessarily associates it to social transformation objectives. A set of terms is related to it that determines its characterization as a solid science with broad scientific basis, which is nourished from diverse fields, such as agricultural sciences (soil science, microbiology, plant physiology, entomology, pathology, agronomy, plant and animal nutrition, animal science, veterinary, among others), natural sciences (botany, herbology, chemistry, physics, mathematics, astronomy, cosmic sciences, etc.), ecological and environmental sciences (ecology, agroecosystems, climatology, agrometeorology, among others) and social, economic and political sciences (sociology, economics, environmental history, etc.).

In summary, agroecology is the scientific, technological and social proposal to achieve sustainable agriculture (Vázquez-Moreno, 2015; Funes-Monzote, 2018). It poses basic agroecological principles (Nicholls *et al.*, 2017) about how to study, design and manage agroecosystems that are productive (Bover-Felices and Suárez-Hernández, 2020) and, in turn, that preserve natural resources; which are also culturally sensitive and social, and viable from the socioeconomic point of view.

From the vision of agroecology, sustainability is a process, which has as attribute the introduction of environmental values in agricultural practices. From the agroecology principles, it is intended to elaborate proposals of collective action through which social actors can substitute the current development model by another one that aims at an ecologically adequate, socially just and ecologically viable agriculture (Flores and Sarandón, 2015).

Emergence of the agroecological movement in the Cuban context

In Cuba, the special period was a deprivation stage, but it was also a period of innovation in sustainable agriculture and in the reorganization of production to obtain food in a more autonomous way. The transition towards agroecological agriculture represented a huge challenge for technicians and farmers, who were used to producing with high-input approach, and did not acknowledge the possibility of sustainable or low-input agriculture to solve population feeding (Funes-Aguilar, 2016; 2017; Nova, 2019).

Cuba, amid that crisis, offered an example. It showed the way towards necessary processes of social and productive transformation (Machín-Sosa *et al*., 2011; Rosset, 2016). The way in which the country faced a deep crisis with the farmer to farmer agroecological movement (MACAC for its initials in Spanish) offered abundant lessons to other countries and organizations that also searched for a way out of situations in which their farmer bases are.

Another methodological advance in this period was the classification of the farms (started, transition and agroecological farms) to stimulate morally the farmer family, and also to induce emulation by other farmers (Machín-Sosa *et al*., 2011; 2017). This classification has as principle to qualify the farms according to the degree of agroecological transformation. The farmer or family, who reaches the maximum level of agroecological integration, feels great satisfaction and earns the respect (and emulation) of their community and cooperative.

The participatory characteristics offered by the MACAC and tradition and habits of the ANAP (National Association of Small Farmers) allowed agroecological transition to a higher scale, although several elements of agroecology were already being practiced, at higher or lower scale. The MACAC generalized its dissemination, could revitalize the horizontal transmission, knowledge socialization and good practices from some farmers to others (Casimiro, 2016b).

The farmer families, most of them linked to this movement, maintain, in general, traditional practices, have agricultural culture, and are the most productive and efficient agricultural production model (Machín-Sosa *et al*., 2010; Triana, 2020a; 2020b; 2020c). In Cuba, in 2011, these families produced more than 65 % of the food, with only 25 % of the land. They reached sufficient yields per hectare to feed between 15 and 20 people per year, with energy efficiency not lower than 15:1 (Funes-Monzote, 2009; Rosset *et al*., 2011; Casimiro, 2016a).

Agroecology meant an alternative among the diverse solutions that allowed the Cuban nation to overcome the crisis times. The unfavorable conditions under which Cuba has lived have forced farmers to assume an increasingly active role in the search for

and implementation of solutions, related in general to sustainable development proposals.

Current situation of agriculture in Cuba

In Cuba, as part of the updating process of the economic and social development model[3], a set of decisive transformations for the sustainability and prosperity of the nation has been started. All this is in broad coherence with the objectives and goals of the Agenda 2030 (Bárcena, 2015).

This agenda states, in its second objective, to end hunger, achieve food security, improved nutrition and promote sustainable agriculture (Bárcena, 2015). For such purpose, in all the productive chain the application of integrated management of science, technology, innovation and environment is to be promoted, aimed at the increase of food production and animal health, which includes the improvement of services for farmers.

It is necessary to indicate that the Cuban State has always given priority to environmental protection, and it is thus manifested in the Constitution of the Republic, with the development of legal norms, such as the Act of Environment and Decree-Law 179 about soil protection, use and conservation. This is in addition to the development of national programs, which directly or indirectly promote soil protection, including the National Program of Soil Conservation and Amelioration (PNMCS), the National Program of Forestry Development, the National Action Program of Combat against Desertification and Drought, among others. Through these projects, practices have been promoted and implemented that protect natural resources and their sustainable use (Riverol and Aguilar, 2015).

For the implementation of these practices it is essential to undertake transformations with the confluence of diverse economic actors that allow actions which contribute to the increase of agricultural production.

The above-exposed facts show, among other issues, that when assuming the challenge of social change and technical-material transformations the protagonism and agreement of local actors are required (González-Díaz *et al.,* 2013), who should implement a management that promotes social participation, which considers the perception of actors to mobilize the individual and collective potentialities, which conditions advances towards prosperity and facilitates the understanding about the aspects related to human subjectivity; it should also overcome the economic-productivist vision and grant privilege to people in the analyses and projects, from the protection of natural resources and the environment (Suset-Pérez *et al*., 2017).

According to Miranda-Tortoló *et al.* (2018), the municipalities have little-used resources and capacities that can generate benefits for the population. Nevertheless, the essential need to make an efficient and pertinent use of them generates the need to apply new concepts and values that lead to a change of mentality in all the actors, for the innovative initiative of the state as well as of the private sector to be triggered.

At present, the municipalities face the challenge of elaborating an effective development program (Machado *et al*., 2007). They must know how to design and apply management systems, capable of promoting and conciliating the three great objectives that, in theory, would lead to supportable development: economic growth, equity (social, economic and environmental) and environmental supportability.

For the conservation of resources and recovery of the knowledge depending on development it is important to consider agroecology. It indicates that there is no rural development if it not based on the implementation of agricultural systems that preserve natural resources, and on their permanent articulation with the local sociocultural system.

The discussion about the concept of rural or local development is broad, generated from agroecology, as theoretical and practical basis of the sustainability of local productive systems. This concept is based on the discovery, systematization, analysis and enhancement of local elements and knowledge (Pomar-León *et al*., 2016) to design through them, in a participatory way, development schemes defined by the local identity of the concrete ethnoecosystem in which it is located (Velarde and Marasas, 2017).

In Cuba, successful experiences are carried out regarding supportable local development. Evidence of this is the results from the Local Agricultural Innovation System (SIAL), which is the methodological proposal of the Local Agricultural Innovation Program (PIAL), led by the National Institute of Agricultural Sciences (INCA) of Cuba and funded by the Swiss Development and Cooperation Agency (SDC). This program intends to articulate actors, at territorial scale, in order to enhance the local agricultural

[3]Started in April, 2016, with the 7th Congress of the Cuban Communist Party (PCC, for its initials in Spanish)

innovation systems, with the generation of genetic diversity and technologies applicable to these areas (Miranda *et al*., 2015; Oropesa-Casanova, 2019). Recently, the Plan of Food Sovereignty and Nutritional Education (SAN) was approved, which proposes Agroecology as theoretical and practical basis, and whose national policy is also in its elaboration process.

Final considerations

Under the conditions of Cuba it would be pertinent to establish local development strategies to achieve improving people's quality of life and preserving the environment, from an agroecological and supportable approach. These actions must safeguard the natural resources of the present and future generations, as well as be resilient in the face of climate change.

Acknowledgements

The authors thank the work team of the international project Local Agricultural Program (PIAL), funded by the Swiss Development and Cooperation Agency (SDC), for contributing with the funding for the development of this research.

Authors' contribution

- Katerine Oropesa- Casanova. Contributed to the conception and design of the article, as well as to the writing and revision of the manuscript.
- Hilda Beatriz Wencomo-Cárdenas. Contributed to the conception and design of the article, as well as to the writing and revision of the manuscript.
- Taymer Miranda-Tortoló. Contributed to the conception and design of the article, as well as to the writing and revision of the manuscript.
- Juan Carlos Lezcano-Fleires. Contributed to the conception and design of the article, as well as to the writing and revision of the manuscript.

Conflict of interests

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

Bibliographic references

Alburquerque-Tur, F. El enfoque del desarrollo económico territorial y la política. enseñanzas para el cambio de modelo productivo. En: J. Noguera-Tur, ed. *La visión territorial y sostenible del desarrollo local. Una perspectiva multidisciplinar*. Vol. 1 Territorio, desarrollo, sistema productivo. Brasilia; Valencia, España: SeBRAe, Universidad de Valencia. p. 47-66, 2016.

Altieri, M. A. *Determinando la capacidad de adaptación y sostenibilidad de los sistemas productivos frente al cambio climático en el marco de la Red de Servicios Ambientales del PMIIE. Informe de visitas de campo y de talleres realizados en Costa Rica y Nicaragua. Informe para ACICAFOC*. Costa Rica: Banco Mundial, BID, 2009.

Altieri, M. A. & Nicholls, Clara I. Agroecología y resiliencia al cambio climático principios y consideraciones metodológicas. *Agroecología*. 8 (1):7-20. https://revistas.um.es/agroecologia/article/view/182921, 2013.

Bárcena, Alicia. *Agenda 2030 y los Objetivos de Desarrollo Sostenible. Una oportunidad para América Latina y el Caribe*. Santiago de Chile: CEPAL. https://www.cepal.org, 2015.

Birner, Regina. Bioeconomy concepts. In: I. Lewandowski, ed. *Bioeconomy*. Cham, Switzerland: Springer. p. 17-38, 2018. DOI: https://doi.org/10.1007/978-3-319-68152-8_3.

Boada, M. & Toledo, V. M. *El planeta, nuestro cuerpo. La ecología, el ambientalismo y la crisis de la modernidad*. Ciencia para todos No. 194. México: Fondo de Cultura Económica, 2003.

Bover-Felices, Katia & Suárez-Hernández, J. Contribución del enfoque de la agroecología en el funcionamiento y estructura de los agroecosistemas integrados. *Pastos y Forrajes*. 43 (2):102-111. http://scielo.sld.cu/pdf/pyf/v43n2/2078-8452-pyf-43-02-102.pdf, 2020.

Casimiro, Leidy. *Bases metodológicas para la resiliencia socioecológica de fincas familiares en Cuba*. Tesis de Doctorado en Agroecología. Medellín, Colombia: Universidad de Antioquia, 2016b.

Casimiro, Leidy. Necesidad de una transición agroecológica en Cuba, perspectivas y retos. *Pastos y Forrajes*. 39 (3):81-91. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-03942016000300001, 2016a.

CEPAL. Conferencia sobre bioeconomía en América Latina y el Caribe 2015. Oportunidades para la agricultura y la agroindustria. *Seminario Nacional de Bioeconomía ALC 2015*. Santiago de Chile: Unidad de Desarrollo Agrícola, DPPM/CEPAL, ALCUE-NET, 2015.

Cortés-Mura, H. G. & Peña-Reyes, J. I. De la sostenibilidad a la sustentabilidad. Modelo de desarrollo sustentable para su implementación en políticas y proyectos. *Rev.-Esc. Adm. Neg*. 78:40-54. https://repositorio.cepal.org/bitstream/handle/11362/44640/S1900161_es.pdf.txt, 2015.

Disterheft, A.; Caeiro, S.; Azeiteiro, U. M. & Leal-Filho, W. Sustainability science and education for sustainable development in universities: a way to transition. In: S. Caeiro, W. Leal-Filho, C. Jabbour and U. M. Azeiteiro, eds. *Sustainability assessement tools in higher education institution*. Switzerland: Springer International Publishing. p. 3-27, 2013.

European Commission. *Commission staff working document accompanying the document innovating for sustainable growth: a bioeconomy for*

Europe. Brussels. https://ec.europa.eu/research/bioeconomy/pdf/official-strategy_en.pdf, 2012.

Flores, Claudia C. & Sarandón, S. J. Evaluación de la sustentabilidad de un proceso de transición agroecológica en sistemas de producción hortícolas familiares del Partido de La Plata, Buenos Aires, Argentina. *Rev. Fac. Agron., La Plata*. 114 (3):52-66. https://revista.agro.unlp.edu.ar, 2015.

Funes-Aguilar, F. Actualidad de la agroecología en Cuba. En: F. Funes-Aguilar y L. L. Vázquez-Moreno, eds. *Avances de la agroecología en Cuba*. La Habana: EEPF Indio Hatuey. p. 19-45, 2016.

Funes-Aguilar, F. Reseña sobre el estado actual de la agroecología en Cuba. *Agroecología*. 12 (1):7-18. https://revistas.um.es/agroecologia/article/view/330301/229261, 2017.

Funes-Monzote, F. R. *Agricultura con futuro: la alternativa agroecológica para Cuba*. Matanzas, Cuba: EEPF Indio Hatuey, 2009.

Funes-Monzote, F. R. Integración agroecológica y soberanía energética. *Agroecología*. 12 (1):57-66. https://revistas.um.es/agroecologia/article/view/330351/229311, 2018.

Georgescu-Roegen, N. Energy and economy myths. *Southern Econ. J*. 41 (3): 347-381,1975.

Georgescu-Roegen, N. *The entropy law and the economic process*. Cambridge, USA: Harvard University Press, 1971.

Georgescu-Roegen, N. Inequality, limits and growth from a bioeconomic viewpoint. *Rev. Soc. Econ*. 35 (3):361-375, 1977. DOI: https://doi.org/10.1080/00346767700000041.

González-Díaz, J. G.; García-Velasco, R.; Ramírez-Hernández, J. J. & Castañeda-Martínez, T. La territorialización de la política pública en el proceso de gestión territorial como praxis para el desarrollo. *Cuad. Desarro. Rural*. 10 (72):243-265, 2013. DOI: https://doi.org/10.11144/Javeriana.cdr10-72.tppp.

Latouche, S. El decrecimiento como solución a la crisis. *Mundo Siglo XXI*. 21:47-53. http://hdl.handle.net/10469/7158, 2010.

Leyva-Galán, Á. & Lores-Pérez, A. Nuevos índices para evaluar la agrobiodiversidad. *Agroecología*. 7:109-115. https://revistas.um.es/agroecologia/article/view/171061/146261, 2012.

Lombeyda-Miño, B. Bioeconomía: una alternativa para la conservación. *Letras Verdes*. 27:13-30, 2020. DOI: https://doi.org/10.17141/letrasverdes.27.2020.3984.

López-Ricalde, C. D.; López-Hernández, E. S. & Ancona-Peniche, I. Desarrollo sustentable o sostenible: una definición conceptual. *Horizonte Sanitario*. 4 (2). http//www.redalyc.org/articulo.oa?id=4578450440002, 2005.

López-Pardo, I. Sobre el desarrollo sostenible y la sostenibilidad: conceptualización y crítica. *Barataria*. 20:111-128, 2015. DOI: http://dx.doi.org/10.20932/barataria.v0i20.16.

Machado, Hilda; Suset, A.; Miranda, Taymer; Cruz, Aida; Olivera, Yuseika; Milera, Milagros *et al*. Gestión del desarrollo local en los municipios: la iniciativa municipal como experiencia decambio en la provincia de Matanzas. *Pastos y Forrajes*. 30 (ne):45-59. https://www.redalyc.org/articulo.oa?id=269120998004, 2007.

Machín-Sosa, B.; Roque-Jaime, Adilén M.; Ávila-Lozano, Dana R. & Rosset, P. M. *Revolución agroecológica: el movimiento de campesino a campesino de la ANAP en Cuba*. La Habana: Asociación Nacional de Agricultores Pequeños, La Vía Campesina, 2011.

Machín-Sosa, B.; Roque-Jaime, Adilén M.; Ávila-Lozano, Dana R. & Rosset, P. M. Transformaciones de la agricultura cubana. *Biodiversidad, sustento y culturas*. (90):40. https://www.biodiversidadla.org/Documentos/Transformaciones_de_la_agricultura_cubana, 2017.

Martínez-Castillo, R. & Martínez-Chaves, D. Perspectivas de la sustentabilidad: teoría y campos de análisis. *Pensamiento Actual*. 16 (26):123-145, 2016. DOI: https://doi.org/10.15517/pa.v16i26.25188.

Méndez, M. A. *La sostenibilidad y sustentabilidad en los museos, dos enfoques principales: la museología tradicional y la nueva museología. Estudio de caso en dos museos de la provincia de Pichincha*. Tesis previa a la obtención de títulos de Licenciada en Restauración y museología. Quito: Universidad Tecnológica Equinoccial, 2012.

Mercado-Ramos, Geovana. La bioeconomía –concepto y aplicación al desarrollo rural. *Rev. Investig. Innov. Agropecu. Recur. Nat*. 3 (4):67-71. http://riiarn.agro.umsa.bo/index.php/RIIARn/article/view/72/58, 2017.

Miranda, Taymer; Machado, Hilda; Bover, Katia; Oropesa, Katerine; Suset, A. & Lezcano, J. C. Principales limitantes y soluciones para la producción de alimentos. Contribución del Programa de Innovación en Matanzas, Cuba. *Pastos y Forrajes*. 38 (3):202-208. http://scielo.sld.cu/pdf/pyf/v38n3/pyf08315.pdf, 2015.

Miranda-Tortoló, Taymer; Machado-Martínez, Hilda; Lezcano-Fleires, J. C.; Suset-Pérez, A.; Oropesa-Casanova, Katerine; Tirado-García, F. D. *et al*. Contribución de la innovación a la gestión local del desarrollo en un municipio de Matanzas. *Pastos y Forrajes*. 41 (4):292-299. https://scielo.sld.cu/pdf/pyf/v41n4/pyf09418.pdf, 2018.

Nicholls, Clara I.; Altieri, M. A. & Vázquez, L. L. Agroecología: Principios para la conversión y el rediseño de sistemas agrícolas. *Agroecología*. 10 (1):61-72. https://revistas.um.es/agroecologia/article/view/300741, 2017b.

Nicholls, Clara I.; Henao, A. & Altieri, M. A. Agroecología y el diseño de sistemas agrícolas resilientes al cambio climático. *Agroecología*. 10

(1):7-31. https://revistas.um.es/agroecologia/article/view/300711, 2017a.

Nova, A. La economía agrícola y la transición agroecológica en Cuba. *Agroecología*. 12 (1):19-24. https://revistas.um.es/agroecologia/article/view/330311, 2019.

Oropesa-Casanova, Katerine; Bover-Felices, Katia; Miranda-Tortoló, Taymer; Machado-Martínez, Hilda C.; Alfonso-Llanes, J. A.; Suset-Pérez, A. *et al.* Experiencias del Sistema de Innovación Agrícola Local para enfrentar los desafíos productivos en el municipio Perico. *Pastos y Forrajes*. 42 (2):171-180. http://scielo.sld.cu/pdf/pyf/v42n2/2078-8452-pyf-42-02-171.pdf, 2019.

Pomar-León, Ariadna; López-García, D.; Calvet-Mir, Laura; Espluga-Trenc, J.; Di-Masso-Tarditti, Marina & Tendero-Acin, G. Dinamización local agroecológica: la participación como estrategia para la sostenibilidad de las comunidades agrarias. Segovia, España: Centro Nacional de Educación Ambiental. http://daniellopezagroecologia.wordpress.com, 2016.

RAE. Sustentable. *Diccionario de la lengua española*. Madrid: Real Academia Española. https://rae.es, 2014.

Riverol, M. & Aguilar, Y. Alternativas para reducir la degradación de los suelos en Cuba y el enfrentamiento al cambio climático. En: E. Martínez-Oliva, ed. *Sembrando en tierra viva. Manual de agroecología*. La Habana p. 121-132, 2015.

Rodríguez, A. G.; Mondaini, A. O. & Hitschfeld, Maureen A. *Bioeconomía en América Latina y el Caribe. Contexto global y regional y perspectivas*. Santiago de Chile: CEPAL. Serie Desarrollo Productivo No. 215. https://repositorio.cepal.org/bitstream/handle/11362/42427/1/S1701022_es.pdf, 2017.

Rodríguez, A. G.; Rodrigues, Mónica & Sotomayor, O. *Hacia una bioeconomía sostenible en América Latina y el Caribe Elementos para una visión regional*. Santiago de Chile: CEPAL. Recursos Naturales y Desarrollo No. 191, 2019.

Roque-Jaime, Adilén M.; Funes-Monzote, F. R.; Vega-Marino, Luz M.; Casas-Valdés, M.; Portuondo-Fornaris, Marilet; Caballero-Grande, R. *et al.* Haciendo Agroecología. La Habana: Asociación Cubana de Técnicos Agrícolas y Forestales, 2016.

Rosset, P. M.; Machín-Sosa, B.; Roque-Jaime, Adilén M. & Ávila-Lozano, Dana R. The Campesino-to-Campesino agroecology movement of ANAP in Cuba: social process methodology in the construction of sustainable peasant agriculture and food sovereignty. *J. Peasant Stud*. 38 (1):161-191, 2011. DOI: https://doi.org/10.1080/03066150.2010.538584.

Rosset, P M. Lecciones de la agroecología cubana. En: F. Funes-Aguilar y L. L. Vázquez-Moreno, eds. *Avances de la agroecología en Cuba*. La Habana: EEPF Indio Hatuey. p. 449-468, 2016.

Santiago-Vera, Teresita; García-Millán, M. & Rosset, P. M. Resiliencia y transformación agroecológica en el sur de México: validación y ajustes de un método participativo para fortalecer la resiliencia de sistemas campesinos. *Agroecología*. 11 (2):23-30. https://revistas.um.es/agroecologia/article/view/330081/229191, 2018.

Sarandón, S. J. & Flores, Claudia C. *Agroecología: bases teóricas para el diseño y manejo de agroecosistemas sustentables*. La Plata, Argentina: EDULP, 2019.

Schejtman, A. & Berdegué, J. A. *Desarrollo territorial rural*. Santiago de Chile: RIMISP-Centro Latinoamericano para el Desarrollo Rural. Debates y temas rurales No. 1, 2004.

Suset-Pérez, A.; Machado-Martínez, Hilda C.; Miranda-Tortoló, Taymer; Duquesne-Baró, P. & Castañeda-Pimienta, Lisset. El cambio social y las transformaciones en el contexto territorial rural. Percepción de los actores locales. *Pastos y Forrajes*. 40 (3):230-240. https://scielo.sld.cu/pdf/pyf/v40n3/pyf09317.pdf, 2017.

Triana, J. *Buscando al mamífero nacional. ¿Qué pasa con la producción porcina en Cuba?* La Habana. https://oncubanews.com/opinion/columnas/contrapesos/buscando-al-mamifero-nacional-que-pasa-con-la-produccion-porcina-en-cuba/, 2020c.

Triana, J. *El caso del queso*. La Habana. https://eltoque.com/juan-triana-el-caso-del-queso/, 2020b.

Triana, J. Bajo la punta del iceberg. Tener tierras sin cultivar cuando no hay suficientes alimentos, no es un problema surgido con la COVID-19, llevamos arrastrándolo muchos años. La Habana. https://oncubanews.com/opinion/columnas/contrapesos/bajo-la-punta-del-iceberg/, 2020a.

Trigo, E.; Henry, G.; Sanders, J..; Schurr, U.; Ingelbrecht, I. L.; Revel, Clara *et al*. Hacia un desarrollo de la bioeconomía en América Latina y el Caribe. En: Elizabeth Hodson-de-Jaramillo, ed. *Hacia una Bioeconomía en América Latina y el Caribe en asociación con Europa*. Bogotá: Pontificia Universidad Javeriana. p. 17-43, 2014.

Vázquez-Moreno, L L. Diseño y manejo agroecológico de sistemas de producción agropecuaria. En: E. Martínez-Oliva, ed. *Sembrando en tierra viva. Manual de agroecología*. La Habana p. 137-164, 2015.

Velarde, Irene & Marasas, Mariana E. Dialoguicidad en procesos de extensión rural agroecológicos: historias y rupturas entre extensionistas universitarios y viñateros de la costa de Berisso (2000-2008). *Rev. Fac. Agron., La Plata*. 116 (3):73-86. https://revistas.unlp.edu.ar/revagro/article/view/6145/5096, 2018.

Zarta-Ávila, P. La sustentabilidad o sostenibilidad: un concepto poderoso para la humanidad. *Tabula Rasa*. (28):409-423, 2018. DOI: https://doi.org/10.25058/20112742.n28.18.