
A Community-based interactive monitoring system for effective REDD+ implementation in Peru

Final Report



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Logos of research project implementing organisations and funding support



SUMMARY

As forest monitoring systems have developed around the world, it has become increasingly apparent that the skills and knowledge local communities possess in regards to forest management can play an important role in contributing to and strengthening monitoring systems. This is especially the case for REDD+ implementation where local communities are actively engaged in forest management. The information that is generated from the monitoring enables to increase transparency and accountability of the forestry sector in order to improve governance and management of the forests.

Together with a number of partners, the Wageningen University have launched a Community-based interactive monitoring system for effective REDD+ implementation in Peru – with funding from the USAID. The main objectives of this project are: 1) to assess the role and pathways for capacity development and multi-level engagement of local communities in monitoring forest changes to support REDD+ objectives for Peru; 2) to develop capacities and implement a prototype monitoring system for forest changes with handheld devices and related technologies to empower the empowerment of local communities to measure forest activities and their impacts; 3) to integrate community based monitored data with other existing data such as remote sensing time series and expert field measurements for effective and interactive REDD+ participation and implementations on the local and the regional/provincial level.

This report outlines results of the project entitled “A Community-based interactive monitoring system for effective REDD+ implementation in Peru”.

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Abbreviations

ACR	Regional Conservation Area
AMARCY	Executor of Administration Contract of the Yanesha Communal Reserve
ANPs	Natural Protected Areas
ARA	Regional Environmental Authority
ARFFS	Forest and Wildlife Regional Authority
ARKANTH	Yanesha Security (Within communal area)
ATFFS	Forest and Wildlife Technical Administration
BPSMSC	San Matias San Carlos Protected Forest
CAD	Self defense committee
CAM	Municipal Environmental Commission
CARE	Asháninka Center of the Ene River
CART	Asháninka Center of the Tambo River
CBM	Community-based monitoring
CCNN	Native Community
CG	Management Committee of PNCB
CIAM	Interregional Amazonian Council
CIFOR	Center for International Forestry Research
CMNUCC	United Nations Framework Convention on Climate Change
CONAP	Confederation of Amazonian Nationalities of Peru
CV	Vigilance Sub-Committee of PNCB
CVCFC	Vigilance and Forest Control Committee
DDs	Deforestation and forest degradation drivers
ECOASHANINKA	Executor of Administration Contract of the Ashaninka Communal Reserve
FCPF	Forest Carbon Partnership Facility
FECONAYA	Federation of Yanesha Native communities
FEMA	Special Prosecutor for Environmental Matters
FIP	Forest Investment Program
GIZ	German International Cooperation

GORE	Regional Government
LLL	Loma Linda Laguna Native Community
MINAGRI	Ministry of Agriculture and Irrigation
MINAM	Ministry of Environment
MLG	Multilevel governance
MRV	Measuring, Reporting and Verification
NFMS	National Forest Monitoring System
NTFP	Non-timber forest products
OEFA	Agency for Environmental Assessment and Enforcement
ONG	Non-Governmental Organization
ONU-REDD	United Nations Programme on REDD+
OSINFOR	Forest Resources and Wildlife Oversight Organization
PIP	Public Investment Program
PNO	Otishi National Park
PNCB	The National Forest Conservation Program for the Mitigation of Climate Change
PNYNCH	Yanachaga-Chemillen National Park
PO	Puerto Ocopa Native Community
RCA	Ashaninka Communal Reserve
RCM	Matchiguenga Communal Reserve
RCY	Yanesha Communal Reserve
REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
SERFOR	National Forest and Wildlife Service
SERNANP	National Service of Natural Protected Areas
SIAL	Local Environmental Information System
SIAR	Regional Environmental Information System
SPP	San Pedro de Pichanaz Native Community
C1	Component 1 - Mapping and Monitoring Forest Conservation Unit
C2	Component 2 - Sustainable Production Systems Unit
C3	Component 3 - Capacity Building and Governance
C4	Component 4 - Monitoring and evaluation

TDC Conditional Cash Transfers

UTMFC Technical Unit of Community Forest Management

VRAEM Valleys of Apurimac, Ene and Mantaro Rivers

1. BACKGROUND

1.1. The REDD+ mechanism

The United Nations Framework Convention on Climate Change (UNFCCC) has outlined a mechanism called Reducing Emissions from Deforestation and Degradation in developing countries (REDD+) that aims to reduce greenhouse gas emission from deforestation and degradation, to enhance the forest carbon stocks and promote the conservation and sustainable management of forests (UNFCCC 2009). Aside from an important step towards reducing greenhouse gasses, REDD+ also includes considerations for co-benefits, safeguards and biodiversity protection.

A country participating in a REDD+ mechanism of the UNFCCC requires a reliable, transparent and credible system of Measuring, Reporting and Verifying (MRV) changes in forest areas and forest carbon stocks (Herold and Skutsch 2008). Thus, a nation should identify the drivers of deforestation and forest degradation causing forest carbon changes and should establish reference levels (Penman, Gytarsky et al. 2003). The national capacities for MRV should be based on an assessment of the gap between the existing national forest monitoring system and the requirements of the REDD+ MRV system. Each nation should establish an effective, efficient and sustainable institutional and implementation framework.

1.2. Community based monitoring

According to the REDD+ monitoring and implementation requirements, it is important to involve local community groups and societies to carry out forest monitoring, in particular, if there is any prospect of payment and credits for environmental services. A variety of practical experiences from developing countries, e.g. Nepal, Tanzania, Cameroon, India and Mexico have demonstrated that local communities can play an essential role in forest monitoring and management program (De Sy V, Herold M et al. 2012; FCPF 2012; Pratihast, Herold et al. 2013). Moreover, if communities are involved in monitoring forests they manage, they may establish 'ownership' of any carbon savings, strengthen their stake in the REDD+ reward system and greatly increase transparency in the sub-/intra-national governance of REDD+ finances.

Handheld devices such as smart phones and personal digital assistant (PDA) devices may play an important role in the measurement and estimation of forest-related carbon emission at the community level mainly for two reasons. Firstly, it supports mobility- supporting community participants to immediately record the measurement in the systems. Secondly, the implementation of the scheme becomes cost-effective and sustainable because of the cost of these devices, access to the internet and ways to link between national and local monitoring activities (Pratihast, Herold et al. 2012). Thus, while remote sensing techniques are the main tools used at the national level to detect deforestation, local level community data can be an important input to analysis of deforestation and degradation events. Community based monitoring (CBM) can help to complement remote sensing estimates and to signal new changes (even before the remote sensing data have been analysed). Important information provided by CBM could be location, time, area and type of the change events in the ground.

CBM can play a useful role when it comes to locally-driven change activities and causes of small scale forest degradation, for example, by subsidence fuel wood collection, charcoal extraction and grazing in the forest. The impacts of these activities are rarely captured accurately in national databases or from remote sensing. In these cases, data acquired by communities is often essential, and can include reporting on incidence of change events, as well as ground measurements on carbon stock changes for tracking and reporting on local REDD+

implementation activities. There are many examples showing that communities can carry out such monitoring activities (Danielsen, Skutsch et al. 2011; Pratihast, Herold et al. 2013). However, the success of these programs depends on socio-cultural aspects as well as the technical capabilities of the members of the community where it is to be implemented.

1.3. Need for local communities engagement in monitoring

Monitoring carried out by local people, communities and non-experts not only provides an additional level of data and information but also promotes the sustainability of any local implementation activity at a wider level (Whitelaw et al. 2003, Garcia and Lescuyer 2008). There are a number of valid reasons to involve the community in forest monitoring process (Fröde and Masara 2007):

- Local knowledge: Local communities have in-depth understanding of the local forest, and tree species nearby. They can provide access to indigenous knowledge systems which can be used for sustainable forest management.
- Communities are on spot: Generally, communities have easy access to the surroundings which are to be monitored, and regular field visits take less time and fewer resources, compared to surveys carried out by external experts.
- Communities need to be involved: Any local implementation that affects forest of or used by communities needs their involvement, to be effective. Involvement increases the sense of ownership and responsibility. Active involvement of community in monitoring process may promote long-term sustainability of the program.

The role of CBM within a national level process depends very much, however, on the drivers and activities to be monitored. Table 1 summarises the potential role of CBM within a national MRV process.

Table 1. Potential role of community based monitoring (*Pratihast, et al. 2013*)

Forest Change Activity		Monitoring Options at National Level	Potential Contribution of Community Based Monitoring
Reforestation		• Remote sensing, • National forest inventory • Monitoring through forestry companies	• Acquiring/signalling the location, time, area and type of change events (in near real time)
Deforestation		• Remote sensing • National forest inventory	• Ground level measurements for local implementation (i.e. of reforestation plots)
Forest degradation	Commercial activities, incl. selective logging	• National forest inventory • Commercial companies (i.e. harvest estimates) • Remote sensing	• Independent local reference for national/other data sources
	Wild fire	• Remote sensing, National forest inventory	• Acquiring/signalling date, area and type of change event (near real time)
	Subsistence forest use incl. fuel wood, charcoal,	• Limited historical data • Possibly national forest	• Regular ground level measurements and

	community forest management etc.	inventory	reporting of forests and carbon stocks • Tracking growth/decrease of local activities (drivers)
Forest enhancement	Increases in biomass due to REDD+ activities at project level		

1.4. REDD+ and Community-Based Monitoring in Peru

Peru's Ministry of Environment (MINAM), an agency of the executive branch, is responsible for designing, establishing, implementing and monitoring national environmental policy and has taken the lead role in preparing the country for the implementation of REDD+ in coordination with several multilateral agencies. Its National Forest Conservation Program for the Mitigation of Climate Change (Programa Nacional de Conservación de Bosques or PNCB in Spanish) was formally established by Supreme Decree No. 008-2010-MINAM in July 2010 with the aim to conserve 54 million hectares of forests by 2021. The PNCB began several initiatives geared at reducing deforestation, among which is the direct conditional transfer program called Transferencia Directa Condicionada (TDC) through which the government offers a financial incentive directed at supporting indigenous communities committed to protecting primary forest within their territories. The incentive involves 10 PEN/ha per year that is left for the committees created to decide how to allocate (discussed further below) based on the community priorities identified in the investment plan.¹ The TDC program also facilitates the development of productive projects (timber, agro forestry, fish farming) through an investment plan (PNCB 2011).

The TDC program engages 59 indigenous communities located in eight regions.² The program is divided into four "components": Component 1 oversees the mapping and monitoring of forests under conservation, which coordinates the Monitoring Committee (Comité de Vigilancia in Spanish or CV) in participating communities to identify and monitor the conservation area in each community. Component 2 focuses on the promotion of sustainable production systems, which coordinates the implementation of the financial compensation with communities through their management committees (CG). Component 3, capacity building, aims to generate the necessary human resources at different levels of governance. Component four (C4) is responsible for the monitoring and evaluation of the program and serves as the advisory body that overlooks C1 through C3.

1.5. Challenges to operationalize REDD+ in Peru

REDD+ is inherently a multi-level governance process (Skutsch and Van Laake 2008; Forsyth 2009; Mwangi and Wardell 2012) that involves a variety of actors, both directly and indirectly, and involves multiple levels and sectors. The concept of multilevel governance (MLG) is increasingly used to examine processes and outcomes in cross-scale, cross-sector and multi-actor contexts (Pahl-Wostl 2009; Mwangi and Wardell 2012). Increasingly policy processes are

¹ The whole community is responsible for deciding how the money is spent through a participatory process in communal assemblies at the start of the agreement between the community and the PNCB. Sometimes, however, the committee responsible for the administration of the money must deal with delays in the disbursement or other conditions for which they must decide how to prioritize which action needs to be covered at the time.

² The TDC operates in Amazonas, Cusco, Junin, Loreto, Madre de Dios, Pasco, San Martín, and Ucayali.

incorporating the inclusion of as many stakeholders as possible as a way of encouraging legitimate decisions and ownership on the basis of inclusive and representative participation (Rantala et al. 2014). With increased duration and quality of participation, stakeholders develop an ownership over the negotiated rules and norms or process and are more likely to accept the costs of implementing them.

The key elements of MLG include the increased role, participation and inclusion of non-state actors in decision-making and actions, coordination among diverse actors, transparency of information and capacities necessary to engage in processes. For instance, national and sub-national governments, NGOs, private companies, indigenous communities and their federations, small farmers and other civil society organizations are involved in the development of REDD+ national strategies and projects on the ground. Participation and coordination across these levels of government represent challenges for REDD+ (Gallemore et al. 2015; Kowler et al. 2015) due to multiple stakeholders with different perspectives, interests, and powers.

Despite its potential, CBM for REDD+ still faces challenges. In considering the incorporation of CBM into REDD+ MRV, we must recognize the knowledge and capacity demands of local communities in this context as well as the existing roles and experiences of communities in monitoring, forest management and conservation activities. However, very little is known about these variables yet, and the long-term sustainability of local monitoring programs will depend in part on the sustained technical capacities of the community members (Pratihast et al. 2014), benefits involved in these initiatives, and the relevancy of monitoring to local contexts, all of which shape local interest and willingness to participate in monitoring (Boissière et al. 2014). CBM under REDD+ is relatively new and the national investment needed for developing an institutional framework to provide technical and perhaps financial support for local monitoring activities needs to be explored (ibid).

In this study, we examine the existing governance arrangements for monitoring at different levels, the existing knowledge, capacity, and interest of local actors as well as the horizontal (community level) and vertical (across levels) coordination among actors to better understand the sustainability and potential scalability of CBM to the NFMS and MRV system. We look at experiences from the TDC Program as an instructive case for learning about CBM to offer insights for REDD+ and MRV.

1.6. Research objectives

The overall objective of this study was :

- 1) to assess the role and pathways for capacity development and multi-level engagement of local communities in monitoring forest changes to support REDD+ objectives for Peru;
- 2) to develop capacities and implement a prototype monitoring system for forest changes with handheld devices and related technologies to empower the empowerment of local communities to measure forest activities and their impacts;
- 3) to integrate community based monitored data with other existing data such as remote sensing time series and expert field measurements for effective and interactive REDD+ participation and implementations on the local and the regional/provincial level

2. MATERIAL AND METHODS

2.1. Case study description

We conducted a case study focusing on the CV in three communities (see Table 3). Communities were selected based on their time of involvement with the TDC program and their level of commitment to their responsibilities and program objectives. Selected communities had all been involved for at least three years in the TDC program and have demonstrated commitment to the requirements of the program. Since smartphones devices were tested in this work as a tool for local forest monitoring, one requirement was that the community have a well-trained monitoring committee. Other selection criteria included the presence of threats of deforestation and degradation of communal forests and location or ease in terms of accessibility to the research team.

Before undertaking interviews and workshops in each community, a presentation was held during their general assemblies in order to communicate the objectives of the study, the interviews and the accompaniment of research team in monitoring activities. The research team coordinated visits to communities and field work directly with the regional PNCB staff, given their consistent coordination and strong relationship with involved communities.

Table 2. General information of Indigenous communities

Indigenous Community	Region	Province	River basin	Estimated population	Year of agreement	Conservation area (ha)	Funds TDC (S/.)	Indigenous organizations	Indigenous group
Puerto Ocopa	Junín	Satipo	Tambo	>1000	2012	8030	80300	CART (CONAP)	Ashaninka
San Pedro de Pichanaz	Pasco	Oxapampa	Palcazu	400	2012	4020	40200	FECONAYA (CONAP)	Yanesha
Loma Linda Laguna	Pasco	Oxapampa	Palcazu	700	2012	2597	25970	FECONAYA (CONAP)	Yanesha

Source: Adapted from PNCB Investment plans for the three communities.

The three communities were located in the center of the Peruvian Amazon, in an area also known as the Central Selva (or *Selva Central* in Spanish) (Fig. 5). This large area has witnessed historic events, policies and struggles that have directly or indirectly molded the natural, socio-cultural and economic dynamics of the territory. The history of the region was shaped by missionary occupation followed by indigenous conquest. Colonization was promoted by the government beginning in the late 19th century. The region has gone through several periods of land use change through extensive coffee plantations, infrastructure development projects, coca leaf plantations and social warfare, and different conservation efforts such as Natural Protected Areas (ANPs) and others.

The community of Puerto Ocopa (PO) is an Ashaninka indigenous community with the greatest area and population of those included in this study. While PO is located in the Satipo province, in the Tambo river watershed, San Pedro de Pichanaz (SPP) and Loma Linda Laguna (LLL) communities are located in the Oxapampa province, in the Palcazu river watershed. SPP and LLL are both Yanesha communities, and both are divided into three sectors based on their location in the territory. However, while in SPP all three sectors are involved in the TDC program and all three receive benefits, only one sector in the LLL community is involved. As a result, the

conservation areas in the three communities vary with respect to their size, which affects the amount of funding dispersed by PNCB to support local activities.

Native communities are recognized by the Peruvian Law through the Law 22175 and are ruled by internal and collectively defined statutes. Community governance is organized under the Chief of the community and chief of sectors and a community council who are elected every two years by a general assembly. The land use issues within the community are ruled by the internal allocation of small areas to each family for swidden fields, agroforestry or other activities. Large forest-covered areas are among those areas selected for conservation under the TDC program.

Drivers of deforestation were identified by members of the communities in the workshops. While in PO community the drivers identified were logging, land issues (land rental, invasions), and oil activities. In SPP community, logging and landslides were mentioned, and in the community logging and illegal crops. In a way, this are partly the motivations that communities have to be involved in forest monitoring activities, and which will be discussed below.

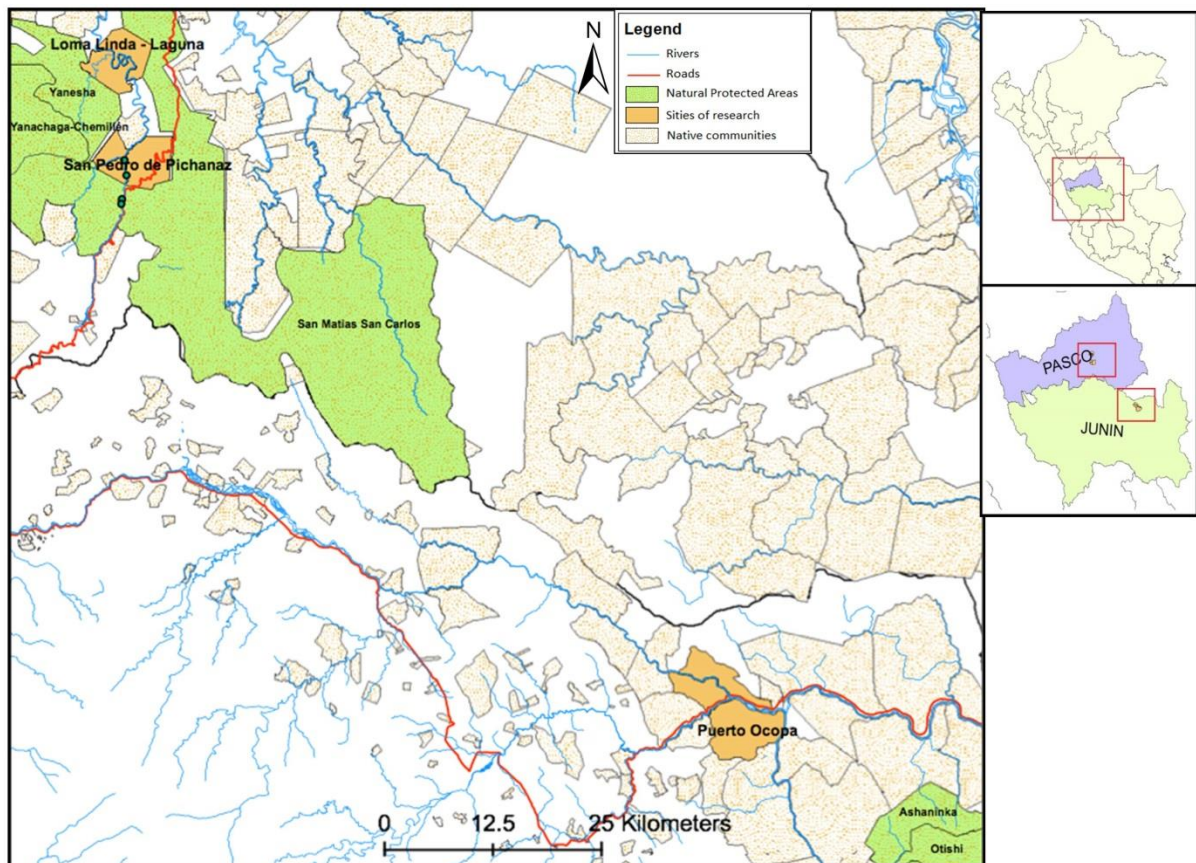


Figure 1. Map of the study area (Adapted from MINAM, IBC data; Scale: 1:1,016,461)

2.2. Multi-level governance assessment

The main goal of this study was to identify the existing governance arrangements, capacities, knowledge and experiences around the development of CBM at the subnational level (community, local and regional). We also assess the opportunities and potential for developing a monitoring system that incorporates efforts from different actors at different levels, representing the scalability of CBM.

In exploring the governance arrangements and mechanisms of the TDC program for its sustainability and scalability, we examine the key components of multilevel governance as presented above and in Table 3. A set of indicators was developed (WRI, 2013; Ansell and Gash 2008) in order to assess the following governance components: participation, inclusion, transparency, information flow, capacity, and coordination as well as other elements that we chose to explore. We did not examine accountability in this research, but it is an important multilevel concept to consider.

Table 3. Summary of indicators with respective interview questions

MULTI-LEVEL GOVERNANCE AND COMMUNITY-BASED FOREST MONITORING			
INDICATORS	METHODS	ELEMENTS OF QUALITY	QUESTIONS
Experience, knowledge and capacities around forest monitoring			
Existing knowledge and experience of forest monitoring	Interviews Focus groups	Land use change	Where, When, How much, Drivers of deforestation and forest degradation - DDs)
		Monitoring activities	
		Frequency	
		Data collected	What activities have been done to monitor these changes/forests? For how long? How often?
		Actors involved	What kind of data is collected in monitoring?
		Usefulness of data	Who has been involved?
			What are these forest monitoring activities used for?
			How do actors use the data collected through forest monitoring?
			What are the advantages of forest monitoring?
			What are the challenges experienced in conducting forest monitoring activities?
			Are current forest monitoring activities an appropriate way to address and control land use changes?

Existing capacity to conduct forest monitoring	Interviews	Learned skills Capacity to interpret, analyze and use relevant information and data Ease and accessibility of use of forest monitoring tools Perceptions of use/application of forest monitoring tools Access to knowledge or experience in forest monitoring, either internally or externally Capacity and resources to fulfill responsibilities (sufficiency)	What has been learned from being involved in monitoring? Is it easy to interpret and analyze the data? Does this information help in monitoring? How convenient is the technology for doing what is expected? What do you expect from these new technologies? Is it easy or difficult to use? What training or capacity building has been, or is expected to be done? Are there sufficient capacities-to fulfill monitoring responsibilities? What are the strengths of local monitoring? What are the difficulties? What is lacking (weaknesses)?
Interest	Interviews	Interest to participate in forest monitoring Commitment of actors Perception of benefits from monitoring	How was the interest at the beginning? Has it changed? Are those responsible for monitoring committed to their work? What are the benefits of participating in monitoring activities?
Participation	Interviews	Inclusiveness and openness for participation in forest monitoring activities Participation and representation of representatives and leaders	Have you participated in monitoring before? If not, would you like to participate in the future? Participation in other monitoring activities? Are all stakeholders involved that should be involved in forest monitoring activities? If not, why are those actors not involved? And who else should be involved?
Coordination	Interviews Focus group	Lines of communication among actors and institutions involved in forest monitoring Frequency Communication effectiveness	Are there coordination difficulties among mentioned actors? Coordination between committees (CV-CG)? Coordination between components (PNCB)?

Information flow / access to information	Interviews	Availability of information	Forest monitoring information is available at community level? What kind of information? How is it shared?
		Timeliness of information sharing	Is information made available in a timely fashion?
			How do different actors involved in forest monitoring communicate?
			How often is this information shared?
			If difficulties or questions arise, who do those monitoring go to for support? What is the response of these actors to concerns raised?

We used a case study design to examine the enabling local conditions for CBM by analyzing the various pillars of multilevel governance in three communities where the TDC program is active. The various data collection techniques used include key informant interviews at different levels and with members of the CV, focus groups and field visits to verify early warnings in addition to other techniques that facilitated the research team's understanding of the local context in workshops held prior to data collection in each community.

2.3. Interactive forest monitoring system

In addition to these objectives, a broader goal of this monitoring component was to establish a community-based interactive forest monitoring system (IFMS), and to test new integrated monitoring concepts. Forest monitoring is enhanced by the integration of a variety of different data streams, including remote sensing data, existing national databases, and community-based data. The main goal of establishing this interactive monitoring framework is to support REDD+ or other climate mitigation activities in Peru with a consistent and transparent system for data collection, analysis, and interpretation.

Figure 1 summarizes the general framework of the IFMS, which complies with generic Web GIS architecture. These functions of IFMS are organized into four functional modules: near real-time data acquisition and processing, storage and mapping, presentation and interaction, and feedback. The four modules mentioned above comprise the primary functionality of the server side. On the client side, users, comprised of local communities and forest professionals in charge of monitoring and decision making, send requests to the server side via a Mobile device or Web-based graphic user interface. The server carries out the corresponding spatial analysis and conveys the results to the client side for feedback, interaction and visualization. The framework is scalable and extensible so that additional functions or map layers from external data sources can easily be added to the application.

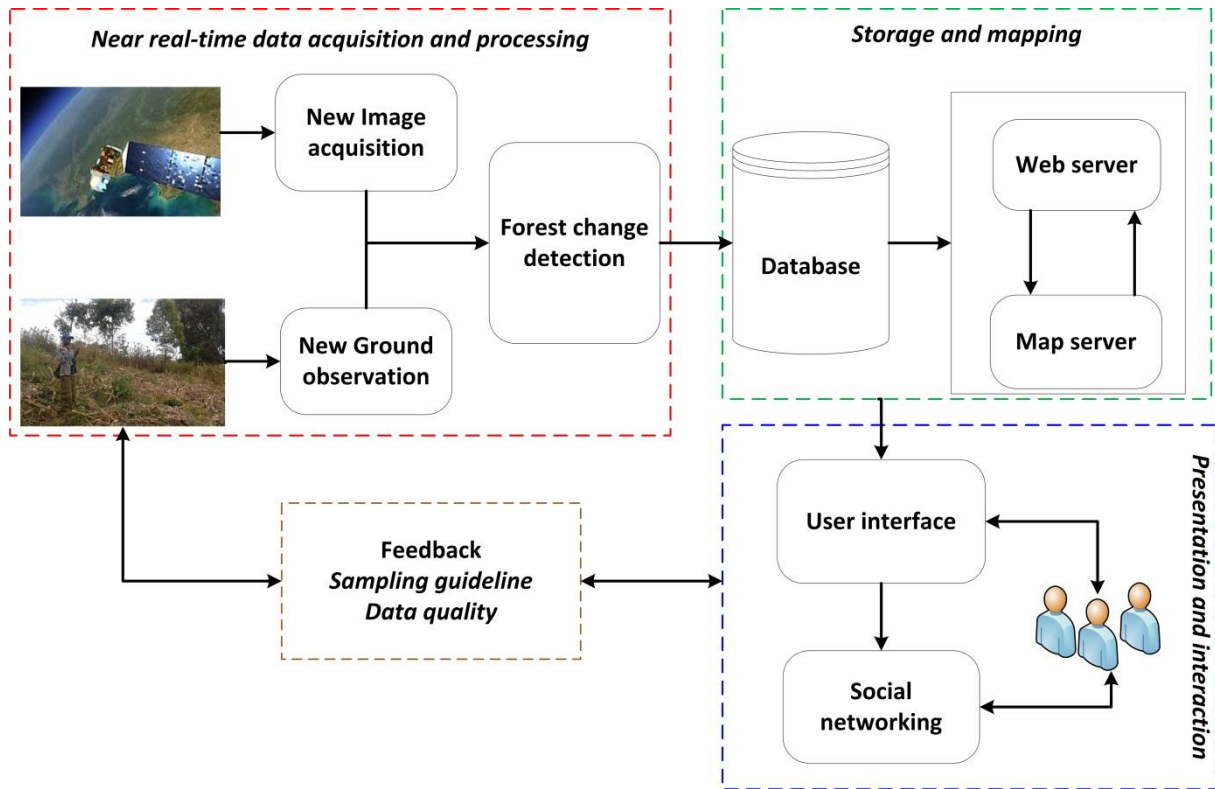


Figure 2. System architecture of near real-time interactive forest monitoring system.

The suggested monitoring system consists of four major components. Each of these components was developed using open source tools. First, we designed and implemented a decision-based data-acquisition form using xml and ODK collect for Android phones, allowing multiple data records to be entered and stored on a mobile phone (text, number, GPS locations, photo, audio etc.) and sent to a central database server [2, 3]. Second, we downloaded all Landsat ETM+ data with cloud cover below 70% from the USGS server. We followed the processing work-flow described in DeVries et.al [4] , using the bfastSpatial R package (<http://www.github.com/dutri001/bfastSpatial>) for near-real-time forest change detection on Landsat time-series data. Third, we used PostgreSQL with the ODK aggregate PostGIS extension to store ground-observation and forest change as vector data. The stored datasets were published via Web Map Service (WMS), which is compliant with Open Geospatial Consortium (OGC) specifications. We used OpenLayers, a JavaScript library that provides functionality, to display and render maps in web pages. Fourth, we developed a graphical user-interface using HTML, CSS, PHP and JavaScript. Server-side scripting was written in PHP to generate forest change location on-demand, publish forest change location in usable format such as gpx and txt, and interact with social networking sites.

2.4. Capacity development on local and regional level

Capacity building program will be one of the key objectives of this project. This program will enable all members of the community and local institution to develop skills and competencies so as to take greater control of their own forest and also contributes to inclusive personal skill development. The following outlines that capacity building takes place on community and the institutional level:

Community level: User friendly training materials will be produced for the developed technology and methods for acquisitions of data. Community training will be conducted before implementation of the program. The training will enhance the capacity of community and will envision approaches and strategies for program implementation. The implementation will be done to monitor change activities.

Institutional level: Local and regional mandated institutional will also be trained to build the capacity for the developed technology and methods for acquisitions of data. All the training materials will be delivering to local institution so that local institution can facilitate the monitoring process in future.

3. KEY RESULTS

3.1. Overview of the interactive forest monitoring system

The developed interactive web-based near-real time IFMS (IFMS access at: <http://cbm.wur.nl>) enables end-users to visualize and analyze the spatio-temporal distribution of historic and near-real time forest change information over the three communities, Peru. These forest change information are updated on a monthly basis. Examples of the deployed IFMS are shown in Figure 3. The left panel shows the interface for spatial and temporal querying. A temporal query is defined by a start date and an end date, while a spatial query identifies a location window. The SQL meeting both conditions are selected from the database and are available for download in GPX format. This GPX format helps the local experts to transfer the monitoring alerts on their GPS device. This alerts empower local expert to reach at suspected locations of recent forest change.

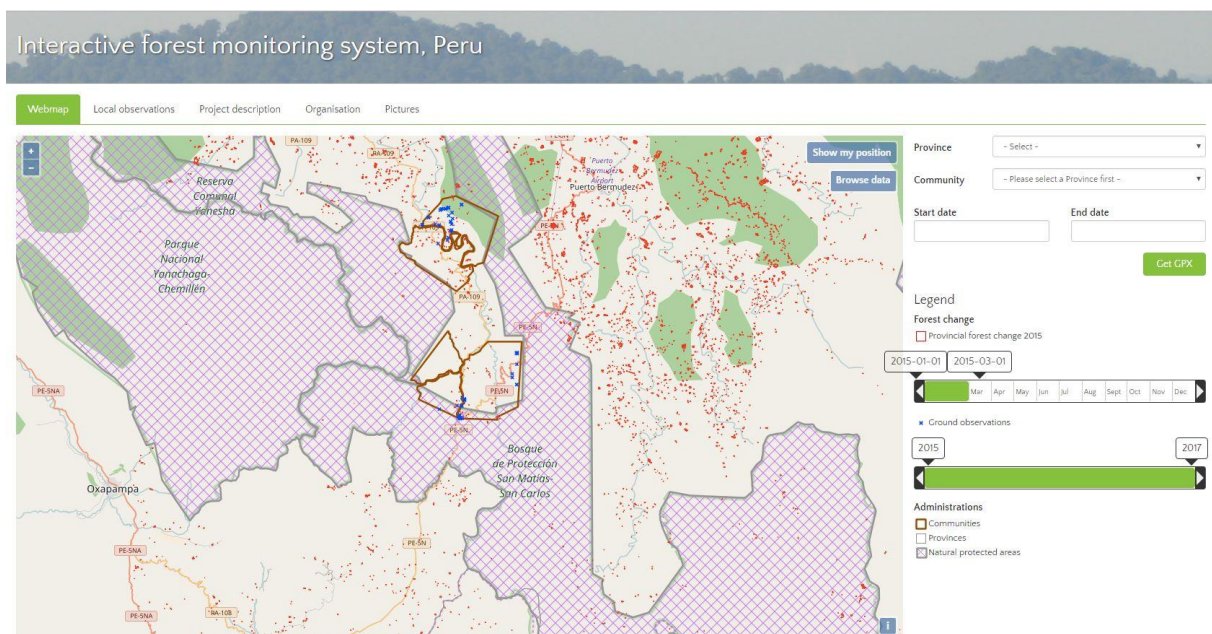


Figure 3. Web interface showing an example of a visualization interface for the Peru case study. In this example, Forest map derived from Landsat image 2010 is used as base map, forest change polygons derived from Landsat data are displayed in red and local observation points in blue.

Figure 4 Shows the forest change location obtained from satellite and verified by local community. These data contain three categories of information: spatial, temporal and thematic. The spatial category includes GPS location, administrative boundary information of forest change location and the estimated size of forest change. The temporal category includes time of forest change. Finally, thematic category provides the information about Land use type, forest change type, drivers of forest change, photo and multimedia description of the forest change location. These datasets contain some sensitive information such as driver of forest change, photo and multimedia description about the process of change. Hence, access restrictions have been made for the general public, but authorised users can have full access and download facilities to all the attributes of these ground data.

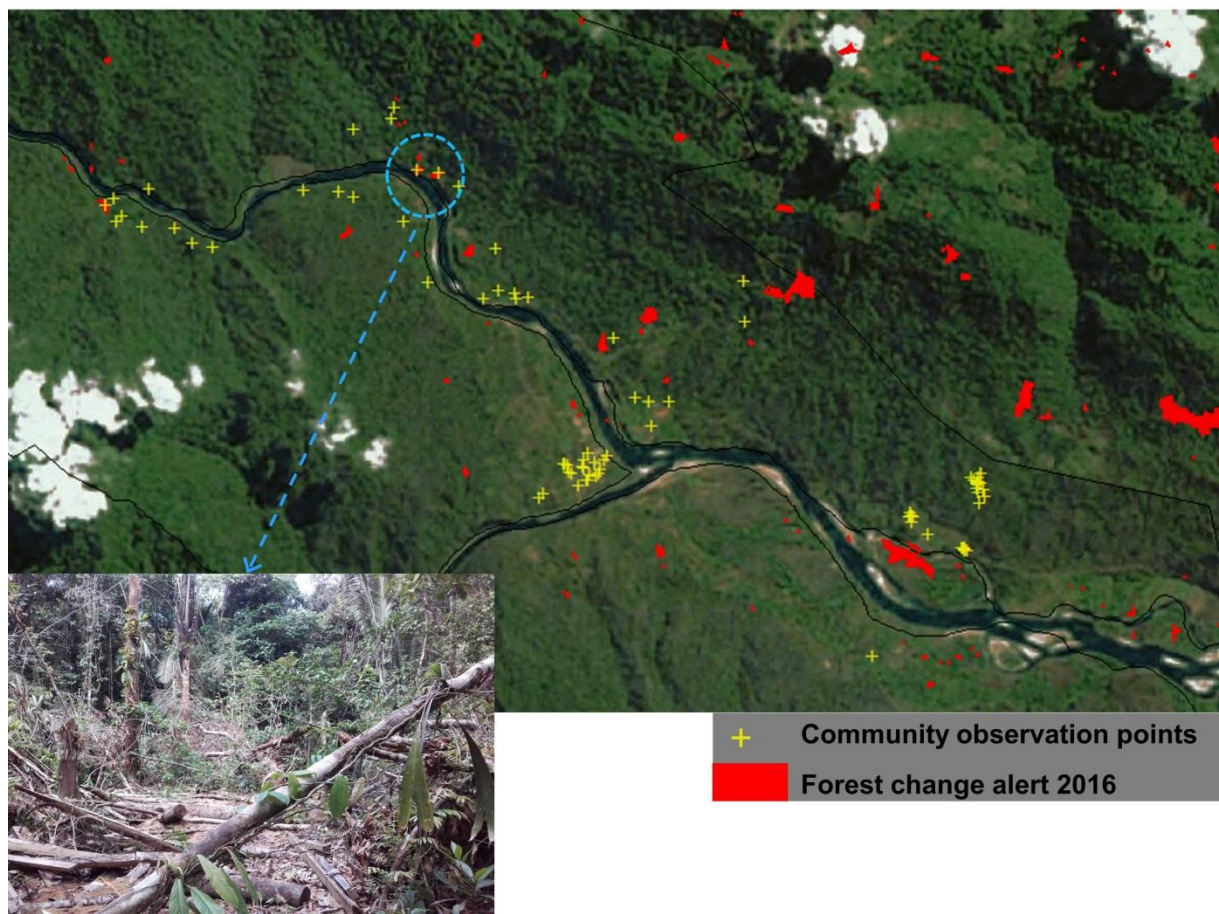


Figure 4. Forest change location obtained from satellite verified by local community.

3.2. Drivers of forest change

The proximate drivers of forest changes are shown in Figure 5. Drivers of forest changes were mostly associated with Agriculture expansion (47%), followed by landslide (20%), intensive timber harvesting (14%), clear cutting (10%), and natural fires (9%).

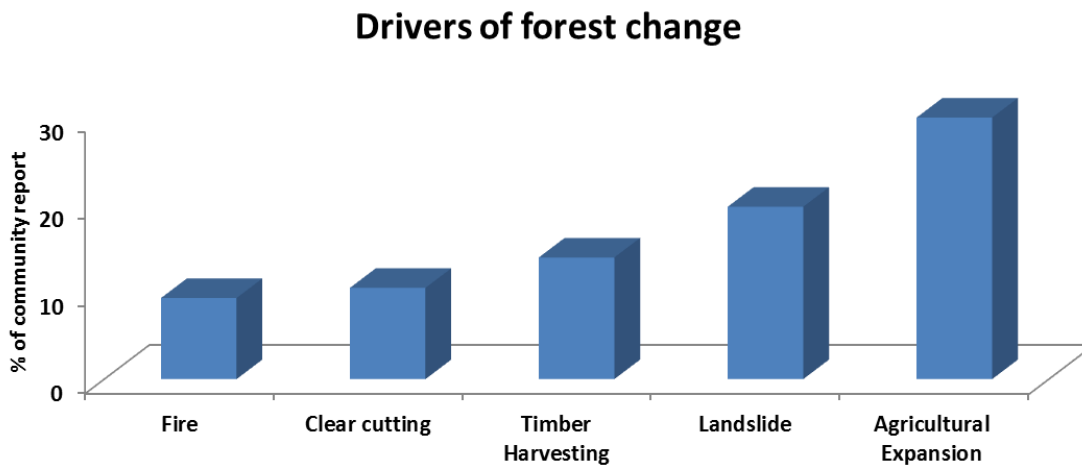


Figure 5. Driver of deforestation and forest degradation

3.3. Impact of forest monitoring

Near real-time forest change alerts have empowered local communities to target their ground observations in disturbance area. More than 200 ground observations have been provided by local communities to monitor forest change. Over the period, more than 30% of forest change alerts provided by satellite is effectively verified by community.

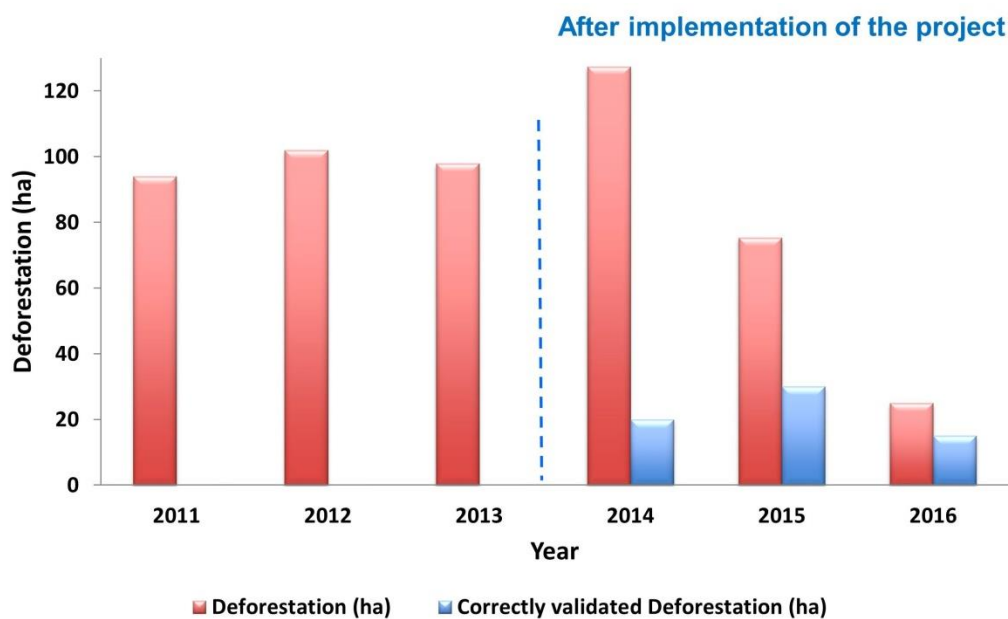


Figure 6. Deforestation detected by satellite and correctly validated by local community

3.4. Governance arrangements

In this section we explore existing local institutional arrangements for forest monitoring as well as other initiatives that are externally-designed for the adoption of particular forest monitoring practices. We look into how these externally-designed initiatives meld with the existing arrangements to ultimately provide the necessary context for assessing the sustainability of these initiatives.

3.4.1. Existing local monitoring initiatives

Indigenous peoples have a strong tradition of protecting their territory as an important form of reducing external threats to their territory and protecting their subsistence livelihoods (Varese 1973, Chirif and Garcia Hierro 2007). Some indigenous communities have developed their own systems of monitoring defined by their own local governance arrangements. While they are generally not focused specifically on conservation, many were created to monitor forest cover change, such as protecting communal areas from illegal trespassers. These kinds of local arrangements and systems are challenging to describe given the great variety of needs and issues pertinent to different communities (Sheil et al. 2015).

Historically, the Ashaninka people have developed a community defense system. The *Ovayeriite* or Ashaninka army, recognized by the Supreme Decree N°741 (1991) as Self-defense Committees or *Comites de autodefensa* (CAD), gained recognition from the national government for their activities to protect their territory and their people during Peru's conflict over terrorism (Espinoza 2009; Veber 2009). These self-defense committees have their own organizational structures, rules, and channels for reporting alerts or threats. All communities within the Ene and Tambo watersheds have a CAD. Coordination and information sharing is frequent between committee members and with the rest of the community through general assemblies. Actions are regularly coordinated with the army and marine forces in case there are warnings or threats from remaining forces from the Shining Path.³

The Yanesha communities do not have CADs, but do have local security guards, referred to as the *Arkanth*. The Arkanth are recognized as communal police as they are responsible for ensuring law and order in the area, including enforcement of sanctions regarding domestic issues such as robberies or crime in the village. The Yanesha communities usually have around seven Arkanths elected through a general assembly.



Figure 7. Logo from Puerto Ocopa's CAD and Arkanth member from LLL community

There is no doubt that with such local arrangements, the proximity of users to the resource confers an ability to observe day-to-day changes (Berkes et al. 2000, Danielsen et al. 2000). According to key informants on the topic in both Ashaninka and Yanesha communities, people generally trust the information that local hunters or community members provide on invasions

³ A terrorist organization, nowadays linked to narco-trafficking, especially in the Valleys of Apurimac, Ene and Mantaro Rivers (VRAEM)

and even illegal logging. Also, community members participate in protecting the boundaries of their territory on a regularly basis.⁴

While the cases presented do not involve any conservation goals at first glance, it is necessary to highlight their structure, position and purpose within communities as they serve as important agents for monitoring. It is of paramount importance that monitoring schemes consider already existing institutions in the field (Boissière et al. 2014; Sheil et al. 2015). Such local experiences and knowledge could represent a starting point for those involved in developing forest monitoring initiatives. One PNCB field officer highlights the importance of understanding some of the existing local monitoring institutions: *“Instead of creating a new model for monitoring, with new roles and charges, we could have adapted one to the already existing institutions at the community level”*.

3.4.2. Forest monitoring under the TDC program

Communities involved in the TDC program are expected to create a management committee (*Comité de Gestión* or CG in Spanish) and a vigilance (or monitoring) subcommittee (*Comité de Vigilancia* or CV in Spanish) elected by the community's general assembly. The objectives of the CG are to manage the financial compensation from the PNCB for the implementation of its investment plan, while the objectives of the CV are to ensure the integrity and protection of communal forests for conservation through monitoring activities as well as prevent and promptly report potential threats to the conservation area.

The CV is composed of five members: president, secretary, vocal and two forest rangers. The CV's activities and responsibilities include the following: (1) monitor community forest for conservation, considering preventive and corrective actions; (2) perform the demarcation of forests under conservation; (3) patrol areas and prepare reports for PNCB; (4) inform the CG and the community of detrimental events to communal forest and propose actions to local indigenous organizations and authorities to rectify events; and (5) give advice to villagers regarding the clearing of new areas or the same areas for agriculture (Ocaña, 2013).

Early warnings or alerts reach the committee through two defined channels. The first is from PNCB's forest monitoring office⁵ in Lima that regularly sends out early alerts on forest cover change based on satellite images to the decentralized PNCB office that sends this information directly to the communities. Threats to communities and conservation areas are also communicated locally by neighbors, hunters or people settled in the community to the community chief or the CV. The structure of communication around monitoring is based on communication patterns in indigenous communities—from the CV to the community chief and then to the Indigenous Organization or the related forest institution.

⁴ Activities scheduled often at the beginning of the year for the dry season months. It allows community members to become aware of the limits of their territory and the conservation status of their forest, in addition to increasing community cohesion.

⁵ Every eight days the PNCB unit of mapping and monitoring produces data for forest cover change from satellite monitoring.

As part of the community's agreement with the TDC through the PNCB, CVs are expected to fulfill their monitoring responsibilities through visits to the field at least four times a year. The number of days dedicated to monitoring (usually two or three) may vary according to the accessibility of the area and the number of GPS points (and associated data gathered) to or the total area to monitor. Data is collected in paper forms and now are also tested in electronic forms with the smartphones. If CVs do not monitor forest cover change or patrol the conservation area, the community may receive a warning from PNCB that could jeopardize their involvement in the TDC program. Moreover, if conservation goals are not met, the community is sanctioned and removed from the TDC program.⁶

Regarding coordination at the local level, the monitoring sub-committees are expected to maintain frequent communication with the CGs and community chiefs. The CVs also have a close relationship with the CADs and it is common that CV members are also CAD members in order to support CV members when they go to the field.

Data collected through the TDC's monitoring activities is done by local people whereas the design of the monitoring scheme and the data analysis are undertaken primarily by external counterparts. The data collected also remains in the hands of the local people, creating local ownership to address the issues regarding forest cover change.⁷ CV members are responsible for sending the data collected to the PNCB.

The committees included in the TDC program vary in their composition across communities, as they all have previously existing local institutional arrangements and thus different ways of adapting to an externally-designed intervention. In some communities, these different institutional arrangements are compatible while in others they are not. For example, in the Ashaninka sector, the CV in the Puerto Ocopa community is composed of members of the CAD, who have similar responsibilities. In this case, the fusion of these committees adds representativeness and legitimacy to the TDC's monitoring activities. In one of the Yanesha communities included in this study, the chief of the community was also the president of both the CV and the CG. This represented a communal decision triggered by the lack of communication between committees of the TDC. Informants from this community explained that centralizing the leadership fostered more effective management under the TDC. In fact, in the second year of this research, authorities changed and the coordination declined between the new chief and the TDC committees, resulting in the delay of monitoring activities.

3.4.3. Monitoring and Control in Natural Protected Areas in the regions

There are six Natural Protected Areas (ANPs) close to the study area that are overseen by the National Service of Natural Protected Areas⁸ (SERNANP). Apart from their conservation status

⁶ To date, 19 communities were sanctioned. Eight communities were observed, four communities were suspended, and seven communities were taken out from the PNCB's TDC program because of failure in protecting their community forest and/or failures in managing the budget they received (PNCB officer, *comm. pers.*)

⁷ For instance, the PO community used data from monitoring to start reporting a situation of boundary trespassing by a neighbor community to its Indigenous Federation.

⁸ On one hand, the Otishi National Park (PNO) and the Ashaninka Communal Reserve (RCA) have part of their length in The Satipo province. The Machiguenga Communal Reserve (RCM), in Cusco, is also close and is part

and goals, they all have a component of monitoring and control in their operational plan. Monitoring activities in an ANP involve routine and special patrols; the former are carried out on a monthly basis while the latter occur once or twice per year depending on necessity. Data is collected regarding threats to protected areas, such as those most relevant to forest cover change, such as illegal logging, illegal crops such as coca plantations, expansion of agricultural frontier, land issues (land rental, invasions), and road building.

In both sectors, given the nature of the communal reserves, the Executor of Administration Contract of the Yanesha Communal Reserve (AMARCY) and the Executor of Administration Contract of the Ashaninka Communal Reserve (ECOASHANINKA) were created as an indigenous counterpart to co-manage the protected areas with SERNANP. Both institutions are governed by indigenous people from the communities who benefit from the communal reserve and play an important role in involving local people in the monitoring and control activities. Besides their coordination with SERNANP, they have a strong bond with the local indigenous federations.

In areas where the PNCB does not operate, the strategy is to rely on the CADs, such as in the RCA area. In areas where there are no CADs, the ANPs rely on promoting the involvement of community monitors or *vigilantes comunales*, such as in the case of the RCY's buffer zone. The community monitors are elected in general assembly as volunteers to carry out field patrols with official park rangers.

Informants identified some confusion regarding these committees, for example in communities involved in the TDC that are located in the buffer zone of an ANP. In this case, there are two monitoring committees—one through the TDC that responds to the PNCB and one in the ANP that responds to SERNANP. While CV members are to monitor the community's conservation area, the other operates within the ANP's limits. Even if their operational area is clearly defined, some confusions were reported regarding who represented the community in matters of forest monitoring and how to report forest cover change or environmental crime detected. There was also confusion regarding how many members the committees should have since both differed in the number of members. For instance, in SPP community exists the CV that responds the PNCB, two community monitors that respond to the RCY and two to three community members that respond to the BPSMSC. Members of the CV are most prepared than the community monitors in terms of monitoring due to frequent trainings they receive and also the equipment they possess (GPS, smart-phones, compass, maps). This, at the time of field trips, evidenced a better knowledge of the community and ANP boundaries for the CV members than the community monitors.

Currently the PNCB and several ANPs are discussing the best way to coordinate their monitoring efforts. The PNCB is perceived as an ally to communities where SERNANP has presence and is also considered a strategic actor in the management plan of some of the ANPs previously mentioned. For instance, there is an agreement of institutional cooperation between the PNCB and the BPSMSC in terms of capacity building for the community monitors. In addition, the PNCB, SERFOR, RCY, the AMARCY and its communities were in the process of modifying their monitoring protocols (See PNCB, 2016). In this way, efforts were made to create a shared protocol for reporting and sharing land use change data between different monitoring entities in

of this corridor. On the other hand, the Yanachaga Chemillen National Park (PNYCH), the Yanesha Communal Reserve (RCY) and the San Matias-San Carlos Protected Forest (BPSMSC) are all located in the Oxapampa province.

the RCY buffer zone. For instance, the CVs should go to the field at least four times per year and at least one time with SERNANP to monitor areas within the RCY.⁹ In this context, there was a clear need to clarify the objectives of each committee in order to avoid conflicts of roles within the community.

Several state entities are also responsible for handling crimes or infractions within ANPs. Interventions and/or forfeitures are carried out with the Police, Indigenous Organizations, the Forest Resources and Wildlife Oversight Organization (OSINFOR), the Special Prosecutor for Environmental Matters (FEMA), or Forest and Wildlife Regional Authority, as appropriate.

3.4.4. CBM under the new Forestry and Wildlife Law (Law 29763)

The new Forestry and Wildlife Law - Law N°29763 deconcentrated several powers in the forestry sector to the regional governments through their Forest and Wildlife Regional Authority (ARFFS), which is responsible for the accreditation of members of an indigenous community as a Vigilance and Forest Control Monitoring Committee or *Comités de Vigilancia y Control Forestal Comunitario* (CVCFC). This committee could apply to be a forest “guardian” or *custodio forestal* under the new Forest Law, which would give it the power to confiscate illegally harvested forest and wildlife products found within the community as well as inform the nearest ARFFS office regarding breaches of the law. The CVCFC is composed of a general assembly and ruled by statutes and regulations established by the community. To effectively fulfill its activities and according to necessity, the CVCFC can request support from the ARFFS, the National Police of Peru and the Armed Forces.

The National Forest and Wildlife Service (SERFOR) is the institution responsible for dictating guidelines to define the actions carried out by the CVCFC. SERFOR is also the national focal point for receiving reports of violations and crimes in forestry and wildlife. SERFOR has created the Technical Units of Community Forest Management (UTMFC) that are supposed to train CVCFC members on forestry issues. The new law acknowledges (Art. 127 of its regulation) other existing communal organizations as responsible for forest monitoring. We ask: how are the CVs aligned with the CVCFC created under the new Forestry and Wildlife Law? At the moment, given the importance of the CVs in the TDC program, efforts are made to support the institutionalization of the CVs to enable its continuity even after the TDC intervention ends as well as prevent the duplication of duties by separate entities that could result in a conflict of legitimacy or a generalized confusion of existing institutions by community members. SERNANP, SERFOR and the PNCB have begun to discuss these issues in order to manage such scenarios.¹⁰

⁹ Workshops on community forest monitoring initiatives were held in Lima and Iscozacín city in June 2016 with the participation of the PNCB, SERNANP, SERFOR, and other strategic actors. Emphasis was placed on forest monitoring under Communal Reserves and communities in their buffer zones. A new forest monitoring protocol was launched for the RCY and the communities engaged with the PNCB (See PNCB, 2016)

¹⁰ As it was mentioned in 3.1.3, the case of Palcazu valley is an example where communities are involved in both the TDC program and are also located in the buffer zone of the Yanasha Communal Reserve, which means that besides the CV, they also have community monitors who are responsible for monitoring the ANP. Furthermore, SERFOR, under the framework of the new Forestry and Wildlife Law, is trying to build

3.4.5. The role of Local and Regional governments

As part of the decentralization process in Peru, starting in 2002 with the passage of the Law of Regional Governments (Law 27867), various powers have been deconcentrated to the regional governments. Only nine regions have completed the transfer of powers consigned with the letters "e" and "q" of the article 51 of the mentioned law that have a ministerial resolution (Aguirre et al. 2015). These letters are related to monitoring activities to ensure the sustainable use of natural resources, grant permits, authorizations and forest concessions within Regional Government's (GOREs) jurisdiction (see Kowler et al. 2016). However, the decentralization process has been delayed with the new Forestry and Wildlife Law. Regions that have not yet completed this process, such as Junín and Pasco, have to now adjust their management tools in order to complete the transfer of powers. According to Che Piu and Menton (2013), there are two models of decentralization that are taking place simultaneously in Peru. One where powers have already been transferred and the other where the authority is temporarily held by the Forest and Wildlife Technical Administration (ATFFS) through decentralized offices in the area.¹¹

To date, the regional governments of Junín and Pasco are in the process of creating their Environmental Regional Authority (ARA). Junín's GORE already has a ministerial resolution for the creation of its ARA, but the process came to a halt and is now picking up again with the new authorities. In 2016, Junín was added to the Interregional Amazonian Council (CIAM), which requires the creation of the ARA.

Even though key actors perceive the leadership of the GOREs as important for forest monitoring, the case of Junín and Pasco represent a paradox. While provinces like Satipo, making up almost half of Junín, as well as Oxapampa, with almost 70% of Pasco region located in the Amazon, the political power of the regions is centralized in cities far away in the Andes. Interviewers at the local and provincial level perceive the GOREs not only to be very removed institutions, but also distant in their focus and scope of how decisions are made. Despite the reality of the well known "Amazonian" regions such as Loreto, San Martín, Ucayali or Madre de Dios, the case of Junín and Pasco (Satipo and Oxapampa provinces) depict the dichotomy between Andean and Amazonian visions and limitations in terms of the interest or priority placed on protecting forest resources. Even a scenario in which duties are transferred to the GOREs, which does not necessarily imply that they are endowed with the capacity in terms of staff, infrastructure and financial resources (Che Piu and Menton 2013), as the resource allocation for projects at the local level could be undermined by the lack of a clear definition of priorities by the GOREs.

With respect to the conservation areas governed by the GOREs, the Pasco GORE is working on the creation of the Chontabamba-Huancabamba Regional Conservation Area (ACR) and the Junín GORE has responsibilities within the already created Huaytapallana ACR. Despite the approved management plan in the Junín ACR, it does not yet have the budget or the rangers to effectively

the CVCFC's capacities. Currently, as a result of a new inter-institutional protocol of monitoring, there will be one single committee, recognized and trained by several institutions. In the communities engaged in the TDC (eg. LLL and SPP), monitoring committees are required to have five members. Monitoring committees in communities that will soon become involved in the TDC program are required to have at least three members. These committees will monitor the community forest as well as the RCY.

¹¹ For the Central Selva, there is an ATFFS located in La Merced city.

put their plan into action. Both GOREs have developed a Regional Environmental Information System (SIAR),¹² a network of technological, institutional and human integration that facilitates the systematization, access and distribution of environmental information within their regions, as well as the use and sharing of this as support for decision-making and environmental management. The SIAR is a component of the National Environmental Information System (SINIA), which is managed by MINAM.

According to the Law of Municipalities (Law 27972), the local governments located in rural areas have competencies regarding natural resource management. Under the new Forestry and Wildlife Law, local governments are considered forest managers in local forest units and support authorities with competencies in monitoring and control within their jurisdiction. However, local governments do not have direct duties related to forest monitoring, at least in the two regions where the research was carried out. Moreover, their environmental management offices are oriented towards environmental-urban issues such as solid waste and effluents.

At the local level, the Municipal Environmental Commission (CAM) is the cross-sectoral participatory space created by local governments in order to coordinate local environmental policies besides promoting the coordination between public and private sectors and civil society entities in environmental matters. For example, the Palcazu local government is promoting the creation of monitoring committees for fisheries in all indigenous communities in the watershed.

The regional governments are expected to play an instrumental role in the NFMS and presumably in scaling up local level monitoring systems to the national level. According to the head of PNCB's Office of Forest Monitoring, "the GOREs are essential for the system's operation and for the coordination of efforts from national and local levels...the GORES should essentially provide the service that is now provided by the PNCB to the communities."

Despite the importance of coordinating efforts in forest monitoring, however, local and regional government offices are not familiar with the TDC scheme and the monitoring conducted by the CVs. Data collected on forest cover change does not reach these offices. In the case of the GOREs, this is explained by the incomplete transfer of competencies through decentralization in the forest sector. Currently, the PNCB is exploring options for ways in which regional governments could engage in and assume responsibility around forest monitoring. The PNCB launched the online forest monitoring platform called "*Geobosques*" in late July as a tool to involve GORES in the NFMS. *Geobosques* is an interactive website where anyone (individuals, institutions and government offices) with internet access can follow the forest cover change of the country on a weekly basis. The PNCB intends for the ARAs and the GOREs to assume the lead in the implementation of *Geobosques*¹³ Furthermore, the PNCB is responsible for designing and implementing the Forest Cover Monitoring Module¹⁴ as part of the National Forest and Wildlife Information System and the National Environmental Information System in collaboration with SERFOR and other relevant entities.

¹² Created under the General Environmental Law (Law 28611), which promotes the consolidation of environmental information from various public and private organizations. At the local level this entity is called the Local Environmental Information System (SIAL) and exists in the Satipo district in Junín, and in Villa Rica, in Pasco.

¹³ Personal communication with PNCB's officer in Lima.

¹⁴ Legislative Decree n°1120, MINAM's Ministerial Resolution n° 324

The multitude of forest monitoring entities at the local and regional levels, including the CVs under the TDC, the CVCFC proposed in the forestry and Wildlife Law, and the community monitors created by SERNANP in natural protected areas, call for the standardization of certain aspects of forest monitoring. The current scenario of multiple and sometimes overlapping monitoring entities could reshape local structures and arrangements of power within the community, but it could also lead to a misunderstanding and/or overlapping of functions and activities associated with local enforcement. While it is better to have more people engaged in conservation and/or monitoring efforts than not, applied forest monitoring schemes should be clear in their protocols, legitimate in their development, transparent in their functions and reporting, and as simple and as locally appropriate as possible (Danielsen et al. 2005).

3.5. Sustainability and Scalability: CBM in practice from a multilevel governance perspective

We now discuss several different factors in assessing the sustainability and scalability of CBM through the experience of the TDC program, beginning with the existing experience, knowledge, capacity and interest around forest monitoring to the different governance components explored as well as other important and relevant factors emerging from this research. The factors discussed in this section capture important implications for the sustainability and scalability of CBM; however, the factors themselves are not all comprehensive in that they do not necessarily pertain to a discussion of sustainability and scalability at the same time but rather to one or the other or both.

3.5.1. Experience, knowledge, capacities, and interests around forest monitoring

The majority of CV members interviewed indicated that they have developed various skills in forest monitoring since the program's inception through continuous trainings from PNCB. They have received trainings on the use of GPS, compasses and maps to monitor the areas of greatest concern as identified by PNCB's early warning system. CVs receive annual trainings and frequent advice for the reports¹⁵ they prepare by PNCB, and occasional trainings by other institutions or NGOs. Eight of the nine CV members interviewed and PNCB field officers acknowledge, however, that there is still a need for further accompaniment by the PNCB. Informants suggest that more assistance is needed in the elaboration of forest monitoring, the administration of funds and management reports. Some of these reports focus on forest cover change while others are based on more financial issues related to the programs' investment plans. These financial reports are perceived as a bureaucratic burden by several CV and CG members.

¹⁵ CVs are expected to prepare reports based on what they found in their field trips. Information is based on events and sites of forest cover change in the conservation area, community boundaries trespassing, and others. The process is followed by PNCB local staff.

Evidence suggests that capacities for local data analysis have not been developed consistently and homogeneously across communities participating in the TDC program. For instance, the PO community demonstrates capacities that are considered much higher than the other communities. However, even if PNCB does the data analysis prior to sending early alerts, some CV members still find it difficult to collect the necessary data in the field, which is critical to their understanding of what they must monitor. Apart from having the capacity to analyze and manage the information they collect through GPS points and interpreting maps, CVs must also have the necessary resources to analyze the information they collect (eg. computers, continuous electric energy, and internet connection). For instance, in PO, the communication with the CV was easier since they have phone connection and are closer to a major town (Satipo), while the coordination with SPP and LLL communities was difficult since there is no phone connection and the distance to a major town is greater. Data should also be stored and analyzed locally, even if this means some loss of quality. In the words of a PNCB employee who works with the TDC program, “it’s necessary to strengthen the capacities of the communities...a community with strong capacities [for forest monitoring] is a community that will be able to defend its territory.” Furthermore, once data is collected, the CV needs assistance or guidance from the PNCB in order to properly channel their reports of environmental crimes, threats to forest cover and territory, depending on the case.

Looking beyond local capacities, it is evident that the capacities of different actors at different levels of governance are uneven. It is considered important for these capacity gaps to be addressed in an efficient and cost-effective way in order for CBM activities to be scaled up to the national level (Pratihast et al. 2014). Key informants interviewed perceive two main obstacles to scaling up CBM—insufficient coordination among actors and the discrepancies in forest classifications and concepts across levels of government, the latter of which will be discussed below. Thus, it is clear that the coordination and standardization of data sharing protocols across different levels is critical to foster integration (Sabogal 2015). Given PNCB’s role in implementing the Forest Cover Monitoring Module, discussed above, their responsibility to organize workshops for actors involved in monitoring activities (eg. GORES, communities, indigenous organizations) on annual monitoring, early warnings, land use and land use change, reference scenarios, forest degradation, could provide an important source of capacity building for these actors.

This research does indicate, however, that local knowledge, interest and commitment to monitoring are some of the principle strengths of the CVs. Members of the CVs committees are very knowledgeable about their territory, given their time spent hunting since childhood, work in the field, and membership in other local organizations, such as CADs and the army. Their commitment to monitoring is part of their motivation to protect their territory, improve their livelihoods and community well-being, gain access to training opportunities, and gain recognition from the community, local authorities and others. One CV member from SPP shared his interest: “We work for the sake of the community. The recognition comes along with achieving our monitoring goals.” Another CV member from PO commented: “the people of the community are satisfied with the little we have done. We have set the community

boundaries. It is important to be recognized. Sometimes I walk around with my CV vest and I notice that people recognize my position [or duties].”

According to informants from the CVs and the PNCB (in Lima and Satipo), willingness to participate in monitoring activities with the PNCB varies across communities and depends, in part, on their past experience (positive or negative) with former state-run programs. They note that in the beginning,¹⁶ there was a general feeling of mistrust from communities regarding the TDC intervention and its conservation goals, but that this has changed over time. In the words of one indigenous leader, “The PNCB is now more flexible, as they are more open to receiving suggestions from indigenous organizations.” This leader believes this may be the first state-run program that addresses multiple needs through allocating funds for capacity building, social projects of community well-being, and in general, moving beyond a conservationist vision. Today, the majority of the informants maintain a positive perception of TDC, particularly since it has fostered land security and in some cases, decreased threats from invasions, promoted conservation awareness and empowered people to protect their land.¹⁷

The responsibilities that go along with CV membership are also perceived as important for CV members’ self-esteem. Six of the nine CV members interviewed expressed their pride¹⁸ for being a member of the CV and their work with the committee in the field. CV members’ pride also seems to be related to the recognition of their work by PNCB in addition to local and regional governments that are concerned about forest monitoring activities in the area. For example, the CVs in some communities are recognized by ordinances established by the local governments, such as in the Pichis watershed. Moreover, CV members are expected to wear a vest with credentials when they go to the field; they actively request these items as it demonstrates their responsibility and authority as they fulfill their monitoring responsibilities. This uniform also enhances their sense of belonging.

The capacities and experiences mentioned at the community level are vital to sustainability. There is no doubt that monitoring is of interest to the communities, given the importance of their territory to their existence as indigenous people. Thus, strengthening local capacities and empowering communities to respond to threats to the environment and forests are seen as critical. In the words of one PNCB field officer, “no matter how much capacity other institutions (SERFOR, OSINFOR, FEMA) have to detect and to respond to environmental crimes, it is impossible for them to be at the specific location as are communities. Efforts to stop deforestation must be done with local communities.” In this way, it is essential that CBM initiatives or those that are externally designed are in line with the interests of the communities engaged. Furthermore, a system based on local people carrying out designated tasks to fulfill higher-level demands or data for the national government will only be

¹⁶ It is important to recall that the PNCB intervention emerged after the social conflicts in Bagua, in 2009, which generated conflict between indigenous communities and government entities.

¹⁷ Personal communication with PNCB’s regional officer in Satipo.

¹⁸ This is more frequent in the case of younger members who are unmarried or who do not yet have kids. These members seem to be more interested in recognition as well.

sustainable when the activities and data collected are perceived as locally relevant and any benefits from the monitoring are perceived as fair (see McCall et al 2016).

3.5.2. Coordination

Multi-level governance and collaborative governance require the coordination of different actors at different levels for the effective and efficient implementation of projects and programs (Ansell and Gash 2008). The monitoring system developed by the PNCB has the potential to address multi-stakeholders' concerns. There is a myriad of actors that could potentially contribute to this system, including indigenous communities and organizations, local authorities at district, provincial and regional levels with competencies in forests or protected areas, and organizations working on community development and conservation. An explanation of these actors and their roles in forest monitoring are discussed in the previous section.

Based on interviews with nine people from local and regional governments, coordination between different levels of government was characterized as low, difficult, costly and almost ineffective (also see Aguirre et al. 2015, Kowler et al. 2016). Evidence indicates that various government entities often work in similar geographic areas without coordinating their actions, which often results in the duplication of efforts, conflicting objectives and even the generation of social conflicts (ibid). For example, the economic development office from the Junín GORE is promoting extensive ginger and pineapple plantations in the Satipo province even though its land use planning process remains incomplete. Another example is the Pasco GORE, which prioritizes the building of the road to Puerto Bermudez without taking into account the voice of SERNANP. On the other hand, interviewees expressed low levels of satisfaction with MINAGRI's Land Titling Office because of the inefficient land titling process.

PNCB officers mentioned not having worked much with indigenous organizations and other government institutions because of what they perceived as these organizations' limited coordination with other actors and capacities around forest monitoring. According to one PNCB officer, "the speed or timing for coordination with indigenous organizations presented a limitation. Sometimes the PNCB was ready to begin but the other institutions were not so the process came to halt." Thus, cross-sectoral and multilevel dialogue was identified as a challenge, summed up by another PNCB officer: "if one wants to intervene it must be done by allying with other actors, which requires openness and the ability to negotiate."

The PNCB has gone through different stages of learning-by-doing in the TDC program. At the start of the intervention in 2011, PNCB began its work in identifying and selecting communities for the program through meetings with the indigenous federations in each watershed. Several years later in 2015, the PNCB adopted a different approach to TDC that begins with coordination with the GOREs in selecting communities and in the overall

management of the program. This approach signifies the involvement of the most important government actors in the program, which may ultimately encourage the continuity of CBM.

Several other opportunities exist for the PNCB to involve strategic actors in a multi-level forest monitoring system. For instance, as SERNANP has presence in six ANPs, and the TDC program involves many communities in their buffer zones, it may be necessary to strengthen their coordination through a shared agenda. For example, coordination exists between the RCY and the BPSMSC and the PNCB regarding local forest monitoring committees; however, this coordination only emerged when these actors realized that their interventions were complementary. Prior to this, each institution worked on building capacities for their own committees. At the local level, there is still confusion in communities (members outside the CVs) about their role in forest monitoring as well as their jurisdiction for forest monitoring. There is also an opportunity for greater coordination and participation under the frameworks of the Biosphere Reserves, one existing in Pasco and the other in progress in Junín. This approach, at least in the Oxapampa province, has fostered dialogue among several relevant institutions.¹⁹

Other strategic actors that could encourage the sustainability and the scale-up of CBM are the institutions with competencies in the forestry or environmental sectors, including SERFOR, OSINFOR and FEMA. Even if the transfer of competencies in the forest sector is still in progress in the Junín and Pasco regions, the offices of Environmental Management and Indigenous People's Affairs from the Pasco GORE and offices of Environmental Management could take the lead in CBM through the TDC program. Moreover, PNCB now coordinates its work on TDC with the GOREs and is in need of creating partnerships with these important regional government institutions. As Pratihast et al. (2013) highlighted, there is a need for creating and strengthening a win-win situation with the different levels of government that would contribute to and benefit from their engagement in the program.

If the support or recognition from indigenous organizations is perceived as important to institutionalize monitoring activities, it becomes essential to analyze the role they could have in a multi-level forest monitoring system. For example, the indigenous federation CARE does not have a specific programmatic focus on forest monitoring, but has always spearheaded the defense and protection of the Ashaninka peoples' territories and forests. It is also important to highlight the indigenous organizations of AMARCY and ECOASHANINKA, which are affiliated with the federations and are both already involved in CBM since they are co-managers of the RCY and the RCA, respectively. As such, they have developed certain capacities and knowledge that could be instrumental in the coordination of TDCs' efforts or work with the indigenous sector. However, it is necessary to prepare for the uncertainty of the outcomes of the TDC program. Not all the communities involved are fully engaged in the TDC program nor do they all have the same response to an externally designed scheme for

¹⁹ In the Oxapampa province, regular coordination and meetings between government institutions and civil society are held in the frame of the Oxapampa-Ashaninka-Yanesha Biosphere Reserve's action plan.

forest monitoring. Consistency, transparency, comparability, completeness and accuracy of data are not achieved overnight.

3.5.3. Participation and inclusion

As understood by participatory governance scholars, involving local communities in decision making around CBM provides community members the opportunity to influence decisions, which encourages their commitment to activities in the long run (Garcia and Lescuyer 2008; see Ansell and Gash 2008). Sustaining local commitment is the key to ensuring the effectiveness of external interventions. The idea is that if local monitors are involved in ways that go beyond data collection, they feel more committed to the cause.

In the TDC program, the involvement of CV committees is moderate in the decision making around monitoring activities, as the CV members have somewhat of a say in the design of their benefits arrangement or the objectives of monitoring, they decide who engages in monitoring activities and when they will occur.²⁰ As mentioned, community members have an opportunity to express their needs for the allocation of funds to support TDC activities. For example, in the SPP community, the three sectors were split up to assess their needs and propose these to the CG. Community members therefore have the opportunity to propose their needs although the limited funds granted to communities makes it impossible for all of these needs to be fulfilled. One PNCB employee noted that the same people tend to speak up or participate in these meetings; he indicated that of a total of 60 meeting participants only 8-10 tend to speak. The money allocated to monitoring activities is based on requests by CV members upon receipt of an early alert from PNCB.

CV members have very little opportunity to participate in the design of the monitoring or benefit sharing. All of the CV members interviewed expressed their dissatisfaction of the different types of benefits, such as monetary, food and logistic supplies that they depend on and use for their field visits. While the CV members decide how they will share these provisions (materials and supplies) amongst themselves, their access to them is controlled by the CG, which as noted, is based on the CV's requests from early alerts and is often affected by delays in the disbursement of funds from the PNCB. Informants across communities mentioned that the CG does not always disperse the money or supplies designated for the CV.

We found that the design and structure of the TDC program places greater and perhaps too much authority in the hands of the CG, which tends to limit the participation and inclusion of the CV members in determining the allocation of these funds. One PNCB employee in Lima reflects on these dynamics and the importance of strengthening the role and recognition of the CV: "PNCB didn't place enough attention on making the CV a much more important entity as

²⁰ Monitoring activities are scheduled by CVs according their activities through the years and the possibility to detect forest cover change. For instance, it is expected there are more patrols between June and September, peak of dry season, time of opening areas for cultivation and fires. However, early warnings (from the PNCB or local informants) can come at any time and CVs are expected to attend this.

recognized by the the community...rather the idea was that the CG empowers the CV.” This employee recognizes that more could be done in order to give the CV more power or more of a say in decision-making around the allocation of funds.

Opportunities to participate in the monitoring activities are limited, as few people are involved in the CV as members. Although elected members are voted on democratically in a general assembly by community members, not everyone has the chance to be elected. Women and elders, for example, do not have this opportunity. CV members recognize that these populations are also not the most appropriate to endure the conditions of forest monitoring, which usually takes place in areas somewhat difficult to access and requires considerable physical activity. Women do, however, take part in other local monitoring initiatives like those mentioned previously (eg. the *Arkanth* or Yanesha community security committees). Some informants believe that the CV should hold positions for these populations.

Concerns were also raised in the workshop held regarding the absence, yet importance of, involving the younger generation (under 20 years old) in monitoring activities. Although the ages of members are mixed, the older members outnumber the younger members. CV members expressed great interest in involving the younger generation as a way of ensuring the continuity of monitoring activities. As McCall et al. (2016) point out, young adults’ technological know-how and familiarity with mobile devices and the internet may form an important part of community monitoring.

3.5.4. Transparency and information sharing

Informants voiced a major concern for the lack of information dissemination between the CV and the community at wide or those not directly engaged in the CV or monitoring activities. Evidence from this and other research indicates that community members who are not involved in the TDC program are unfamiliar with how the TDC program really works (Pizarro Cabezas, 2013). The PNCB only trains CV members on concepts and monitoring techniques and does not provide learning opportunities to those outside of the CV. Interviews with community members and direct observation in communal meetings indicate that community members tend to be unfamiliar with environmental concepts and issues apart from the information that CV members share in communal meetings. Some CV members claim that the community does not often provide much time for an update on forest monitoring activities and CV members themselves do not want to confuse community members given their unfamiliarity with the concepts and the TDC program.

Traditionally, indigenous communities and their governance structures are characterized as highly centralized and hierarchical (Pizarro Cabezas, 2013). The centralization of functions not only allows for the concentration of power of an elite few, but it also creates a bourgeoisie of knowledge. As such, management skills and knowledge in forest monitoring tend to not permeate other sectors of the community. Environmental awareness or education does not

often reach those outside of the monitoring committees. Funder et al. (2013) mention that when participatory monitoring programs and information management systems are almost exclusively composed of community elites, they risk becoming powerful platforms for autocratic decision-making and control over key productive resources.

Information sharing between the PNCB and the ANPs operating in the same area is increasing (See 3.1.3) as a result of their inter-institutional cooperation agreements. For instance, the PNCB provides information about forest and deforested areas within the BPSMSC to its office on a regular basis. CVs send the data collected to PNCB's forest monitoring office and reports of threats to their indigenous organizations with data, GPS points, photos and any other evidence, depending on the environmental infraction or forest cover change. Information sharing across levels is expected to increase with the expected clarity around the involvement of different actors in and use of the *Geobosques* tool. With the implementation of *Geobosques*, there is a possibility that the data collected by the CV could reach the regional governments.

3.5.5. Local relevancy

If the aim is to monitor attributes that are not relevant to the local context, locally based natural resource monitoring may not be suitable (Danielsen et al. 2014; McCall et al. 2016). Local communities involved in CBM or PMRV may gain information and become empowered to deal with issues relating to their own resources, threats and potentials. For instance, in one opportunity the CV in SPP suggested visiting a remote place within the conservation area where there are several large trees with potential for producing valuable timber seedlings. By doing so, they guaranteed the security of the resource that may be integrated into an agroforestry model with cocoa promoted by the TDC. In the LLL community, the CV decided to monitor the northern boundary of their territory during the fire season with the purpose of monitoring an old and expansive area of grasslands, which borders their conservation area and is where they source timber for domestic use. Other local monitoring experiences linked to the management of threatened species of local importance are recognized in the northern Peruvian Amazon, where palms and fisheries are actively monitored by local people who depend on their management (Pronaturaleza, 2014).

During the first few months of this study, the CV members received an introductory training of how to use smart phones as a forest monitoring tool. At the beginning, the majority of informants perceived the interface used for data collection to monitor forest cover change as complicated because of the difficult concepts to grasp.²¹ As a result, the application and its corresponding prompting questions were modified, which made it a more locally appropriate and a less time consuming activity. The issue of local relevancy is also tied to the need to

²¹ E.g. percentage of canopy cover, type of understory

standardize the concepts used at the national and local levels in a way that makes them locally appropriate and relevant to the local context.

3.5.6. Standardization of data sharing protocol

Bellfield et al. (2015) suggest that the imposition of concepts, criteria, and objectives to local people could serve to subjugate local practices and forest classifications. We identified several discrepancies in forest classifications and concepts used at the community and national levels—the former are based on local knowledge while the latter is based on scientific classifications. For example, CV members of all communities were unfamiliar with the concept of understory when they were asked to identify the type of understory (eg. woody shrubs, non woody shrubs, woody vines, herbaceous plants, grass) of sites where they were collecting GPS points. Bellfield et al. (2015) place emphasis on the need to harmonize forest classifications and concepts between the community and national levels, indigenous or local knowledge and scientific classifications. Standardizing aspects of CBM methodologies by establishing basic minimum standards, protocols and guidelines on best practices is expected to enhance comparability and replication at scale (Sabogal 2015). Standardized methods are also considered essential to scaling up data that can feed into national information systems (Danielsen et al. 2013).

On the other hand, some informants referred the outdated cadaster data at the national level as a major limitation to the detection of forest cover changes in particular and monitoring activities in general: “The cadaster of ANPs and the forestry cadaster have different geographical basis. Both the forestry and indigenous community’s cadaster are outdated and show considerable overlapping titled areas when in reality they are not.” Kowler et al. (2016) also reported the presence of different cadasters that are used separately in land-use planning by different institutions at multiple levels that do not coordinate with each other in the process.

3.5.7. Compensation

Compensation for local participation in monitoring activities is a never ending debate (see Danielsen et al. 2005). A community-based approach to monitoring is considered to be more sustainable when the valuation of local benefits outweighs the costs of local participation. If local benefits are not enough to cover the participation costs, monitoring will not occur (ibid). Often, conservation initiatives are limited by their conservation orientation and inadequate benefit-sharing system in which local communities have restricted livelihoods options (Kowler et al. 2016).

The case of TDC is not an exception. This study draws attention to the importance of understanding the opportunity costs of local community involvement in activities that take

them away from their daily activities. As mentioned, the TDC program pays communities 10 PEN/ha protected in their community. Communities are to receive, as stipulated in the investment plans, a fund to cover expenses for forest monitoring activities, such as fuel, transportation, food supplies, and equipment. This money goes directly to the CG that must discuss how it will be allocated in the communal assemblies, where all community members are to have a say in the distribution of the fund. CV members interviewed, however, report delays in receiving these funds up to two to three months behind, which also significantly delays monitoring activities.²² The CG deals with delays in the disbursement of funds from PNCB. An employee of the PNCB who works with the TDC program indicates that these delays are due to bureaucratic holdups.²³

CV members do not receive monetary compensation for their work though they do receive trainings on forest monitoring technologies and techniques. The majority of the CV members believe they should receive monetary compensation for their work, primarily because their involvement in monitoring activities requires significant time away from their families or time they would otherwise invest in earning income through their work in their fields. In the words of one CV informant: “Each day I go for forest monitoring I stop earning 50 PEN that I would easily earn by doing moto-taxi service”. Bellfield et al. (2015) suggest financial compensation for community members undertaking this work and argue that relying on community reciprocity or participation alone does not match the opportunity costs of engaging in more attractive economic activities.²⁴ With respect to including younger populations in this work, McCall et al. (2016) point out that in communities where youth are in search of opportunities in urban areas, monitoring efforts that are officially recognized and even monetarily supported can be an incentive for young people to stay in the community and assume a variety of leadership roles.

Several informants suggest alternative compensation mechanisms for members who regularly go to the field. Among these are that CV members should be exonerated from their mandatory communal responsibilities, such as village-wide cleaning, given they dedicate time to monitoring activities in the field for the community’s well-being. Three CV members also pointed to the opportunities they have for earning additional income because of their trainings and use of new technologies and techniques for forest monitoring. For example, CV members from PO report incidences in which they were asked by small farmers and neighbors to delimit their plots for monetary compensation.²⁵

²² Investment plans under TDC consider a productive component and activities such as cocoa and coffee cultivation, which requires resources allocation. Sometimes, the whole budget is designated to such activities without considering the monitoring component, which also should have a part of it. In some cases, inefficient coordination between the CV and the CG explain the delays in disbursement whereas in others the delays came from the PNCB office itself due to limitations and bureaucratic burdens. During the research, this limitation was identified in the three communities.

²³ Holdups are a result of a variety of reasons, such as a simple delay in writing an invoice for disbursement that significantly affects the timing of field activities.

²⁴ During the length of research at least one CV member of each community resigned at their responsibilities of being involved in monitoring, for being committed to other jobs.

²⁵ Personal communication, PNCB-Satipo staff, April 2015.

Similarly, there are a variety of local and forest resources such as crops, wildlife, fisheries and non-timber forest products (NTFPs) that can be integrated into a monitoring and compensation scheme to support their sustainability once the TDC program ends. It is important that these resources have important local and market value that provide alternative sources of income to make these schemes more economically feasible, which would ideally encourage local participation in and commitment to the program in the long run.

There are several communal reserves that provide an example of voluntary or unsalaried work since their community monitors are volunteers. In this case, SERNANP is not allowed to spend funds on equipment and logistics for people who do not work directly with the institution because of the burdensome budget requirements set by the state. Therefore, SERNANP depends on agreements with other institutions (e.g. local governments, NGOs) to overcome this issue. This strategy depicts how these financial burdens could be overcome by fostering partnerships. For instance, the El Sira Communal Reserve has an agreement with the local government of Puerto Bermudez, in the Pasco Region, which is now covering the budget for community monitors. Also, some communal reserve offices, alongside their indigenous counterparts, are promoting productive projects (eg. reforestation, cocoa cultivation, fish farming) in which the community monitors are compensated for participating in monitoring activities.

This and previous research point to the importance of involving local people in the design and/or development of a compensation or benefit-sharing mechanisms that will directly affect them, which would ultimately encourage the equal or fair distribution of monetary and non-monetary benefits alike (Kowler et al. 2016).

4. CONCLUSIONS AND RECOMMENDATIONS

This study aims at addressing the need for advancing community-based forest monitoring

methods that combine emerging technologies, optical remote sensing and CBM in order to improve tropical forest monitoring. The main contributions of this work are towards better defining the role of local communities, technical and operational conditions under which CBM can contribute to national forest monitoring systems. We focus on the participatory nature of TDC in its engagement of indigenous communities in monitoring activities, their capacity and knowledge around forest monitoring, their coordination with different actors at different levels, and benefits derived from their participation.

Demonstrated in this research, local people play an important role in protecting their natural resources, and indigenous communities in particular have various governance arrangements to ensure justice and safety in communities. Externally-designed programs that set up organizations in this context that do not take into account local organizations or local power structures risk causing conflict among leaders or overlapping functions. Informants identified some conflicts in the role of these committees, such as the communities involved in the TDC that are located in the buffer zone of an ANP. Evidence suggests that incorporating elements from these local organizations into these committees and/or finding ways for collaboration or even shared leadership across committees, particularly between already existing local governance arrangements and those externally introduced, helps to ensure the legitimacy of new governance arrangements.

Local communities have significant experience and knowledge of their land and natural resources and are considered the most appropriate stewards of their land. Local capacities and experiences around conservation and monitoring are vital to the sustainability of externally designed initiatives like TDC, particularly given the interests of local communities in protecting their territory and their existence as indigenous people. Thus, strengthening local capacities and empowering communities to respond to threats to the environment and forests is seen as critical. Despite local knowledge and experience in protecting and monitoring their forests, findings indicate that the technical nature of the data collection process involved in monitoring activities may require additional local capacity building, particularly if the data is to be scaled up to national forest monitoring systems. Evidence also indicates that the capacities of different actors at different levels are uneven, particularly local and regional governments.

Multi-level governance and collaborative governance require the coordination of different actors and fluid information sharing across different levels for the effective and efficient implementation of projects and programs. Insufficient coordination among actors and the discrepancies in forest classifications and concepts across levels of government are two of the major challenges identified in scaling up CBM. Considering the many actors that could contribute to this system at different levels, it is necessary to look at their specific competencies in forests or protected areas to determine their potential role and contribution to a multi-level forest monitoring system. Indigenous organizations that maintain strong ties to local communities may be key actors in institutionalizing monitoring activities, given their role is clearly defined.

This research points to a lack of information sharing between local and regional governments and communities and between PNCB and these levels of government. Information sharing is most fluid between local communities and the indigenous federations. Local governments' limited competencies in the forest sector explain their limited knowledge of and participation in

forest monitoring while regional governments are either in the process of exercising their new competencies. PNCB is prioritizing the involvement of regional governments in the TDC program as they are currently engaging them in decision-making processes rather than solely engaging with local communities. Information sharing will only become fluid once these different actors begin coordinating and have a clear understanding of their roles within the system. Such coordination and information flow will enable the effective scale up of local monitoring efforts to national-level monitoring systems, such as the NFMS and MRV.

This research also highlights the inconsistency of forest classifications and concepts used at the community and national levels and the need to harmonize the indigenous or local knowledge and scientific classifications. Standardizing aspects of CBM would ensure the comparability and replication of methodologies at scale, which would feed into national information systems.

Conservation programs that involve local communities in activities to protect forests and monitor areas to reduce threats to their territories and conservation areas have most recently begun to incorporate compensation mechanisms. Questions regarding what benefits are distributed and how they are distributed have become central to low emission rural development initiatives. Most importantly, the design of the compensation mechanism should take into consideration the opportunity costs involved in the local involvement in conservation activities to determine the most appropriate compensation for local participants that dedicate their time to conservation activities. Evidence suggests that the incentives for local monitoring do not necessarily outweigh the opportunity costs involved and for some, are perceived as inadequate considering the time and income loss from taking time away from livelihood activities. The compensation is actually directed towards the fulfillment of monitoring activities rather than individual compensation. This research draws attention to the potentially beneficial role of local communities in decision making around the distribution of benefits as a way of ensuring the equity of benefits, strengthening ownership in the process and placing accountability in the hands of local people themselves.

Recommendations

We have come up with a series of recommendations based on the research findings to address what is needed to institutionalize a CBM system for its sustainability and potential scale up to national monitoring systems such as the NFMS.

- **The incentives for people engaged in forest monitoring should be tangible and outweigh the opportunity costs** involved in local monitoring activities. In addition to the benefits of territorial security and conservation awareness, the TDC program could encourage the institutionalization of these local governance structures through laws and ordinances from different sectors and levels of government only when they are complementary to already existing local institutions for monitoring.

- Forest conservation through the TDC program should **create opportunities for and provide access to alternative livelihoods options or activities**. CV members would benefit from compensation opportunities from other activities such as paid jobs as technicians for delimiting private lands, forestry inventories, mapping and geo-referencing natural resources with potential (ecotourism, sustainable agriculture, reforestation, NTFPs, etc.) within the community.
- Monitoring programs would benefit from **involving local people in the design and/or development of the compensation scheme** that will directly affect them as a way of encouraging the fair distribution of the benefits distributed among participants, ownership of the process and long-term commitment.
- In order to increase local environmental awareness and capacities, **capacity building efforts must reach a wider audience than just the CV members**. Strategic media outlets like local radio programs, environmental education programs, continuous community meetings or talks by former CV members or a strategic partnership with indigenous organizations could contribute to the dissemination of and around environmental stewardship as well as local and regional governments.
- Interventions like TDC in forest monitoring should **foster the engagement with or help to create adequate channels for capacity-building with other relevant institutions**, such as SERNANP, SERFOR, when appropriate. Shared trainings provided by relevant institutions in the forest sector would be a more efficient approach in order to cover several topics in less time, which would ultimately be more cost-efficient. Special attention should also be paid to making information easily understandable or locally appropriate.
- The **engagement of relevant government and non-government actors, such as regional and local governments and indigenous organizations** (federations and ECAs) would help institutionalize the monitoring scheme, unify existing and ongoing efforts so as to prevent overlapping or duplicating institutions, and encourage the sustainability of monitoring activities by different actors over time. Such coordination would enhance the legitimacy of monitoring entities and activities as well as encourage the effective scale-up of CBM.
- The potential sustainability of CBM would be undermined if those developing monitoring interventions do not **take into account local and previous existing mechanisms or arrangements for forest monitoring**. Externally-designed initiatives such as TDC have the chance to integrate already existing governance arrangements into their structure, which would enhance the legitimacy of these forms of governance. Some of the experiences examined in this report present an enormous opportunity for different local arrangements and actors to come together and coordinate.

- **Unified criteria in forest monitoring and increased coordination among institutions is necessary for interventions to avoid duplicating efforts** or creating institutions with overlapping roles and competencies that could result in significant confusion at the community level. These efforts would ensure the effective scale-up of the CBM and the integration of monitoring activities at different levels.
- There is still limited knowledge of the new Forest and Wildlife Peruvian law (and other relevant environmental laws) at different levels and sectors (even more at the community level) in forest monitoring procedures, roles and responsibilities. Socializing the law among all actors would allow clear roles and responsibilities.
- **Further research could examine the existence and structure of already existing or traditional monitoring initiatives** in order to explore the possibilities for adapting new approaches of monitoring to already existing arrangements or institutions.

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APPENDIX A – INTERVIEW PROTOCOLS

Interview with CV members

Name: _____ Age: _____

Years living in the community (Name of community)? _____

If not from there: Where does he/she come? _____

How long he/she think to stay in the community? _____ Yes/No, Why?

Occupation: _____

How _____ many _____ hours/week? _____

TDC background:

1. What are re responsibilities of the CV in the TDC program? What do you do?
2. What happens if CV fails to meet its commitments?
3. How long have you been working on forest monitoring?
4. How the community has been trained in forest monitoring?
5. What role does the CG plays in the mechanism?

Information

6. What kind of data is collected in monitoring?
7. Do you find easy to interpret and analyze the data?
8. How this information helps you in the monitoring?
9. How this information is shared with the PNCB and your community?
10. How the CV contributes to the community? Is the community interested in the information?
11. Does the community know about the work of the CV? How much?
12. How often does the CV visit the forest for monitoring?

Benefits

13. What are the benefits to get involve with the CV? / (probe: capacity building, enhanced forets monitoring/reduce the risk of invasions, get payments)

Knowledge of land use change:

14. Do you believe that there is any threat to the forest/territory (eg. Invasions, illegal activities, other causes of deforestation) Who, Where, When and How?

a. How does the CV face illegal activities?

15. Do you believe that the CV responds to these threats?

16. In the map:

a. Which are the areas of your territory that face more threats? Which areas have lost more forest?

b. Which areas have recovered?

Actors & Participation:

17. Who else have worked in monitoring (at different levels) Are there any other actors involved besides the CV?

Actors	Roles/ Responsibilities
Community	
Local govt.	
Regional govt.	
National govt.	
Other actors	

18. Is there any other actor that should be involved in forest monitoring? Why?

Capacities:

19. What have you learnt in your experience with the CV?

a. What are the strengths of the CV?

What are the difficulties? What is missing? (Weaknesses)

20. Does the CV has the resources and capacities to fulfill its responsibilities?

21. Is the CV prepared to face threats mentioned before?

22. What do you expect from these new technologies?

23. Is this technology easy or difficult to use?

Interest:

24. Since you started to participate with the CV, does your interest changed?

Coordination:

25. With who you coordinate more regarding forest monitoring?

a. How do different actors coordinate? – Community, local govt., reg. govt., nat. govt.?

26. Who do usually you ask for help if an invasion arise? (the government?)

a. What do you get as an answer?

27. Are there difficulties in coordinating with those actors?

28. What kind of coordination you have with the CG?

Network analysis:

29. With who else you communicate regarding forest monitoring? (Snowball)

Accountability:

30. What rules exist within the community to monitor activities in the conservation area?

a. Does the CV give some sanctions?

Interview with community members (non-CV members)

Name: _____

Years living in the community (Name of community)?

If not from there: Where does he/she come? _____

How long he/she think to stay in the community? _____ Yes/No, Why?

Occupation: _____ How many hours/week? _____

- (1) What do you know about the CV (of PNCB)?
- (2) What does the CV do? What are the responsibilities?
- (3) Have you participated in the CV before? Yes/No. Would you be interest to participate in the future?
- (4) Have you participated in other monitoring related activities? (eg. Self-defense committee)
- (5) How the CV does contribute to the community? Is the information interesting to the community?
- (6) How do you know about the activities of the CV?
 - a. The community has knowledge about CV's work?
- (7) Is the information useful? How?
 - a. Do you believe that there is any threat to the forest/territory (eg. Invasions, illegal activities, other causes of deforestation)
- (8) Do you believe that the CV responds to these threats?
- (9) Do you believe that the CV complies with its responsibilities?
 - a. Do you believe that the CV is committed to its work?
- (10) What are the strengths of the CV?
- (11) What are the weaknesses of the CV? Difficulties? (What is missing?)
- (12) How it could be improved in the future?

Interview with organizations and other entities not involved in the TDC program

Name: _____ Institution: _____ Charge: _____

- (1) What do you know about the CV (from PNCB)?
- (2) What does the CV do? What are the responsibilities?

(3) Do you believe the CV contributes to the community?

(4) How do you articulate with the CV?

a. What kind of information do you receive from the CV?

b. How and how many you coordinate with the CV (meetings)? Examples:

c. With who else do you coordinate about forest monitoring?? (is the CV?)

(5) Do you believe that there is any threat to the forest/territory (eg. Invasions, illegal activities, other causes of deforestation)

(6) Do you believe that the CV responds to these threats?

(7) Do you believe that the CV complies with its responsibilities?

a. Do you believe that the CV is committed to its work?

(8) What are the strengths of the CV? What are the weaknesses of the CV? Difficulties? (What is missing?)

(9) How it could be improved in the future?

(10) With who else you coordinate about community forest / territory monitoring?

Actor	Frequency	Way of communication	Topic

Interview with people directly involved with the TDC implementation

Name: _____ Position: _____

Background

(1) What are the activities does your component do?

(2) What are the results to date?

(3) What are the next goals?

(4) Are there any challenges along the way?, How to address these challenges?

Roles

(5) What are the actors involved in the activities developed by your component (local, regional and national level)?

(6) How does your component articulates to other institutions?

Forest monitoring

(7) What role should assume the local and regional governments in forest monitoring?

(8) What is required for institutionalizing local forest monitoring in a larger system such as the national forest monitoring system (NFMS)?

(9) Do you believe that the CVs have sufficient capacity, resources, etc. in order to incorporate their work into system?

(10) Do you believe that the national government has the ability to incorporate the work of the CVs into this system (NFMS)?

Capacities

(11) What activities were developed at each level (local-CG and CV, regional) for capacity building?

(12) What are the capacities developed at different levels of government (local, regional, national) regarding your component? For how long?

(13) What are the capabilities required at different levels to achieve the objectives of the component?

(14) What capacities are missing at different levels?

Articulation

(15) How does your component articulates with other Program components? What kind of information is shared? How often?

(16) How is the articulation with other institutions? (inter-sector articulation at national level)

(17) How does coordination between CG and CG should be?

Wrapping up

(18) Lessons learned?

(19) What is required to sustainability of activities once the TDC program ends (2021)?

6.5 *Interview with Regional and local governments*

Name: _____ Institution: _____ Position; _____

Land use and land use change:

(1) What activities / tasks performed within your institution?

(2) The government has any office(s) / areas related to natural resource management? Which?

(3) What is the main economic activity in your district/ region?

a. ¿What are the different types of land use in your district/ region? (e.g. coffee, cocoa)

(4) Do you believe there are threats to the forest / territory within your jurisdiction (e.g: invasions, illegal logging, other causes of deforestation) Where?

(5) Who are the main actors contributing to the change in land use in the district / region?

a. to deforestation?

b. to forest degradation?

Knowledge about the CVs:

(6) Do you know about the CVs of the PNCB (If NO, skip to question 14)

(7) What are the activities of the CV? Which duties they have?

(8) Do you believe that the CVs contribute to the communities?

(9) Your institution/office/area has any articulation with the CV (or to the PNCB)?

- a. Do you receive information from the CV? Which kind of information?
- b. When and where did you coordinate (meetings, workshops, etc.)? Examples.
- c. With who else you coordinate about forest monitoring?

(10) Do you believe the local forest monitoring (CVs) responds to the threats previously mentioned?

(11) Do you believe they fulfill with their responsibilities?

- a. Are they committed with their duties?

(12) ¿What are the strengths of the CV? Weaknesses/difficulties (¿what is missing?)

(13) ¿How to it could be enhanced in the future?

(14) If coordinate about community forest monitoring, with whom do you coordinate?

Actors	Frequency	Way of communication	Topic (about what)

Capacities:

15) There are many government policies (local, regional, national) that influence in the use of land / forests (such as permits, concessions, road construction, land management, etc.) What are the issues in which your institution (district / regional government) has competencies (roles, responsibilities)?

Management and control of territory	a. Have control and direct decision (Yes, No, area)
	b. Land use planning / ZEE system
	c. Land titling / delivery of certificates of possession
Forest Management	Timber concessions / PFNM/ tourism /

and control	others
	Creation / control on NPAs
Others	Conversion rights assignment
	-Underground concessions:
	-Oil/ Gas
	-Mining
	-Infrastructure (roads)
	-Energetic sector (hydro plants)

a. Do you find any difficulty to exercise these powers? ¿What are the barriers you (your institution) face from other government offices?

16) How does the district / regional government advanced in the decentralization process?

a. ¿Did you receive enough competencies and budget to fulfill your duties?

Government efforts

17) Till what extend do you believe the activities to reduce deforestation point to the real and main causes of deforestation? Explain

a. In your opinion, ¿What are the main strengths and challenges for the government in this process? (*Adapt the question to the region*)

b. ¿What other actions or policies should be taken/modified to face the drivers of deforestation?

c. ¿What is required for those who are engaged with deforestation and forest degradations change those practices and activities? ¿What kind of incentive they should receive so they can improve their activities? Is this could work? Why?

d. ¿Should local and regional governments assume a main role in the forest monitoring? Which role?

Articulation between different levels of government

18) Please, explain your relation with other levels/sectors of government (district/provincial/national) in regards of forest and land topics

a. What level of communication exist between the district / provincial and regional govt.? Do they coordinate? Are there spaces for coordination?

b. With who else from the local governments do you coordinate?

c. Are you satisfied with the activities/efforts from the regional government?

APPENDIX B - PHOTO GALLERY



Forest monitoring workshop and trainings

