Food and Agriculture Organization of the United Nations

e-Agriculture Promising Practice

Drones for community monitoring of forests

New technologies for self-management of indigenous territories in Panama

Key facts

- **Location:** Panama
- **ICT used:** GIS, remote sensors, mobile phones and drones
- **Area of work:** Forestry
- **Target group**: Indigenous communities (Bribri, Bugle, Emberá, Kuna, Naso, Ngäbe and Wounaan)
- **Stakeholders:** UN-REDD, FAO, COONAPIP, MIAMBIENTE, Rainforest Foundation US
- **Timeframe:** 2015-2017

In 1950, approximately 70 percent of the Panamanian territory was covered with forests, a figure that fell to 60 percent of the area in 2012, and which is still decreasing. Indigenous people are the main forest inhabitants and they play an invaluable role in monitoring and conserving forests, a fundamental resource for biodiversity and food security. To strengthen the natural resource management capacities of indigenous territories, FAO, with support of the UN-REDD programme, implemented a community forest-monitoring project. The project had as strong focus on capacity development of members of the indigenous communities. The training included the preparation of flight plans, arming and flying drones, image processing and mapping with high-resolution images. The main objective of the project was to identify changes in specific points of forest cover undergoing deforestation and degradation processes, to monitor the status of crops and to monitor invasions of territory. The introduction of drones made the whole process a lot easier.

Capacity development was at the heart of the project. The trained indigenous technicians were the key players for its implementation and success.

Project partners

The **UN-REDD collaborative program** was launched in 2008 to support countries' readiness to implement actions to reduce emissions from deforestation and forest degradation; and to have the role of conservation, sustainable management of forests and enhancement of carbon stocks in developing countries (REDD +). This program is based on the convening power and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Program (UNDP) and the UN Environment Program (UNEP).

The UN-REDD Program supports nationally-led REDD + processes and promotes the informed and meaningful participation of all stakeholders - including indigenous peoples and other forest-dependent communities - in the national and international implementation of REDD +.

With this background information, we want to show how the UN-REDD Program has been an essential partner through the comparative advantages of each agency, in this case FAO supporting the issue of forest monitoring in indigenous territories.

The **Food and Agriculture Organization of the United Nations (FAO)** is the main partner of the project and provides technical assistance and practical training to the indigenous communities.

The **National Coordination of Indigenous Peoples of Panama (COONAPIP)** coordinates eleven general congresses, including four indigenous districts in Panama and actively participates in the country's economic, social, cultural and environmental policies, contributing to the collective and multicultural aspiration of indigenous peoples in Panama. Its work focuses on the legalization of indigenous territories and the indigenous economy, among other functions. The role of COONAPIP was key to this project, as it initiated its proposal with FAO and requested funds from UN-REDD, through the Ministry of Environment, to carry out community monitoring.

COONAPIP also had the responsibility of being the liaison with the indigenous peoples, helping in the coordination and communication with the traditional authorities. All activities were organized through them, who in turn acted as interlocutors with the traditional authorities if a problem arose.

The **Ministry of the Environment of Panama (MIAMBIENTE)** secured liaison with the National Forest Monitoring System, supported the training activities and attended the academic courses with the presence of members of the institution.

The **Rainforest Foundation**, for its part, supports communities in developing processes to resolve conflicts over land tenure, reporting illegal logging by timber companies, managing forests and protecting the environment. Globally, they develop campaigns to influence national and international laws to protect rainforests and their inhabitants. Rainforest Foundation, US supported communities with territorial management scaling and participatory mapping.

Local communities, traditional authorities and indigenous technicians were placed at the heart of the project and, through COONAPIP, were involved in all aspects of the program. Traditional authorities appointed technicians, supported activities and incorporated community monitoring into their worldview. The indigenous technicians were the key players in the implementation and success of the project.

Timeframe of implementation

The community forest monitoring project began in 2015 and was extended to 2017, which allowed the expansion of activities to more communities and, at the same time, to organize the exchange of experiences with other countries. The first drone flight took place in April 2016, in the Madugandi Comarca. Since then, more communities have joined, and by June 2017 the 12 indigenous territories of all ethnic groups in Panama (Bribri, Bugle, Emberá, Kuna, Naso, Ngäbe, and Wounaan). During 2017 there have also been exchange of experiences with Guatemala, Paraguay, Colombia and Peru.

Context and problems raised

In 1950, approximately 70% of the Panamanian territory was covered with forests (5.3 million hectares). In 2012 this figure fell to 60% of the area (4.5 million hectares). According to FAO's 2015 Global Forest Resources Assessment, between 2010 and 2015, 16,400 hectares of forest per year were lost (equivalent to 90,000 soccer fields per year).

Deforestation and the loss of ecosystem services associated with forests represent the loss of natural capital from which the livelihoods of local communities and indigenous peoples derive. This implies a close relationship between deforestation and food insecurity, a risk that is increased by the poverty conditions that, in general, affect this segment of the population.

Forests cover more than half of the Panamanian territory. Indigenous peoples, the main inhabitants of these areas, play a vital role in the care and monitoring of this important resource for food security.

Panama is advancing in the development of the **National REDD + Strategy**. As part of the **joint UN-REDD national program**, work was done on the design of a **National Forest Monitoring System (SNMB)**. The SNMB was defined as a multipurpose system that provides key information for REDD + and for the monitoring of forest resources in general. In this context and complementary to the SNMB, a project was carried out for the community management and monitoring of forests in indigenous territories, supported by resources from the UN-REDD program through FAO, in conjunction with the National Coordinator of Indigenous Peoples of Panama (COONAPIP) and the Ministry of Environment of Panama (MIAMBIENTE).

The development of the SNMB was part of the joint national program. FAO provided the methodologies, the satellite system, the forest inventory and the geo-portal, to give it visibility and transparency. The SNMB is still under development and in the process of institutionalization in MIAMBIENTE.

To strengthen the natural resource management capacities of indigenous territories, FAO, through the UN-REDD Program, implemented a community forest monitoring project. Based on this project, personnel of eleven of the twelve congresses and indigenous councils of the country were trained in the use of drones. The training included the preparation of flight plans, arming and maneuvering drones, image processing and mapping with high-resolution images.

The main objective of the project was to identify changes in specific points of forest cover undergoing deforestation and degradation processes, to monitor the status of crops and to monitor invasions of territory. The maps generated will enable the authorities to guide decision making for the protection, management and conservation of their forests and natural resources, thus contributing to the Sustainable Development Goals 13 and 15 linked to ecosystem and climate care.

The technicians were also prepared for the development of forest and carbon inventories, to generate databases on their forest resources

so that, later on, they could implement a community intellectual property protocol on traditional knowledge of flora species.

Currently there are six monitoring stations operating in the different indigenous communities of the country, coordinated by young technicians who form a community forest monitoring network, which favors the exchange of experiences between territories and technicians, strengthening the learning among its members.

Community forest monitoring aims to improve the management and conservation of natural resources in indigenous territories by:

- Capacity building of indigenous technicians in the areas of remote sensing of geographic information systems (GIS) and forest and carbon inventories.
- Generation of geo-referenced information among the different indigenous territories, using a standardized methodology and, at the same time, serving the specific needs of each territory.
- Standardization of the storage of remote sensing data at different scales and processing of field-collected information that is reliable and truthful.

Implementation of the project and development of technical tools

The project on community monitoring of forests in indigenous territories included the following activities:

1. Introductory training for indigenous technicians in Geographic Information Systems (GIS) and remote sensing for forest monitoring.
2. Acquisition of monitoring stations for the storage of geo-referenced data and remote sensors for community monitoring of forests, for some indigenous congresses and councils.
3. Drafting of the first draft of the community intellectual property protocol on traditional knowledge of flora species and collecting reference plant material in indigenous territories. (see box)
4. Development of a database for forest inventories.
5. Training on methodology and measurements for the National Forest and Carbon Inventory of Panama (INFC) and collection of forest data in indigenous territories.

Community intellectual property protocol

As part of the National Forest Inventory, there is a need to collect reference plant materials in indigenous territories. In general, several projects have gone to these communities to collect plants in their territories and use indigenous genetic resources. To protect itself, the communities demanded an indigenous lawyer to develop a draft in community intellectual property protocol, through a participatory process, which aims to protect communities and reconcile their demands. This experience turned out to be a great learning experience for everyone involved.

Currently there are six monitoring stations, operating in the different indigenous communities of the country and coordinated by young technicians, who form a community forest-monitoring network.

Community forest monitoring provides information on the different natural resources, biodiversity and health of the environment. In addition, community monitoring should obtain information that is of interest to the communities and territories involved. The information collected in the territories can provide data for the National System of Forest Monitoring. However, it must be taken into account that certain steps should be taken for **Free, Prior and Informed Consent** (see box) for exchange of information.

A proper forest management and protection of natural resources and ecosystems of indigenous communities can only be achieved through the knowledge they have about their territory at local level. Community forest monitoring allows the communities themselves to lead the collection and analysis of information, according to the particular interests of each community and territory.

Through continuous monitoring at various levels - at territorial and local levels - it is possible to determine if there are changes in forest ecosystems. The combination of terrestrial and remote sensing monitoring allows knowing the dynamics of loss, degradation and restoration of the forest cover. The results of these analyses support decision-making by the way of congresses, indigenous councils and local authorities, to direct actions for the conservation and sustainable management of resources in their territories, in favor of the well-being of the communities. This knowledge about the situation and dynamics of forests in indigenous territories, a product of community monitoring, is also an important complement to the SNMB.

In this sense, it was necessary to establish a conceptual framework that establishes the duties and coordination among the actors involved and defines the components, basic infrastructure and other requirements for sustaining the community forest monitoring system. The three levels of monitoring - Congresses and Councils, Indigenous Territories and National Territory - are based on a technological infrastructure and technical capabilities developed that integrate local knowledge with the technical and scientific bases of forest monitoring. The conceptual framework was developed in a participatory manner with the support of all stakeholders.

Free, Prior and Informed Consent (FPIC) is an internationally accepted principle of Sustainable Development, which recognizes that it is desirable to open a consultation process, through which a community potentially affected by a project is involved in an open process and informed dialogue with individuals and persons interested in following the activities in the area or areas traditionally occupied or used by the affected community. The need for consent covers all issues related to the life of indigenous peoples, as it is an extrinsic right to the exercise of the right to self-determination and a basic component of the right to land, territories and resources.

With respect to technological infrastructure, it is proposed to install a network of monitoring stations equipped with adequate physical equipment, which will be extended to the extent that more resources are allocated for operation and maintenance. As an initial investment, one (1) central station and six (6) monitoring stations have been installed in different indigenous territories of the country, where all the information generated by the monitoring system is stored and administered and the dedicated resources are housed to process this information.

Community forest monitoring also brings technical capacity building in the communities, as it involves the active participation of local staff with varying degrees of knowledge, professional training and roles. The technicians who are endorsed by the different participating indigenous congresses and councils have received the technical training necessary to carry out measurements / observations of forest inventories and the collection of forest data for terrestrial monitoring within their own territories; monitoring by remote sensing with satellite images and aerial photographs obtained with drones and the use of Geographic Information Systems (GIS) for generation and management of monitoring system information.

As part of the implementation of the developed capacities, a network of monitoring stations was installed where standardized information is collected in six territories.

The tools used to obtain information are: **Open source software: Google Engine, QGIS, ODK**

Tool	Description
QGIS	Desktop GIS software to visualize, create, edit, manage and analyze spatial data, besides creating maps and other cartographic products.
Google Earth Pro	Desktop software to visualize spatial data, satellite images and maps, produce 3D images and videos for presentations and reports.
Google Earth Engine	Online platform for the visualization of geospatial data and large-scale scientific analysis of large datasets. Contains historical series of satellite images.
RealFlight	Drone flights simulator for the learning and practice of flight maneuvers with multiple aircraft models, useful to improve technicians' skills for drone flights.
Mission Planner	Open source software to direct the RPA ground control station (drones): schedules flight missions, monitors the state of the aircraft in operation, and generates telemetry records.
Open Data Kit - ODK	Free open source toolset for mobile data collection: Develops data capture forms, collects data from mobile devices and manages them on a server.
PostgresQL / PostGIS	Open source software for object-relational database management, with an extension - PostGIS - for spatial databases.
Geoserver	Open source software to share geospatial data from different sources as geoprocessing services, using open geographic information standards such as WMS, WFS, WCS, among others.

Geo-referenced database with satellite information and forest inventories

The database consolidates the information generated by the various components, allowing the input of satellite and terrestrial data. The database provides information for natural resource management processes and allows us to cross-reference data and make more accurate comparisons. Some of the objectives to be considered are the stabilization, security and integrity of data management. This methodology, besides achieving the standardization or uniformity of the use of centralized information - both local and national - will give us an analysis of the data suitable for feedback to the communities.

Community monitoring centers will have the potential to collect information based on other variables, such as:

- Biophysical variables
- Socio-economic variables
- Cultural variables
- Generation of community alerts: with the inputs provided in the satellite monitoring and the database, reports can be made to generate community alerts that improve the management of the territory.
- Usage plans

The collection should follow the guidelines of the Intellectual Property Protocol, coordinating actions with local community authorities, designated technicians and involving users of forests.

Drones

The information generated by drone flights can have multiple applications and can be used for different purposes, depending on the requirements of each community. This would include forest monitoring, territorial planning, monitoring of forest fires, population growth dynamics, and invasions of their territories and monitoring of crops, among others.

In addition to obtaining images of very high spatial resolution, the high superposition of images obtained with the drones allows to derive data of height, from a digital stereoscopy.

With this information on the height and the ground cover, we can calculate the altitude and the volume of the vegetation and, together with the land points, gather the necessary topographic information. Through the multi-temporal analysis of these results, we can identify, in an automated way, very subtle coverage changes, such as the extraction of a particular tree.

This technology, as a whole, allows the consolidation of a surveillance system in areas with active dynamics, as it will provide information in real time, reliable, easy to process and practically independent of climatic conditions, which allows:

- The monitoring of areas with continuous cloud permanence
- To be economically efficient for the monitoring of inaccessible areas and with little visual coverage
- Be easy to learn and to generate reliable results
- Empowering communities to use the tool from their own capacities, since it can be monitored when needed
- Optimize surveillance: The evidence gathered can be useful for legal proceedings.

The drone model chosen for this project is the "Fix-wing drone model E384" from Event 38 Unmanned System. This model was chosen for being easy to use, easy to repair and very light, and can cover large distances in a single flight. This model also makes it possible to carry out, specifically, flight plans and post-processing for the monitoring of the earth.

Fixed Wing Equipment, Model E384. This equipment is designed for photogrammetry and mapping applications and its main features are:

Physical characteristics	**Operational characteristics**
Dimensions: 71 inches (180 cm) width of wings 51 inches (129 cm) long	Cruising speed: 27 mph (44 km/h)
Weight: 5 lb (2,3 kg)	Flight time: 100-120 minutes
Maximum load capacity: 2,2 lb (1 kg)	Range: 40-54 mi (64 to 85 km)
Flight battery: 4 cells, 8,0 Ah	Climate: autonomous operation up to 25 mph (40 km/h)
Pixhawk autopilot, includes GPS	Modes of operation: assisted, automatic and autonomous mode
Remote control: Spektrum DX5e	Real-time telemetry station on a laptop up to 10 km
Telemetry Options: 433 MHz and 915 MHz	Maps up to 960 acres (3.8 km^2) per flight of 5 cm/pixel
Wings and body can be assembled for easy portability	Automatic camera control Canon S100 12,1 MP

In general, it is argued that the use of drones has the following advantages and disadvantages:

Advantages:

1. Obtaining very high-resolution images in areas of high cloudiness (the advance of illegal logging does not wait for sunny days or some satellite to pass).
2. Lower cost than a field visit in large areas, in addition to generating an indisputable result and easy interpretation to convey what is happening.
3. Reduction of time: the data capture occurs at the moment and the storage capacity of the equipment allows its subsequent analysis.
4. Increased staff safety. It is not necessary to cross thousands of hectares in a day, nor to fly over areas with the risk that this implies.
5. Accessibility: Areas that, due to their orography, are difficult to study can be accessed with the equipment.

Disadvantages:

1. It is more expensive to use a drone and to buy all the equipment, than to use satellite images. Because for this function the images are not available, the use of the drone is the only existing alternative.
2. Being a dynamic three point of reference system (the user, the controller and the drone), the temporal reaction in the execution of actions can become conditioned, which could generate a delay between the emission and the execution of those actions, affecting the team if the conditions are not adequate.
3. The acquisition requires initial investment and the maintenance of the equipment needs fixed personnel, specifically formed to give it an appropriate use.
4. New regulatory standards will define the use of drones in the national territory, which requires updating.

To carry out the flights it is necessary to follow the protocol established in the prepared forms: pre-flight / post-flight checklist and take-off supervision, documents detailing the procedures for:

→ preparing the equipment

- Verification of all equipment required for drone missions, using the pre-flight / post-flight checklist.
- Battery Charge: Battery charger programmer (Lipro balance charger) for aircraft batteries (8000 ap) at 5 volts, camera battery charge and transmitter or control batteries.
- Internal connections: connection of telemetry cables, drone battery, camera and autopilot system (Pixhawk).
- Assembly of the drone: assembly of fuselage, tail and elevator, wings, elastic bands to fix, camera, cable connections, battery of the drone and, finally, the motor propeller.

→ connection to telemetry and flight mission planning

To elaborate the flight plans it is necessary:

- Prepare the laptop computer by connecting the telemetry modem to the USB port, then connect to the E384 from the E38 Mission Planner software.
- Create the flight plan: search the site of interest, create the polygon of the area to be flown and generate flight lines based on parameters such as camera, flight altitude, desired resolution of images, 60% photo overlap (recommended), available battery time and others. The *Mission Planner* manual describes in detail the procedures to follow with the application.

Equipment for collecting forest information

For terrestrial data collection, an application is used to identify newly cleared lands and to find areas identified during previous flights.

The application can be installed on a smartphone, since its use is quite common in indigenous communities and all technicians have one. Other applications used allow adjustments, depending on the needs of the project. For example, some allow you to make a field form to collect the data in the field. They are free access applications that technicians can download and use on their own mobile devices.

Impact

In Panama, the monitoring component of forests in indigenous communities has greatly aided global monitoring and has helped meet the demands of the REDD program at the national level. Pre-project monitoring had not covered those areas of the forests that belonged to indigenous territories.

An important component of the initiative was the emphasis on the training aspect. Indigenous communities have been trained in the use of drones and other technologies to monitor changes in land use and coverage of all areas. With these technologies, they have been able to generate very precise data that help them to make decisions and manage their territory.

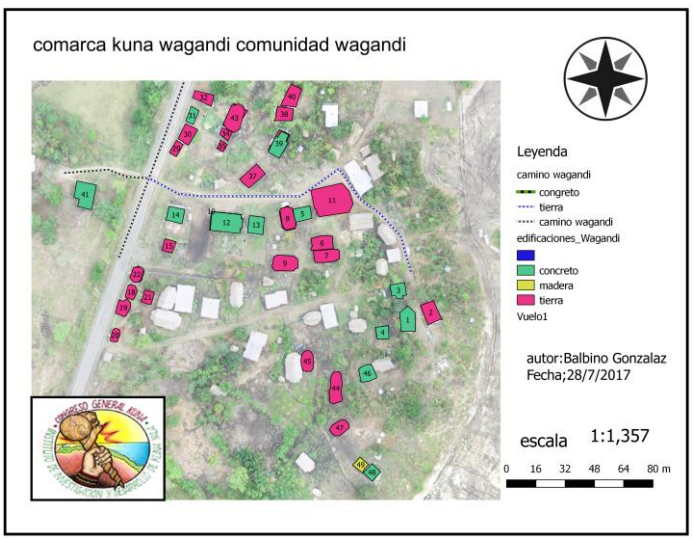
Communities can use data and information to dismantle and report illegal logging operations, but also to monitor fires, crop crops, water resources, etc. The use of the data depends on the decisions of the indigenous authorities. Since they use the data independently, each territory uses the technical tools according to their own needs.

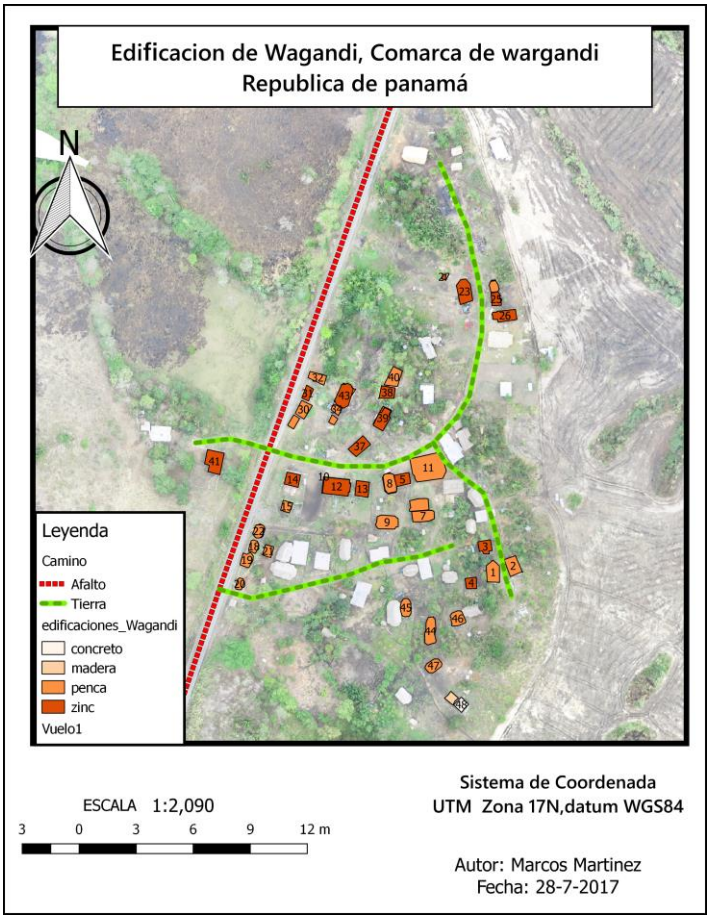
After the training of the technicians, these have applied their knowledge in other applications complementary to the monitoring of forests. There are pilots for community forestry and other more practical functions that are needed and, in some cases, provide economic support. Nowadays, the technicians support several local actions, like the identification of areas of fire, which also can be located with the drones or with free satellite images.

Many communities want to acquire their title deeds and for this, the technicians have helped to make the field survey and to design the maps. The trained technicians use the tools and their new GIS capabilities to develop maps that support them in demands of rights to the earth, that are going to submit to the government. They themselves outline it with the members of their community and coordinate it directly with COONAPIP. The competent national authorities are already evaluating the documents for the titling of the ownership of five territories.

The training has also transformed the dynamics of indigenous communities. After the project, its members are more empowered to propose issues and develop proposals, prepare high-quality technical reports that are very supportive of traditional decision-making authorities. Although the focus at the beginning of the project was forest monitoring, the people involved are already applying tools for other needs in their territories.

Indigenous technicians actively participate, incorporating what has been learned to the realities of their territories, which will contribute to improving the management of their forest resources, while maintaining their traditional knowledge.





They have also encouraged the exchange of experiences between territories through the technicians, which makes learning among them strengthened. Their participation in different trainings has strengthened the knowledge in the monitoring of forests and has strengthened the relationship between them. They are the ones to lead the discussion on community monitoring issues with the authorities.

On the other hand, the previous practice with flight simulators facilitates the maneuver with the fixed wing drones. This is how the technicians who practiced previously in the training could take off, fly and land the drones successfully.

Innovation and success factors

Thanks to the use of drones and new technologies, community monitoring of forests has been transformed positively. With the new knowledge and equipment available, communities can generate very accurate data that help them make decisions and manage their territory, and extend the range of areas that can be monitored. But beyond technology, it has been the people involved in the project who have pulled it off.

The practice has had positive results, thanks to the close collaboration with COONAPIP and the technicians chosen by the traditional authorities of the indigenous territories. The project was designed for them and, at all times, adapted to the needs and demands of the communities. Its members not only participated in the process, but also directed it and that is where the success of the project resides.

Those involved wanted to do the work for themselves and thanks to their motivation, it is how they managed to make the proposals work. It is clear that communities want to empower themselves and not only participate, but also to organize the workshops. It is worth mentioning that, thanks to the mediation of COONAPIP, each community was able to choose at least one technician to work with the authority corresponding to their territory.

To achieve these results, it was very important to integrate a holistic vision to the actions and activities developed. The introduction of new technologies was only a small part of the process, since training has also favored and stimulated creativity in the use and application of new knowledge and technologies to solve the technicians' own needs and to benefit their communities.

The project introduced a number of innovations, for example, constant feedback between technicians and their authorities, strengthening the processes of internal governance of communities, which was essential to the success of the project.

Challenges

During the activities, there was an unanticipated limitation related to the participation of women in training activities. At first there were women participating in the training, but at the end of the activities they had stopped attending. So far we have not identified the specific reasons why women left the project and how we could reverse the situation. What is clear is that the gender approach in the project was poorly developed and this should be prioritized in future actions. For example, through the Voluntary Guidelines on Responsible Governance of Tenure, which mentions the removal of obstacles to the rights of indigenous women as one of the keys to success for sustainable governance of natural resources.

On the other hand, the selection of the technicians created several obstacles: being these chosen by the authorities of the territories, the criteria were very varied and, in some cases, they did not take into account certain basic aspects – for example if the technician had an email - that complicated the process at various stages of the training.

The project also presented some challenges related to the forest monitoring system, such as:

- System sustainability
- Credibility of the information generated at community level for the national authorities
- Comparability of information
- Incorporation into the National Forest Monitoring System and Nationally Determined Contributions (NDC)

Lessons learned

In general, there was no cultural resistance to the implementation of the project since at each stage, through the COONAPIP, the indigenous authorities were consulted and involved. The same proposal came from a joint effort with the authorities, which recognized that new technologies could favor forest monitoring and thus strengthen forest governance and land tenure. Currently, there are capacities created within communities in database management and geographic information system to generate maps of territories, remote sensing with high and low resolution images and collection of forest information.

From this project, we can also draw a significant lesson on the importance of the partner COONAPIP. During the process, the institution was the initial driver and focus at each stage of the project and the link between all the parties involved. They also supported the Free, Prior and Informed Consent (FPIC) process before starting any activity in indigenous communities. Sometimes, the authorities did not fully understand the objectives of the project and opposed its implementation. The dialogue, facilitated by the Coordinator, was very important to adapt the activities to their wishes and needs.

Indigenous technicians also played a key role in the project. A bond and a network have been created, after having conducted various activities throughout the year. They know each other better, continue with the exchanges and support each other thanks to the regularity of the meetings. The indigenous technicians are those who have the trust of the indigenous authorities and were chosen by them. Therefore, they also play an important role in the dialogue and adaptation of activities during the process.

At the end of the project, the team believes that government participation should be strengthened, which will contribute in the future to integration with the national monitoring system. Likewise, strategic alliances and the identification of new relevant actors could be strengthened in order to make more efficient use of available funds and broaden the scope of actions.

The continuity of the project with different sources of funding, created a favorable environment for the understanding and dialogue among stakeholders to identify issues in their territories. The technicians have put all their energy in the project to be successful, which has allowed the adaptation and improvement of activities to manage their natural resources during the process.

Sustainability

Global experience is contributing to environmental sustainability, however, there are some issues regarding sustainability in relation to the use of ICTs and drones to be taken into account.

Over time, the drones will be damaged and, at the end of their useful life, they will have to be replaced. In order to reduce costs, the project is testing with a cheaper type of drone, always considering open source alternatives.

On the other hand, most trained technicians are volunteers and much of the work is done and managed at the community level, which avoids financial dependence on projects. But the cost of field missions is quite high and it is not always easy for communities to continue with the work.

In order to strengthen the sustainability of the project, a national indigenous forest monitoring network was created for the time being composed of 17 members, with at least one representative from Congress.

To ensure greater sustainability, several alternatives can be considered, for example:

1. Incorporate community monitoring to the Ministry of Environment to receive long-term support and to propose a definitive component of monitoring at the national level.

2. Incorporate monitoring within the costs of forest resources utilization through the management plans.

Replication and upscaling

With the support of FAO, two indigenous technicians conducted two workshops on the use of drones in Guatemala. During 2017, a workshop will also be held in Paraguay, to share the experience with the indigenous communities of that country.

In October 2017, the Rainforest Foundation US will organize a workshop in which indigenous Panamanian technicians will train indigenous communities in the Peruvian Amazon. In addition, a virtual platform for the exchange of experiences on community forestry monitoring for Central American countries is being prepared with the support of FAO and UN REDD.

Testimony

Eliceo Quintero, a young indigenous from the Ngäbe Buglé Comarca, a participant in the project, emphasizes how interesting the experience has been thanks to its many levels of innovation:

"These tools allow us to know the characteristics of the forests and the resources we have in our territories. Training has been carried out to analyze geographic information and use of technology tools in the field, with direct applications in the forests".

About the results, Eliceo Quintero adds that the data they have collected have been interesting because they have served to find out unique characteristics of the development of the species in the area:

"We have identified local native species, analyzed the forest cover, how the impact of deforestation has changed and it has been useful to us to discover some interesting places and sacred sites. It has also allowed us to test the levels of organization of the community and strengthen the administrative management of our authorities."

On the future of this initiative, young people aspire to seek more instruments to expand their reach and to generate a community-monitoring network at national level, a valuable contribution to *"monitor and protect their resources, recover degraded areas and give them a good management of its resources in the future."*

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Resources

- Virtual forest monitoring platform: http://monitoreoforestal.gob.mx/monitoreocomunitario/
- Press release: http://www.fao.org/americas/noticias/ver/en/c/417510/
- Photo Gallery: https://www.flickr.com/photos/faomesoamerica/sets/72157664564838383 https://www.flickr.com/photos/faomesoamerica/sets/72157664564838383
- Images of the project in a report on deforestation in Panama: http://www.tvn-2.com/nacionales/TVN-Investiga-Reforestar-plantar-vida_0_4738776166.html
- Indigenous Peoples of Panama will use drones to care for the forests: https://youtu.be/QLAtNLC7zzI
- FAO implements drones as guards of the indigenous forests of Panama: https://youtu.be/550r4GmhSJM

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