# Beyond restoration ecology:

social perspectives in Latin America and the Caribbean

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### CHAPTER 11

## Participatory research for restoration and agro-ecological production

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#### INTRODUCTION

Interdependent science is based on research performed in collaboration among scientists and local communities (Fortmann, 2008). This collaborative practice originates from a philosophical position of inclusion, which recognizes that everybody generates knowledge. Fortmann (2008) claims that scientists can answer certain research questions while people with other types of knowledge answer other equally important questions. However, certain questions are more properly answered in collaboration. This chapter describes a process of participatory research carried out over 25 years by researchers from the CIPAV Foundation and farmers of the community of Bellavista, located in the municipality of El Dovio, Valle del Cauca, Colombia (Giraldo *et al.*, 2014). Several researchers, specialized in different disciplines, led projects that tried to convert productive systems by adopting more sustainable practices, and to restore forests. A premise that has guided this partnership among formal scientists and communities for the generation of knowledge is that integrated land management requires a combination of biodiversity conservation, ecological restoration and sustainable use of natural resources.

#### **STUDY AREA**

The village of Bellavista is located in the Pacific slope of the Western Cordillera in Colombia, between 1,650 and 2,000 meters of altitude. With an average temperature of 18°C and 1,500 mm of rainfall distributed bimodally throughout the year, this 391-hectare watershed is representative of the premontane moist forest in the biogeographic Chocó region.

Some events in the history of this locality should be mentioned to understand the context of the collaborative work of CIPAV and the community. In the 1970s, the farmers replaced their traditional crops with monocultures of fruits with a high commercial value, especially 'tomate de árbol' (Cyphomandra betacea) and, to a lesser extent, 'lulo' (Solanum quitoense). The rapid expansion of these commercial crops resulted in the elimination of large areas of native forests and the loss of the food sovereignty of the families. In the 1980s, the 'tomate de árbol' crops collapsed due to the rapid spread of anthracnosis, a disease caused by fungi. As a result, the community faced an economic crisis, worsened by food insecurity. The beginning of CIPAV's work in this locality coincided with this crisis (Osorno, 2003; Giraldo et al., 2014).

#### SUSTAINABLE PRODUCTION

The main focus of CIPAV's work with the community of Bellavista was participatory research for agro-ecological production based on the synergy between the traditional knowledge of farmers and scientific and technical knowledge. Simultaneously, a land use planning process was carried out at the 'Los Sainos' micro watershed, which was crucial to identify the areas that needed to be restored to ensure hydrological regulation. CIPAV also collaborated in strengthening three small local organizations, which will be described later.

The first research projects were carried out in small farms and focused on reestablishing food security by integrating plant and animal production. Pioneer trials of mixed fodder shrub plantations were performed in Bellavista, and farmers participated in the agronomic assessment of these perennial crops. Gradually, the community leader Tiberio Giraldo, transformed his experimental plots into a polyculture, which he called 'home-garden for human and animal food security'. There, he planted a wide variety of organic crops for his family in between the fodder furrows.

In the 1990s, an extreme drought motivated the community to undertake the ecological restoration of the forest. This process was supported by various research projects on native trees. At the same time, several community members who were transforming their farming systems and restoring riparian buffers, developed



Figure 1. Agro-forestry system with *Cordia alliodora* trees, ornamental plants and fodder shrubs. Natural Reserve El Ciprés, property of Tiberio Giraldo.

a special awareness about native trees. For this reason, when Tiberio Giraldo began to notice regenerating timber trees in his polyculture, he decided to manage that regeneration, and his plot became an agroforestry system, which he later enriched by planting a *Cordia alliodora* grove.

Some CIPAV researchers focused on animal production, while others worked on low cost technologies to enhance the domestic water supply. A technological innovation that emanated from this interaction with farmers was a waste water decontamination system with aquatic plants (Pedraza *et al.*, 1998). In this system, the water used to wash the animal facilities (mainly pigsties) circulates through a continuous flow biodigester and, then, the effluents move through a series of channels, where different species of aquatic plants remove nutrients from the water. In the final stage, the water goes to a fish tank, before it returns, uncontaminated, to the river.

#### **ECOLOGICAL RESTORATION**

The community process of forest restoration began in 1994 and was motivated by the need of improving the water supply. In an autonomous initiative, the farmers convinced the owner of higher lands of the micro watershed to allow them to reforest the catchment area. In addition, the leaders of this process convinced each land owner to allow forest recovery in the land strips adjacent to the streams by releasing these buffer areas from agriculture; some of the owners agreed to release a few more meters than what is required for this purpose by the Colombian environmental regulation.

Participatory research invigorated several community processes in Bellavista. For instance, a small infrastructure investment provided accommodations for visitors, who attended field courses and exchange programs where the local farmers shared their knowledge with farmers from different Colombian regions. In these workshops, based on the method that Tiberio Giraldo called 'hands on learning', a small farmer could learn techniques for growing diverse fodder plants, raise pigs with local resources, vermiculture, waste water decontamination and restoration of Andean forests. At the end of the course, the students took home a variety of seeds to initiate their own polycultures and forest restoration processes. Thus, an offer of practical training services was generated in plain language suitable for a scarcely educated rural population.

In the 1990s, three small community organizations were established and strengthened in this community:

CAMPAB: This group of farmers (adult men and women) was formed to support each other throughout the implementation of small productive and environmental projects. The members of CAMPAB worked collectively through invitations to 'mingas' (workdays in the members' farms). Several of the members participated both as trainers and trainees in the 'farmer to farmer' capacity building process. During two decades, CAM-PAB has efficiently and transparently managed a small rotating fund among its members.

'AMIGAS DEL BUEN SABOR' (friends of the good flavor): This association gathers adult women of the community who work in processing local food (especially as preserves). This association has been successful in negotiating and managing projects, which allowed the construction of their own facilities suitably equipped to process food with high hygiene standards. Likewise, they manage their own small rotating fund independently from CAMPAB's and have trained other groups of rural women who wanted to form small food processing businesses.

'HEREDEROS DEL PLANETA' (Heirs of the planet): This association brings together youngsters and children of the community and, thus, is key to ensure the generational continuity in productive and environmental achievements. This group owns a small forest reserve and has worked on research projects with native trees and in small ecological restoration projects. Likewise, they have participated in exchange programs with other youth groups and managed a small fund.



Figure 2. Members of the group Herederos del Planeta in Bellavista during a research activity in the forest.

#### CO-RESEARCHER FARMERS

In 1997, CIPAV began to formalize the participation of community members in Bellavista and other rural communities as co-researcher farmers. Several CIPAV researchers engaged young high school students of different localities in research projects so that trained people would be always available for collecting samples and field data. The connection with young students seeks to contribute to their scientific and personal education. The co-researchers slowly began to participate in experimental design and sampling as well as in outreach activities in their communities. Several of them have greatly contributed to the generation of knowledge in books, videos as well as in radio and television programs.

The co-researchers not only allow researchers to make observations and collect data continuously, which enhances the efficiency of research funding, but they also contribute with their practical talents to replace expensive equipment and supplies with local materials and technology. In addition, their knowledge about local history, ecosystem dynamics, plant phenology and plant-animal interactions, among other subjects, is key for the research process (Piedrahita *et al.*, 2007).

The co-researchers benefit from this collaboration through financial support for their college education, by learning from their close interaction with researchers, and by strengthening their research skills and values such as discipline, capacity to ask questions, design experiments and obtain and interpret data. These tools have been important as these young students became professional researchers, teachers and community leaders. It should be noted that all methods applied by CIPAV researchers to generate knowledge in collaboration with co-researcher farmers are based on the scientific method.

#### 'ARBOLOCO' (Montanoa quadrangularis Sch. Bip. Asteraceae) FOR THE ECOLOGICAL RESTORA-TION OF ANDEAN LANDS

'Arboloco' is a multipurpose Andean tree that grows frequently in disturbed areas between 1,300 and 2,800 m of altitude in Colombia and Venezuela. Its seeds are wind-dispersed. Young trees usually have a main straight stem that later forms multiple branches that reach heights and diameters equal to or larger than those of the main stem. Any of these branches can produce stilt roots, which allow the tree to anchor horizontally on a slope (Calle, 2006; Calle & Murgueitio, 2010).

Between 1997 and 2005, CIPAV developed a research program focused on 'arboloco', which contributed to the knowledge about the ecology and natural history of this tree and proposed low cost techniques for the restoration of Andean forests based on the special attributes of this species. One of the projects focused on the regeneration habits of 'arboloco' based on the following research questions: Are there differences among habitats in the regeneration of 'arboloco'? and which micro-habitat characteristics influence the establishment of seedlings? During two years, a CIPAV researcher and three co-researchers evaluated the regeneration of this tree in small plots located in different habitats of the agro-landscape. The results of the study showed that some shade (20-40% of canopy cover) and availability of bare soil favored the regeneration of this species. Likewise, they found that a high proportion of trees are naturally established in strips adjacent to the forests (Calle et al., 2008).

The research based on those initial questions advanced until a casual remark from Tiberio Giraldo steered the project into a new direction. Throughout his life at Bellavista, Tiberio had observed that 'arboloco' is established in areas where the 'soil is disturbed'. A literature review confirmed that soil disturbance is very important for the establishment of different tree species with small, wind-dispersed seeds. This observation gave rise to a new research question: How does soil disturbance influence the germination, survival and establishment of *M. quadrangularis*?



Figure 3. Agro-ecological system with 'arboloco' (*Montanoa quadrangularis*) in the background and horticultural crops in the foreground in a restored riparian forest. Los Sainos micro-watershed, El Dovio, Valle del Cauca, Colombia.

With the participation of Tiberio, the research group designed a new experiment to evaluate the effects of soil disturbance with two treatments: 1) grass removal, soil disturbance and manual dispersal of 'arboloco' seeds, and 2) manual dispersal of 'arboloco' seeds on an untouched grassland (control). During seven months, a notably higher density of 'arboloco' seedlings and a faster growth rate were observed in disturbed soil treatment than in the control (undisturbed soil).

This simple experiment showed that soil disturbance facilitates the ger-

mination of seeds and the growth of seedlings, which suggests that 'arboloco' has a catastrophic regeneration method. Thus, although 'arboloco' successfully establishes in areas adjacent to forests, its main regeneration niche is disturbed soils, i.e., 'arboloco' is a specialist of landslide specialist.

In 2005, CIPAV began to work on the restoration of areas affected by landslides applying a technique that combines biomechanical structures and high-density planting of native species. Impressive results were obtained in the first sites where 'arboloco' was planted in a bamboo terrace system. 'Arboloco' exhibits a rapid growth, contributes to soil recovery through its abundant leaf litter and forms stilt roots that help physically bind the bamboo terraces.

Another simple application derived from through this study was the planting of 'arboloco' strips parallel to a forest edges to accelerate the advance of forests over grasslands.

A row of 'arboloco', established at low cost through direct planting of seeds on a narrow strip of disturbed soil, grows fast and contributes to the regeneration of forest species. Another low cost application is the establishment of living fences on disturbed soil. Both techniques were applied successfully for the restoration of the riparian forest in 'Los Sainos' stream.

#### IDENTIFICATION OF NATIVE TREES FOR THE RESTORATION OF ANDEAN FORESTS

Between 2006 and 2008, the group 'Herederos del Planeta' actively participated in a research project on the phenology, regeneration habits and propagation of 12 native tree and palm species. Small groups of children and youngsters chose a species to investigate, tagged the trees individually and agreed on a method to estimate the fecundity of the trees. They evaluated the tagged trees every two weeks during 18 months. At the end of the project, each group had contributed new knowledge on the phenology, regeneration (recruitment of plants in

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different habitats) and propagation of their focal species. This project was focused on the values and lessons that scientific research can promote on young people: patience, admiration for nature, concentration and discipline (Calle *et al.*, 2010, 2011).

With the support of the Environmental Leadership & Training Initiative (ELTI), a program of the School of Forestry and Environmental Studies of Yale University in collaboration with the Smithsonian Tropical Research Institute, two graduate students, who had been co-researcher farmers in Bellavista, designed and coordinated a new project to train children and young researchers. With this goal in mind, they focused on the phenology and natural regeneration of 'balso blanco' (Heliocarpus americanus), another multipurpose tree from the Andes. During 18 months, the children studied the phenology of 50 trees in agriculture plots, paddocks and forests edges. They observed and counted the number of flowers and fruits every two weeks during the reproductive stage and every four weeks during the vegetative stage. As part of the research process, the children filled sheets with numbers to estimate the size of the flower harvest (average number of flowers per branch x number of flowering branches) and the fruit harvest (average number of fruits per branch x number of fruiting branches). In addition, they studied the regeneration of 'balso blanco' in 20 circular plots located within crop areas, paddocks, forest borders and forest interior. The children of this

project invited a group of youngsters from 'Cañón del río Garrapatas', an area that produces panela sugar ('piloncillo'), where 'balso blanco' is used in the cleaning process of cane sugar juice. The visitors learned about the results of the project and were motivated to start their own research on native trees.

At the end of both projects, the writer Miguel Caro carried out creative writing workshops so that the children could narrate the research in their own words.

#### INDIRECT RESULTS OF PARTICIPATORY RESEARCH

After more than two decades of participatory research, several changes have been achieved by the community of Bellavista (Table 1). For instance, today there is an appropriation of the agroecological methods and philosophy. The families involved in the research processes continue to apply several of the environmentally friendly productive practices. However, the community has not been immune to new waves of profitable monocultures, which accelerate the degradation of soils and forests. The most recent trend is the culture of 'arracacha' (Arracacia xanthorrhizacreole celery) in steep slopes, which has accelerated soil erosion.

Several families of the community value their land more now than three decades ago. The greater self-esteem of the farmers is also evident. In addition, there is a new generation of youngsters and children who desire to learn and make positive contributions to their community.

Likewise, participatory research has been useful to publicly value the knowledge of women. Fortmann (2008) states that through participatory research, several women understand that male domination is not inevitable, and that they can think, speak and act for themselves.

Some of the young co-researchers of the 1990s are now the first generation with college degrees in this community. Three of them joined the CIPAV team as professional researchers, where they are valued by their colleagues because they have a rare combination of scientific skills and ease to interact with rural communities. Another coresearcher is a high school teacher, who has been repeatedly recognized as the best teacher of the school by her students.

The shared history of participatory research between CIPAV and the community of Bellavista is the result of a long relationship based on friendship and trust, which has supported different training schemes, sustainable production and knowledge generation initiatives through several projects, overcoming long periods without financial support. The learning process has been invaluable for both the community and CIPAV as well as for the thousands of people that have visited this wonderful enclave of the Colombian Andes. We hope that other research groups in Latin America can build long lasting and fruitful relationships with rural communities for knowledge generation and ecological restoration.

#### BEYOND RESTORATION ECOLOGY...



**Figure 4.** Two generations of researchers in Bellavista. From left to right: Lina Paola (PhD student, Universidad de Antioquia), Adriana María (restoration researcher at CIPAV), Nelly Victoria (agronomist), Eudaly (high school teacher) and María José (researcher in the 'balso blanco' project).

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ASPECTS	1993	2013
Conservation	- Fragmented forests Biodiversity loss	<ul> <li>Forest fragments connected and enriched with late succession species</li> <li>Private nature reserves.</li> <li>Ownership of catchment areas.</li> </ul>
Water supply system	Insufficient offer for 25 families	Sufficient supply for 75 families.
Water for human consumption	Individual networks	Five water intakes, appropriate supply networks and control in the houses
Water quality	High sedimentation and dumping of organic matter	Low sedimentation, productive decontamination and slow filtration
Water use	Waste and negative impact of livestock production	Rational use, protection of the riparian corridor, subs- titute water troughs for cattle, rain harvesting and storage systems.
Farming and agricultural production	Monoculture - Dependence on external inputs - Negative environmental impact - Loss of food sovereignty	- Agroforestry systems. - Rational use of soil, water and biodiversity - Farm planning. - Food security.
Social participation	Low participation Lack of knowledge of environmental issues and environmentally friendly production	Three community organizations, participatory research (CIPAV), community-based ecological restoration, agro- ecological conversion, and exchange of experiences (workshops, trips, and training). Local project negotiation and management capacity, water concession for 10 years, voluntary economic support from users to pay taxes, concession and ma-
		Empowerment and a deep appreciation of the land and of 'campesino' - farmer culture. Community cohesion.

**Table 1.** Comparison of several aspects of Bellavista at the beginning of the participatory research process and two decades later.

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This book invites us to reflect on the restoration of terrestrial ecosystems in the context of a region whose identity is still under construction, Latin America and the Caribbean, immersed in a social, economic, ecological and political crisis, whose roots originate historically and politically in colonialism and in the prevailing model of capital accumulation. For the first time, insights and practical experiences on restoration are gathered from most Latin-American and Caribbean countries. Furthermore, this book offers a social approach to restoration, which will likely become preponderant in this field and in this region. The authors claim that a Latin-American knowledge of restoration is under construction and that this discipline can be a significant tool to empower local populations, which might, in turn, lead to a collective action of change.

Case studies from 11 countries of the region were compiled, involving multiple voices that emerge beyond generalist principles and with a bottom-up approach. The main idea of the book is to open a debate about the identity of ecological and social restoration in this region.

This book is targeted to restoration specialists, volunteers, environmental managers, researchers, politicians and NGOs working on the complexity of socioecological restoration in a region with unavoidable social problems. It is intended for people with similar concerns to those of the chapters' authors. This work tries to integrate a movement on the rise, almost silent, born with its own narratives of successes and failures that do not hinder its development. Finally, the determination and commitment of Latin-American and Caribbean social actors to restore not only natural values but also social, ethical and cultural ones is remarkable.













