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Sustainable Land Management for Adaptation to Climatic change in La Gloria Community, Camagüey

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Abstract

Context: Despite the development priority given to sustainable agriculture, and having the methodological resources for Sustainable Land Management (SLM), implementation is slow, which is caused by the implementation of non-conservationist practices, and the impacts of climate variability and change. The existing information refers to the practical experiences of SLM in particular sites, though the challenges of the process of management innovation are dealt with less frequently.
Aim: To optimize the design and implementation processes of SLM plans, for adaptation to climatic change on La Gloria community farms.
Methods: Participatory research-action, engaging observation, in-depth interview, literature review, and SLM, climatic change approach integration, along with other approaches of sustainability and innovation management.
Results: The synergistic effect of SLM approaches and adaptation to climatic change for sustainability in agriculture are evidenced locally, and improvements are made to the SLM plan design and implementation processes, for adaptation to climatic change.
Conclusions: The methodological approach implemented allows for the integration of R + D+ +i, science and technology management. The creation of farmer and specialist capacities enhance the synergistic effect needed for sustainability in sustainable land management, and adaptation to climate variability and change in local farming practices, which have been evidenced in nature-based solutions adopted by the farmers.

Key words: climatic variability, climatic change, sustainable land management.

Introduction

A fundamental analysis in sustainable land management is related to the impacts of variability and climatic change on ecosystems, natural resources, and the social and economic sectors.

Climate science research has reported variations in relation to average temperature increases every year, a rise in the mean level of the sea, variations in precipitations, a significant increase and extension of droughts, and changes in water availability (Planos, Rivero & Guevara, 2012).

These manifestations are becoming more frequent, and in addition to the island condition, increase the number of accumulated environmental problems in the country. Among them are soil degradation, reduction of agricultural yields, lower water resources, salinization of ground waters, and deterioration of environmental quality, with a direct impact on sustainable economic and social development.

In this context, it is important to develop a new way of thinking in relation to land resources use, by introducing sustainability-carrier tools that assist in this purpose. One of them is Sustainable Land Management (Urquiza et al., 2011). However, its implementation has been slow if compared to the need for extension, as a result of non-conservationist farming practices, and the impacts of climatic variability and change.

Regarding SLM, the international experience mostly refers to interesting experiences in the application of good practices in particular areas, though less is discussed on the challenges faced by SLM implementation in productive areas, in order to extend the application in agroecosystems, and speed up the expected results. Urquiza et al. (2011); World Environmental Fund (2014); Association Program of Country in Sustainable Land Management (2008); United Nations Food and Agriculture Organization (2016); Cuellar et al. (2015).

Multiple opportunities are offered by the program referents in the country to elevate the efficacy of SLM, among them, the Program of the Republic of Cuba to Fight Climate Change (Ministry of Science, Technology, and the Environment, 2017).

The National Plan of Economic and Social Development (PNDES, in Spanish) toward 2030 (Communist Party of Cuba, 2017) has the purpose of "Assuring the conservation, protection, and rational use of natural resources, and adaptation (including risk prevention), and mitigation actions of climatic change impacts, so that the relation with nature and the environment becomes a factor contributing to sustainable and prosperous social and economic development", which is a challenge and opportunity to move toward sustainability in food production.

Likewise, the Goals of Sustainable Development (GOS) contextualized in the country are challenges and opportunities, particularly goals 2, 13, and 15, to eliminate hunger and promote sustainable agriculture, fight climatic change and its effects, and to protect the resources from the land and ecosystems, altogether (United Nations, 2015).

The aim of this paper was to optimize the design and implementation processes of SLM plans, for adaptation to climatic change on eight farms in La Gloria community. Results: Analysis of the synergistic effect of adaptation to climatic change and SLM approaches for sustainability in agriculture, locally, and improvements to SLM design and implementation processes oriented to adaptation and climatic variability and change.

Materials and Methods

A review of the literature and existing background in this topic were the cornerstone in the reflection of the synergistic effect of sustainable land management and climatic variability and change adaptation approaches, as well as challenges and opportunities, on sustainability in the local agriculture, offered by the national programs, and R+D+I projects, and the need to acknowledge the challenges confronted by SLM process in the production areas.

The case study presented in the second selection, on improvements of design and implementation of SLM plans for adaptation to climatic change on La Gloria Community farms was done from a qualitative study perspective, with participatory observation, and participatory research-action, which enabled active involvement of farmers and specialists in different local science and innovation entities through a productive exchange of experiences.

In-depth interview was done to farmers and community leaders (twelve); it helped identify the needs of the community, including the need for learning.

The manual of proceedings for sustainable land management (Urquiza et al., 2011) was the basic element for diagnostic and design of SLM plans on the farms.

Other methodological proposals for farming extension, science and technology management, people education, and participatory workshops helped in the innovating process.

Results and discussion

The contemporary problem of food production has evolved from a merely technical dimension to more social, economic, political, cultural, and environmental dimensions, centered on sustainability in agriculture (Altieri & Nicholls, 2000, p. 14).

The concept of sustainable agriculture has become prominent in research, politics, and practice. The goal of sustainable agriculture is to balance the economic, environmental, and social aspects of agriculture, creating a long-term resilient agricultural system. In recent decades, several concepts have been used in research and politics to encourage the adoption of sustainability practices in agriculture (Rose *et al*, 2019).

The report of the United Nations Organization for Food and Agriculture (2016), specifies that sustainability in Cuba requires higher agro environmental culture by all the people; to know environmental changes and tendencies; continue to use scientific knowledge for sustainability; ensure the prevalence of the ecosystemic approach on the sectoral approach; prevent and reduce present and future vulnerabilities and risks in the Cuban archipelago; and continue to fight pollution systematically and with a high priority.

In the last decades, the Cuban agricultural model moved from an form of agriculture depending on high inputs, especially regarding investments and equipment, from external sources, that showed signs of exhaustion since the second half of the 1980s, to a low-input model under pressure during the special period, with drastic impacts on production yields and levels (Machín, Roque, Ávila & Rosset, 2016).

The predominant cooperative model today, with sustainability approaches, was favored with the distribution of lands among individual farmers, since 2008. This process is inserted in the nation's strategy to increase efficiency of food production by area unit.

In the current global context, the challenge posed by climatic change has a special significance due to the threat of impacts on life on the planet. Thus, the adaptation approach becomes a priority, especially to small islands.

The future climate of Cuba is estimated to become more arid and extreme, characterized by prolonged and frequent drought events, and severe water shortages. The dry landscapes in the eastern part of the country will intensify, and advance progressively to the west, producing a change from humid tropical climate to dry sub-humid, threatening with desertification processes. The current climatic trends, and the most probable scenarios for the next 100 years will lead to deterioration of the overall environmental quality, as a result of decreased water potential regionally, the loss of land in low coastal areas, soil degradation, decreased agricultural yields of staple crops..." (Planos, Rivero & Guevara, 2012

In face of that scenario, the synergistic effect of sustainable land management approaches, and adaptation to climatic variability and change to reach sustainability in agriculture in Cuba, is undeniable.

Among the factors that reinforce manifestations of climatic variability and change, and limit the national production of basic foods are, non-conservationist farming practices, such as inadequate use of farming machinery, irrigation systems, and pesticides, along with inappropriate residue management, which promotes soil degradation, decreased water availability and quality, and negative effects on biodiversity and environmental services from agroecosystems.

Additionally, low levels of cropland use, low productivity, and accelerated growth of water demand in the sector. There is no correspondence between the results of accumulated research and the productive and economic results (Funes, 2008), all of which leads to the thought of existing reserves in terms of innovation

These insufficiencies, aggravated by the restrictions imposed by the US blockade that has affected the purchase of transportation means, fuels, equipment, inputs for agriculture, and information, limit the capacity for adaptation, and increase the vulnerabilities of agriculture under the effects of climatic variability and change.

Accordingly, the Ministry of Agriculture (MINAG, in Spanish) has design the Program to Fight Climatic change in the sectors of agriculture and forestry, and manages the National Program to Fight Desertification and Droughts, and the Agrarian Network of Climatic Change (RACC, in Spanish), that connects the work of all the scientific institutions of MINAG, and other ministries related to agriculture and forestry.

The importance of integrated approaches to fight soil degradation is discussed in the Global Status Report on the Environment Fund, Fight against Soil Degradation in Productive Landscapes (2014). The analysis stresses on the important of processes, practices, tools, and knowledge innovation, materialized in several projects and programs that demonstrate the added value of these approaches related to the protection of ecosystem services when efforts are made to improve the living standards of communities, through sustainability management, and rational use of environmental resources.

The report notes that integrated ecosystem management (IEM) and sustainable land management (SLM) make the proper setting to link land management to water management, climatic change, conservation of the biological diversity, mitigation of poverty, and sustainable development.

The introduction of sustainability approaches in smaller areas is not enough, the extension of farming ecosystems is also required. The implementation of SLM plans directed to climatic variability and change at the level of productive bases is a demand, but also a huge challenge.

The improvement of the process of design and implementation of these plans requires the inclusion of other sustainability approaches, such as ecosystemic vision, integrated management of land resources, projection of sustainable social and economic development, land use planning, and environmental and territorial arrangement, as essential elements of the productive cycle, engagement and empowering of women in sustainable development management, consensus and intersectoral coordination, community self-coordination, and integrated management.

Insufficient knowledge management is identified as one of the main barriers to the implementation of sustainable land management (Cuellar et al., 2015). There is a pressing need to continue to gather and provide knowledge on innovation, considering innovation a complex process, especially in agriculture, in which multiple actors must integrate knowledge wisely, including the critical role of farmers.

In that sense, scientific-technological management in the frame of Research-Development-Innovation (R+D+I) projects offers opportunities for innovation management to favor sustainable agriculture in the productive bases of the country. There are several examples of the contribution of various national, international, territorial projects to sustainability in agriculture, such as the Project Environmental Bases for Local Food Sustainability (BASAL in Spanish), the Program of National Association for Sustainable Land Management (CPP-OP15), that supports the National Program to Fight Desertification and

Droughts in Cuba, and the experience of soil, water, and forest preservation plots.

The implementation of R+D+I projects not only involves the organization of financial resources, but also an important number of specialists from different scientific and technological disciplines and organizations with the capacity of integrating and accompanying farmers in the task of designing and implementing SLM with and adaptation approach to climatic variability and change.

However, there are still multiple barriers to achieve successful development of these projects in agriculture, which are associated to objective and subjective limitations of the variety of actors engaged.

Identifying and determining these barriers is a relevant task, considering the contribution of R+D+I projects to experimental areas, which might help with the extension of sustainability approaches in agricultural and forestry ecosystems, the most extensive in the country, thus ensuring the ecologic viability of adjacent natural and semi-natural areas, which otherwise would be further isolated.

A diagnostic of the situation of land resources, both natural and socio-economic is necessary, with a multidisciplinary and multisector perspective (Urquiza et al., 2011), as well as the development of communicational skills that promote technical discussions among farmers and specialists that validate the results. A well-argumented diagnostic favors the identification of technological actions and solutions to be included in the SLM plan oriented to variability adaptation, and climatic change in the production units.

Resolution 6/2017 issued by the Environmental Agency acknowledges Sustainable Land Management and economic incentives designed today promote sustainable land management in Cuban agriculture. The productive bases that sustainable land management implements have comparative advantages to access SLM categorization.

Case study Sustainable land management actions for adaptation to climatic variability and change on community farms in La Gloria

La Gloria community is located on the north coastal line of Camagüey, one of the most vulnerable areas in the country to climatic change. Farmers have faced limitations in terms of sustainability of their productions, due to soil degradation and aridity, low index of trees, insufficient water and irrigation systems availability, and poorly diversified production.

Project “Strengthening Good Practices of Sustainable Land Management for Adaptation to Climatic Change in La Gloria Community”, which lasted three years (2017-2019), was coordinated by the Center for Environmental Research of Camagüey (CIMAC), and funded by the Small Donations Program (SDP), of UNDP, and the National Fund for the Environment (FNMA in Spanish).

Eight farms from Camilo Cienfuegos CCS (cooperative of credits and services) with a total extension of 210.6 ha, and engaged in the production of various crops and smaller livestock, were part of the project (**Fig. 1**).

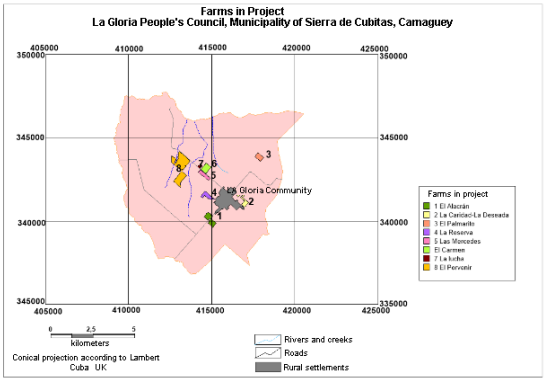

Fig. 1. Farms of La Gloria Community project.

Although sustainable land management plans were not initially intended for adaptation to climatic variability and change on the farms, this idea was developed from the start of the project, based on the consideration that it was an effective way to meet the goal of introducing 100 ha under the SLM approach in the mid-term.

The limited time of the project, and the need of sustainability, sustained the priority that each farmer could have a SLM plan. Hence, work was focused on improvements to the process and design of SLM plan implementation in productive units of the community, based on the integration of the adaptation approach to climatic variability and change, and other approaches of sustainability, management of a more participatory and integrated process by farmers, stressing the role of innovation management, and technical discussions, as the basis for the creation of capacities.

The key improvement moments were,

- Identification of the felt needs of the inhabitants of the community.
- Awareness creation and planning of activities.
- Participatory and multidisciplinary diagnostic.
- Selection of SLM actions for implementation, and creation of the SLM Plan with an adaptation approach to climatic variability and change.

- Contextualization, implementation, and follow up of SLM actions.
- Socialization of results.

Training was transversal throughout the process. Adequate engagement of specialists from R+D+I organizations into the community, which enabled a more concerted effort by a group of experts in topics like sustainable land management, science and technology management, agricultural extension practices, soil conservation and improvement, irrigation and draining, plant nutrition, reforestation, popular education, and so on.

The participating organizations, under different modalities (projects, scientific-technological services, counseling, collaboration, etc.) were the Center for Environmental Research in Camagüey, the provincial branches of the Soil institute, and Agricultural Research and Engineering in Camagüey, the Scientific and Technology Unit of CITMA, the Weather Center in Camagüey, and the Ministry of Agriculture in the province and the municipality. Other science, technology-innovation, and local scientific and technological associations, such as ACTAF and ANAP contributed with training actions.

The experience of a group of experts from the Soil Institute of Camagüey with the local farmers, and SLM experimental areas in the province, favored soil diagnostic, SLM plan design on the farms, and the leadership of experts in the implementation of soil conservation and improvement actions. Meanwhile, specialists from the Institute of Agricultural Engineering Research contributed to the extension of sustainably irrigated areas.

Researchers and specialists from the Center for Environmental Research in Camagüey, and the Science and Technology Unit contributed with their environmental knowledge, biodiversity, environmental arrangement, sustainable development, science and technology management, and others.

Detailed knowledge of the municipality by technicians and specialists from the Ministry of Agriculture in Sierra de Cubitas has been a work opportunity for such important tasks as reforestation in those areas.

The innovating process derived from the felt needs of the inhabitants of La Gloria, focused on food safety, sustainability of farming, and water access, within the context of climatic change.

Awareness and planning included the active engagement of farmers on each location, as well as researchers and specialists. Depending on the complexity of the activities, several modalities were adopted, including participatory workshops.

The diagnostic of land resources on each farm was done from a multidisciplinary and multisector perspective. It included climatic, edaphic, hydrological, biodiversity, socioeconomic, and agroproductive characterization of each location, their strengths and weaknesses, which differed in every case.

Among the most common strengths observed are stability of labor, and the innovating capacity of farmers, whereas the main weaknesses were associated, among others, to the natural restrictions of each location, insufficient organic residue processing, and the utilization of green fertilizers as a measure to improve soils, the absence of power alternatives: solar, biological, and wind, under exploitation of fields, no irrigation based on weather forecasts, and shortages of proper farming tools for tilling.

The diagnostic was the basis for the identification and selection of actions and technologies on each farm, mostly natural (NbS), and agroecology, to design SLM plans for adaptation to climatic variability and change.

The SLM plan for adaptation to climatic variability and change is dynamic and under continuous optimization, according to new knowledge and technologies available, and the changing conditions of the environment, which can provide knowledge to farmers of where to and how to advance in the sustainability of agricultural practices.

These actions were organized according to the structured recommended by Urquiza et al. (2011): local arrangement; alternatives for area preparation; crop selection; varieties and species; water management alternatives; adequate agrotechniques; proper methods for ecosystem management; economic use of residuals or power and economic control.

The actions in the SLM plans, innovating by nature, are intended to offer sustainable use of essential resources like water, soil, biodiversity, the introduction of farming technologies that maximize yields depending on the agroecology in the changing conditions of climate, the strengthening of food safety in the community, and the reduction of vulnerabilities in face of extreme events. Generally, comprising the sustainable land management approach, and adaptation to climatic variability and change converge in them.

The contextualization of SLM actions on every area, and active engagement of farmers from the diagnostic stage favored empowering and technological assimilation, as well as effective implementation, reinforced by the participation of experts.

Some of the good practices and technologies implemented as part of the plans for farms are,

- Diversification of agricultural production, and introduction of more resistant varieties to the local agro-meteorological conditions.

- The application of soil improvement and conservation technologies in 20 ha (application of organic matter, green fertilizers, and stalks, crop rotation, animal traction, live and dead barriers, and neighboring sowing).
- Application of biofertilizers in 32 ha
- Efficient water management and use for irrigation based on the installation of three irrigation systems by sprinkling covered 21 ha.
- The elimination of invading species (EIS) in more than 60 ha, through manual methods, and goat grazing, to recover farming areas.
- Technology for goat breeding on raised flooring, under mechanical milking.
- Reforestation, with more than 30 ha planted with wood and fruit species.
- Protected cultivation houses.

Plan implementation follow-up revealed that at the end of the project, the farms with advanced SLM implementation fulfulled 40-50% or more. These farms were El Alacrán, La Deseada-La Caridad, Las Mercedes, El Carmen, La Lucha, and El Porvenir, accounting for 174.39 ha of lands under SLM, according to Urquiza et al. (2011).

El Alacrán was given the condition SLM Initiated Land, by CITMA Environmental Agency. The creation and presentation of the technical record to apply for such condition was endorsed by the previous existence of the diagnostic in the location, SLM Plan, and gradual implementation of actions.

When new advances in the completion of new SLM actions are achieved in the production areas (35% completion), the number of initiated lands can increase, taken into account that the total extension of the eight farms is 210.60 ha.

The preparation of farmers, technicians, and specialists, depending on their expressed demands, and the demands presented as a result of innovating practices foreseen in their SLM plans, was a critical support for the introduction of new technologies in an environment where every one learns.

In farmer technological promotion, any practical experience is better than dealing with topics in short courses and leaflets, as has been the case (Quintana & Cardentey, n.a.). In keeping with that idea, the main modalities used were technical discussions and creation of awareness, and customized field training.

The main topics addressed were impacts of climatic change, conservation, and soil improvement, utilization of biofertilizers, forest-grazing systems, green fertilizers, agroecology, management of water for irrigation, sustainable land management plans, technology for goat breeding in pens, reforestation, protected cultivation technology, practical norms for food manufacturing, multipurpose autochthonous microorganisms (MAM).

The stages of diagnostic, design, and implementation of the actions in the SLM plan were not conceived linearly, but overlapped. It ensured progress from the onset of the project, in the implementation of a group of SLM actions through a successive approximation process.

The project has favored the socialization of results through related discussions among community, provincial, and national farmers. Farmers and specialists presented their experiences in several different meetings, including: The Knowledge Fair on Science, Community, and Sustainability for Life; II National SLM Workshop; national goat breeder discussions; discussions on protected cultivation houses; gender lenses; discussions with farmers with Güira de Melena; Discussions with BASAL Project members; ECOVIDA, CITATENAS, Agro development, The Soil Conference, and others.

The environmental impacts of the results are seen in the progress made toward food safety on agroecological bases; valuation and diversity of the agrarian landscape of the community, and the promotion of experimental areas that encourage the need to innovate in order to make sustainable use of resources, and face climatic variability and change.

The increase of climatic risk perception through training, was reinforced by the experience of living through hurricane Irma, which caused a strong negative impact on the location. This experience led to understanding the need for adaptation to climatic variability and change through good SLM practices.

In the mid and long-terms, new positive impacts in the restoration of natural resources and the agrarian ecosystem can be attained based on the sustainability of the innovating process, which has been favored by the existence of SLM plans with an adaptation to climatic variability and change approach.

The economic impacts are seen in the increase of production and yields, and contribute to a raise in community food safety. The economic indicators of cooperative Camilo Cienfuegos showed a stable production increase in 2015-2018, except for fruit trees, which were struck by hurricane Irma. Likewise, there was a rise in the annual income during this period. The eight farms included in the Project, accounting only 6% of the productive potential of the CCS, contributed with 10% of the cooperative's income, with a 6% annual increase of productions.

Household income on the farms within the innovating process was 6% on average, when productions and yields began to rise. This value is significant, considering the priorities given to nature-based solutions that favor farming sustainability on the locations.

The innovating process also favored the funds granted by the Program of Small Donations (PSD) of UNDP, and the National Fund for the Environment

(FNMA), that enabled the purchased of technology, aids, supplies, and scientific-technological services that have strengthened the productive potential on the farms.

The social impact of this innovating process is evidenced by increased income and food safety of farm households engaged, and the increase of a sustainability culture among farmers, and the recognition of the need and possibility of participating in innovation projects, and hold discussions of best experiences.
The innovative process contributed to a reduction of gender differences by encouraging farmer women engagement, from training to implementation of good practices and technologies. Women have presented their results in fairs, national workshops, discussions, and media presentations.

Conclusions

The synergistic effect of sustainable land management approaches, and adaptation to climatic variability and change on the sustainability of local farming practices was corroborated.

The contribution of R+D+I projects and science and technology management, and the creation of capacities for farmers and specialists, the design and implementation of SLM plans for adaptation to climatic variability and change, and the promotion of experimental areas that encourage the other farmers in rural communities, were aknowledged.

The methodological approach done to introduce improvements to the process of design and implementation of SLM plans for adaptation to variability and climatic change, has been validated, thus shortening the time for design and implementation, and ensuring quality.

The good practices implemented, and the ones to be implemented, are mainly based on natural solutions (NbS), and agroecology, as part of a farming model with low external dependence, looking to sustainability.

The results are a response, at a community scale, of a claim made by the nation to extend SLM areas, and fight climatic change. They have contributed to greater food safety, community resilience, and the capacity of their inhabitants to protect land resources, and adapt to climatic variability and change as the basis for sustainable agricultural practice.

Author contribution

Josefa Primelles: design of research, surveys, and interviews, field work, information processing, redaction of the manuscript, and final review.

Roselia Iglesias Moronta: design of research, surveys, and interviews, field work, information processing.

Roberto Cabezas Andrade: design of research, surveys, and interviews, field work, information processing.

Conflicts of interest

Not declared.

References

Altieri, M., & Nicholls, C. I. (2000). Capítulo 1. Bases Agroecológicas para una Agricultura Sustentable. *Agroecología. Teoría y práctica para una agricultura sustentable.* (pp. 13-43). México: Programa de las Naciones Unidas para el Medio Ambiente. Retrieved on June 20, 2019, from: http://www.agro.unc.edu.ar/~biblio/AGROECOLOGIA2%5B1%5D.pdf

Cuellar, E. de la C., Fresneda, C., Rivero, C. J., Thompson, M., Sánchez, G., & González, Y. (octubre-diciembre, 2015). Plan de manejo sostenible de tierra para la producción de leche en la UBPC Aguadita, Cienfuegos, Cuba. *Pastos y Forrajes*, *38*(4), 448-456. Retrieved on June 20, 2019, from: https://www.redalyc.org/pdf/2691/269143377009.pdf

Fondo del Medio Ambiente Mundial (FMAM). (2014). *Lucha contra la degradación de las tierras en paisajes productivos.* [s.l.]: Editores Publications Professionals LLC. Retrieved on May 10, 2019, from: https://www.thegef.org/sites/default/files/publications/GEF_LandDegradation_CRA_SPA_0.pdf

Funes Aguilar, F. (2008). *La agricultura orgánica en Cuba. Papel de la ACTAF y su VII Encuentro La Habana 2008.* La Habana: ACTAF. Retrieved on June 20, 2019, from: https://www.agroecologia.net/recursos/publicaciones/publicaciones-online/2009/eventos-seae/cds/congresos/actas-bullas/seae_bullas/verd/sesiones/13%20S4B.%20AME.LATINA/S3D1.pdf

Machín, B., Roque, A. M., Ávila, D. R., & Rosset, P. M. (2016). *Transformaciones de la agricultura cubana.* Retrieved on May 26, 2019, from: https://www.grain.org/article/entries/5603-transformaciones-de-la-agricultura-cubana

Ministerio de Ciencia, Tecnología y Medio Ambiente. (2017). *Enfrentamiento al cambio climático en la República de Cuba.* La Habana: Autor. Retrieved on May 26, 2019, from: http://repositorio.geotech.cu/jspui/bitstream/1234/2864/1/Plan%20de%20Estado%20para%20el%20Enfrentamiento%20al%20Cambio%20Clim%C3%A1tico%20en%20la%20Rep%C3%BAblica%20de%20Cuba%20%28Tarea%20Vida%29.pdf

Organización de Naciones Unidas para la Alimentación y Agricultura – FAO. (2016).

Análisis y diagnóstico de políticas agroambientales en Cuba. La Habana: Autor. Retrieved on September 10, 2019, from: http://www.fao.org/3/a-i5559s.pdf

Organización de Naciones Unidas. (2015). *Objetivos de Desarrollo Sostenible.* Retrieved on May 26, 2019, from: http://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/

Partido Comunista de Cuba. (2017). Bases del Plan Nacional de Desarrollo Económico y Social hasta el 2030: Visión de la Nación, Ejes y Sectores Estratégicos. En *Documentos del 7mo. Congreso del Partido aprobados por el III Pleno del Comité Central del PCC el 18 de mayo de 2017 y respaldados por la Asamblea Nacional del Poder Popular el 1 de junio de 2017*. (Tabloide Especial). La Habana: Autor.Retrieved on May 7, 2019, from: http://repositorio.geotech.cu/jspui/bitstream/1234/2723/1/Bases%20del%20Plan%20Nacional%20de%20Desarrollo%20Econ%C3%B3mico%20y%20Social%20hasta%20el%202030.pdf

Planos Gutiérrez, E. O., Rivero Vega, R. & Guevara Velazco, V. (eds.). (2012). *Impacto del Cambio Climático y Medidas de Adaptación en Cuba*. La Habana: CITMA. Retrieved on May 26, 2019, from: http://www.redciencia.cu/geobiblio/paper/2012_Planos_Impacto%20y%20Adaptacion,%20Libro.pdf

Quintana O., & Cardentey, I. (s.f.). *La agricultura sostenible como vía de desarrollo en Cuba.* Retrieved on May 28, 2019, from: https://www.monografias.com/trabajos36/agricultura-cuba/agricultura-cuba.shtml

Rose, D. C., Sutherland, W. J., Barnes, A. P., Borthwick, F., Ffoulkes, C., Hall, C.,… Dicks, L. V. (2019). Integrated farm management for sustainable agriculture: Lessons for knowledge exchange and policy. *Land Use Policy, 81* (2019), 834-842., doi: https://doi.org/10.1016/j.landusepol.2018.11.001

Urquiza, M. N., Alemán C., Flores L., Paula, M., & Aguilar, Y. (2011). *Manual de Procedimientos para Manejo Sostenible de Tierras.* La Habana: CIGEA. Retrieved on December 2, 2019, from: http://repositorio.geotech.cu/jspui/bitstream/1234/2934/1/manual%20manejo%20sostenible%20de%20tierra.pdf

Appendix. Images showing the development of the innovating process.