

Theoretical considerations about sustainable land management at a landscape scale

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Abstract

Objective: To reflect on the most relevant fundamentals to support strategic management of sustainable land management at landscape level, as well as integrated resource management, sustainable territorial development and food security.

Materials and Methods: This descriptive study was based on a literature review of concepts such as sustainable land management, landscape, sustainable development and its implications in mitigating and coping with climate change. Scientific papers related to the topic were consulted in Google Scholar and Researchgate and other generic forms of scientific literature.

Results: Different conceptions of the need for sustainable land management to be extended to broader geographic spaces, in this case the landscape, were analyzed. The proven effectiveness of management techniques to ensure the resilience of agroecosystems is well known. However, these areas are very small compared with the magnitude of environmental problems. Achieving the scaling up of sustainable land management to the landscape constitutes a challenge that can generate environmental, economic and social benefits.

Conclusions: In this context of climate change it is necessary to achieve the implementation of sustainable land management at landscape scale because of the multiple benefits that it implies in different orders, both natural and economic, which is translated into the improvement of the living conditions of communities and their food sovereignty.

Keywords: climate change, agricultural development, sustainable development

Introduction

Transformations and modifications in land use and land cover, driven by climate change, are causing rapid changes in global geographic spaces. This may threaten access to natural benefits for all human communities. Research points to changes associated with increasing mean annual temperature, sea level rise, rainfall patterns, expanding droughts, and decreasing available water (Planos-Gutierrez *et al.*, 2015). It is crucial, according to the scientific community, to search for effective solutions to address climate change and ensure sustainable agricultural production. An essential component of this task is to understand how climate variability and change affect geosystems, natural resources and societies (Primelles-Fariñas *et al.*, 2020).

In Cuba, attempts at sustainable land management have focused mainly on specific practices in limited areas or on a small scale. There is little dis-

ussion of the challenges facing the expansion of these practices on a broader scale so that results can be achieved more quickly. Initiatives such as the Country Partnership Program for Sustainable Land Management (2008)¹, the Procedures Manual for Sustainable Land Management (2011)², the World Wildlife Fund (2014)³ and the Food and Agriculture Fund of the United Nations (2016) stand out.

Landscape studies, understood as the tangible representation of the natural environment perceived by individuals reveal human influence over time and highlight historical elements in the contemporary landscape (Martínez de Pisón, 2007). Implementing sustainable land management practices in larger domains, such as the landscape, is relevant and complex, especially for those who make decisions with territorial impact. This approach requires a profound change in the forms of production and

¹ <https://www.citma.gob.cu/programa-op15-manejo-sostenible-suelos/>

² <https://repositorio.geotech.cu/xmlui/handle/1234/2934>

³ <https://imco.org.mx/informe-planeta-vivo-2014-via-wwf/>

Received: March 25, 2024

Accepted: June 06, 2024

How to cite a paper: Espinosa, Adrián Juan. Theoretical considerations about sustainable land management at landscape scale. *Pastures and Forages*. 47:e07, 2024.

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commercialization, breaking with traditional intensive models that have persisted for generations.

The objective of this work was to reflect on the most relevant fundamentals for supporting strategic management of sustainable land management at the landscape level, as well as integrated resource management, sustainable territorial development and food security.

Materials and Methods

During the research development process, the dialectical materialist and historical-logical methods were used, with the purpose of demonstrating the causal and functional relationships of the landscape, by analyzing the dynamics of this object and the essential and contradictory relationships that act simultaneously. The background of sustainable land management, sustainable development, landscape evolution, integrated resource management, climate change adaptation and mitigation, and the process of landscape anthropization were also addressed.

For the development of the research, the synthetic analytical, systemic, modeling and comparative methods were used, particularly in the literature search related to the fundamental aspects of the process and the geoeological situation of the landscape.

Among the materials used, basic for the development of the research, we can cite the SLM Procedures Manual, proposed by Urquiza-Rodríguez *et al.* (2011), and also periodic reports on the level of introduction of good agricultural practices and their results in the intervention sites. Forty-six articles and papers were consulted, including four in English.

At the empirical level, the method of landscape analysis was applied by means of its technical and analytical procedures, which made it possible to know and explain the regularities of landscape structure and functioning, study its properties and determine the indexes and parameters on dynamics, history of development, states, processes of formation and transformation, as well as aspects related to sustainable landscape management.

The document analysis technique was used for the search and study of specialized bibliography on topics related to sustainable land management, landscape analysis and characterization.

Results and Discussion

Sustainable land management in relation to climate change adaptation and sustainable territorial development. In order to understand the defi-

inition of sustainable land management, “management” is understood as a set of actions for the use of goods and services from natural, social and material resources, considering the characteristics of the environment in which they interact. “Sustainability” is aimed at the use of natural resources without compromising their capacity for natural regeneration. Finally, the term “land” refers to a defined area of the earth’s surface that encompasses the soil, topography, surface deposits, water and climate resources, human, animal and plant communities that have developed as a result of these biophysical conditions. Therefore, sustainable land management is the conjugation of technologies, policies and activities, based on the resilience of geosystems that includes economic benefits to the communities that inhabit those spaces (Urquiza-Rodríguez *et al.*, 2011; Galeas-Sosa, 2020).

The establishment of sustainable land management is a complex process that involves different key result areas (Urquiza-Rodríguez *et al.*, 2011). The first of these refers to the management of the area, where an assessment is made of the distribution of the study area according to the productive purposes and whether the technologies to be applied are in correspondence with the site properties. In this section, it is important to analyze the availability of resources, such as water, energy sources, soil suitability and available labor force, all in terms of production planning. In the establishment of management units in agricultural landscapes, it is important to rely on the information provided by environmental management studies. This favors the achievement of an integrated diagnosis, which serves as a basis for carrying out sustainable land management action programs at the landscape scale.

The second key result area refers to soil preparation and maintenance alternatives, which involves methods for the control of undesired plants and the solution to crop residues, where the use of fire is not recommended. Little-aggressive soil tillage methods and the application of soil conservation and amelioration measures based on agroecological solutions are highly valued, and their scope influences the characteristics of the agricultural landscape.

Crop, variety and species selection form the third set of key result areas. This assesses the match that must exist between soil suitability, water availability, available labor force and agricultural cultural traditions, in this case, of the landscape.

It includes the selection of plant varieties and livestock species resistant to biotic and climate stress conditions. Diversification of production or introduction of new varieties by at least 10 % of the annual total is recommended, as well as the exploitation of the crop area for two to three harvests per year, with crop rotation and crop alternation. For agricultural landscapes, the use of short-cycle crops and the reduction of livestock density per hectare to levels that provide stability to the natural system to prevent degradation are recommended.

One of the most relevant key result areas is water management alternatives. It is therefore important that there are no losses due to water leaks in irrigation systems, that irrigation is carried out taking into account the weather forecast, that the applied technology is low in water consumption and that its use is as efficient as possible. It is vital to have rainwater harvesting systems for different uses. This includes the construction of small reservoirs; also the construction of works that contain soil erosion, as well as the maintenance of its humidity. It is advisable to protect the headwaters of rivers and streams, in addition to reforesting the hydro-regulating strips. All this favors the landscape balance, due to the conservationist activities that favor the naturalization of productive areas.

The fifth area of key results is aimed at the application of appropriate agro-technology. In this sense, the use of own quality seeds, nursery planting and prioritization of local species are recommended. The application of alternatives in the integrated control of pests and diseases is another aspect to be valued, in addition to the implementation of food conservation alternatives.

Sustainable land management includes appropriate methods of harvesting forested areas in its sixth key result area. Therefore, it is necessary to have a fire prevention plan, ensure forest diversity, and use mixed harvesting systems, such as temporary and sequential agroforestry systems. It is important to achieve a 10:1 ratio between timber and fruit species, as well as the use of other products such as honey, seeds, oils, resins and pruning residues. It is also recommended, for the agricultural landscape, the establishment of natural areas that function as biological corridors for native and migratory species, thus avoiding the disruption of the ecological balance.

The seventh key result area of sustainable land management is aimed at the economic use of residuals. For this reason, treatment measures must be implemented to prevent pollution in the broadest sense of the term. The economic use of solid and liquid waste is recommended through practices such as composting, vermiculture, and the application of mulching, among others.

The last of the key results refers to energy and economic control. This is why the costs of the activities must be controlled, as well as the obtained economic benefits, whether in terms of crop or product yields or monetary benefits. The reduction and substitution of imports is valued, in addition to fuel saving. Another important aspect is related to the use of energy alternatives such as wind, solar, mechanical and the installation and operation of biogas digesters, the use of biomass for energy production from pyrolysis, the use of oleaginous ligneous plants to produce biodiesel, as well as the development of agroenergy systems, among other options (Suárez *et al.*, 2011).

Adaptation to climate change. As can be seen, sustainable land management practices can contribute to improving soil fertility and soil structure. By incorporating large amounts of biomass into the soil and applying minimal soil intervention, the soil itself and water are conserved in relation to the existing fauna and edaphobiota, strengthening the elementary cyclical mechanisms. This means better nutrient content for plants and increased water retention capacity, favors resilience capacities, in addition to contributing to food security (Eririogu *et al.*, 2019). The adoption of appropriate sustainable land management practices improves crop yields which, at the same time, can favor many ecosystem services, such as carbon sequestration, biodiversity and reduction of anthropogenic disturbances (Almagro *et al.*, 2016; Ramírez-Iglesias *et al.*, 2020).

However, in moving towards the scaling up of sustainable land management to landscapes, a challenge as transcendent for agricultural landscapes as climate change cannot be ignored.

Article 1 of the United Nations Framework Convention on Climate Change (CMNUCC, 1992)⁴ defines the term climate change as a change in climate attributed, directly or indirectly, to human activity that alters the composition of the atmosphere

⁴ <https://unfccc.int/es/process-and-meetings/que-es-la-convencion-marco-de-las-naciones-unidas-sobre-el-cambio-climatico>

and that is in addition to natural climate variability observed over comparable time periods. For the Intergovernmental Panel on Climate Change (IPCC, 2014), the term is conceptualized as a change in the state of the climate, identifiable as a result of a change in the mean value and variability of its properties, which persists over an extended period, usually numbered in decades or longer periods. In Cuba, the Ministry of Science, Technology and Environment (CITMA) assumes this concept and establishes that the observation time to define or declare a climate change must be over a period longer than 30 years (CITMA, 2017).

Intensification in land use and exploitation of natural resources has been exacerbated during the last decades in Latin America, due to significant changes in precipitation and temperature increase. The IPCC (2014) considers that there is no doubt that the impacts of climate change on island states will have serious effects on their socioeconomic development and the state of their biophysical resources. As a consequence of the effects of climate change, the loss of biodiversity is accelerated, which is a threat to the development and quality of life of communities (Henry and Hodson-de-Jaramillo, 2021).

Climate change also has impacts on development, as it affects populations, asset generation processes and livelihood security, as well as natural resources and the provision of geosystem services for human well-being.

However, the synergistic effect of sustainable land management and adaptation to variability and change approaches in the effort to move towards agricultural sustainability in the country is undeniable (Primelles-Fariñas *et al.*, 2020). In both urban and rural areas, climate change adaptation and mitigation measures are increasingly inserted in sustainable territorial development policies and programs (Viguera *et al.*, 2019).

Environmental management models, land-use plans, strategic territorial planning, integrated watershed management and integrated coastal management are among the tools for achieving territorial sustainability suggested by the scientific community in the face of the growing global environmental crisis.

Since 2014, the term adaptation to climate change was introduced by the Intergovernmental Panel on Climate Change to refer to the process of adjusting to the current or projected climate and its effects. In human systems, it seeks to

moderate or avoid harm and take advantage of beneficial opportunities. In some natural systems, human intervention can facilitate adjustments to projected climate change and its effects (IPCC, 2014). Adaptation involves any action that signifies an adjustment of a natural or human system in response to current or expected effects of climate change or its impacts (Barton, 2009). It is important to highlight that some countries in the Latin American region have made efforts with the purpose of adapting to climate variability and change through the implementation of measures such as the conservation of geosystems, the use of early warning systems and the implementation of surveillance systems for diseases (Conde-Alvarez and López-Blanco, 2016).

Sustainable territorial development. Sustainability is based on the use of natural resources without compromising their capacity for natural regeneration, that is, the capacity of the land to recover previous levels of production or to resume the trend of increasing productivity after an adverse period due to drought, floods, abandonment or human mismanagement (Urquiza-Rodríguez *et al.*, 2011).

Sustainable development is a process in which economic policies, in their broad spectrum, are designed with the purpose of achieving a development that satisfies the needs of present generations, without limiting the potential for the satisfaction of future generations, without jeopardizing geosystem services. The implementation of actions focused on sustainable development is understood as a viable alternative because it could satisfy the needs of the present generation, without endangering the capacity to develop in the short, medium and long term. Achieving sustainable development is an objective towards which international public policy-making agendas of the last decades are directed (Hermida and Manté, 2019).

Sustainable development is possible through better governance, based on laws and patterns of territorial development, which are manifested in the content of their use to qualitatively change the parameters of territories (Frey, 2021). Accordingly, the study of the management of sustainable territories, in the context of the influence of the factors that determine the achievement of the objectives, becomes an urgent task of modern territorial economy (Kryshtanovych *et al.*, 2020).

Territorial development is defined as a process of social construction of the environment, driven

by the interaction among geophysical characteristics, the individual and collective initiatives of different actors and the operation of economic, technological, sociopolitical, cultural and environmental forces in the territory (CEPAL, 2020). In this construction towards sustainability, the territory plays a leading role. It is defined as a human community with a sense of appropriation and belonging to a specific natural and social space. This implies the construction of a sense of appropriation and belonging, harmonizing the expectations and needs of the individual with those of the human collective and its natural and social space. In addition, this development is subject to tensions that are expressed as inequalities between individuals in the territory and between territories. Added to this is the recognition of the right to diversity and the guarantee of sustainability. The presence of these inequalities brings with it social, economic and environmental costs, which justify the existence of territorial development policies that are expressed in a consensus on the need to move towards more inclusive, supportive and cohesive societies and gives people a leading and participatory role in the path of sustainable development (CEPAL, 2019; Arenas-de-Mesa and Cecchini, 2022).

The implementation of these policies and programs requires superior results in terms of environmental planning, integrated management of land resources and innovation, with solutions that favor nature-based procedures and the participation of social actors. The need to integrate environmental issues as a key dimension in strategic planning at the regional and local levels is strengthened, so as to identify the effects of climate change as one of the main phenomena affecting natural geosystems and especially landscapes. Sustainable development of the territorial economy is a process of dynamic capacity building of the territory, which motivates economic agents to expand reproduction, increase competitiveness and, on this basis, improve the standard of living of the population without using the resources of future generations (Barton, 2009; Flores, 2016; Planos, 2016; Noboa-Salazar *et al.*, 2021).

Importance of scaling up sustainable land management to landscapes for territorial environmental sustainability. Despite the priority of developing sustainable agriculture and having methodological resources for sustainable land management, its implementation is slow, which is reinforced by the predominance of non-conservationist practices

and the impacts of climate variability and change (Primelles-Fariñas *et al.*, 2020). The destruction and degradation of geosystems are the main reason for biodiversity loss and constitute a threat to development and quality of life. Currently, the fundamental pillars of environmental management and development of the economy are scientific knowledge, territorial approach, biodiversity conservation and sustainable use of geosystems (Henry and Hodson-de-Jaramillo, 2021).

The landscape, due to the potentialities it offers, is the ideal space to extend sustainable land management practices, since natural and economic-social factors converge and can coexist in balance, so that the sustainability of the system can be guaranteed. It has become a scenario of high impact in the convergence of anthropic and natural factors. Human-induced changes in nature are advancing at unprecedented rates and scales (Verburg, 2022). As a geosystem, the landscape relates geomorphological, hydroclimatic, biological and social elements that determine its potential (Martínez-Rivillas, 2022).

There are different concepts in relation to defining the landscape depending on the research, management and even perception context. These can be considered, from a scientific and transdisciplinary point of view, as “complex spatial-temporal systems, integrated by natural and anthropic elements and processes, subject to human action, which modifies their original natural properties” (Salinas-Chávez *et al.*, 2019).

Landscape is the form taken by geographical, physical and human facts on the earth’s surface. The landscape approach involves understanding how the natural order is manifested in space, formed by the dialectical combination of natural components and, how it is modified, transformed and culturally appropriated by human societies (IGT, 2019). It can be analyzed as a physical system that arises from the interaction between socioeconomic, natural systems and that provides services, whose benefits are taken advantage of by human beings. It is the space on which human beings create their way of life, their needs for food, clothing, shelter, trade and exchange, displacement, their aesthetic tastes, their playful moments, their artistic creation (Moreno-Trujillo, 2018). As the intensity of this link varies, not only the structure and function of the landscape varies, but also the value that individuals, social groups and communities assign to it (Cordoves-Sánchez *et al.*, 2019).

Landscape is considered as a changing and dynamic phenomenon, whose components form a system with two main vectors: human beings and nature. It is important to analyze that these components form an indissoluble and complementary binomial, where one conditions the other and vice versa, in a state of equilibrium. The landscape shapes the physiognomy, morphology or formal expression of space and territories and reflects the vision that the population has of its environment. It is also seen as a sensory image, perceived as something affective, symbolic and material, and therefore has direct or indirect effects on psychology and society, establishing a relationship between the natural and the result of human activity. It has properties derived from the functioning and interactions between social and environmental processes, including ways of life and governance systems. Therefore, protecting the landscape means securing the essence of a culture and the history of every people.

Defining the geocological sustainability of the landscape is useful to carry out a new interpretation, or a use and management of it for different political, economic and ideological purposes. In this context, the production of scientific knowledge for sustainability needs innovative approaches that link different disciplines to understand the complexity and dynamics of these systems (Mateo-Rodríguez, 2011; Quispe-Ojeda, 2022).

A sustainable landscape also implies the incorporation of sustainability in the productive and social process. It can be understood as a place where human communities, resource use and carrying capacity can be maintained in perpetuity (Mateo-Rodríguez, 1997).

The agrarian landscape, as part of cultural landscapes, refers to the geographic space intervened by man for the development of agricultural, animal husbandry and forestry activities. Agricultural landscapes have characteristic elements, such as cultivated space, uncultivated space, infrastructure and population settlements. They are visible and tangible elements, subject to the evolution of time, where some of them are abandoned, others transformed and others disappear (Conde-Álvarez and López-Blanco, 2016).

Agricultural landscapes have gone from being a scenario valued in aesthetic and creative terms, to being an object of scientific consideration and consumption by companies; they are also currently understood as a component of the identity of a territory, a catalyst of quality of life and a refer-

ence for the implementation of many policies and actions (Rio-Pedregosa, 2019). Generally, agrarian landscapes are the result of a dynamic, heterogeneous, multi-scale, changing transformation process, shaped by communities and territory, complex in the treatment of natural resources and ecology (Miranda-Paredes *et al.*, 2022).

Since the agricultural landscape is spatially heterogeneous, the provision of geo-ecosystem services varies depending on how it is configured. This configuration is closely linked to the decisions made around landscapes that are particularly dominated by an exclusively agricultural form of production. This dynamic has led to the transformation of landscapes on a global scale, due to the growing demand for food, fiber and fuel, thus turning resources and their availability into strategic factors and the landscape into their supplier (Morea, 2020). This is manifested in the appearance of extensive homogeneous areas, where landscape functions have been deteriorated to the point of disappearing.

An agricultural landscape offers important environmental goods and services. Among them, those of supply (food for human populations, domestic and wildlife, access to drinking water sources, genetic resources and pollination); regulatory (on climate, air quality, water availability, reduction of soil erosion, risk of natural disasters, pests and diseases); supporting (soil formation, development and retention, favoring nutrient cycling, water supply and atmospheric oxygen production through the photosynthetic process of its vegetation) and cultural (aesthetic values of the landscape itself and its harmony with the environment, knowledge systems); in addition to the fact that the agricultural landscape plays a part in social relations and in the sense of belonging of those who live there (Montero *et al.*, 2018).

Modern agriculture has led to the denaturalization of the landscape, due to the elimination of components that are of no economic benefit to humans, which causes an imbalance in the functioning of geoecosystem services and harms the entire system. Therefore, it is necessary to develop and implement strategies that can integrate conservation and restoration in productive landscapes, so that the objectives of biodiversity and natural resource conservation, generation of environmental goods and services, mitigation and adaptation to climate change, increased agricultural productivity, food security and human well-being can be achieved simultaneously (Calle *et al.*, 2016).

Landscape analysis and treatment can be approached from different spheres, such as territorial, urban or small-scale, being incorporated into Land Management and Planning Plans at various governmental levels with assigned competencies (Cordero-Cueva, 2013). This approach goes beyond administrative boundaries, as it integrates populations, infrastructure, social and economic activities that shape territorial dynamics by interacting with the ecosystem services of the landscape (González-Acuña and Soto-Velásquez, 2022). An integral perspective of this type underscores the importance of involving communities in the design, management and evaluation of strategies for the management of landscape resources, highlighting citizen participation in the design, management and evaluation of public policies (Quispe-Lifonzo, 2019).

The application of sustainable land management practices at the landscape level has as a direct result the improvement of the sustainability of these spaces and the generation of a synergistic positive effect, in terms of the sustainability of territorial development and the confrontation of climate change.

The production model in the Cuban agricultural sector, according to Rodríguez-Seijo (2012), inevitably transitions from conventional agriculture to sustainable agriculture with low chemical and energy inputs, in harmony with the environment, due to the ecological, economic and social consequences of conventional industrial agricultural practices. Therefore, the success of this production model depends, to a large extent, on the availability and sustainable use of the natural services that the landscape can offer.

Scaling up of sustainable land management practices to landscapes, in the process of sustainable territorial development. To guarantee the scaling up of sustainable land management, a solid relationship must be established between decision-makers and the other actors involved, such as private and state farmers, political and mass organizations and civil society. In this regard, it is up to the government structures to provide technical advice, together with fiscal guarantees, to finance projects and incentives. The objectives of government programs should help companies in the search for new markets and the scaling up of their sustainable products, processes and technologies, restoration and conservation of landscape resources, as well as favoring the quality of employment and salaries that meet the workers' basic needs. This is materialized in a management instrument aimed at promoting territorial development.

The application of formulas for strategic interaction with the private sector, companies, academia, workers and non-governmental organizations is important. Their implementation can ensure the character of public good (Fernández-García and Olay-Varillas, 2021). It is therefore necessary that the actors adopt a short, medium and long term vision, aspiring to a continuous scaling up of their sustainable land management activities through investment in knowledge and innovation, in correspondence with the sustainability of the landscape. The private sector should be willing to proactively support the formation of a public good partnership with government. Civil society organizations should be empowered based on the acquired knowledge and the good practices carried out. Small and medium-sized enterprises should promote an intensive dialogue to generate alliances that benefit all stakeholders (Goites *et al.*, 2020; Morales *et al.*, 2021).

In the scaling up of sustainable land management to agricultural landscapes, the actions to be carried out will inevitably imply opening up to new perspectives and responsibilities, for example, perceiving the landscape in its multiple dimensions of development, not only economic, but also social, environmental and cultural, paying special attention to its inhabitants and also to the sense of belonging, inclusion and social cohesion; appraising the resources of the landscape from an endogenous perspective, but without neglecting or disassociating itself from what the geographic space contributes in its different spheres, aiming at a development in which the fundamental objective is to achieve collective wellbeing, overcome poverty and inequalities; concretizing dialogue processes that promote a social construction within the landscape, where the participation of the actors allows the solution of collective problems and the effectiveness of the proposed sustainable land management actions; emphasizing the sustainability of processes, giving emphasis to the capacity of the landscape to accommodate diverse interests and project sustainable processes over time (Morales *et al.*, 2021).

Assuming a strategic management of sustainable territorial development, based on the scaling up of sustainable land management practices to the agricultural landscape, entails great challenges that mean adapting to the new climate conditions and simultaneously participating in a mitigation strategy, all of which entails economic costs of such magnitude that climate change becomes an

essential conditioning factor of the characteristics and options for economic development in the coming decades (CEPAL, 2009). The decision-makers, actors and components of the landscape, as a geosystem, are articulated under a logic of control and appropriation of social processes established by territorial management plans.

This type of strategic management is inserted in a context in which the territories assume the basic space of governance in Cuba and it is essential that science and technology effectively accompany this endeavor, with the objective of achieving a conception of development that can be concretized in actions that integrate economic and social development in harmony with the environment, to raise the quality of life of the population and preserve the environmental goods and services of the landscapes.

The existence of guiding documents of the country, such as the conceptualization of the Cuban economic and social model of development, the state program for facing climate change, the national and provincial environmental strategies and the objectives of sustainable development, contextualized for the country in the economic and social development plan until 2030, as well as science and innovation policies, constitute an opportunity and reference for the projection of sustainable territorial development.

Conclusions

Scaling up sustainable land management at the landscape level is essential for sustainable territorial development, particularly in the environmental management of Cuba's dominant agrarian landscapes. This approach is fundamental for the coordinated management of land resources and for the development of strategies to face climate change. By adopting it, the sustainability of the environmental goods and services provided by these geographic spaces is promoted, which improves the health and well-being of communities.

Sustainable land management has the power to cultivate well-tended, managed and structured landscapes that can adjust to inevitable territorial transformations without sacrificing the valuable cultural traditions of their residents. This approach aims at maintaining the physical and abstract elements of these landscapes, eliminating any polluting or disturbing factors that may threaten their heritage or compromise their ability to support the common welfare of communities.

To move forward in this direction, it is urgent to elaborate and implement territorial development strategies with a solid scientific and technological basis. These strategies must demonstrate a sustainability approach, including a holistic and ecosystemic vision, in terms of climate change adaptation and disaster mitigation management. From a multidisciplinary and interdisciplinary perspective, environmental issues must be addressed, which also attend to sustainable economic and social development, and integrate knowledge, dialogue and public participation in addressing technoscientific issues and environmental and territorial planning as pillars of the productive cycle.

Conflict of interests

The author declare that there is no conflict of interest.

Author's contribution

- Adrian Juan-Espinosa. Conceptualization, research, formal analysis, writing the original draft, corrections to the final version.

Bibliographic references

- Almagro, M.; Vente, J. de; Boix-Fayos, C.; García-Franco, N.; Melgares de Aguilar, J.; González, D. *et al.* Sustainable land management practices as providers of several ecosystem services under rainfed Mediterranean agroecosystems. *Mitig. Adapt Strateg Glob Change*. 21 (7):1029-1043, 2016. DOI: <https://doi.org/10.1007/s11027-013-9535-2>.
- Arenas-de-Mesa, A. & Cecchini, Simone. Igualdad y protección social: claves para un desarrollo inclusivo y sostenible. *El Trimestre Económico*. 89 (353):277-309, 2022. DOI: <https://doi.org/10.20430/ete.v89i352.1407>.
- Barton, J. R. Adaptación al cambio climático en la planificación de ciudades-regiones. *Rev. geogr. Norte Gd.* (43):5-30, 2009. DOI: <https://dx.doi.org/10.4067/S0718-34022009000200001>.
- Calle, Zoraida; Bloomfield, Gillian S; Santamaría, Saskia; Brancalion, P.; Ribeiro-Pinto, S.; González, Gabriela *et al.* Experiencias de fortalecimiento de capacidades para la restauración ecológica en América Latina. En: Eliane Cecon y D. R. Pérez, coords. *Más allá de la ecología de la restauración: perspectivas sociales en América Latina y el Caribe*. Buenos Aires: Vázquez Mazzini Editores. p. 35-367. https://elti.yale.edu/sites/default/files/rsource_files/libro_final_7-11_perspectivas_sociales_re.pdf, 2016.
- CEPAL. *Desarrollo territorial*. Santiago de Chile: CEPAL. <https://www.cepal.org/es/subtemas/desarrollo-territorial>, 2020.
- CEPAL. *La economía del cambio climático en América Latina y el Caribe. Síntesis 2009*. Santiago

- de Chile: CEPAL, Naciones Unidas. http://mundocasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/01_La_economia_del_cambio_climatico_-_Sintesis_2009.pdf, 2009.
- CEPAL. *Planificación para el desarrollo territorial sostenible en América Latina y el Caribe*. Santiago de Chile: CEPAL. <https://www.cepal.org/es/publicaciones/44731-planificacion-desarrollo-territorial-sostenible-america-latina-caribe>, 2019.
- CITMA. *Enfrentamiento al cambio climático en la República de Cuba. Tarea Vida*. La Habana: Ministerio de Ciencia Tecnología y Medio Ambiente. <http://financiamientoclimatico.cubaenergia.cu/index.php/descargas/8-folleto-tarea-vida/file>, 2017.
- Conde-Álvarez, Ana C. & López-Blanco, J. Coords. *Variabilidad y cambio climático. Impactos, vulnerabilidad y adaptación al cambio climático en América Latina y el Caribe. Propuestas para métodos de evaluación*. México: Instituto Nacional de Ecología y Cambio Climático. <https://biblioteca.semarnat.gob.mx/janium/Documentos/Ciga/Libros2013/CD002498.pdf>, 2016.
- Cordero-Cueva, F. Competencias y gestión territorial. *Memorias del VIII Simposio Nacional de Desarrollo Urbano y Planificación Territorial*. Cuenca, Ecuador: Austrocopy. <http://sndu.org/wp-content/uploads/2016/08/Libro-Memorias-VIII-Simposio-Naciona.pdf>, 2013.
- Cordoves-Sánchez, Minerva; Vallejos-Romero, A. & Hernández-Navarro, S. Dimensión social del paisaje como herramienta para la gestión de espacios naturales en entornos agrícolas. *X Congreso Ibérico de Agroingeniería*. España. <https://zagan.unizar.es/record/84526>, 2019.
- Eriogou, H.; Mevayekuku, E. D.; Echebiri, R. N.; Atama, A.; Amanze, P. C. & Olumba, U. M. Income diversification and sustainable land management practices among rural cassava-based farmers in Imo State. *J. Agric. Ecol. Res. Int.* 18 (3):1-14, 2019. DOI: <https://doi.org/10.9734/jaeri/2019/v18i330061>.
- Fernández-García, F. & Olay-Varillas, D. La planificación estratégica como instrumento de desarrollo territorial integral. *Ciudad y Territorio Estudios Territoriales*. LIII (208):285-310, 2021. DOI: <https://doi.org/10.37230/CyTET.2021.208.01>.
- Flores, E. R. Cambio climático: pastizales altoandinos y seguridad alimentaria. *Revista de Glaciares y Ecosistemas de Montaña*. 1 (1):73-80, 2016. DOI: <http://dx.doi.org/10.36580/rgem.il.73-80>.
- Frey, Marie-L. Geotourism—Examining tools for sustainable development. *Geosciences*. 11 (1):30, 2021. DOI: <https://doi.org/10.3390/geosciences11010030>.
- Galeas-Sosa, R. A. *Las prácticas de manejo sostenible de la tierra (MST) y su relación con la mitigación del cambio climático en los ecosistemas andinos tropicales*. Quito: Sede Ecuador, Universidad Andina Simón Bolívar. <https://repositorio.uasb.edu.ec/bitstream/10644/7338/1/T3212-MCCSD-Galeas-Las%20practicass.pdf>, 2020.
- Goites, E.; Tito, G. M.; Nugent, P.; Patrouilleau, Maria M.; Vitale-Gutierrez, J. A.; Perez, Martin A. *et al. Espacios agrícolas periurbanos: oportunidades y desafíos para la planificación y gestión territorial en Argentina*. Argentina: Ediciones INTA. <https://repositorio.inta.gov.ar/handle/20.500.12123/7740>, 2020.
- González-Acuña, V. H. & Soto-Velásquez, María E. Actores sociales en el ordenamiento y gestión territorial de los gobiernos locales del Perú. 30 (64):77-85, 2022. DOI: <https://dx.doi.org/10.15381/quipu.v30i64.24170>.
- Henry, G. & Hodson-de-Jaramillo, Elizabeth. Bioeconomía, modelo para un desarrollo territorial sostenible e inclusivo. En: A. Gaviria-Urbe, E. Manrique-Reol, F. Di-Palma, G. Poveda, S. Baena-Garzón, C. Duque-Beltrán *et al.*, eds. *Ciencia y tecnología: fundamento de la bioeconomía-Propuestas del foco de biotecnología, bioeconomía y medio ambiente*. Vol. 3. Bogotá: Universidad de los Andes, Ediciones Uniandes. p. 165-190. <https://agritrop.cirad.fr/597552/7/ID597552.pdf>, 2021.
- Hermida, M. & Manté, Mercedes. Los indicadores ambientales para la medición del desarrollo sostenible de Tierra del Fuego. 11 (1):1-27, 2019. DOI: <http://doi.org/10.22305/ict-unpa.v11i1.770>.
- IGT. *Atlas Nacional de Cuba "LX Aniversario"*. La Habana: Instituto de Geografía Tropical, CITMA. <https://atlas.geotech.cu/>, 2019.
- IPCC. *Cambio climático 2014. Informe de síntesis. Contribución de los Grupos de trabajo I, II y III al Quinto Informe de Evaluación del Grupo Intergubernamental de Expertos sobre el Cambio Climático*. R. K. Pachauri y L. Meyer, eds. Ginebra, Suiza: IPCC. https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full_es.pdf, 2014.
- Kryshstanovych, M.; Dzanyy, R.; Topalova, Elzara; Tokhtarova, Ilmira & Pirozhenko, Nataliya. Challengers to conceptual understanding of sustainable development regarding decentralization of power and responsibility in the conditions of the postmodern society. *Postmodern Openings*. 11 (3):257-268, 2020. DOI: <https://doi.org/10.18662/po/11.3/212>.
- Martínez-de-Pisón, E. Paisaje, cultura y territorio. En: J. Nogué, ed. *La construcción social del paisaje*. Madrid: Biblioteca Nueva, 2007.
- Martínez-Rivillas, A. Paisaje cafetero de la montaña de Ibagué, Colombia: un estudio ecológico a escala de geofacies y geotopos. *Cuad. Geogr. Rev. Colomb. Geogr.* 31 (1):65-87, 2022. DOI: <https://doi.org/10.15446/rcdg.v31n1.80997>.

- Mateo-Rodríguez, J. La ciencia del paisaje a la luz del paradigma ambiental. *II Taller sobre organización geográfica del paisaje*, 1997.
- Mateo-Rodríguez, J. M. La concepción sobre los paisajes vista desde la geografía. *Boletim de Geografia*. 24 (1):1-26, 2011. DOI: <https://doi.org/10.4025/bolgeogr.v24i1.12492>.
- Miranda-Paredes, Linda E.; Peñaherrera-Pachar, Paula B. & Jorge-Patiño, A. N. Paisajes rurales: identificación y caracterización de componentes de paisaje. Parroquia Cotaló. Tungurahua. *Módulo Arquitectura-CUC*. 28 (1):157-188, 2022. DOI: <https://doi.org/10.17981/mod.arq.cuc.28.1.2022.05>.
- Montero, R.; Pimentel, A.; López, P.; Montejo, L.; Aguilar, R.; Fumero, M. & Primelles, J. *Plan de manejo sostenible de tierras. Finca El Alacrán*. Camagüey, Cuba: CIMAC, 2018.
- Morales, Cielo; Pérez, Roxana; Riffo, L. & Williner, Alicia. *Desarrollo territorial sostenible y nuevas ciudadanías: consideraciones sobre políticas públicas para un mundo en transformación*. Santiago de Chile: CEPAL. <https://www.cepal.org/es/publicaciones/46579-desarrollo-territorial-sostenible-nuevas-ciudadanias-consideraciones-politicas>, 2021.
- Morea, J. P. Modelos de desarrollo y soberanía en América Latina: Una visión desde la gestión territorial. *Geopolítica*. 11 (1):71-93. <https://ri.conicet.gov.ar/handle/11336/174415>, 2020.
- Moreno-Trujillo, Eulalia. El paisaje agrícola como patrimonio cultural: bases legales para un análisis crítico. *Rev. int. doctrina jurisprud.* (18):1-22, 2018. DOI: <http://dx.doi.org/10.25115/ridj.v0i18.1907>.
- Noboa-Salazar, J.; Vergara-Romero, A.; Sorhegui-Ortega, R. & Garnica-Jarrin, Lisette. Repensando el desarrollo sostenible en el territorio. *RES NON VERBA REVISTA CIENTÍFICA*. 11 (1):19-33, 2021. DOI: <https://doi.org/10.21855/resnonverba.v11i1.500>.
- Planos-Gutiérrez, E. O.; Guevara-Velazco, A. V.; Rivero-Vega, R.; Pérez-Suárez, R.; Centella-Artola, A.; Fernández-Richelme, A. *et al.* Impacto del cambio climático y medidas de adaptación en Cuba. *AACC*. 5 (3):1-9. <https://revistaccuba.sld.cu/index.php/revacc/article/view/247>, 2015.
- Primelles-Fariñas, Josefa; Iglesias-Moronta, Roselia & Cabezas-Andrade, R. Manejo sostenible de tierras para la adaptación al cambio climático en la comunidad La Gloria, Camagüey. *Agrisost*. 26 (2):1-10. <https://revistas.reduc.edu.cu/index.php/agrisost/article/view/e3104>, 2020.
- Quispe-Lifonzo, H. H. *Gestión territorial descentralizada orientado a resultados y la creación del valor público en el Gobierno Regional de Lima, 2017*. Tesis para optar el grado académico de Doctor en Gestión Pública y Gobernabilidad. Lima: Universidad Cesar Vallejo. <https://repositorio.ucv.edu.pe/handle/20.500.12692/32153>, 2019.
- Quispe-Ojeda, T. C. La agroecología como alternativa para el desarrollo sostenible y sustentable. *CIENCIAMATRIA*. VII (14):34-45, 2022. DOI: <https://doi.org/10.35381/cmv8i14.605>.
- Ramírez-Iglesias, Elizabeth; Cuenca, K. & Quizpe, W. Manejo integrado de agroecosistemas en América Latina: Una opción para maximizar la producción resguardando la biodiversidad. *TEKHNE*. (23):1-11. <https://revistasenlinea.saber.ucab.edu.ve/index.php/tekhne/article/view/4472/3713>, 2020.
- Río-Pedregosa, J. M. del. *El espacio rural: el paisaje agrario, la comarca de La Alpujarra Granadina y su proyección didáctica*. Máster en Profesorado de Enseñanza Secundaria Obligatoria, Bachillerato, Formación Profesional y Enseñanza de Idiomas. España: Universidad de Jaén. https://crea.ujaen.es/jspui/bitstream/10953.1/11484/1/DELRO_PEDREGOSA_JUANMANUEL_TFM_GEOGRAFIAEHISTORIA%20%281%29.pdf, 2019.
- Rodríguez-Seijo, I. *La preparación del docente de la especialidad Agropecuaria para dirigir el desarrollo de las habilidades profesionales básicas de los técnicos de nivel medio en Agronomía desde una concepción agroecológica y sostenible*. Tesis presentada en opción al grado científico de Doctor en Ciencias Pedagógicas. Villa Clara, Cuba: Departamento de Agropecuaria, Facultad de Ciencias Técnicas, Universidad de Ciencias Pedagógicas "Félix Varela". <https://dspace.uclv.edu.cu/items/de372d83-f997-4edc-a6bf-a13113d07c14>, 2012.
- Salinas-Chávez, E.; Mirandola-García, Patricia H.; Barros, M. H. de S. & García, L. da R. N. El estudio de los paisajes como fundamento para la evaluación del potencial turístico del municipio Paranaíba, Ms, Brasil. *Gran Tour, Revista de Investigaciones Turísticas*. (19):79-102. <https://eutm.es/grantour/index.php/grantour/article/view/91>, 2019.
- Suárez, J.; Martín, G. J.; Sotolongo, J. A.; Rodríguez, E.; Savran, Valentina; Cepero, L. *et al.* Experiencias del proyecto BIOMAS-CUBA. Alternativas energéticas a partir de la biomasa en el medio rural cubano. *Pastos y Forrajes*. 34 (4):473-496. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-03942011000400007&lng=es&tlng=es, 2011.
- Urquiza-Rodríguez, María N.; Alemán-García, C.; Flores-Valdés, L.; Ricardo-Calzadilla, Marta P. & Aguilar-Pantoja, Yulaidis. *Manual de procedimientos para el manejo sostenible de tierras*.

- La Habana: CIGEA. <https://repositorio.geotech.cu/xmlui/handle/1234/2934>, 2011.
- Verburg, P. H.; Metternicht, G.; Aynekulu, E.; Deng, X.; Herrmann, S.; Schulze, K. *et al.* *The contribution of integrated land use planning and integrated landscape management to implementing land degradation neutrality entry points and support tools*. Bonn, Germany: United Nations Convention to Combat Desertification. <https://www.unccd.int/sites/default/files/2023-09/UNCCD%20Integrated%20Land%20Use%20Planning-rev.pdf>, 2022.
- Viguera, Bárbara; Alpizar, F.; Harvey, Celia A.; Martínez-Rodríguez, M. Ruth; Saborío-Rodríguez, Milagro & Contreras, Lucía. Percepciones de cambio climático y respuestas adaptativas de pequeños agricultores en dos paisajes guatemaltecos. *Agron. mesoam.* 30 (2):313-331, 2019. DOI: <https://doi.org/10.15517/am.v30i2.33938>.