Agrobiodiversity in Cuban home gardens from the rural areas

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The biodiversity maintenance by farmers in home gardens is a type of *in situ* conservation of plant genetic resources, which has the advantages of preserving the evolution processes and adaptation of crops in their microenvironments, and to conserve the diversity at all levels (ecosystem, species and genes) (Jarvis 2000; Eyzaguirre & Linares 2001). In this context some researches were conducted to promote the use and develop of the rural home gardens for the *in situ* conservation of the agricultural biodiversity in Cuba, demonstrating the value of them in the maintenance of the diversity through their use.

The research work was performed with the participation of 39 home gardens from western, central and eastern regions of Cuba. The selected families live in the nucleus or in the periphery of the protected areas: Reserves of the Biospheres "Sierra del Rosario" (western region) and "Cuchillas del Toa" (eastern region). The members of the communities of these areas have received an environmental education adressed to the conservation of the wild flora and fauna of the locations. In the case of the central region the communities of the selected area have a strong influence of the Botanical Garden of Cienfuegos, the oldest in the country, been founded in 1901, and meets both, the conservation and training functions in the region. Interviews were carried out mainly with the owners for gathering information concerning to genetic resources, and social, cultural and economical aspects related to them.

The possibilities of integration of the genetic resources *in situ* conservation of cultivated plants, with that of the wild flora and fauna of each region, and educational national programs, was one of the aspects that was considered during the development of the work.

Inventory of the agrobiodiversity and their use

The inventory revealed the existence of 508 species that belong to 352 genus and 108 families. Around 80% of the diversity corresponds to cultivated species and the rest to wild species used by the families.

The study of the diversity showed the presence of seven cultivated species in the home gardens that had not been reported in the last inventory of cultivated plants carried out in Cuba (Esquivel *et al*. 1992). An outstanding detail was the presence of three endemic species: *Protium cubense*, *Garcinia aristata* and *Piper aduncum* subsp. *ossanum*, maintained and used as condiments in some home gardens from the eastern region.

Only 25% of the total diversity registered is common (coincidence of species) among the three studied regions, being this, an indicator of their differences. There was less number of species in the eastern region, in comparison with the rest of the study areas; however, it had more infraespecific variability.

The isolation and the difficult access of the area located in the eastern region, and also some social and cultural features (strong Haitian influence), differentiate the eastern region of the rest of the communities of the Island, and this, have an implication on the agricultural management of the species. Roots and tubers are of wider acceptance that in the rest of the regions and a bigger variability has been observed in those species; an example is yam (*Dioscorea* spp.), whose cultivation is characteristic of that region. On the other hand, the farmers from this region also cultivate and consume more species of grains; so there, the variability is very high (*Phaseolus vulgaris*, *Phaseolus lunatus*, *Cajanus cajan*, *Zea mays* and *Vigna umbellata* are the most frequent), with regard to the other two study regions.

The results confirmed that the registered cultivated diversity in the studied home gardens, is distributed among the three studied regions, constituing this, the starting point to analyze these areas like possible Minimum Effective Units of *In Situ* Conservation of Plat Genetic Resources in Cuba.

The ornamental species occupy an important place in the home gardens orchard (197 registered species), following by medicinal plant (114), woods for construction and repairing the houses (54), fruits (38), condiments (25), other uses like insecticides, coal, etc. (20), living fences (12), wood for construction of work instruments (11), roots and tubers (10), beverages (10), grains (9) and food animal (7). Most of them are used for the family consumption.

Cuban farmers manage the diversity through their use, and select it according to the necessities of the family, especially at the species level and within the species (Castiñeiras *et al*.. 2000; 2001), but the number of individuals for species/ variety/

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population is small; however, for crops that report high economic benefit to the families in the rural areas, the agroecosystem and the landscape play an important role in the selection of the species, the production is performed in a bigger area, with a reduced number of species/ varieties, as well as, a high number of individuals per variety. In this case biotic and abiotic factors of the ecosystem have influences, because the selection approaches go directed to the yield and the adaptation of the species in question, activities that are carried out with a minimum ecological risk, because of the minimum use of chemical products.

Exchange of experiences with farmers

Workshops with farmers and scientists were organized in each region, with exhibitions of the biodiversity managed in the home gardens by the farmers involved. These meetings had a positive impact in the communities, since they allowed the exchange of experiences concerning to "seed" conservation and exchange from different varieties and species among the farmers, as well as, the popularization of the value of conserving agrobiodiversity in home gardens, especially to the local, political and educational authorities in each region, who were invited to the workshops.

General considerations about Cuban home gardens

Cuban home gardens are characterized to be a dynamic agricultural ecosystem, where a high diversity of useful species is appreciated. The ornamental garden is almost located in the front part and/or one of the sides of the household, where some other species are located too, like fruit trees, medicinal and condiment species. Other groups of species used for family feeding are distributed little farther from the house, in a continuous rotation system, dependente of the size of the property, where men and women, both, participate in the agricultural activities.

The home garden is a dynamic unit, because of its internal mobility in space and time, also for the variability of labours, which influence in the number and variability of the species. Men play a predominant role in the management of the home garden, although women are in charge of some groups of cultivations, like ornamental and medicinal plants, as well as the care of a few domestic animals, as chickens.

Fruits group is important in the contribution of vitamins and minerals for the families, as a substitute of vegetables, since the last one requires of high water consumption, and in the rural areas this resource is scarce, because the season for vegetable cultivation, coincides with the dry season. Casava (*Manihot esculenta*), bananas (*Musa* spp.), taro (*Colocasia esculenta*), cocoyam (*Xanthosoma* sp.), beans (*Phaseolus* spp.) and corn (*Zea mays*), among others, manifest the attachment to a certain food culture (their origin goes back to some aboriginal cultures from Meso and South America), where the roots, tubers and grains are important in the family diet. For this reason, they occupy bigger spaces inside the farmer property, due to the need of more volumes for feeding the family and for domestic animals. The presence of other species is influenced by historical factors; such it is the case of the coffee plantations (Pérez de la Riva, 1944) that also has importance in the State economy, and is located in Cuban mountain areas.

As the number of individuals for cultivated species and/or variety is small within home gardens (sometimes there is only a single plant), it can constitute a threat for the diversity conservation. It becomes indispensable to draw national strategies to minimize such risks as possible.

The best environmental health, in terms of soil fertility and species management inside the home garden systems, is appreciated in the family gardens located within the protected areas and its surroundings. In those cases, the preparation of soils and weed control is carried out with animal traction or manually; most of the species are cultivated without irrigation, with organic fertilization or without fertilization.

In terms of socio-cultural approaches, in former times migratory flows of the families took place from the fields toward the cities. With the increment of literacy, farmers' children did not carry out studies related with agricultural activities, and they left the lands, going to other places, looking for better economic benefits. However, it has been observed some kind of reversion of the process in the last years, favoured by new agicultural policies of delivering lands and the encouragement that represents a better price for the agricultural products in the market. The own family self-consumption that is achieved with the production of the home gardens, favours the farmer's permanency in their properties.

Effective Minimum Units of In Situ Conservation

Because of the similarities and differences of the agricultural biodiversity found in the three areas, the aspects related with the management of the crops and the motivation of the farmers to continue conserving their traditional varieties with the new participative point of view, the three regions studied were propose as Effectives Minimum Units of *In Situ* Conservation of Plant Genetic Resources in Cuba, with the objective to concentrate and support the *in situ* conservation in the near future, relating them to other national conservation strategies as Protected Areas and Botanical Gardens networks. The training about management and improvement of seeds and soil fertility with the use of different organic methods in home gardens should also continue. The popularization concerning to the importance of the *in situ* conservation of the agricultural biodiversity in the home gardens and the benefits that this represent from the economic and social points of view should be extended to all population's sectors.

Conclusions

Home gardens of the rural areas in Cuban western, central and eastern regions offer a material and spiritual guarantee to the families and they are a managed reservoir of diversity, maintained and conserved by the rural communities through their use. These communities have played a decisive role in the conservation over the time, allowing this diversity has arrived to our times.

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Protecting biodiversity and establishing a sustainable development in the Sabana-Camagüey ecosystem [1]

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The Cuban experience during the implementation of its Sustainable Development Model has been based in the ecosystem approach. This approach has been the best approach to promote the synergism among all the dimensions of the sustainable development.

The sustainable development model adopted by Cuba promotes the environmental planning taking into account the natural resource protection in harmony with the development of the productive forces, and it is aimed to achieve the sustainability at prioritized ecosystems, considering the environmental problems existing in them – included the social component – and their solutions.

Based in this conceptual approach, a number of National Programs (of Bays, Watershed, Reforestation, Mountains, Desertification and Droughts, Wetlands), have been identified, among them, those dealing with the fragile ecosystems (small and very small islands of the Cuban Archipelago).

According to the recognized need of protecting biodiversity and establishing a sustainable development of tourism, fishing and other economic activities, the project "Protecting biodiversity and Establishing a Sustainable in the Sabana-Camagüey Ecosystem" was carried out. This Project was signed on December 1993 and financed by the Global Environment Facility, the Cuban Government (Ministry of Science Technology and Environment, Ministry for Foreign Investment and Collaboration) and Environment Canada. The potential impact of biological events in the Sabana-Camagüey Ecosystem (SCE), in northern Cuba, on the rest of the hemisphere, is part of the reason for GEF to support a UNDP project to consolidate biodiversity protection in that ecosystem

Caguanes, Piedra Key, Sabana Camagüey Archipelago, CUBA

The Sabana-Camagüey ecosystem, Cuba.

The Sabana-Camagüey Ecosystem (SCE) occupies a strip of approximately 465 km along the central north zone of Cuba. It includes the northern watersheds of five provinces of the country, as well as the archipelago, the adjacent marine shelf and the oceanic Exclusive Economic Zone (Fig. 2). Its archipelago constitutes the largest system of keys in the Wider Caribbean and represents 60% of all the Cuban keys in number (2,515 keys). Mangrove swamps are profusely distributed in the keys and along the mainland coast. The keys, beaches and coral reefs of the region are well known for their quality and beauty. The larger keys

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Figure 2. Schematic limits of the Sabana - Camagüey Ecosystem encompassing: watersheds, marine shelf, the archipelago and the Exclusive Economic Zone.

are populated with diverse plant formations. All this variety of habitat encloses a great diversity of marine and terrestrial flora and fauna, and gives shelter to a high level of terrestrial endemism, which places this zone among the richest in biodiversity in Cuba and the Wider Caribbean.

More than 708 species of terrestrial flora have been found in the area. Of these, 126 are endemic. Additionally, 958 species of terrestrial fauna, including 549 insects and 209 species of birds, have been noted. This part of Cuba provides winter habitat for visiting birds.

Brief review of the resources, use and threats at the Sabana-C amagüey ecosystem

The most generalized and traditional use of the marine shelf of the Sabana-Camagüey Archipelago is fishing, though activities of oil exploration and extraction are accomplished since few years ago in the most western extreme.

The influence of the improper management of the watershed, over fishing and harmful fishing practices partially affected the fisheries of the Sabana-Camagüey Archipelago and its marine biodiversity. For different reasons, the mortality of important areas of mangrove swamps has occurred in some places. Coral reefs have been affected by the herbivore sea urchin (*Diadema antillarum*) mortality and several kinds of coral diseases, as well as by macroalgal proliferation due both to low herbivore population and land based nutrification.

Before the Project the tourism development plans presented a development stereotype that would be in conflict with important biological resources, and they were not fully in accordance with the evolution of the tourism market of the Caribbean. Furthermore, it was and still being necessary to increase the efficiency of the incorporation of scientific information and environmental concerns to the development planning process. These problems constituted core issues in this project, among others not less important.

The Strategy

The strategies for biodiversity protection and sustainable economic development of the region were first developed by the project for the various sectors based on the "issue analysis" process (problem driven approach), in which biodiversity and sustainable development issues were identified and options for their solution examined. The options were analyzed further within the interdisciplinary working group and the strategies as outlined here are presented as the result of the multidisciplinary, multiagency review and analysis. The sectoral strategies were taken and were prioritized (based on resources and time) and integrated (across the sectors) to develop the Strategic Plan for the Region.

Objectives of the strategic plan

The strategic plan objectives are envisioned as follows:

- Contribute to the conservation of Cuba's biodiversity, based on the protection of species and habitats of the SCE;
- Promote the conservation of the cultural heritage, including historical, cultural, architectural and archaeological sites of interest in the SCE;
- Promote the expansion in Cuba of tourism and ecotourism industry related to the terrestrial and marine environment, as well as other activities and investment opportunities in the SCE;
- Encourage the creation of employment opportunities, and maximize the benefits for the local population of the SCE;
- Strengthen the capacity to manage and execute the recommended strategies, actions and projects in the SCE; and
- Recommend pilot investments or projects that will help encourage the economy of the SCE gradually, while providing a vision of the general strategic plan as well as a "step by step" execution program.

Strategic plan

The strategic plan of the whole SCE region offers the wide framework for strategies and actions. It encompasses all the planning zones within the region (watershed, marine shelf, keys and the oceanic Exclusive Economic Zone). The general strategies identified by this UNDP/GEF project for biodiversity protection and sustainable development can be found in Alcolado, García and Espinosa (1999).

Ongoing second phase of the project

The ongoing second phase, the project *Priority Actions to Consolidate Biodiversity Protection in the Sabana-Camagüey Ecosystem* (UNDP/GEF CUB/98/G32) , that began in 2000, is aimed at formal adoption and implementation of prioritized actions of the proposed strategy. The objectives and their implementation of this second phase, are summarized as follows:

Establishment of eight key priority protected areas for conservation, demonstration and replication. All these areas (which constitute 15.35% of the SCA with its marine shelf), have been chosen as a result of studies carried out during the first phase of project. At present time, four of this eight protected areas have been legally established, their management plans designed and implemented, information printed for distribution, interpretative trails set up, park personnel trained in biodiversity planning and management, and minimal scientific and logistical equipment provided to ensure monitoring and feedback to planning and management functions. In the other four protected areas, although not yet legally established, their operative plans are already

elaborated and implemented and their park personnel trained in biodiversity planning and management, in the same way.

Consolidation of coordinated institutional capacities for sustained long-term integrated coastal management. This objective includes the following activities:

- Establishment of an Authority for Integrated Coastal Management (AICM) for the SCE. It include formal institutional and inter-institutional structuring, staff training, and the acquisition of minimum required equipment for integrated coastal management. On completion of the project, the Authority for Integrated Coastal Management for the SCE would have been legally established and would be in operation.
- Inventories and rapid environmental assessments carried out in areas of globally significant biodiversity, prioritized on the basis of special protection needs or existing or potential threats.
- Detailed zoning and planning in prioritized areas in order to incorporate biodiversity conservation and environmental protection criteria.
- Establishment of a network of four (plus one already existing at Cayo Coco) small environmental monitoring stations.
- Evaluation of financial mechanisms for biodiversity conservation and management. This will allow the costs of environmental variables and biodiversity conservation to be internalized in development plans and programs and will prevent the misuse of benefits resulting from particular mechanisms and economic incentives.

Education and awareness raising for environmental management, sustainable development and biodiversity conservation and sustainable use. The biodiversity component has included the introduction of provincial biodiversity education policies; workshops and seminars to raise awareness among decision makers and different community and economic sectors that affect biodiversity; production of didactic materials; dissemination of biodiversity values through the mass media.

During the development of the first and second phase of the Project, relevant problems have been identified. These problems have been created by conditions and use trends in the Sabana-Camagüey Ecosystem. In consequence, management objectives, proposed actions and their solution implementation have been developed. Some of the most important of them are summarized below:

By means of workshops, meetings and exchange of information, the lessons learned during the development of this project have been widely disseminated in the Caribbean region, with ecosystems and pressures over their biological resources, due to excessive human impacts, particularly tourism and overfishing, and the climate changes.

The Cuban government has demonstrated, by supporting this project and in by other ways, its appreciation of the need to protect the biological heritage of this part of the country. It is a narrow window of opportunity to develop tourism in right way, while responding to the other challenges of biodiversity protection and sustainable economic development in the region.

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Problems posed by conditions and use trends in the Sabana Camagüey Ecosystem

Some Problems:	Progress:	Management objectives:
Deficiencies in management and decision-making processes.	During the GEF Project implementation, a collective way of planning work and opportunity and problem identification has been applied (participation of the SCE provinces and the staff of institutions, scientific and technical disciplines, and economic sectors involved in the studies, conservation and development of the SCE).	Gradually implement the ICM of the SCE through the creation of the **AUTHORITY FOR INTEGRATED COASTAL MANAGEMENT OF THE SCE.**
Lack of an organized and interconnected information and database system.	A huge volume of data introduced in a GIS has been generated during the GEF Project, and part of the information is at the participant institutions.	Interconnect the information bases and databases of the main national and provincial performers of ICM in order to facilitate management actions and decision-making.
Lack of a Protected Area System.	The project has made a very important proposal aimed at implementing a Special Region of Sustainable Development comprising the whole archipelago and part of the coastal mainland	Formalize and implement a protected area system encompassing the whole SCE so to protect its valuable biodiversity resources.
Land based Marine pollution	In the Project, an analysis of the land-based pollution was carried out at the sub-watershed level and its extension and effects on the marine biodiversity have been determined at a strategic scale. This allows conducting future actions more properly (Environmental Licensing processes, for instance).	Stop the increase of organic pollution and gradually reduce it to recover biodiversity and fishing potential; gradually introduce technologies for waste treatment that are both more economical and friendly with the environment; and monitoring.