



IMPACTFUL INNOVATIONS

LESSONS FROM FAMILY AGRICULTURE ON ADAPTATION
TO CLIMATE CHANGE IN LATIN AMERICA AND THE CARIBBEAN

2015 COMPETITION FOR SUCCESSFUL CASES



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ACRONYMS

CBA	Community-based Adaptation
ALTAGRO	Andean Agriculture in the Altiplano
APNI	Asociación de Piscicultores del Norte Integrado
ASA-MAG	Agencia de Servicios Agropecuarios del Ministerio de Agricultura y Ganadería
IDB	Inter-American Development Bank
CAR	Compañía de Desarrollo y Acción Regional
CENTA	Centro Nacional de Tecnología Agropecuaria
CEPAC	Centro de Promoción Agropecuaria Campesina
ECLAC	Economic Commission for Latin America and the Caribbean
CIAT	International Center for Tropical Agriculture
CIRNMA	Centro de Investigación de Recursos Naturales y Medio Ambiente
CTCN	Climate Technology Centre and Network
FLAR	Fondo Latinoamericano para Arroz de Riego
GEF	Global Environment Facility
FONTAGRO	Regional Fund for Agricultural Technology
IICA	Inter-American Institute for Cooperation on Agriculture
INTA	National Agricultural Technology Institute (for its acronym in Spanish)
IPCC	Intergovernmental Panel on Climate Change
MAG	Ministerio de Agricultura y Ganadería
MAIS	Sustainable Smart Agro-climatic Module (for its acronym in Portuguese)
MINAET	Ministerio de Ambiente, Energía y Telecomunicaciones
OFDA/CRED	Centre for Research on the Epidemiology of Disasters of the Office of Foreign Disaster Assistance
NGO	Nongovernmental Organization
UNEP	United Nations Environment Programme
REDEH	Rede de Desenvolvimento Humano (for its acronym in Portuguese)
SDR	Secretaría de Desarrollo Rural
SENAR	Serviço Nacional de Aprendizagem Rural
IRR	Internal Rate of Return

CONCRETE SOLUTIONS TO CONCRETE PROBLEMS

The new climate scenarios are severely affecting farming families in Latin America and the Caribbean; therefore, it is necessary to work in an integrated manner to minimize the social effects and consequences of these changes.

Inequality and poverty require creative models and solutions for adapting to climate change and to increasingly frequent extreme events, such as droughts and floods. The resilience of the most vulnerable sectors varies throughout ecoregions. However, understanding the factors and comprehensive approaches needed to address these issues allows for the creation of tailor-made solutions to undertake climate effects in each ecoregion.

Sharing information and knowledge on best practices and innovations that have been successful for adapting to these scenarios is key to working in preventing and reducing the effects of these issues and developing concrete tools that improve decision making at all levels. This is not only about sharing knowledge, but also learning about experiences, meeting their protagonists, and learning from practices that worked as well as from those that did not. To quote an old saying, you learn from your mistakes.

In this context, dissemination has a catalytic role. Socializing this knowledge enables us to understand factors and their relationships and involve more actors to create comprehensive solutions.

This is why FONTAGRO has focused its action on agricultural innovation and has defined it as a participatory process in which people use technological, organizational, and institutional knowledge to produce goods and services that, when used by society, generate social, environmental, and many other benefits.

Society's participation as a whole is key to working on innovative models for adapting to climate change, as well as bringing different tools to the most affected sectors.

This publication, produced by FONTAGRO with the support of the Global Environment Facility and our sponsors, combines a wealth of knowledge and experience gained from eleven successful cases that show how farmers, working in a participatory manner, adopted technologies that concretely improved the quality of life of their families and the region.

José Luis Repetto, PhD
President of FONTAGRO

ADAPTING TO CLIMATE CHANGE AS A CONDITION FOR DEVELOPMENT

Climate change poses additional challenges for inclusive economic and social development. The agricultural sector is probably the one that is most affected by the negative effects of climate change, lowering yields and increasing production costs, thus reducing quality of life, especially that of family farmers.

The competition for successful cases of family agriculture adaptation to climate change is one of the activities supported by the IDB to promote the innovation, generation, and transfer of knowledge needed to address the challenges brought about by climate change. This publication outlines contest-winning organizational processes, practices, and technologies, so they can be adopted by communities that face similar risks and opportunities.

With this competition, the IDB, the Inter-American Institute for Cooperation on Agriculture (IICA), and FONTAGRO, with the support of the Global Environment Facility, acknowledge the deserving achievements of several farmers, local organizations, nongovernmental organizations, research institutions, and governments in our region that are committed to finding options to successfully address climate change and improve the living conditions of millions of farming families.

Pablo Pereira dos Santos
Manager
Infrastructure and Energy Sector

The experiences gathered in this publication are also a source of useful knowledge and inspiration for the region. For example, fish-farming women in Bolivia have shown how farming families can sustainably generate income and improve their quality of life, by anticipating climate change risks. Similarly, farming families in Nicaragua and Mexico have discovered water use and conservation practices that have not only enabled them to multiply their agricultural production, but also improved their ability to effectively cope with droughts, which are an expected result of climate change.

We congratulate the winners of the competition for successful cases of family agriculture adaptation to climate change and thank participating institutions for their contributions. We hope that this joint work will lead to new collaboration opportunities, which, in turn, will entail tangible results to improve the quality of life of farming families in Latin America and the Caribbean.

Juan Pablo Bonilla
Manager
Climate Change and Sustainable Development
Sector

Inter-American Development Bank

INCLUSIVE INNOVATION

The Inter-American Institute for Cooperation on Agriculture (IICA) is pleased to present this publication, the result of its joint work with the Regional Fund for Agricultural Technology (FONTAGRO) and the Inter-American Development Bank (IDB). It embodies one of the examples of the new cooperation model that IICA promotes for institutions and countries to achieve the welfare of people in the Americas. That effort, which reflects our new vision of the agricultural sector, aims to meet the demands of countries with equity and to increase the impact of our cooperation in the region, reflected in measurable results.

The cases outlined in this publication were part of the Competition for Successful Cases carried out by FONTAGRO and its sponsors. These cases have identified new ways of producing and have promoted the inclusion of agrifood chain stakeholders as well as new alliances to meet the demand for agricultural products, within a context in which family agriculture has the opportunity to meet the growing need for food and the ability to generate higher incomes for families, despite the challenges brought about by climate change.

Some of the results highlighted in the publication on the adaptation of agriculture to climate change are consistent with the work performed by IICA, whose professionals work every day to provide solutions that increase the sector's resilience, encourage generational change among producers and professionals, and reduce social exclusion.

This is made possible by strengthening the capacities of family farmers, integrating small farmers into value chains, and promoting public policies aimed at boosting innovation studies in the field and addressing future challenges.

The dissemination of this publication among decision makers will be key to drafting policies that promote the development of sustainable innovations and foster the adaptation of family farming to climate change, food security, productivity, and inclusive competitiveness.

Dr. Víctor Villalobos Arámbula
IICA's Director General

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Organizers would like to thank all institutions and individuals who made it possible to carry out FONTAGRO's 2015 Competition for successful cases of innovations for family agriculture adaptation to climate change in Latin America and the Caribbean.

Especially:

Family farmers who participated in all the different cases and whose effort, commitment, and perseverance have enabled them to develop innovations that can be widely shared for the benefit of other farmers.

Institutions that submitted cases, for their effort in developing, documenting, and sharing cases and lessons learned.

The sponsors of the Competition, FONTAGRO, GEF, IDB, and IICA, for their technical and financial support. Members of FONTAGRO's Board of Directors for their support in carrying out the Competition.

Case proposal evaluators, IDB's Ana Ríos, PhD, and Katalin Solymosi, PhD; IICA's Kelly Witkowski, MA; and CTCN/UNEP's Jason Spensley, MA, and Sandra Bry, PhD.

Final proposal evaluators, Huntington Hobbs, MBA; Walter Baethgen, PhD; and Doribel Herrador, PhD.

Editors who collaborated with case drafting: Liliana Rosenstein, Engineer; Iciar Pavez, PhD; Guillermo Pérez, PhD; Abel Rojas, PhD; Danilo Pezo, PhD; and José Luis Rueda, PhD.

INTRODUCTION

CLIMATE CHANGE AND AGRICULTURE

Agriculture in Latin America and the Caribbean is becoming increasingly important for the welfare of its people, as well as for attaining global food security and improving nutrition levels, which is one of the Sustainable Development Goals. This has been demonstrated in a recent joint publication of the Inter-American Development Bank (IDB) and the Global Harvest Initiative,¹ which highlights growing exports of agricultural and livestock products from the region, as well as estimates that show that this is the only region in the world with the potential to significantly contribute to meeting growing global food and fiber demand. Moreover, the region is heterogeneous: there are subregions, such as the Southern Cone, where most food is produced, as opposed to areas in the Andean Region and Central America, where the challenge of improving food security and populations' nutrition still exists.

During the United Nations Climate Summit held in September 2014, the effects of climate change in all sectors of the economy, including agriculture, were discussed at length. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change² (IPCC) records the effects of global warming acceleration, which span from melting ice in the Arctic to the reduction in yields for major crops. In the case of maize, for example, yields have decreased at a 3.8% rate worldwide since 1980, which is equivalent to a fifth of current global reserves and could be attributed to higher temperatures.³

Changes in diets, driven by increased urbanization and higher incomes, also stimulate the production of food with high carbon footprints, such as meat and milk. Meat consumption is expected to reach more than 450 million tons by 2050, 50% more than

current global production,⁴ which can increase greenhouse gas emissions due to increased logging carried out to expand grazing areas, as well as enteric fermentation by ruminants.

According to the 2014 study, "Agriculture and Future Climate in Latin America and the Caribbean: Systemic Impacts and Potential Responses" published by the IDB, the main changes in agriculture resulting from the impact of climate change in Latin America and the Caribbean are:

a) Atmospheric and Soil Temperatures that Negatively Affect Agriculture. These changes would affect crops' photosynthesis process, decrease yields, and result in long-term changes in ecosystems' hydrology and ecology, including evaporation and evapotranspiration rates, as well as water storage in lakes and reservoirs.

b) Decreases in Top Soil Moisture. The decrease in moisture in the upper soil horizon could result in a considerable reduction of suitable land for rainwater harvesting, and this could be exacerbated by prolonged periods of drought.

c) Sea Level Rise. Many of the low-lying areas of the Latin American and Caribbean region are used for intensive agriculture. Some examples include the coastal plains of northern Colombia and Venezuela, the Gulf of Mexico, and the coastal areas of the Sea of Cortez in Mexico, as well as the delta of the River Plate in Argentina, the Magdalena River in Colombia, and the state of Maranhão in Brazil.

d) CO₂ Fertilization. Increasing temperature in a world with high concentrations of CO₂ could lead to vegetation growth. The interaction of these two variables can also generate the opposite effect on yields.

¹ Inter-American Development Bank (IDB)/Global Harvest Initiative. 2014. The Next Global Breadbasket: How Latin America Can Feed the World. <https://publications.iadb.org/handle/11319/6436>

² Intergovernmental Panel on Climate Change (IPCC), 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

³ Lobell, D. B., Schlenker, W., Costa-Roberts, J. May 5, 2011. "Climate Trends and Global Crop Production Since 1980." Science. DOI:10.1126/science.1204531.

⁴ Alexandratos, N., Bruinsma, J. 2012. World Agriculture towards 2030/2050: The 2012 Revision. ESA Working paper No. 12-03. Rome, FAO.

Agriculture may also be affected because of higher climate variability. According to the OFDA/CRED International Disaster Database (EM-DAT), from the first half of the 20th century to the first decade of the 21st century, the frequency of floods and droughts in the Americas increased twentyfold. This significantly affects regions that are vulnerable to climate. For example, Peru's Ministry of the Environment estimated its losses to be equivalent to 444,707 hectares of agricultural production, i.e., equivalent to US\$910 million, during the 1995 to 2007 period. In Central America, the agricultural sector suffered US\$155 million and more than US\$355 million in losses due to the impact of hurricane Mitch in 1998 and tropical storm Stan, respectively (ECLAC 2009).

Family farmers are among those most affected by climate change, because they tend to work in precarious conditions and have less access to technical, financial, and knowledge resources. In Latin America and the Caribbean, the family-agriculture sector includes 17 million small units, i.e., 80% of farms, and accounts for 40% of total production. Many low-cost innovations can improve the yields of small agricultural holdings and help improve small producers' resilience. The increase in income enables farmers to have more resources for adapting to climate change.

Within this context, FONTAGRO, in partnership with the "Mechanisms and Networks for Technology Transfer Related to Climate Change in Latin America and the Caribbean" project, funded by the Global Environment Facility (GEF) and implemented by the IDB, as well as with IICA's support, organized a competition aimed at identifying successful cases of family agriculture adaptation to climate change and disseminating lessons learned.

The competition took place between May 2015 and March 2016. Forty-nine cases were submitted and evaluated by a panel of experts. The panel recommended the best eleven cases that were to be documented, largely with the support of professionals hired by FONTAGRO, so as to have documents with appropriate technical support. These cases were evaluated by a second panel of external experts, which recommended the list of winners for each category to FONTAGRO's Board of Directors. The Board of Directors accepted the recommendations of the panel of external experts and allocated awards to the winning cases.

Each case includes data—quantifiable in most cases—that shows that producers are now in better conditions than they were before they carried out the innovations.

This publication includes a detailed description of

winning cases:

Associations of Producers and NGOs Category:

- *Adapta Sertão*: an Efficient Coalition to Address Climate Change in Brazil
- Fish for Life: Improving Agricultural Families' Food Security and Finances in Bolivia

National Organizations and Universities Category:

- Native *Criollo* Goats: from Producing to Survive to Producing to Live in Argentina.

International Organizations Category:

- Addressing Poverty and Climate Vulnerability in the Peruvian Altiplano.
- Water Harvest: The Eco-efficient Agriculture Grail in Nicaragua and Mexico.

FONTAGRO's Board of Directors also decided to award an Honorable Mention to the following case:

- Towards Productive and Environmentally Friendly Cattle Farming in Costa Rica.

In a separate chapter there are summaries of the other finalist cases:

- Innovative Agricultural Credit Program for Sustainable Growth in Haiti.
- Climate Change and Resilience: New Family Farming in El Salvador.
- Pre-Hispanic Irrigation System in Bolivia: Efficient Water Use.
- Innovation within Everyone's Reach: Surface Silo Network for Adapting Family Agriculture and Indigenous Cattle Farming to Climate Change in Catamarca, carried out in Argentina.
- Coffee Agroforestry Systems: Resilience to Climate Change in El Salvador.

In general, cases have had major involvement by technology users and have been implemented in partnership with several research and development institutions. These experiences clearly demonstrate that generating measures for the adaptation of family agriculture to climate change while obtaining economic benefits is possible. These cases represent win-win situations.

Lastly, we have included some reflections and a summary of lessons learned.

We hope that this publication will be useful for drafting policies to support family agriculture innovation and, especially, adaptation to climate change. We also expect these examples and lessons learned to be used in training, research, development, and innovation activities.

The Editors

METHODOLOGY OF THE COMPETITION FOR SUCCESSFUL CASES

The 2015 Competition for Successful Cases of “Innovation in Family Agriculture Adaptation to Climate Change” was organized by FONTAGRO and the “Mechanisms and Networks for Technology Transfer Related to Climate Change in Latin America and the Caribbean” project, funded by the Global Environment Facility (GEF) and sponsored by the Inter-American Development Bank (IDB) and the Inter-American Institute for Cooperation on Agriculture (IICA).

The Competition was announced on FONTAGRO’s website on May 15 and it was publicized through different media channels until September 24, 2015. The Competition was divided into the following phases:

Phase I: Nomination and Proposal Submission

Within the May to September 2015 period, 49 proposals narrating experiences related to family agriculture adaptation were received. An evaluation panel was created; it included five sponsor representatives and external experts, who assessed the proposals and rated them according to the following criteria:

- Extent of their impact and reduction of vulnerability to climate change
- Financial sustainability and economic efficiency
- Evidence (impact studies, statistical data, censuses, publications)
- Replicability of the experience in similar situations or environments, both inside and outside the region
- Identification of lessons learned and opportunities to improve

The evaluation panel recommended eleven finalist proposals, which each scored 75 points or higher. There were no finalists in the Private Enterprises category, because no case obtained the 75-point minimum required score. Therefore, it was agreed that two proposals would be awarded in the Associations of Producers and NGOs Category.

Phase II: Preparation of Successful Cases from the Selected Proposals

Finalists were invited to present their full cases. FONTAGRO’s Technical Administrative Secretariat offered the assistance of consultants to prepare the final documents.

Phase III: External Evaluation Panel for Finalist Cases

An evaluation panel made up of three external experts with extensive experience in such issues as agricultural research, development, and innovation and adaptation to climate change reviewed the cases according to the following criteria:

- Reduction of vulnerability to climate change.
- Extent of their impact: Production, socio-economic, and environmental indicators.
- Scaling-up potential: Potential for replication and feasibility of use of the methodology, technology, and/or knowledge; accessibility, cost, and simplicity; economic, social, and environmental sustainability; and lessons learned.

Panel members drafted an evaluation report that was presented to FONTAGRO’s Board of Directors, which, in turn, approved the evaluation panel’s recommendations and awarded the corresponding prizes.

Winners were announced on FONTAGRO’s website on March 14, 2016. The official award ceremony took place on May 17, 2016, in Washington, D.C., in the United States.

WINNING CASES



SUCCESSFUL FARMERS ADDRESS CLIMATE CHANGE

Reginaldo Santana cuts Nopal in Brazil's Sertão <<

Reginaldo Santana has a small, 23-hectare farm in Jacuípe basin, a semiarid region of the state of Bahia. After the great drought of 2010 and 2011, natural pastures were degraded and he had to confine his 30 animals in pens and buy expensive feed supplements for them. Even so, he only produced 50 to 60 liters of milk per day, in a single morning milking.

“We had to buy 80% of the forage from suppliers; we were working at a loss. Moreover, preparing food for cattle with the help of an employee took most of the day. We would sell milk door to door in the city to earn more income, but we still got

into debt,” he recalled.

The producer then joined *Adapta Sertão*, an alliance of public and private organizations that helped him transform his farm into a profitable and sustainable business. Santana is one of the 465 family farmers who participate in the Sustainable Smart Agro-climatic Module (MAIS, for its acronym in Spanish), a program that provides technical assistance and microloans to facilitate the adoption of technologies that are resilient to climate change, a phenomenon that is already worsening drought in the region.

The first step was to sell low-productivity animals, such as older cows, that eat as much forage as younger cows, but give almost no milk. He also introduced pastures that are adapted to the severity of the environment, with the idea of lowering supplement costs and improving diet quality.

“We sold 21 cows and kept only nine, the most productive ones. With the money we earned, we paid our debts and planted 0.7 hectares of Nopal (Opuntia spp., or prickly pear cactus). Thanks to the improvement in cows’ feed, I started milking them twice a day and selling the milk to a local wholesaler. I no longer need an employee,” he stated.

Therefore, with the support of *Adapta Sertão’s* technicians, Santana decided to go further and plan an expansion phase to reach 200 liters of milk per day. To that end, he applied for a bank loan for expanding his *Nopal* area to two hectares and buying some cows with improved genetics. This financing also included a small tractor to facilitate soil management and transfer goods, as well as a machine for grinding *Nopal*.

Seven months into working with *Adapta Sertão*, the farmer was able to start cutting *Nopal*. A key issue was learning how to prepare balanced diets. ***“Nowadays we just need to buy protein concentrate, which is economically feasible. We also stopped spending more than two hours a day preparing feed; we now do it in 15 minutes. I can pay more attention to other farm activities,”*** he said.

SUCCESSFUL RESULTS

After one year of implementing the new system, Santana produces 100 liters of milk per day. Operating costs fell from US\$0.65 per liter to US\$0.11 per liter, and the product is sold at US\$0.36 per liter. The next step will be to buy the mechanical harvester to further increase efficiency.

“We went from producing four liters of milk per animal per day to more than twelve liters. Nowadays I earn the equivalent of minimum wage plus US\$533 in gains per month,” he affirmed.

Apart from professionalizing Santana’s activities, what was important to him was the improvement in his quality of life. ***“I have more time and I can go home and enjoy lunch with my family. I hope to achieve 200 liters per day by 2016. I am proud,”*** he concluded.

[CASE 1: ADAPTA SERTÃO]



ASSOCIATIONS OF PRODUCERS AND NGOs CATEGORY

CASE 1: ADAPTA SERTÃO. ADAPTING TO CLIMATE CHANGE IN THE HANDS OF THE COMMUNITY

AUTHORS:

Daniele Cesano (Adapta Sertão), Alexandre Maia (Universidade de Campinas), Jennifer Burney (University of California, San Diego), Igor César (Adapta Sertão), Thais Corral (Rede de Desenvolvimento Humano), Carlos Ravelo (consultant), José Luis Rueda (consultant).

EXECUTIVE SUMMARY

Efficient Coordination to Address Climate Change

Brazil's *Sertão* is Latin America's most populated semiarid region. Agricultural production is the main activity for 15% of its population and it is a source of additional income for many of its inhabitants. However, farmers achieve low yields due to their farms' low technological level and to the intensification of seasonal droughts over the past fifty years.



Farmers grow Nopal, which stores water and guarantees animal feed during the dry season in Brazil's *Sertão*.

In this regard, the state of Bahia, where the *Adapta Sertão* project is carried out, has recorded a 2°C increase in average temperature and a 400 mm decrease in rainfall, i.e., a 30% drop. Consequently, milk and staple crop productivity has considerably decreased.

In view of this situation, *Adapta Sertão* was established in 2006 as an alliance of several organizations, which helps small farmers in the Jacuípe basin, lo-

cated in the driest area of the state of Bahia. It aims at improving productivity, strengthening producer organizations, and promoting value addition and market access, in order to face increasing threats from the environment. The strategy is based on a process known as Community-based Adaptation (CBA). This methodology involves working together with local institutions and leading farmers, so that adapting to new technologies emerges from the community and the community can take ownership of innovations and sustain them, without solely relying on government programs. In this regard, experience suggests that welfare policies work only as a seed, while CBA seeks for changes to be sustainable.

To achieve these objectives, a climate-smart agricultural production system was created. It is called Sustainable Smart Agro-climatic Module (MAIS, for its acronym in Portuguese) and it includes providing microloans and transferring low-cost technologies that are resilient to climate change, to major value chains: milk, goats, fruits, and vegetables.

Early results indicate that advanced farmers achieved 30% to 100% productivity gains within the first year of applying the MAIS, which spans over five years, so as to ensure that the whole community adopts it.

Adapta Sertão's experience shows that climate change could pose an opportunity to develop a new production culture in Brazil's semiarid region, which is affected by underdevelopment's inherent problems, such as food insecurity and migration to urban areas. Official actions for access to technology, financing, and technical assistance are still fragmented. Forging alliances and establishing connections among those policies through local initiatives represents a breakthrough approach with sustainable benefits.

THE CASE SUMMARIZED IN SIX PICTURES



1- Rainwater harvesting + water recycling.



2- 3,500m² of Nopal to feed 5 cows or 35 sheep/goats over the first year.



3- Storing water: cisterns, earth dams, etc.



4- Rainfed hay and irrigated forage + balanced diet.



5- Storing forage (1 to 3 years).



6- Cattle confined in corrals.



FISH FOR LIFE, WORK, AND FAMILY UNITY

Sonia López's story <<

Sonia López has to get up very early in the morning, inspect her fish farm, and go to her stall, where she sells fish in the market; that is when she is not covering her shift as a nurse at the hospital, and she does all this without neglecting her chores at home. Over the past eight years, this has been the routine of several women who, in 2008, decided to change their lifestyle, their organization, and their business activity. This change occurred when 15 families decided to take a risk and invest in fish farming, with the support of an NGO called CEPAC.

The town of Yapacaní, in Santa Cruz, Bolivia, a very warm land with temperatures that surpass 32°C and high rainfall that

exceeds 2,500 mm per year, holds more than five thousand families that engage in agricultural activities. Many of them focus on rice monocultures (with low yields because of climate change), which generate annual incomes of US\$3,000; i.e., not enough to carry out a decent living or to pay bank debts.

CEPAC's proposal, which involved starting fish farming, was not of much interest to men; however, it sparked the interest of a group of 15 women who decided to take the risk, since they did not have much to lose and this was something new that they could learn. The proposal was to invest in fish farms without subsidies, with access to

revolving-fund loans.

They found the possibility of generating US\$6,000 in annual income per pond very appealing, so they redirected their gaze “from the *Chaco* to fish.”

Sonia states that she has Quechuan origins and was born in Villa Victoria Cochabamba. She moved to Yapacaní with her parents, when she was very young. Sonia, her husband, and their daughters used to cultivate rice. They were indebted, as were other producers, until one day they heard about CEPAC’s offer on the radio and they made the decision, as a family, to attend the meeting that changed their lives. Within 10 months of having built the first two ponds and farmed *tambaqui* with the help of a loan used for building the ponds and buying fish feed, she managed to sell the fish production and earn a total income of US\$12,000. With that money she paid the rice, fish feed, and pond excavation debts and there were still funds left over to reinvest in building another pond.

Sonia now has eleven ponds, she farms more than 20,000 fingerlings, and her annual income is around US\$60,000. This has enabled her to improve her family’s housing, food, health, and education; she now has her husband’s full support. She is the president of the *Asociación de Piscicultores del Norte Integrado* fish farming association, which has 30 members (70% of them are women) and has helped 200 families in the area to engage in this activity. Her family eats fish every day (in soup, fried, grilled) and the main market for her product is Yapacaní. Sonia has been invited to join local organizations, visited Brazil to learn and share her experiences, improved family unity with her daughters and her husband, and she is valued as a woman in her home and in the community. She says: **“nothing ventured, nothing gained; I gained a job, a family, and a better way of life... Thank you, God, CEPAC, and other organizations for encouraging us.”**

[CASE 2: FISH FOR LIFE]

CASE 2: FISH FOR LIFE: DO NOT GIVE FISH, TEACH HOW TO FISH

AUTHORS:

Widen Abastoflor Sauma (CEPAC NGO), Sonia López Quiroz (Asociación de Piscicultores del Norte Integrado), Cintya Castellón Antezana (CEPAC NGO), Giovanni Crespo de Ugarte (CEPAC NGO), Abel Rojas Pardo (consultant).

EXECUTIVE SUMMARY

The town of Yapacaní (in the subtropical region of Bolivia) holds approximately 10,000 families; 5,000 rural families depend solely on farming and are living in poverty, mainly due to their dependence on rice monocultures, which are highly vulnerable to climate change (i.e., affected by frequent floods and long periods of drought) and market price fluctuations. In 2008 producers in the area, through the *Asociación de Piscicultores del Norte Integrado* (APNI), an association, in partnership with the Centro de Promoción Agropecuaria Campesina (CEPAC) center, chose to diversify their livelihoods through fish farming. This had a series of impacts:

Providing Better Quality of Life for Fish-farming Families

The initiative promoted by CEPAC generated increasing fish-farming activities, which began with 15 families in 2008. The town of Yapacaní now has 200 families⁵ that focus on fish farming. Fish supply has increased from 25 to 720 tons per year (60% is locally consumed); increased availability has directly impacted per-capita consumption, which rose from 3.8 kg per year in 2008 to 8.6 kg per year in 2014. The sale of fish generates US\$15,000 in additional income per year for each family, compared with the average US\$3,000 generated by a farming family per year. In turn, this activity promotes greater family integration, better education for children, improved health, higher-quality family housing conditions, and less emigration.

Empowering Women

In this town, fish farming has become an activity that is led by women. Before fish farming, women were not acknowledged as partners in economic organizations; 70% of husbands had doubts about this productive activity and in some cases made fun of women entrepreneurs.

Now they are formal partners and co-owners of productive assets with the same rights and duties as men.

Adopting New Technologies

APNI partner families had no fish-farming knowledge; they have learned to raise the “Tambaqui” (*Piaractus brachipomus*) species. Fish farming has become a resilient activity, as opposed to agricultural activities; it has decreased the expansion of the agricultural frontier that was dedicated to such extensive crops as rice and soybeans, and incorporated the efficient and sustainable use of water resources as a productive activity, by establishing fish farms, where fish are raised in captivity. It is estimated that all 450 ponds (averaging 2,000 m² each) generate a 90-hectare water mirror and contribute to a socially and environmentally sustainable economic activity.

Overcoming the Vulnerabilities of Monoculture

Bolivia is a landlocked South American country. It is still one of the countries with the lowest fish consumption in the world. Its fish supply depends on freshwater ecosystems. Bolivia’s fish-farming potential to contribute to rural livelihoods and local food security has lagged behind that of neighboring countries (such as Chile, Peru, Argentina, and Brazil). Its main bottlenecks are socio-economic barriers, institutional isolation, high cost and low quality of inputs, and the lack of appropriately trained technical support.

The town of Yapacaní is located between two very fragile areas: El Choré forest reserve (773,692 hectares) to the north, and Amboró national park (442,500 hectares) to the south. Both reserves are affected by the expansion of the agricultural frontier and micro basins’ subsequent deforestation, which causes a serious decline in water courses that supply urban populations, as well as an accelerated loss of soil fertility.

⁵ Hinojosa V., and Colque P. December 2015. Mapping of stakeholders for the Fish for Life II project.

THE CASE SUMMARIZED IN SIX PICTURES



1- Feeding fish.



2- Training, field trip.



3- Postharvest training.



4- Harvesting fish.



5- Consuming fish at the market.



6- APNI members on parade.



“INSURANCE AGAINST ADVERSITY”

“Native criollo goats from Neuquén brought back hope. After the drought and the fall of volcanic ash, young people had begun to emigrate. Today they are happy; they even build sheds for them. They not only have meat to eat, but also baby goats to sell in Bariloche, with which to buy other food,” said Ana María Cumilaf, from the Municipality of Comallo, who is a member of the executive board of the project carried out by 90 agriculture families from Línea Sur in Río Negro, most of them of Mapuche origin.

The initiative has the support of the Secretaría de Agricultura Familiar de la Nación ministry, the National Agricultural Technology Institute (INTA, for its acronym in Spanish), and the Government of Río

Negro; it was launched in 2013, two years after the Puyehue volcano erupted. The innovation consisted of introducing goats from north Neuquén—renowned for surviving in extreme conditions and for their great prolificacy—as a way to quickly recover the decimated herd.

“It was very difficult: farmers had lost up to 90% of their cattle, mostly including Angora goats and Merino sheep, which were not very resistant. Therefore, we designed the project to bring more rustic animals that provide good meat; we obtained the funds and accompanied beneficiaries every step of the way,” Cumilaf recalled.

Each family received a five-year loan to acquire 29 females and one male, which

had to be returned, together with the goat kids, to be reallocated to other producers. ***“We had to buy goats in small batches and concentrate them until there were 500 heads. Then they were loaded onto trucks and traveled more than 1,000 km back, feeding them with forage until they had all been distributed from farm to farm. It was a very long journey that farmers would not have been able to make on their own,”*** said Cumilaf.

Another challenge was managing group surplus marketing, ranging from transferring animals and engaging slaughtering services to selling to the public in Bariloche’s *Mercado Municipal* market, which had provided farmers with a space. ***“We asked those who were going to participate to sign up. Then we went to the field, along with the technicians, to see the baby goats and monitor whether or not they had met their commitment. We provided a truck and every seven to eight producers paid for diesel fuel, so expenses were lower,”*** the official stated.

Nowadays, production of the new species covers 40% of families’ meat consumption, replacing chicken, which used to be bought at high prices. Moreover, sales were very successful during the Christmas holidays: at the market there was a line of people wanting to buy that spanned two blocks. ***“Repeating this experience would be very good; there are many people who are interested in having these goats, it is like having insurance against family disintegration,”*** Cumilaf concluded.

[CASE 3: NATIVE CRIOLLO GOATS]



NATIONAL ORGANIZATIONS AND UNIVERSITIES CATEGORY

CASE 3: NATIVE CRIOLLO GOATS: FROM PRODUCING TO SURVIVE TO PRODUCING TO LIVE

AUTHORS:

Pablo Losardo (Secretaría de Agricultura Familiar de la Nación), Alejandro Fornasa (Secretaría de Agricultura Familiar de la Nación), María Rosa Lanari (INTA Bariloche), Liliana Rosenstein (editor).

EXECUTIVE SUMMARY

Over the past two years, 90 agriculture families from southern Río Negro, backed by official and private organizations, carried out a project of technological, organizational, and commercial change, which is enabling them to address the climatic adversity that affected 2,800 producers, by means of diversifying production and developing a specialized quality-goat-meat chain.

The innovation consisted of detecting and introducing highly rustic native *criollo* goats from north Neuquén, leveraging the existing knowledge of producing food for farmers' own consumption, in an area historically dedicated to wool and fibers. Another innovation, especially for small producers, was that this change was implemented through a contract by which the farmer received 30 goats, to be returned as of the third year, for them to be reallocated to other families.

Shortly thereafter, given the prolificacy of the new species, the first animals were slaughtered in a meat processing plant with federal inspection, and precise logistics were designed to enable direct access to Bariloche's *Mercado Municipal*, all with very smooth coordination among stakeholders.

For the time being, the model is helping to address the area's problems with snow, drought, and volcanic ash, which decimated cattle, sheep, and Angora goats and generated losses of up to 95% of stock, compromising food security and farmers' permanence. Meanwhile, a new commercial channel starts to generate genuine income to participating families.

The future potential of the proposal is provided not only by the possibility of expanding the number of beneficiaries by involving neighboring farms, but also because it is a self-managing experience that

can be replicated in other areas of the Argentine Patagonia that are low on meat.

The case recreates the importance of preserving biodiversity to overcome challenges posed by climate change. Meanwhile, it positions native *criollo* goats as an opportunity to add value to low-quality pastures, by sustainably producing animal protein. For decision makers and leaders, this is a low-cost alternative with high human resource employment and high social impact that should be considered when drafting agricultural policies.

In summary, the initial objective was to satisfy rural families' own consumption and reach the local urban population with competitively priced meat. Over the medium and long term, when scaling-up is achieved, developing gourmet products would be possible by launching a brand such as *Chivito patagónico* (Patagonia goats) to achieve a position in Bariloche's tourism market, thus creating value.

THE CASE SUMMARIZED IN SIX PICTURES



1- Technician and farmers agree on aspects of the project in Línea Sur.



2- Producer and technicians from Río Negro inspecting goats before buying them in Neuquén.



3- Producers, technicians, and officials concentrating animals before transferring them to Río Negro.



4- Goat receipt and inspection in Línea Sur fields.



5- Producer signing for the receipt of the herd with Pablo Losardo (left) and Ana Maria Cumilaf (behind), from the project's executive board.



6- The general public buying goats in Bariloche's Mercado Municipal market. Photographs: Alejandra Bartoliche.



LEARNING ABOUT TECHNOLOGIES RESILIENT TO CLIMATE CHANGE AS A GROUP IN THE PERUVIAN ALTIPLANO

“When I started my activities many years ago, I noticed that despite production diversification, small farmers still worked for their own consumption. They sold some of their surplus below cost or ‘bartered’ it. Now, after years of disseminating the importance of producing high-quality goods, organizing, and selling in volume, we certify 380 tons of organic quinoa for export per year. It was hard work,” said Agricultural Engineer Vicente Choquehuanca, a researcher with a long track record in the Peruvian Altiplano region.

Mr. Choquehuanca played an important role in the Andean Agriculture in the Altiplano

(ALTAGRO) project, led by the International Potato Center, which promoted agriculture families’ specialization in value chains. He now serves as head of the organic quinoa program of Agroindustrias CIRNMA, the business arm of the *Centro de Investigación de Recursos Naturales y Medio Ambiente*, a research center.

“By 2003, we were able to certify the farms of 386 families and we continue to increase our areas. However, tangible benefits have only just been reaped over the past five years, as the product has gained value: 2013 was declared the International Year of Quinoa,” he stated. They have now

reached 482 farms from which quinoa is sent to such demanding markets as Europe and the U.S.

“Even though it is true that benefits were obtained thanks to the boom in demand, having been prepared and having substantially improved productivity were key to seizing opportunities. As a result, families’ incomes were multiplied by ten,” he said.

For Choquehuanca, the most important result has been that farmers have taken ownership of organic production knowledge and the benefits of joining the value chain. ***“They no longer sell quinoa at markets and, with their new techniques, they obtain an interesting margin between production costs and selling prices,”*** he underscored. Nowadays, some 9,000 families, 15% of producers in the Altiplano, export certified organic quinoa. ***“The product processing and standardization link that our company developed now bears the financing of the field, planting, and certification phases, thus providing predictability,”*** he concluded.

FEEDING

Progress towards differentiated-quality products is not ALTAGRO’s only achievement. The program also developed initiatives focused on food security, within a framework of high climate variability that is accentuated by the effects of global warming. One of the initiatives was to build greenhouses in schools, which provide more than 2,200 children with access to fresh vegetables every day.

“Diet at the school cafeteria was a routine, based on potatoes, chuño, noodles, rice, and, very rarely, vegetables, because we could not usually find any at the market. In 2007, we built a small greenhouse and learned how to produce organic vegetables,” Rubén Calcina, Headmaster at the *Instituto de Educación Rural de Huataqui-ta*, in Cabanillas, Puno, recalled. He continued: ***“now we can feed children vegetables daily and, as teachers and parents, we have understood that it was possible to grow them in our tough climate. We sell what we do not eat at school and with that income we cover what we need to continue producing. Therefore, with our own funds, we improve children’s nutrition.”***

[CASE 4: A COMPREHENSIVE
APPROACH TO ADDRESSING
POVERTY AND VULNERABILITY
IN THE PERUVIAN ALTIPLANO]

INTERNATIONAL AND MULTINATIONAL ORGANIZATIONS CATEGORY

CASE 4: A COMPREHENSIVE APPROACH TO ADDRESSING POVERTY AND VULNERABILITY IN THE PERUVIAN ALTIPLANO

“Innovation Adds Value to the Community”

AUTHORS:

Roberto E. Valdivia (CIRNMA), Carlos U. Leon-Velarde, Roberto Quiroz, and Víctor Mares (CIP), Danilo Pezo (consultant).

EXECUTIVE SUMMARY

Sixty-eight percent of the agriculture population in the Peruvian Altiplano lives in extreme poverty and faces high climate variability, which is exacerbated by the effects of climate change.

Within this context and with the support of the Canadian International Development Agency (CIDA), in 2006 the Andean Agriculture in the Altiplano (ALTAGRO) project was launched. The initiative was led by the International Potato Center, an organization that focuses on improving the lives of poor people who depend on root and tuber food systems, in collaboration with the *Centro de Investigación de Recursos Naturales y Medio Ambiente*, a nonprofit organization in the region.

Its objective was to help farmers leave subsistence production and move towards market-oriented activities, sustainable both economically and environmentally, with the aim of improving food security and family income. For this purpose, the project focused on developing value chains with comparative advantages in terms of their productive potential, nutritional contribution, domestic and international demand, and resilience to growing climate threats.

With this vision, innovations covered several areas. Regarding organic quinoa, these actions allowed for capturing value in such demanding markets as the United States and Europe, as well as increasing family income tenfold. Similarly, dairy farming efficiency was improved and connected to cheesemaking, distribution, and consumption, thus improving productivity and quality throughout the value chain. Craftswomen were also trained so their garments meet new designs required by demand.

Another activity driven by ALTAGRO was trout production; these fish are now sold with standardized quality both in Peru’s market and internationally. Lastly, and in direct correspondence with improved nutrition, family and school greenhouses were introduced to promote horticulture as a means to promote a diversified and healthy diet.

The methodology used for adopting technologies combined group learning, technical assistance, and supervised credit. Financing was provided by creating revolving funds, supplemented with contributions from local banking institutions and nonprofit organizations, among others. It is interesting to note that even though loans—averaging US\$790 per family—accrued interest, repayment was significant, which speaks well of the motivation and competitiveness achieved.

Direct beneficiaries included some 2,200 families, with more than 6,600 members—60% of them women—from 100 rural communities. There were also 8,400 people from 129 villages in the region who benefited indirectly. Participants were not only lifted out of poverty, but they also registered a 70% increase in their capital index—an indicator of the welfare of communities compiled by the World Economic Forum—thanks to their improvements in financial, social, human, and natural capitals.

The project validated the importance of interinstitutional work for building the capacities of farming families, disseminating technologies, and organizing value chains. Even though the project lasted a relatively short time, i.e., five years, it was built on the basis of years of previous experiences from several institutions and it left a very important mark in a region where the presence of government agencies is limited and work is often done with a paternalistic and welfare-based approach.

In this regard, ALTAGRO played a catalytic role by creating synergies among all of the governmental and private organizations that operate in the Altiplano. The initiative underscored the need for long-term programs that foster the addition of the results of specific projects, so as to promote sustainable development for farming families within the context of climate change.

THE CASE SUMMARIZED IN SIX PICTURES



1- Farmers actively participated in selecting quinoa seeds.



2- Farming women were largely responsible for milking.



3- Quality control helped improve market access for crafts.



4- School greenhouses helped improve families' nutrition.



5- Cheesemaking at the local plant helped dairy farmers get connected to markets.



6- Training activity in the Peruvian Altiplano: key to knowledge dissemination.



THE FARMER WHO WON THE BATTLE AGAINST DROUGHT

Over the coming weeks, Jaime Cáceres will not only water seven hectares in which he cultivates beans and maize, but his most precious treasure will also provide water to two neighboring farms whose owners are still waiting for rain. He will charge five thousand *córdobas* (equivalent to US\$170) to one of them, who will be able to take water from the reservoir every other day. He will not charge the other one, his friend David Cruz, because the half hectare in which Mr. Cruz has beans has become almost ruined by drought. Jaime will help him revive it by giving him water once a week.

Six years ago it was impossible to access water. But Jaime, a 40-year-old, young, yet already 'veteran' farmer, decided to risk

everything when he was invited to join the project. Farmers called him "crazy" and accused him of damaging the land.

However, tired of losing his crops to prolonged drought in Nicaragua's dry corridor, he allowed technicians to enter his farm, called *El Porvenir* located in the Montefrío community of the town of Jalapa, to teach him how to use his land for sustainable production. After a few months, a reservoir was ready to hold more than 97,000 m³ of water. He just had to wait for it to rain and for runoff to do its job.

Every day at six in the morning Jaime is ready to start tilling the land, which supports his wife and four children, as well as the

families of his seven siblings, who work on his farm. Last winter the reservoir was filled to the brim. Thanks to gravity-fed irrigation technology for beans and drip irrigation for maize, the Cáceres family carefully waters its crops. Jaime prefers drip irrigation ***“that way I economize water and crops develop better.”***

The reservoir has enabled him to grow rice in summer and sell its seeds. He also raises tilapia, which he sells wholesale and retail. And his four dairy cows have not gone without water again. ***“Making this pond has been the best decision of my life,”*** he proudly says. Results are this sane farmer’s best defense: 25 quintals of beans per hectare and 140 quintals of maize per hectare right in the middle of the dry season.

Jaime, a man of few words but much action, cannot remember how much he had to invest to build the water reservoir. That is the least of it, he says. Now he is preparing for the February and March harvest. He will leave enough of the maize and bean production for daily consumption. The rest, he will sell in the village and to truckers passing through the battered streets of his community in search of the lucky farmers who won the battle against drought.

[CASE 5: WATER HARVEST]

CASE 5: WATER HARVEST: THE ECO-EFFICIENT AGRICULTURE GRAIL

“Water harvesting, continued production,
and financial success”

AUTHORS:

Santiago Jaramillo, Edward Pulver, Eduardo Gaterol (FLAR-CIAT), José Luis Rueda (consultant), Carlos Ravelo (consultant), Adriana Varón (CIAT).

EXECUTIVE SUMMARY

Central America is one of the regions that is most vulnerable to climate risks in the world (Kreft, S.; Eckstein, D. 2013). The Central American dry corridor is a dry tropical forest ecoregion that spans from Guanacaste in Costa Rica to southern Mexico, which holds nearly 7.5 million people whose main socioeconomic activity is rainfed agricultural production, mainly involving staple grains such as maize, beans, and rice, as well as cattle farming. This area is characterized by a unimodal-trend rainfall regime, i.e., rain is concentrated into five months and the rest of the year there is extreme drought. This means that many farmers, most of whom do not have irrigation, may only produce food and have farming employment during half the year, a factor that causes poverty, hunger, unemployment, and migration.

To address the negative effects of drought in Central America, the International Center for Tropical Agriculture (CIAT) and the *Fondo Latinoamericano para Arroz de Riego* (FLAR) implemented a project cofinanced by the Fondo Común para los *Productos Básicos* fund in Nicaragua and Mexico, which spanned over four years (2008-2012). The project sought to introduce and promote “water harvesting” as a practice for adapting to climate change and as a continued-production economic and sustainable alternative, by transforming rainfed irrigation systems in dry areas and tapping into rainwater runoff. The project worked with small family producers of staple grains. It helped build pilot reservoirs and install several irrigation systems on their farms, as well as validate agronomic crop management technologies used for high productivity with irrigation.

The project placed special emphasis on human capacity development, family empowerment, and technology transfer, because it considers these factors to be key to the sustainability and scaling-up of water harvesting over time.

Similarly, the active involvement of countries’ municipalities, producer associations, and environmental authorities was crucial to implementing the initiative

and disseminating technology to other regions.

For six crop cycles, the project proved that by irrigating through water harvesting and using better technologies, agricultural and livestock production, as well as nonagricultural rural business, are feasible during the dry season. Water has enabled annual yields of staple grains (maize, rice, and beans) to double or even triple, as well as helping diversify with other crops, water cattle, and produce tilapia. The project shows that farmers do not need to migrate with cattle in search of better conditions; this allows for maintaining family unity and generating new employment options and better income within farmers’ own farms (see Photo 1).

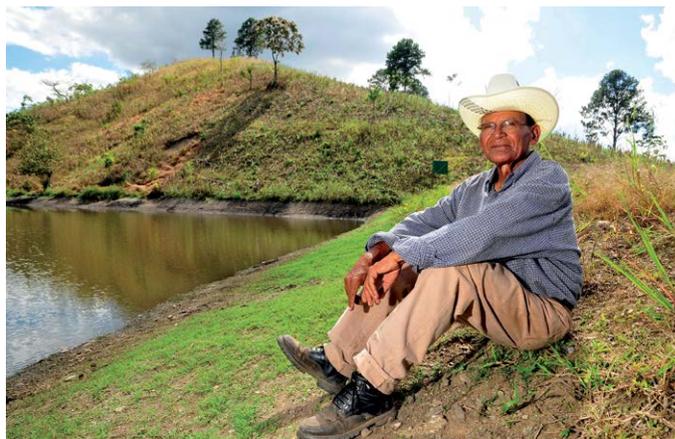
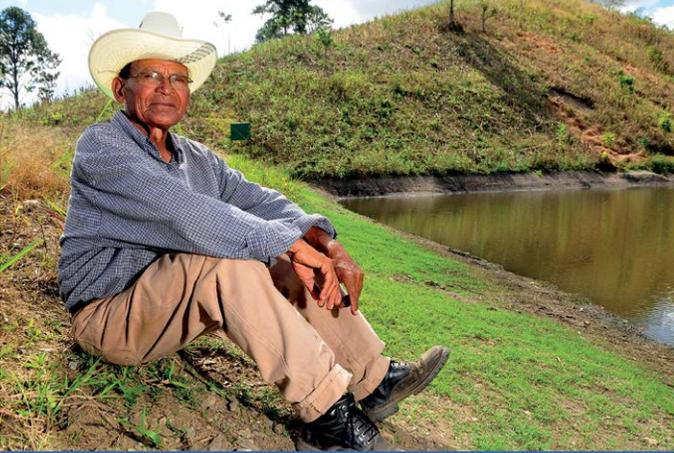
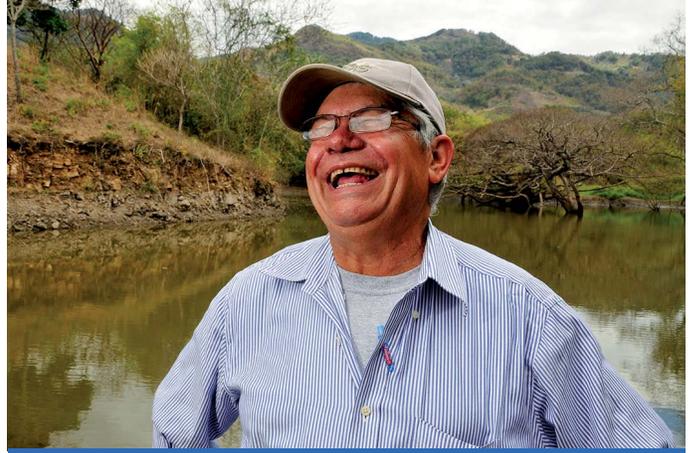


Photo 1. Through water harvesting, Joaquín González and his family, in Jalapa, Nicaragua, found the solution to producing food and employment in dry areas throughout the year. Photo: Neil Palmer/CIAT.

THE CASE SUMMARIZED IN SIX PICTURES



1- Joaquín González and his family in Jalapa, Nicaragua.



2- Víctor Beltrán in his reservoir in Nicaragua.



3- Cáceres Moncada family reservoir in Jalapa, Nicaragua.



4- Some of the water uses of the Cáceres family.



5- Satellite image of the Contreras family reservoir in Veracruz, Mexico.



6- Rural youth actively participate in courses taught through the project. Photos: N. Palmer/CIAT.



“TOWARDS PRODUCTIVE AND ENVIRONMENTALLY FRIENDLY CATTLE FARMING”

Participant: José Luis Vargas (Cattle farmer in Sta. Marta, Hojancha) <<

“For many years we managed livestock extensively, so when pastures were not enough, we used new land for planting pastures and shrunk the natural forest area. However, we felt that this did not let us earn a decent livelihood, because production was low, income was very limited, and, worse still, we realized water was increasingly lacking, not only for our animals, but also for drinking throughout the community. You cannot imagine what cows looked like in the summer, without enough feed and, worse still, without water.

We had to spend a lot of money to buy feed and medicine, but animals still died—we lost a portion of our capital each summer. Engineers from the *Ministerio de Agricultura y Ganadería* and the *Ministerio de Ambiente in Hojancha* showed us that if we did not change our management, we could even lose the farm. After several discussions within the community, all of us, “*Hojancheños*,” decided that we had to take the lead in reversing this process by applying what engineers called silvopastoral systems.”

We followed their recommendations: we did not let cows into areas with steep slopes, we stopped applying chemicals and cutting down weeds so the forest could regrow and produce water, because there are many springs within the forest. We planted improved pastures in less steep land and we protected small trees against cattle damage in paddocks, some of them for wood, such as schizolobium trees (or *gallinazos*), and others for livestock feed, such as bay cedars (or *guácimos*), because animals eat their fruits and leaves in summer. We built more paddocks divided by live fences and planted good-wood trees—such as teak—along the boundaries. We realized that planting hardwood trees, such as Teaks, on our boundaries was cheaper than pruning copperwood (or *jinocuave*) fences. To feed the cows in summer, when most pastures are dry, we planted different varieties of elephant grass and sugar cane as “fodder banks” and we started planting fodder trees close together, in what are called “protein banks.” In my case, I planted gliricidias, buttercups, and mulberries, which are known to grow well in Hojancha. I also bought some poultry manure and citrus pulp to supplement my animals. I had to build feeders and buy a grinder to feed my animals in the summer, bringing them back from the paddock for a few hours.

Before I only had cows that produced calves to be sold at weaning or after one year. But now, I also focus on fattening steers. I have three different types of batches: from weaning to 12 months, from 12 to 18 months, and from 18 to 24 months, when animals reach weights of 450-470 kg. That enables me to sell better quality animals and, more importantly, to carry out fat steer sales every three months; i.e., income is more frequent and higher than in traditional systems, in which animals reach that weight when they are four years old or older and animals often have to be sold quickly so they do not continue to lose weight or die.

This has enabled me to obtain not only a better income, but also the satisfaction of helping the environment, and I am not afraid of climate change. Moreover, many farmers in Guanacaste lost animals to drought last year, but I did not suffer, I kept producing at the same rate and sold fattened animals while other farmers did not have any.”

**[CASE 6: TOWARDS PRODUCTIVE
AND ENVIRONMENTALLY FRIENDLY
CATTLE FARMING]**

HONORABLE MENTION

CASE 6: TOWARDS PRODUCTIVE AND ENVIRONMENTALLY FRIENDLY CATTLE FARMING

AUTHORS:

Marcela Rivera-Céspedes (UNAFOR-Chorotega)¹, Juan Bautista Méndez (MAG)², Lubica Guindon, Eloy Méndez (UNAFOR-Chorotega)¹, Danilo Pezo (consultant)³.

EXECUTIVE SUMMARY

In the late 1980s the Hojanca canton was in crisis, soil and pastures were seriously degraded, water became increasingly scarce, and rivers and streams dried up in summer; meat prices fell and many families had to emigrate because they could no longer live on their farms.

In the mid-1990s a Comprehensive Development Plan promoted using areas with slopes greater than 60% for regenerating forests and areas with lower slopes for intensifying cattle production, through a silvopastoral approach. This included planting improved, no-till pastures in less steep areas, rational rotational grazing, introducing timber and fruit trees in paddocks and along boundaries, managing live fences, planting and using forage banks with strategic supplementation in the summer, minimum infrastructure—corrals, feeders, troughs, and a grinder—for semistabling in summer, and banning animals from springs to prevent damage and contamination.

This was supplemented with training and technical assistance, improved producer organization to boost producers' access to markets, credit, and incentives, such as payment for environmental services. Proposed changes resulted in improving productivity, diversifying production, obtaining greater economic benefits, reducing greenhouse gas emissions, increasing soil carbon sequestration, and being less vulnerable to extreme climate change events.

Costa Rica's Government has started the implementation of initiatives aimed at controlling greenhouse gas emissions in cattle farming and has taken the experience in Hojanca as a model for promoting the "Low-Carbon Cattle Farming Strategy," conducted by the *Ministerio de Agricultura y Ganadería (MAG)* and the *Ministerio de Ambiente, Energía y Telecomunicaciones (MINAET)*.

¹ Coordinator of the Knowledge Management Center, Project and Legal Counsel, and Executive Director of the Asociación Agroforestal Chorotega (UNAFOR-Chorotega), respectively.

² Director of the MAG's Agencia de Extensión Agrícola y Ganadera agency - Hojanca.

³ FONTAGRO consultant.

THE CASE SUMMARIZED IN SIX PICTURES



1- Live fences.



2- Grinder.



3- José Luis Vargas, cattle farmer in Santa Marta. Hojancha.



4- Improved pastures.



5- Women actively participated in the work of forest nurseries.



6- Capacity building is key for producers.

SUMMARY OF FINALIST CASES

CASE 7: ARGENTINA. WHEN PRODUCTION DEPENDS ON INFRASTRUCTURE

The Dry Face of Climate Change

AUTHORS:

Sebastián María Alconada, Federico Navamuel, Alejandra Nava, Rocío Celeste Dietz, (Argentina's Ministerio de Agricultura, Ganadería y Pesca).

Climate change manifestations in the province of Catamarca, Argentina, led to a 1°C increase in average temperature and a 30% drop in rainfall over the past decades. Family farming is very vulnerable to these phenomena, and it is a strategic sector because it generates more than 65% of the food that local population consumes.

When this experience started, cattle farming in *Catamarca's Valle Central* was in critical condition and farming families' food security was at risk. Herds recorded losses because of the degradation of natural pastures that were overgrazed during times of forage deficit, due to the lack of access to maize, which is a key input to supplement animals.

Grain shortages forced farmers to shop in remote areas. Moreover, doing it individually, by the bag, led to higher product prices. Another limitation was the lack of storage infrastructure, which is essential to improving logistics.

Although the province has a dry and arid climate, severe and prolonged drought in recent years led the *Ministerio de Agricultura, Ganadería y Pesca de la Nación* to declare an agricultural emergency in 2009. This situation gave rise to an opportunity for the provincial government, municipalities, and family farmer associations to work together and find a structural solution to the problem.

● Silos that add value

The strategy agreed upon by participating public and private organizations was to prioritize the improvement of basic infrastructure for cattle farming in order to facilitate herd supplementation and contribute to the sustainability of family activities. This strategy sought to promote food security and rural permanence.

With this vision, the innovation developed since 2012 involved implementing a network of silos at strategic points, for farmers to be able to get access to maize in their own area, thus shortening times and lowering transportation costs. To carry out this initiative, management consortia were established; they included producers and representatives from the government agencies that managed the silos. Thanks to this connection, grain was purchased in larger volumes, which resulted in more convenient prices.

The silos were installed in municipal land to ensure families' easy access. To calculate grain needs, a diagnosis was made in the department of Ambato, right in Valle Central, which has been severely affected by climatic events. Breeding activities and the condition of natural pastures were studied; the amount of supplement required by local herds was planned based on that study.

A revolving-funds system was also created to facilitate farmers' purchases of maize. The national government provided funding by means of a nonrefundable contribution for building the silos and acquiring the grain for the initial load, as well as such work equipment as grinders and carts. That covered the first cycle of the silo. Provincial authorities would cover subsequent cycles until the payments made by producers were sufficient to support the initiative.

The model is aimed at farming families' self-management and, therefore, their future sustainability.

Operations by means of consortia and revolving funds allowed for producers to get direct access to maize, eliminating intermediaries and enabling them to take advantage of bulk purchase discounts. Another benefit was having the option to pay cash upon taking maize or to pay in the future with cash, grain, or animals.

In parallel, the strengthening of small farmers' knowledge was encouraged through training and technical support to improve the practice of supplementing their animals.

● “Farmers Do Not Beat Around the Bush”

Thirty-five silos that each hold 40 tons were installed on municipal land and managed by management consortia through revolving funds.

The initiative benefited more than 1,200 families with an average of 5 hectares each, who received a total of 280 tons of maize, which is equivalent to about 93,000 feed rations. Over the first year, some funds revolved four times, demonstrating this tool's positive impact. In this regard, what farmers paid for grain in 2012 was 8% less than the market value and in 2015 the differential reached 15%, a byproduct of the experience gained.

Access to lower-cost maize guaranteed production system continuity and overgrazing of natural pastures was avoided, with its consequent environmental benefit. In addition, livestock mortality decreased and early unfinished-animal sales slowed down. In times of forage crises these sales are carried out at a particular disadvantage.

The experience also contributed towards the formalization of producers. To participate in the initiative they had to register with the *Registro Nacional de la Agricultura Familiar* and the *Monotributo Social Agropecuario* tax entity, which promote access to social security and tax regularization, thus promoting better quality of life for the farming population.

● Lessons Learned

Growth achieved during the experience is attributed to the incentive given to farmers to establish associations and take responsibility as a group. Their organizations' participation in managing revolving funds generated trust among families and strengthened their ties with the State. In turn, this interaction led to a more efficient use of the public resources that had been invested.

A sample of the model's success is that, in order to ensure continuity, the province of Catamarca is implementing a maize growing program that covers 400 hectares in its first stage. The idea is to supply the demand for animal feed with local production to avoid spending resources in other provinces and making transfers, which have a negative impact on the environment. This is, undoubtedly, key to establishing a virtuous circle for the initiative's sustainability.

Lastly, the case confirms that the actions carried out with family farmers do not seek to accumulate capital, but social reproduction within the context of a dignified life.

THE CASE SUMMARIZED IN SIX PICTURES



1- The arrival of the grain silos makes grain available to farming families.



2- Strategically located silo for small farmers to have access to maize through the revolving fund.



3- Management consortia: members manage the silos.



4- Grain purchased in groups is brought by truck from remote areas.



5- Technician controls distribution operations.



6- Farmers and technicians after a training session to improve the practice of supplementing their animals.

CASE 8: BOLIVIA. MODERNIZING WITH PRE-HISPANIC TECHNIQUES

The Fight for Water

AUTHORS:

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The Cebollullo community is located in the department of La Paz, Bolivia, 2,780 meters above sea level. Its main economic activity is the production of vegetables irrigated with water from snow-covered **Illimani** mountain, whose glacier operates as a natural reservoir and regulates the flow received by the system.

Increases in temperature caused by climate change accelerated its melting; 21% of the snow surface and a 22 meter depth have been lost over the past 46 years, which led to high variability regarding resources available for irrigation.

Even though this melting generated more water, the lack of reservoirs and changes in rainfall patterns caused runoff and landslides during the rainy season, thus accelerating soil erosion on the steep slopes found in the region. Meanwhile, dry periods were severely affected by greater water scarcity. All this seriously compromised agricultural activities carried out on farms that span from 1,700 m² to 6,900 m².

Within this framework, water distribution for irrigation went from being a free system to becoming a shift system, thus increasing the complexity of agreements among stakeholders and causing conflict among those located at the top and bottom of the basin. There were water “thefts,” sales of shifts, and unauthorized night services, which drew back farmers’ yields and incomes.

● Back to Ancestral Traditions

The aim of the experience carried out by 80 farming families, with the participation and support of universities and nonprofit organizations, was to improve irrigation efficiency by upgrading pre-Hispanic techniques and installing artificial reservoirs to achieve a continuous and efficient horticultural production.

The innovation involved the reintroduction of an ancient irrigation system with zigzag corrugated

furrows, which differ from the straight ones used until then, in that the length for water to travel is extended, so both the slope and water speed are reduced. This favors infiltration of the sheet of water required by the crops while reducing erosion processes.

Six reservoirs with a capacity of 20,000 liters each were also installed, benefiting from family labor and local materials. This minimized irrigation event variability, allowing stored water to attenuate water stress during the dry season. Therefore, 70% flow uniformity was achieved throughout the year, with specific benefits for everyone.

The benefits of the new irrigation system were assessed with the participation of farming families. To this end, measurements were taken at the inlet and outlet of the furrows, which showed the volume that entered, the runoff, and the infiltration, in order to calculate the efficiency of the application. In the previous system, this indicator showed values that oscillated between 7% and 30%, with deep percolation losses of 2% to 41% and surface runoff losses of 46% to 86%. In the new system, the indicator for efficiency increased to 65%, not only because of technological change, but also due to the strengthening of the community that led to a better relationship among users. In this regard, an innovative institutional aspect was the appointment of an “Irrigation President” with organizational functions and arbitration powers over any conflicts that may arise among irrigating parties.

To implement the program, the School of Agronomy of *Universidad Mayor de San Andrés*, Bolivia; *Universidad de Córdoba*, Spain; and the Spanish Agency for International Development Cooperation conducted a socio-environmental assessment and provided financing and technical advice.

● Irrigation Helps the Community Flourish

The *Cebollullo* experience has lasted five years and has enabled the 80 participating families to achieve greater water availability and irrigation uniformity. Production rose from two to four horticultural crops per year, which increased incomes by 30%, reaching US\$6,000 per family per year. Quality seeds and other inputs were incorporated and crops were diversified by implementing rotations to preserve the soil. Nowadays, farmers have a vegetable basket that includes lettuce, cabbage, onions, tomatoes, potatoes, oca, peas, and fava beans.

To confirm the impacts of the initiative, 57 beneficiaries were polled about the effects of zigzag furrow irrigation on crop yields, farmers' incomes, and families' social development. In this regard, increased product supply and variety, coupled with improvements in producers' organization, enabled farmers to take advantage of their proximity to the cities of La Paz and El Alto. Fresh vegetables were sold daily in major markets, at fair prices for both producers and consumers.

Another aspect the study revealed is that technological changes carried out to counteract the effects of climate change also had favorable impacts on social issues: farmers' food and access to health, education, and housing has improved, and migration in search of work to meet family needs has dwindled.

The experience was partially replicated in neighboring communities with the support of other institutions, such as in La Granja, or through irrigating parties' own initiatives, such as in Palca.

● Lessons Learned

Adopting an irrigation system is an innovation that requires ownership by all beneficiaries as a group, i.e., through coordination among farming families, irrigation organizations, and community authorities.

The experience showed that a necessary condition for success is to identify the producers who are most interested, i.e., men and women who show leadership to earn the trust of the whole group and finalize the implementation of activities in the interests of the community. It was also understood that experiences should not be extrapolated to other regional municipalities without previously carrying out environmental studies, particularly on water availability.

Lastly, results obtained in the case of Cebollullo indicate that, often, solutions to the problems that afflict small farmers regarding issues inherent to climate change can be addressed without resorting to such sophisticated technologies as pressurized drip irrigation systems, which require high budgets. Revaluing ancestral knowledge is also an alternative for modernizing the activity.

THE CASE SUMMARIZED IN SIX PICTURES



1- Farming families and technicians agree on the actions to be performed on their farms.



2- Farmer prepares the ground to irrigate with ancestral methods.



3- Farmers participate in group tasks to install a reservoir.



4- Irrigation President observes a reservoir full of water.



5- Vegetable crop in Cebollullo, at the foot of snow-covered Illimani mountain.



6- Farmer harvests lettuce to sell at the market in La Paz, Bolivia.

CASE 9: EL SALVADOR. GOOD CROP MANAGEMENT IMPROVES QUALITY OF LIFE

Coffee Agroforestry Systems for Resilience to Climate Change

AUTHORS:

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● Knowing Where We Are

The coffee sector is highly important to El Salvador, both economically and socially; it totals 5% of agricultural GDP. In addition, coffee growing is carried out in areas with higher rainfall, especially in basins' upland areas, so good management is essential to ensuring aquifer recharge and water availability in lower areas.

However, small coffee farmers face the problems associated with their lack of knowledge about technologies that may be used for environmentally friendly production. They engage in monoculture and use traditional, low-yield varieties that are easily affected by pests and diseases, without employing soil conservation or water harvesting techniques. Therefore, their lands are affected by runoff during the rainy season. Most families only develop the first link of the production chain, so farm sustainability is at risk.

This scenario is part of a global reality, in which developed countries are responsible for most of the greenhouse gas emissions associated with climate change. On the other side of the spectrum, Central America is one of the regions that is most affected by these hazards, especially because of family farming's high vulnerability.

The experience of Salvadoran coffee growers to overcome this problem was developed in the *Cañaverales* River basin, in Morazán, within the dry corridor of the country, where coffee production has been significantly diminished over the past few years. On top of having prolonged and recurrent droughts, the most dreaded disease of the species appeared: coffee rust. As a result, the harvest of the 2015/2016 cycle fell 42% compared with 2012/2013.

According to the *Consejo Salvadoreño del Café*, the coffee council, in 2011 there were 130,000 jobs in the coffee belt and by 2015 that number had fallen to 50,000.

● Producing with Sustainable Practices

Within this context, in 2009, some 100 families from the department of Morazán started to renew their farms with coffee-rust-resistant cultivars; they also diversified production and engaged in best management practices. The initiative involved the development of agroforestry systems and was driven by the support and advice of nonprofit organizations, especially the Catholic Relief Service and the *Asociación de Cuencas del Golfo de Fonseca*, a farmers' association. It was also supported by some government agencies.

Changes began with the replacement of traditional varieties for disease-resistant ones, with a focus on specialty varieties, which result in higher income. Improvements included: developing farmers' own nurseries, analyzing soil in order to apply fertilizers as needed, and using organic fertilizers produced on-farm to reduce costs.

Conservation practices adopted included: managing soil's vegetation cover to mitigate the effects of erosion, and implementing terraced fields and plantations with designs that prevent runoff and favor infiltration and nutrient retention. Farmers also installed reservoirs for harvesting rainwater, and micro irrigation equipment for using resources efficiently.

On this basis, processing improved and resulted in higher final-product quality. Some farmers are moving towards vertical integration by including roasting, grinding, and artisan packaging, and even selling directly to consumers in their community, as well as in nearby communities. They also plan to create a brand to add value to the product.

In terms of production diversification, farmers have also adopted banana cultivation, which provides short-term income. Producers developed thermal chambers to obtain "shoots" with which they produce reproductive material free from disease. Other species incorporated were citrus, cacao, pink cedar, guineo banana trees, and pine trees, with their subsequent economic and environmental benefit.

Many farmers were trained to keep production and economic records, which enables them to better manage their business. This helped them shift from subsistence production to managing a genuine quality-coffee business.

● Benefits of Good Management

The initiatives carried out increased production and improved the lives of people on Morazán's diversified farms. Yields for specialty coffees—the main crop in these new models—had increased from 3 to 19 quintals every 1.7 acres by the third year since the models started. In the fourth year production costs decreased by 12% to 20% compared with the previous year. At the farm level, volumes harvested and family income both increased by around 60%.

Conservation practices adopted at the top of the basins revived springs that had dried up and nowadays guarantee a sustainable water supply for low areas. Agroforestry systems also increase carbon sequestration and thus offset the impact of climate change.

One of the projects, called *Cosecha Azul* (Blue Harvest), helped producers and other organizations build a small coffee processing plant, thus promoting the vertical integration of the local economy. Meanwhile, the CENTA Café project buys plant material from farmers to share it among their neighbors and certifies nurseries to ensure the health and quality of new crops.

A prominent feature is that gender perspective was promoted throughout all projects. Women's work was consolidated in several practices, from taking care of seedlings and planting them to processing and selling roasted coffee. The whole family is involved in the business: wives, sons, and daughters participate at all stages of the production chain, thus promoting labor and employment.

● Lessons Learned

Coffee agroforestry systems are a tool that can curb the impacts of climate change; they confirm that the vulnerability of family farming can be overcome through technical and organizational innovations at an affordable cost.

The successful production and economic results that were attained through conservation practices led to the visit of delegations from other regions in the country and from Honduras and Nicaragua—which have coffee plantations in similar environmental conditions that sought to learn about the experience and replicate it.

The learning-by-doing method used by extension workers, based on knowledge dissemination and support in the field, yielded excellent results for technology adoption. In turn, the demonstration effect of

the practices implemented by innovative producers was the best way to convince other stakeholders to replicate the new agroforestry systems.

This method made it possible to change the mentality of family farmers, who have become real entrepreneurs and now lead diversified farms, based on quality coffee and conservation management.

THE CASE SUMMARIZED IN SIX PICTURES



1- Reservoirs for rainwater harvesting in new agroforestry systems.



2- Farmers use micro irrigation equipment on sloping land to prevent runoff.



3- Rain gauge to measure rainfall on the farm.



4- Farmers get certified-quality plants at a coffee nursery.



5- Soil conservation work for growing specialty coffee.



6- Coffee bean-drying table in enterprises that reach consumers.

CASE 10: HAITI. CREDIT THAT FEEDS

What You Need to Know

AUTHORS:

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Haiti's population is around 10 million, and 54% of its inhabitants live in rural areas; 75% of them live in poverty and 47% suffer food insecurity.

The agricultural sector, which accounts for 28% of GDP, is the main source of income in Haiti's economy. Despite its importance, limited access to credit and a lack of adoption of best management practices hinder its sustainability and growth. This is magnified when taking into account that the sector's main crops, such as maize, beans, rice, peanuts, and vegetables, are the basis of farming families' diets.

These weaknesses are combined with the effects of climate change, which include increases in temperature, rainfall variability, and water levels. This will expand flood areas and reduce the country's surface area, which outlines an alarming prediction. The department of Nord, where this case takes place, is highly exposed to hurricanes, floods, seismic risk, landslides, and tsunamis.

● From Field to Market

Within this framework, in 2012 iF Foundation, a nonprofit organization established in the United States, launched a program to increase staple crop production. Its actions cover all links in the food chain: from introducing improved seeds, incorporating fertilizers through an interest-free loan, and providing technical assistance, to connecting farmers with the market so as to improve their bargaining power.

Small farmers, whose lands cover an average area of 0.32 hectares, receive a loan and pledge to repay it once they sell their harvest. The amount varies depending on the crop; for example, loans for maize total US\$60 per farm. Technicians draft a work plan with beneficiaries; they are also responsible for distributing inputs, hiring labor, and periodically visiting beneficiaries individually or in groups.

iF Foundation has its own fields, in which it selects the technologies to be applied and validates them in the local environment before they are released. In this regard and continuing with the maize example, the program was aimed at improving maize's nutri-

tional value to address the problem of malnutrition, so it promoted the use of protein-rich varieties. For rice—another key crop regarding diet—the program introduced mechanization, improved irrigation efficiency, and is conducting tests of cultivars fortified with zinc, which are beneficial for nutrition. Furthermore, it encourages crop rotation and zero tillage, which allows for planting without turning the soil, but leaving it covered by topsoil remnants from a previous crop, in order to protect soil from erosion.

Technicians are also tasked with weighing harvested grain in the presence of producers and providing advice to prevent contamination risks during storage, which could affect human health and commercial quality. Thus, the program seeks to promote trust and participation based on business management.

Producers reserve a quarter of their production for their own consumption and they can choose to either sell individually or as a group, through the program, to businesses and nonprofit organizations. Proceeds are used to repay the loan, generating a small surplus that genuinely capitalizes producers.

In summary, innovation promotes participating families' food security with the added benefit of their obtaining greater surplus quantity and quality for the market, in a country with high socioeconomic and environmental vulnerability.

● Reaping the Fruits of Labor

So far, 840 farming families, including 4,200 members, have benefited from the iF Foundation program. The flexibility this foundation offers of repaying the loan at the end of the campaign enables families to cover other expenses necessary for sustainability. In the 2013-2015 period reimbursement rates per farmer ranged from 55% to 77%.

As for crop results, in the case of maize average yields rose from 800 kg per hectare in 2012, to 1,260 kg per hectare in 2015, and 78% of the producers paid their loans.

Regarding peanuts, in the first campaign 100% of producers were able to repay the loan and generate profit, and in the next cycle their gross incomes were 81% higher than the loan they had received. They all chose to sell their crops as a group, through the program.

During the first rice campaign producers achieved

profits of 95% of loan costs and 93% of them repaid the loan.

All beneficiaries also adopted sustainable agriculture practices. A significant aspect of this experience's potential is that the foundation has a weather center, which helps provide information and advice for planning such events as planting dates, thus facilitating the adaptation to climate change even for those producers who do not participate in the initiative.

Lastly, the program generated direct jobs for 50 people who live in the area: agricultural engineers, agricultural technicians, and field staff. Ten tractor operators were also hired to prepare a total of 446 hectares of farmland throughout those three years, thus contributing to economic movement in the region.

● Lessons Learned

Loans granted, even when they are subsidized, have both a financial role and the effect of conferring dignity upon farmers: they enable farmers to gain rights and assume obligations, and they give them freedom to make decisions; therefore, loans are more motivating than donations.

Regarding professional assistance, as producers acquired knowledge, it was preferable to restrict technicians' visits during key farming stages, so as to foster the role of farmers in decision-making. The program obtained better results by bringing together groups of farmers than by contacting them individually.

An issue that was taken into account was the fact that when loans and technical assistance are provided by the same organization, as in this case, there is a risk that producers may attribute the result of a bad campaign to the advice of a professional or to trade negotiations. Therefore, the program separated these functions: advisors are not the same people who collect payments.

Perhaps the fundamental aspect of the case in Haiti is that it confirms that the technology needed to alleviate food insecurity and its aggravation due to the effects of climate change is available. Success goes hand in hand with financing and management.

THE CASE SUMMARIZED IN SIX PICTURES



1- Plot with irrigation, from a program beneficiary.



2- A farmer observes a rice crop with improved varieties.



3- Farmers participate in a mechanized rice harvesting experience.



4- Peanut bags for group sales to food manufacturers.



5- Farming family produces for selling as a group in the market.



6- A girl eats food produced by small Haitian farmers.

CASE 11: EL SALVADOR. ASSUMING COMMITMENTS WITH THE COMMUNITY BEATS THE ODDS

The Starting Point

AUTHORS:

Henry Michael Sambrano, Armando Ramírez, and Ernesto Magaña (*Fundación Ayuda en Acción*), Iciar Pavez (*consultant*).

Adverse events caused by global warming are increasingly recurrent and less predictable in Central America, and they cause costly environmental, social, and economic losses. Providing farming families with opportunities and strengthening them is key to breaking this cycle.

In the town of Tacuba, El Salvador, where the case takes place, 42% of households are in extreme poverty and child malnutrition reaches 38%.

Farming families have two sources of income and access to food: the production of staple grains for their own consumption, for which they lease small plots on agro-ecologically fragile slopes, and wage labor on coffee plantations—the main activity in the area—, although work is seasonal and unstable. Within this context, low international prices, recurrent droughts, and the coffee rust outbreak caused harvest decline and the subsequent reduction in labor demand. As a result, farming families' food insecurity increased, causing migration.

This highly vulnerable situation prompted the intervention of the *Ayuda en Acción* foundation, established in Spain in 1981, which works with the view that improvement depends not only on the availability of appropriate technology, but also on the prominent participation of farmers in their learning processes, and collective organization for change.

● Towards Group Formalization

The innovation involved forming a group of 40 producers who created a mutual savings fund. To do this they opened a bank account and each of them contributed at least US\$25 of the revenue they generated on their agricultural campaigns, until they raised US\$2,000. Those resources were used to leverage a loan. This enabled them to plan and perform actions based on collective needs. The foundation provided support through technical assistance, supplied inputs, and continuously helped with the initiative's organization and management.

The group then ventured into vegetable production on a leased plot. Each member contributed unpaid work to develop a greenhouse and build a storage facility equipped with a solar panel for power generation.

Some time later, the group was formalized and it became a legal entity, creating the *El Mandarino* cooperative, which tackled new production initiatives, such as beekeeping, fruit growing, and fish farming. One of its projects involved the construction of a 400 m² pond for producing tilapia, a tropical fish of commercial interest. These investments were financed with its own resources as well as external ones.

When activities began to bear fruit, access to food improved and diets diversified, because families started obtaining their supplies at the cooperative, without resorting to the market. Specifically, they went from producing maize on their own plots to also growing tomatoes, chili peppers, cucumbers, pineapples, guineo bananas, plantains, papayas, and cacao, as well as getting honey and fish, as a group. It was a great achievement.

A portion of the proceeds obtained from selling these products was reinvested in the mutual fund and the group decided to buy the land they had been leasing. Thus, they advanced from tenants to collective owners, positioning themselves as decision makers in the process of managing productive resources and, therefore, their livelihoods.

● Turning Words into Deeds

Fifty-five farming families made up of 316 people increased their income from US\$90 per month to US\$216 per month and managed to cover and comfortably exceed the cost of the rural basic food basket, which is equivalent to US\$126 per month. They left behind the tasks they used to perform to survive and moved towards new agriculture models, transforming vulnerability and exposure to climate risk into adaptation and mitigation.

El Mandarino's successful experience served to boost the formation of other associative groups and strengthen the *Progresando hacia el futuro* and *San Juan de Dios cooperatives*; *Ayuda en Acción* also participated in these processes.

In addition, food availability increased in the nearby

communities of *El Jícaro*, *Chupamiel* and *San Juan de Dios* and, as a result, family nutrition improved and surplus was generated, which in turn increased incomes.

All of these groups held activities to exchange experiences, technology, and knowledge in their lines of work, as well as production diversification, which *El Mandarin* had developed.

The impacts of the initiative were measured in Tacuba's female population. A study conducted by *Universidad de El Salvador* a national university interviewed 24 beneficiary women to assess their perception of themselves after the experience, regarding affective, social, and cognitive areas. The first area obtained the lowest score, because interviewed women subordinate their personal appreciation to acknowledgment on behalf of their families. However, results were high in the social area, because it goes hand in hand with the community's appreciation of labor achievements, as well as in the cognitive area, since active participation in productive projects leads to greater independence and autonomy.

Lastly, there are nonquantifiable results, such as empowerment achieved by cooperatives, especially *El Mandarin*, which are now direct partners of institutions and markets.

● Lessons Learned

The group that embarked on the initial experience was reduced at a first stage, resulting in discouragement and skepticism about associativism's chances for success. However, those who defected later on returned and rejoined the group. One of the lessons learned was that this is part of a process, and that we would have to rethink the way in which to evaluate development projects, which mostly use the number of participants as an indicator of results.

Attaining better market connections remains a challenge, especially regarding products that are new to the community and difficult to manage, such as tilapia. Price variability continues to generate uncertainty, because it is a factor that is beyond producers' control, even for the expanded scale achieved through cooperatives.

Support from the municipal government and some agricultural development organizations was limited, which indicates that there are new possibilities of replicating the initiative.

Lastly, this case confirms that it is possible to positively influence communities by means of successful experiences involving farming families' self-management with institutional support.

THE CASE SUMMARIZED IN SIX PICTURES



1- Houses of farmers in extreme poverty.



2- Rural inhabitants meet and pose problems and possible solutions.



3- Organized farmers form a cooperative.



4- One of the first steps is to incorporate participatory honey production.



5- Empowerment. Participatory discussion and planning sessions.



6- Cooperative members decide to buy land going from tenants to collective owners.

LESSONS LEARNED

In all cases, the effect of climate change has been expressed mainly through the intensity and frequency of extreme events. Therefore, adaptation measures have been aimed at buffering these effects and increasing the productivity and resilience of production systems implemented by family farmers.

Successful projects are those that best integrate different intervention dimensions, namely financial (accessible loans), technical (available knowledge and good advice), inclusion and participation (producers participate in all processes and women's participation is explicitly sought), and environmental interventions. There are successful projects that integrate several dimensions, but are very simple and highly focused, thereby increasing their potential of being replicated and/or scaled-up.

The success achieved in all of these cases has been made possible thanks to an integrated effort among family farmers and the support of multiple organizations, and it results from a combination of factors. Impacts have been diverse: in some cases innovations have helped to produce during prolonged drought, reduce agriculture's vulnerability to the increased incidence of extreme events, use crop varieties and animal breeds that are more resistant to the effects of climate change, diversify, and increase sources of income for families so that they can better address climate change, among others. For the purposes of this chapter, we have highlighted some of the lessons that have led to successful cases.

1. PARTICIPATION

This is an essential element, especially when it comes to adapting to climate change, which is specific to local needs and priorities. Family farmers participated very actively in all cases, from identifying the problem to developing and validating innovations, thus addressing producers' real needs. The fact that this was so, empowered farmers and facilitated subsequent scaling innovations.



2. ORGANIZATION AND COORDINATION

Intersectoral collaboration is key to adapting to climate change. The effort came both from several producer organizations and from public and private institutions. Coordination was essential. For example, in the case involving native *criollo* goats in Patagonia, integration efforts between two producer communities in different provinces located more than 1,000 km away was vital. One acted as a goat supplier and the other one as a buyer to diversify the composition of its herds, so they developed a win-win situation. Similarly, the organization and association of small milk producers in the Altiplano were essential to providing inputs for cheese factories. But in all cases, innovations would not have been possible without the support of public organizations, which provided expertise and facilitated processes.

3. CAPACITY BUILDING AND LEADERSHIP

In most cases there was a strong emphasis on strengthening local capacities, be it to improve knowledge about new technologies or to develop local leadership. For example, in the case involving water harvesting and the establishment of reservoirs for irrigation during the dry season in Mexico and Nicaragua, multiple training courses were organized for several hundred producers, to highlight the advantages of these practices. In the case of the innovations developed in the Altiplano, several demonstrations, competitions, and workshops were also organized, to train thousands of farmers in the use of new technologies for producing milk, quinoa, and vegetables in greenhouses, as well as preparing garments for export, among others. Training is the key element to ensure that producers understand technologies and use them properly.

4. TECHNOLOGIES AND KNOWLEDGE

In all cases the availability of technologies and knowledge was essential for developing innovations. There were many sources that varied from local knowledge to long-range research or adaptation from other countries. For example, the case that involved pre-Hispanic irrigation technologies rescued local knowledge on the use of zigzag irrigation techniques and validated it in the current situation. Other cases were the product of many years of research, as in the case involving silvopastoral systems in Hojanca, Costa Rica, where the *Centro Agronómico Tropical de Investigación y Enseñanza* and other organizations have been working steadily in agricultural research and natural resource management, developing and validating technological improvements as organizational innovations. In other cases, such as Fish for Life in Bolivia, experiences and genetic material for fish farming in ponds were developed in Brazil.

5. TECHNICAL ASSISTANCE AND LENDING

Taking into account the limited adaptive capacity of many small producers, especially regarding the availability of technologies and financial resources, it is not surprising that technical assistance and credit have been key elements when adopting new knowledge and expanding the use of innovations. Notably, they both went hand in hand, as is the case with *Adapta Sertão* in Brazil and the case in the Peruvian Altiplano. Success has also been reflected on high loan recovery rates, which shows producers' commitment and innovations' success.



6. WOMEN'S ROLE

The participatory approach involves gender analysis, so that the needs and aspirations identified correspond to the activities performed by different family members. This has helped direct activities towards specific family members and it has improved the effectiveness of research and development projects. In several cases the roles of women and youth were highlighted as one of the factors for success. For example, in the case of the Altiplano, it was crucial to work with weavers on training sessions to prepare garments for export. Moreover, working with school teachers, mothers, and students was essential to promoting vegetable cultivation in greenhouses and their subsequent consumption for improving nutrition, a situation that is even more noteworthy because in the Altiplano, for climatic reasons, vegetables cannot usually be produced in open fields and they are not available to feed the rural population. In the case of “Fish for Life” in Bolivia, the empowerment of women and their ability to become microentrepreneurs was critical to the case's success.

7. COMPREHENSIVE APPROACHES, VALUE CHAINS, AND MARKET

Another factor for success has been the comprehensive and multidisciplinary work with a production-chain approach, so that innovative activities would be considered along the chain and value would be added to primary production. In many cases innovations covered crops, cattle farming, and fish farming, diversifying production and reducing risk. Even though it is true that this is common practice in families' subsistence agriculture, in successful cases there was a strong connection to markets, whether local or international, which resulted in a considerable income increase. That is the case of organized hubs of milk producers and processors, organic quinoa producers, or fish farmers in the Altiplano; the case of coffee agroforestry systems in El Salvador, which dealt with aspects of coffee production, processing, and sales; and the case in Haiti, which promoted commercial innovations by organizing producers to sell peanuts as a group to marketers and to sell vegetables in markets directly, but work was also undertaken with maize and beans; or the other cases that combined reservoir construction to provide drinking water and crop irrigation with fish farming, generating multiple benefits.



8. PERSEVERANCE

While it is true that most cases presented evidence of innovations implemented over the past few years, they have generally been built on work that has been done for many years, highlighting the importance of investing in agricultural research and development with a long-term outlook. This is the case for silvo-pastoral systems in Costa Rica; coffee agroforestry systems in El Salvador; the use of improved maize, bean, and peanut varieties in Haiti; the use of improved maize and rice varieties in Nicaragua and Mexico; and work in the Altiplano, among others. Adapting to climate change is a continuous process that requires creativity, learning, and perseverance in order to achieve development goals both in the short and long term while facing a changing climate.



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