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Integrated management of pig and sheep production systems
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Cover photograph:
George Cho in his farm in Belize.

Editorial

Belize has been a member country of CATIE (Tropical Agricultural Research and Higher Education Center) since 1994. Within the scope of this membership, the Center has contributed to the postgraduate studies of eight Belizean professionals:

- Sergio Perrera García and Francisco Gutiérrez Chang, Phytoprotection
- Emelda Yah Correa, Biotechnology
- Michelle Ivette Alonzo and Tanya Santos, Environmental Socioeconomics
- Wilbert Eugenio Sabido, Tropical Agroforestry
- Pedro Raimundo Carrillo and Boris Miguel Arévalo Jiménez, Tropical Forest and Biodiversity Management and Conservation

In addition, Clifford Martínez is currently completing his Master's degree in Tropical Agroforestry, and Hanna St. Luce Martínez is completing hers in Tropical Forest and Biodiversity Management and Conservation. Belizean alumni from CATIE's Graduate School have gone on to hold important positions in the public and private sector, as well as renowned national and international non-governmental organizations (NGOs)

In partnership with Belizean government and ministry specialists, CATIE has identified current needs in national agroenvironmental issues. In response to these needs, key projects have been implemented in the last five years, including: Central American Cocoa Project (PCC); Forests and Forest Management in Central America (Finnfor); and Sustainable Management of Agricultural Lands in Mesoamerica (Mesoterra). These initiatives work in collaboration with local partner organizations (Toledo Cacao Growers Association and Friends for Conservation and Development), producer organizations and government institutions (the Ministry of Agriculture and Fisheries and the Ministry of Natural Resources and Central Farm) to strengthen the capacity of its producers and technical

personnel so that they and their families may improve their knowledge about the sustainable management of productive systems, increase the resilience of these systems in the face of climatic variations, and improve the competitiveness of cacao, livestock and forestry product value chains.

With the support of partner institutions, CATIE has tested cacao varieties that are more productive and disease-tolerant in Belizean conditions. These varieties have been provided to producers in Toledo and Stan Creek, and producer trainings have been offered in order to improve cacao farm management. In terms of livestock, CATIE has been working to introduce silvopastoral systems and improve productive infrastructure on farms, as well as focusing on topics such as climate change, agroecology and farm cost-benefit analyses. Regarding forestry, the Centre has promoted the sustainable management of forests and agroforestry systems through regional courses in integrated forest management, forest plantation management and forest governance. It has also incentivized the incorporation of timber trees into livestock and agriculture farms and studied their growth dynamic, as well as promoted silvicultural management of timber species, and worked to strengthen community forest management in Mennonite populations of Upper and Lower Barton Creek, Springfield and the Cayo district.

CATIE and its Belizean partner organizations work together to create political guidelines that result in the sustainable management of land use and an increased resilience of productive systems in the face of climate change. For example, CATIE and its partners simplified existing laws regarding the utilization of timber in forest or agroforestry systems, and contributed to the methodologies used by Belize to negotiate its REDD agreement.

This edition of *InfoCATIE Belize* presents CATIE's work during 2012 in Belize with the PCC, Finnfor and Mesoterra projects, which form part of the Mesoamerican Agroenvironmental Program (MAP). We will talk about how this work has benefited various stakeholders—including producing families and producer associations, public and private institutions, NGOs and decision-makers. These efforts seek to make sustainable improvements to livestock and forestry production, as well as continual improvements to producer livelihoods.

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Regional initiative promotes forest development in Belize



Sustainable forest management can generate economic income and social and environmental benefits, through the production of timber and non-timber products.

CATIE's Forests and Forest Management in Central America (Finnfor) project aims to strengthen national capacity for implementing sustainable forest management in natural forests and agroforestry systems. In line with the project's strategy of working through partners, Finnfor has worked with the Departments of Forestry and Agriculture in Belize since August of 2010.

Through Finnfor, CATIE has invested in specialized forest management training,

reduced-impact forest harvesting, directional felling, and other topics geared toward technical professionals and advocates of forestry and agroforestry. Finnfor has also worked to simplify sustainable timber harvesting policies.

Thanks to this initiative, seven Belizean students have participated in regional courses in integrated forest management, forest plantation management and forest governance. Three international scholarships were also granted for graduate

or undergraduate studies at the National School of Forest Sciences of Honduras (ESNACIFOR) and CATIE.

In addition, the project is developing a strategy for orienting a response to the damages caused to forests by hurricanes in Belize. All of these efforts aim to strengthen and increase the country's small group of technical professionals, in order to improve decision-making in forest management and governance.

Diversified farms

Another project area is the incorporation of timber trees into agricultural and livestock farms, with the aim of increasing income for Belizean families. To date, a total of 12 permanent observation parcels have been installed in the agroforestry systems of nine livestock farms in the Cayo district.

The objective of this initiative is to study the growth dynamic of timber trees, so as to analyze traditional management practices and promote forestry management of the species that demonstrate the most significant potential.

The results have been shared with relevant communities through field visits, as well as materials about the management of timber trees in pasture lands.

The timber production value chain was also systemized, as was the traditional agroforestry practices of the Mennonite communities of Upper and Lower Barton Creek and Springfield, in the Cayo district. By disseminating this information, the hope is to share best practices that can be applied in other Belizean communities.

Community forestry

Community forest management is recent in Belize, having begun in 2007 in the southern district of Toledo. Finnfor completed a systemization exercise that analyzed the Boom Creek Village case study, one of the three communities practicing community forestry.

Permanent observation parcels

Finnfor conducted a diagnostic with a network of permanent observation plots (PPM), comprised of approximately 40 parcels of coniferous forest, forest reserves and private forests. Forestry research equipment was also provided to the Department of Forestry.

The information gathered by Finnfor provided the basis for encouraging authorities and interested parties in the regional dialogue around PPM.

Strengthening networks

Creating forest management networks is a transversal project objective. Finnfor has promoted dialogue between stakeholders such as the Department of Forestry, the Department of Agriculture, the Environmental Research Institute at the University of Belize, the Program for Belize, Friends for Conservation and Development (FCD), Ya'axché Conservation Trust, and others.

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Promoting sustainable development in El Cayo



In order to achieve the above, Mesoterra works with partner organizations in Belize.

In the El Cayo district of Belize, more than 70% of agricultural lands are in a process of soil degradation (evident from the loss of fertility and low productivity). This leads to negative economic, social and environmental impacts. When coupled with climatic and market changes, these impacts then create adverse conditions for families whose livelihoods depend on the land and natural resources. Through its Sustainable Management of Agricultural Lands in Mesoamerica (Mesoterra) project, CATIE aims to advocate for public and private organizations to promote the sustainable management of their agricultural territories.

This initiative encourages sustainable soil practices in livestock production, vegetable farming and agroforestry, using participative methodologies and tools such as ‘farmer field schools’ (FFS) and farm plans, in order to improve farming families’ land management knowledge and skills (with a focus on integrated and agribusiness systems). The results will include an improved capacity to recover from the effects of climate change, improvements to the well-being of producers and communities, and the recuperation of ecosystem services.

In order to achieve the above, Mesoterra works with partner organizations such as the Ministry of Natural Resources

and Agriculture (MNRA), Friends for Conservation and Development (FCD) and non-formal and formal producer organizations (such as the Apiculture Cayo Quality Honey Producers cooperative,

the Oshmulka women's association, San Antonio Maya Green Growers and Santa Familia Grains, Vegetable and Legume) in the Cayo district.

The project's accomplishments include:

- *More than 40 training events were carried out with more than 120 participants—25% of which were technical staff and 75% producers; 15% of the participants were women.*
- *More than 20 technical professionals from public and private institutions, and 60 small producers, obtained improved knowledge and skills, thanks to 12 international events held in Guatemala, Honduras, El Salvador and Costa Rica. The events covered topics such as climate change, sustainable livestock farming and dairy processing, agroecology and organic beekeeping.*
- *Technical staff and producers, representing every district of Belize, participated in four training events in topics such as integrated farm systems, farm planning, FFS, farm records and cost-benefit analysis, and agroecological crop management.*
- *With the support of the MNRA and FCD, 18 training events have been facilitated in the Cayo district for more than 80 producers. Topics included farm planning, agroecological vegetable management, protein banks, energy banks, multi-nutritional blocks, silo usage, improved watering point construction, milking parlors and pasture management.*
- *Utilizing the concept of integrated farming, more than 25 farms have established protein banks with shrub species, energy banks, multi-nutritional blocks and silos, as well as improved pastures, improved water tanks, facilities for improving sheep management, and milking parlors. These technologies can make farms more profitable and sustainable, as it is estimated that production costs will be reduced by 30% and productivity increased by 10-15%, thus increasing the income of farming families.*
- *The exchange of ideas has been facilitated between policy makers, technical professionals and producers from the Belizean and Guatemalan Ministries of Agriculture, as a development strategy for the agricultural sector.*
- *Capacities have been strengthened in the Oshmulka women's group, improving the infrastructure for the production of vegetable pylons by more than 100%.*
- *On a national level, knowledge and methodologies regarding FFS have been used to improve the extension system.*

The Mesoterra project is part of CATIE's Mesoamerican Agroenvironmental Program (MAP).

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Integrated management of pig and sheep production systems



The training included diverse topics regarding sustainable livestock production, as well as the joint development of a farm management plan.

The following is an interview with George Cho regarding the changes he made to his farm in order to convert it from a conventional to a sustainable system, and the economic and environmental impact that was generated as part of this transformation.

Initially, Cho was trained by technical personnel from CATIE's Sustainable Management of Agricultural Lands in Mesoamerica (Mesoterra) project and Belize's Ministry of Agriculture and Fisheries (MAF). The training included diverse topics regarding sustainable livestock production, as well as the joint



development of a farm management plan, which Cho has been implementing. The objective of the initiative was to reduce initial production costs by improving the use of the farm's existing resources.

What types of land use and facilities did your farm have in 2010?

In 2010, the farm had 23 acres of forest and 12 acres that were cultivated in beans and corn. There were sufficient facilities to manage 200 pigs of various sizes and provide free-range pasture for 30 Pelibuey sheep.

What changes did you make to the land use distribution and farm facilities from 2010 to 2012?

During this period, we planted five acres of improved grasses (Mombaza and

Brachiaria brizantha), which were divided by wire fences into four separate pastures for the management of sheep. I also planted an acre of *Leucaena* forage bank, and an acre with mixed forage such as sugar cane, mulberry, breadnut, *Leucaena* and *Trichanthera*. In addition, I built a 387.5 square-foot sheep corral, a 32 foot-long biodigester, and a 1,000-gallon capacity watering point on the higher part of the farm.

How many animals did you have, and what was pig and sheep production like in 2010 and 2012?

I have always had around 200 pigs, 18 of which are sows, two are males, and the rest are developing and fattening pigs, as well as about 30 sheep. Production in both years has been the same. I sell five 190-pound



pigs per week to the Mennonites, and I occasionally sell one or two sheep per month at a price of 2 BZD (Belizean dollars) a pound.

What has been the impact of the changes on the economy of the farm?

Well, before, I would give the pigs and sheep a feed concentrate, for which I spent about 3,000 BZD per week. In addition, each week I'd have to haul 1,000 of water from the village (a distance of about 10 km), which cost the farm 100 BZD.

Now, I spend about 1,500 BZD a month on pig and sheep feed. I feed the pigs whey and cooked chicken intestines and four

days a week I feed them 170 kg of sugar cane, 170 kg of chopped mulberry and half the feed I used to use before. I give the male sheep 170 kg of a mixture of grass (Cameroon or Marafalfa) and *Leucaena*, and the days that I don't give the animals mulberry, I take them out to pasture. Since I built the watering point 11 months ago, I have not had to haul any water from the village.

What has been the environmental impact of the changes?

My parents use the gas produced by the biodigester to cook in the house, and for the last four months we haven't needed to cut wood from the forest for cooking.



Also, because we built the watering point, I have water for the animals and don't need to waste gas to drive to the village for this resource.

How might your experience help other producers in Belize?

My farm is like a school, where neighboring farmers and producers from across Belize and Guatemala come to learn more about managing sugar cane, mulberry, *Trichanthera* and *Leucaena*, as well as the use of watering points and manure. Visitors go home convinced that it's possible to

produce a good part of the food animals need right on the farm. In addition, when I have some seed, I'll give it to other producers so that they can experiment, and they get excited to start planting their forage banks.

How would you describe the experience that you have gone through with your farm?

It has been extremely valuable, because I am producing at a lower cost and in a more environmentally friendly way. I've also continued to experiment with new things, some of which I am sure that I can adopt in my farm.



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Partnerships strengthen the cacao farming sector in Belize



Drying cocoa, Punta Gorda, Belize.

Since 2007, CATIE, in partnership with the Toledo Cacao Growers Association (TCGA), the Inter-American Institute for Cooperation on Agriculture (IICA) and Belize's Ministry of Agriculture and Fisheries (MAF), has coordinated activities to strengthen Belize's cacao farming sector. In 2008, CATIE launched the Central American Cocoa Project (PCC, in Spanish), with the aim of improving the quality of life for cacao farming families and increasing the potential of the Central American cacao sector.

In the Toledo district and southern Stann Creek, more than 700 Belizean families associated with TCGA currently produce cacao in agroforestry systems (AFS).

Production and environment

Thanks to this CATIE initiative, Belize currently has two hectares (four acres) of six productive and disease-tolerant cacao varieties. Families, producer organizations, ministries and industries observe their behavior under Belize's climatic and management conditions, and collaborate in a process of cacao renovation and planting. A multilocal test plot was established with the same objective, in which the behavior

of 19 new high-quality varieties, selected by CATIE, will be observed.

As part of the agroforestry strategy, the families received 6,000 forest species to increase the value and diversity of their cacao AFS, and the provision of ecosystem services.

Strengthening the organization

TCGA is now an entrepreneurially strengthened organization. The PCC facilitated a process to improve its performance and partnerships, created procedural manuals, trained staff and developed a business plan for cacao commerce.

Cooperation and advocacy

With the objective of energizing the sector and strengthening partnerships, the project hosted two national forums, with the co-sponsorship of CATIE, the Cacao Task Force, IICA, TCGA, Ya axché Conservation Trust and Green and Black's. More than 100 people participated in each of the two events.

Education

As part of the PCC 'farmer field schools' (FFS), 472 families—a total of 1,094 people, 37% of which were women—obtained their graduation certification. FFS use a participative training methodology developed at the family farms. Two cycles were carried out (2009-2010 and 2010-2011) in 24 communities, in which eight sessions were conducted in various topics regarding cacao farm management improvements.

In 2012, a new, four-session FFS cycle began, with the participation of 150 families. The promoters' team provided

follow-up to the work that families had done on their farms, which had been converted into models. At the end of the process, the farms were evaluated. Those that demonstrated the innovations of the learning process were rewarded.

In addition, as a compliment to the FFS, six visual guides (as strip cartoons) on diverse cacao farm management topics were published. The guides were then distributed to the families participating in the program.

Participative management

The TCGA has participated in the four PCC Evaluation and Planning Workshops, and has presented its results, challenges and limitations. During these workshops, follow-up to the activities is provided and the technical-operational advancements and the budget execution are evaluated.

More than 500 cacao producer families have strengthened their skills and capacities in order to improve their cacao AFS, and new stakeholders have joined the sector. However, it is necessary to consolidate a base of partner organizations, promote better momentum on the part of the Cacao Task Force, and engage the MAF in order to position the country as a high-quality cacao producer.

The PCC comprises part of the CATIE's Mesoamerican Agroenvironmental Program (MAP), the aim of which is to improve the well-being of rural areas of Mesoamerica.

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Analysis of forest degradation and its underlying causes in the Toledo district of Belize



This study was carried out from January through August of 2012, in the Toledo District of Belize.

Due to the growing awareness regarding the role of forests as a source of livelihood for many forest-dependent communities and societies, as well as for climate change mitigation and adaptation, this research was implemented with the following objectives: a) to determine the interactions between the direct and underlying causes of forest degradation in the Toledo District of Belize and b) to analyze the extent of forest degradation in relation to the geospatial features of roads and settlements.

This study was carried out from January through August of 2012, in the Toledo District of Belize, which is characterized by gently rolling hills and undulating lowlands. Its vegetation is dominated by submontane and lowland broad-leaf forest. For the first objective of the study, qualitative primary data was collected using semi-structured interviews and workshops with a group of 42 respondents, considered key informants.

The group was made up of government representatives, local stakeholders and individuals and organizations involved in the promotion of conservation and sustainable forest use and management in Toledo. For the second objective, researchers used geographic information systems (GIS) and remote



sensing technologies, through which a spectral mixture analysis (SMA) was conducted on a series of Landsat Satellite Images for the period of 1980-2010. This combined analysis allowed researchers to estimate the proportion of various land cover components (vegetation, soil and shadow) within a pixel. Further validation was provided by ground truthing via GPS.

Within the first objective, the results show that 57% of the individuals interviewed consider milpa farming to be the principal direct cause of forest degradation; illegal—or legal but unsustainable—timber harvesting practices, carried out under short-term harvest licenses, was the main cause for 38%; while 5% feel that infrastructural development is the main direct cause.

The perceived underlying causes of forest degradation due to milpa farming include poverty (job creation and subsistence, 44%), tradition and culture (33%) and education (lack of awareness and formal education of better practices, 21%). In regard to forest degradation due to timber harvesting, the respondents stated that high levels of poverty (42%), weak laws (or rather the lack of enforcement

and monitoring of legislation in place, 35%), and poor institutional capacity and organizational structures in the forest sector (23%) were the principal causes.

For the second objective, a spectral mixture analysis (SMA) on the Landsat images allowed us to distinguish degraded forest and regrowth forest (degraded in the sense that biomass and composition have not yet met the levels of the original forest). The extent of regrowth forest caused by milpa farming was calculated at a total of 5,702.67 hectares for the period of 1989-2010, while forest degradation due to timber harvesting occurred in an estimated 6,200.19 hectares during the same period.

Lineal regression analysis indicated that the distance from settlements has an effect on forest degradation caused by timber harvesting and milpa farming ($P= 0.0005$ and $P = 0.107$, respectively). There is no correlation between forest degradation and distance to roads.

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The Tropical Agricultural Research and Higher Education Center (CATIE) is a regional center dedicated to research and graduate education in agriculture, and the management, conservation and sustainable use of natural resources. Its members include the Inter-American Institute for Cooperation on Agriculture (IICA), Belize, Bolivia, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Venezuela, Spain and the State of Acre in Brazil.



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