PROJECT TITLE:	ENABLING CUSTOMARY LANDOWNERS TO PARTICIPATE EFFECTIVELY IN CFM AND REDD SCHEMES WITHIN FOUR PILOT AREAS OF PNG
REPORT TITLE:	TECHNICAL REPORT TWO: *STRATEGY SELECTION FINDINGS AND TECHNICAL SPECIFICATIONS FOR THE FULL PROJECT PROPOSAL*
AUTHOR:	ADIA BEY, PACIFIC ISLAND PROJECTS LTD. Allotment 20, Section 66, Page Street, Rabaul, East New Britain Province, Papua New Guinea

PROJECT NUMBER:	CFM-PPD 006/10 REV.1 (F)
HOST GOVERNMENT:	GOVERNMENT OF PNG
EXECUTING AGENCY:	PNG FOREST AUTHORITY
PROJECT COORDINATOR:	GEWA GAMOGA, NATIONAL FOREST SERVICE
STARTING DATE:	2 NOVEMBER 2012
DURATION:	9 MONTHS

PLACE OF ISSUE:	PORT MORESBY, PNG
DATE OF ISSUE:	16 APRIL 2013
DISCLAIMER:	THIS DOCUMENT REFLECTS THE OPINIONS OF THE AUTHORS AND NOT THAT OF ITTO OR PNG FA.

Table of Contents

Table of Figures

Abbreviations and Acronyms

CFM	Community Forest Management
GIS	Geographic Information System
ILG	Incorporated Land Group
IPCC	Intergovernmental Panel on Climate Change
ITTO	International Tropical Timber Organisation
NFM	Natural Forest Management
OCCD	Office of Climate Change and Development
PIP	Pacific Island Projects
PGIS	Participatory Geographic Information System
PNG	PNG
PNGFA	PNG National Forest Authority
REDD	Reducing Emissions from Deforestation and Forest Degradation
SABL	Special Agricultural Business Lease
SBSTA	(UNFCCC) Subsidiary Body for Scientific and Technical Advise
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard

1. Summary

The International Tropical Timber Organisation (ITTO) is currently helping the PNG Forest Authority (PNGFA) to formulate a full-project that enables customary landowners to participate effectively in CFM and REDD schemes within 4 pilot areas of Papua New Guinea (PNG). The second technical report concludes the second round of project design activities; culminating with the project planning workshop with selected partners and key stakeholders in Port Moresby. This report presents the key strategies that were selected by project partners for the full-project, together with the proposed technical options, requirements and recommendations for data collection, management and dissemination. The report also outlines some possible components of the "model community-based land ownership mapping and forest resource assessment system" that can be designed in greater detail during the full-project's implementation phase.

2. Introduction

With the support of the International Tropical Timber Organisation (ITTO), the PNG Forest Authority (PNGFA) is designing a project that will enable customary landowners to participate effectively in Community Forest Management (CFM) and programs to Reduce Emissions from Deforestation and forest Degradation (REDD). This PNGFA project will support six partner organizations to strengthen the capacity of landowner groups for mapping land tenure and assessing forest resources. Equipping landowner groups with appropriate tools for sharing knowledge of their customary lands is central to this project, along with mobilizing this information to improve land use planning, forest management and national and sub-national REDD programs.

This report is comprised of three parts. The first section provides an overview of the research methods used to gather information for this report. The second section presents key project strategies selected by partners, with particular reference to those related to data collection and data management. Finally, the third section outlines initial technical options, requirements and recommendations for data collection, management and dissemination to achieve project objectives. The third section also suggests system components that can be designed in greater detail with participating landowner groups during the full project.

3. Methodology

This report presents information gathered from (1) a comprehensive review of relevant literature, (2) a summary of organizations involved in community forest management (CFM) and reducing emissions from deforestation and degradation (REDD), (3) semi-structured interviews with representatives of each partner organization, and (4) focus groups addressing project issues with partners organizations and other key stakeholders.

Literature review

The literature review targeted resources that help contextualize the project amongst broader forest conservation initiatives and resources that could improve project implementation or expose project partners to CFM or REDD components that they may not yet address. Over 150 articles, reports and guides that address CFM and REDD were gathered and documented in two stages.

The full list of 161 references published during the past 15 years is presented in a bibliography matrix. The matrix indicates the sub-topics addressed by each reference to enable partners to easily identify materials relevant to their work. The annotated bibliography summarizes 38 references that were deemed central to this PNGFA project. The CFM and REDD sub-topics addressed by the literature review are outlined in Table 1. The annotated bibliography is provided in Annex A.

Many of these resources (excluding books) are now available to the project partners and other stakeholders through this project's DropBox folder.

Table 1: Literature review sub-topics

Full bibliography (14 sub-topics, 161 sources)	**Annotated bibliography** (8 sub-topics, 38 sources)
• PNG-specific • Governance, domestic policy & law • Community forest management • Livelihoods, socio-economic issues • Land tenure and rights • LULUCF • Biodiversity & other ecosystem services • Degradation • Reference levels • Monitoring, reporting and verification • Cost and financing • Payments & benefits • Approaches and proposals • Implementation & lessons learned	• Community engagement • Community forest management • Community forest monitoring & monitoring, reporting and verification • REDD+ in PNG • Reference levels in PNG • Payments for REDD and other ecosystem services • Natural resource conflict management • Guidance Materials

Organization review

The web-based organization review identified government and non-governmental institutions as well as multi-institution initiatives that address CFM, REDD or other aspects of forest conservation. A summary of each organization or initiative is provided in the Organization Review Word document, while contact details are provided in the accompanying Excel spreadsheet. This contact list has been consolidated with the CFM-REDD project's email list to foster an inclusive dialogue for project development, and at a later stage, project expansion. A list of relevant organizations identified is provided in Table 2. The organization review is provided in Annex B.

Table 2: Relevant organizations

1. Conservation International 2. European Union 3. FORCERT 4. Forest Carbon Partnership Facility 5. Foundation for People and Community Development 6. Secretariat of the Pacific Community (SPC) 7. James Cooke University 8. Kokoda Initiative 9. Lowering Emissions in Asia's Forests (LEAF) 10. Live and Learn 11. Mahonia na Dari 12. Mangrove Rehabilitation for Sustainably-Managed, Healthy Forests 13. New Guinea Binatang Research Center 14. Oil Search Limited	15. Pacific Forest Alliance (PFA) 16. PNG Australia Forest Carbon Partnership 17. PNG Department of Environment and Conservation (DEC) 18. PNG Forest Authority 19. PNG Office for Climate Change & Development 20. Research & Conservation Foundation (RCF) 21. Responsible Asia Forestry and Trade (RAFT) 22. The Nature Conservancy 23. Tree Kangaroo Conservation Program (TKCP) 24. United Nations REDD 25. Wildlife Conservation Society 26. Winrock International 27. Woodland Park Zoo 28. World Wide Fund for Nature (WWF)

Questionnaire

The project team disseminated a web- and paper-based questionnaire to project partners and other stakeholders to gather more up-to-date information regarding existing CFM-REDD activities and to assess the technical needs and resources associated with these activities.

The questionnaire covered the following topics:

- Programmatic and geographic scope of forest management projects
- Software used for data collection and analysis
- Existing datasets related to CFM and REDD
- Data needs
- Willingness to share data
- Preferred data formats

The survey results form an initial part of the requirements for the CFM-REDD forest data management system. A summary of questionnaire results is presented in Annex C.

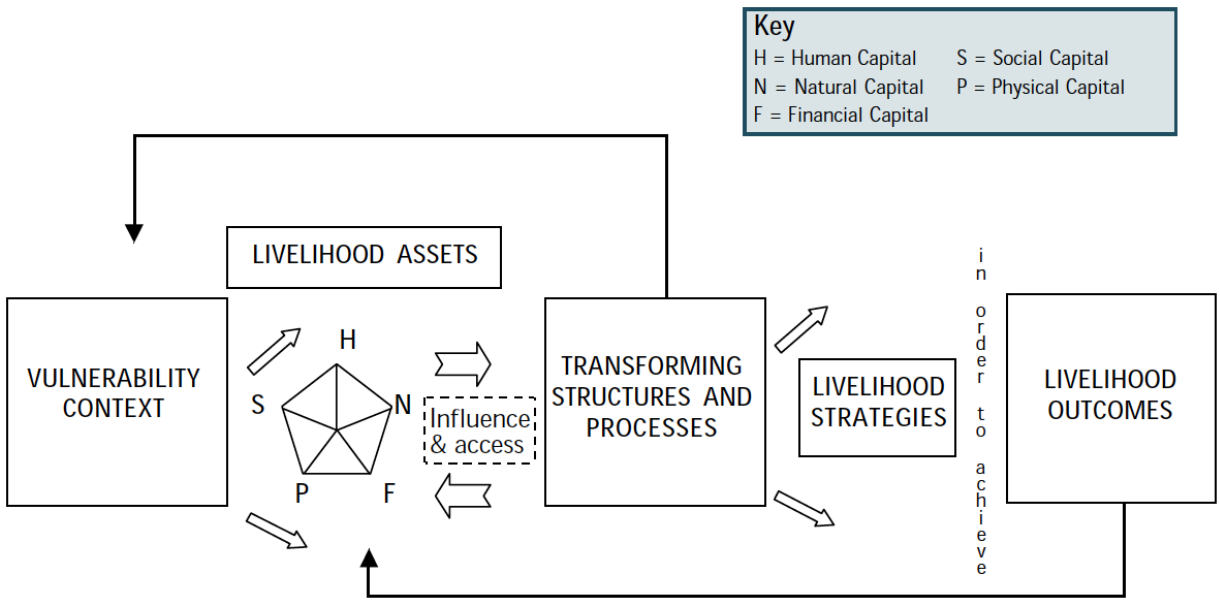
Interviews

Semi-structured interviews were conducted with representatives from partner organizations and other stakeholders in the Eastern Highlands, Madang, Manus, Milne Bay, Morobe and West New Britain provinces, and the National Capital District. The organizations represented include government entities, non-governmental organizations and research institutions:

- Department of Environment and Conservation (DEC)
- Eastern Highlands Provincial Administration
- FORCERT (Forest Management and Product Certification Service)
- Foundation for People and Community Development (FPCD)
- Japan International Cooperation Agency (JICA)
- Lowering Emissions in Asia's Forests / Winrock
- Morobe Provincial Administration
- Office for Climate Change and Development (OCCD)
- Partners with Melanesians (PWM)
- PNG Forest Authority (PNGFA)
- PNGFA Forest Research Institute (FRI)
- Research and Conservation Foundation (RCF)
- Tree Kangaroo Conservation Program (TKCP)
- University of PNG (UPNG)
- Wildlife Conservation Society (WCS)

The first part of the interviews helped form a more complete Sustainable Livelihoods profile for the landowner groups supported by each institution (Figure 1). The Sustainable Livelihoods Framework (DFID 1999) is an approach to conceptualizing objectives, scope and priorities for promoting development and alleviating poverty.

Figure 1: Sustainable Livelihoods Framework (DFID, 1999)



The second part of the interviews shifted focus from the participating landowner groups to the partner organizations, and the *transforming structures and processes* introduced through their work, their *strategies* for working with communities, and the *assets* at their disposal. Assets such as technical capacity, land tenure and environmental data, equipment for recording information, and software for analyzing data, and internet connectivity are relevant to the objectives of this CFM-REDD project. These assets, as well as the processes and strategies for leveraging the local and institutional knowledge have informed the technical specification and procedural strategies outlines in this report.

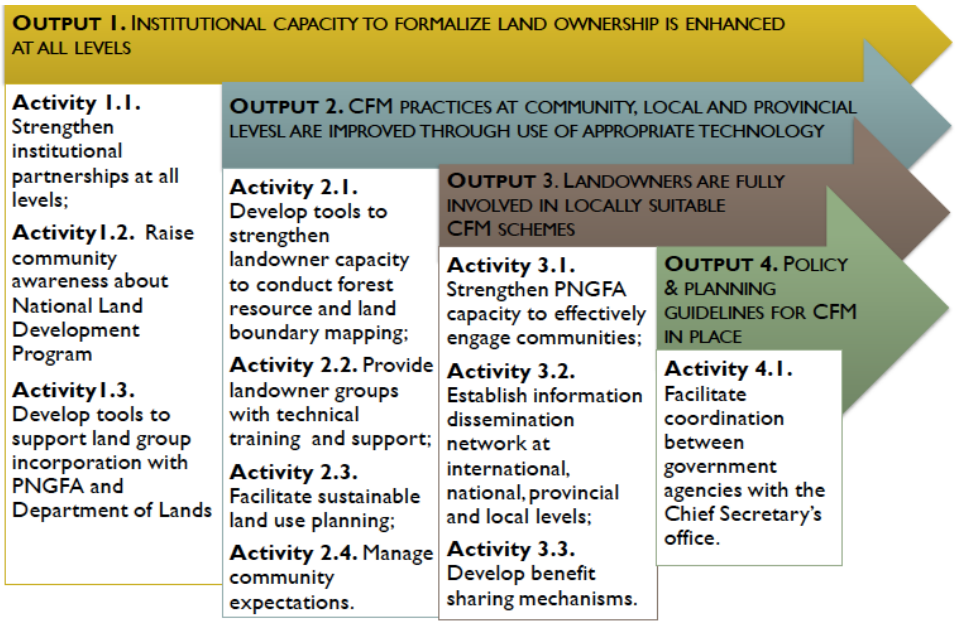
Focus groups

PNGFA hosted the CFM-REDD Pre-project workshop in Port Moresby from September 17-19 to finalize key components of the full project. In the context of this gathering, several focus group sessions were conducted to refine or develop (1) the list of problems addressed and (2) objectives sought for the project, as well as the (3) scope, (4) level of community engagement and (5) stakeholder responsibilities for the land tenure and forest data manage system developed through the project. All of these components have directly or indirectly shaped the technical specifications and strategies presented in this report.

4. Implementation Strategies

During the project development workshop in September, project partners agreed on the following goals for the full project: (1) institutional capacity to formalize land ownership is enhanced, (2) CFM practices are improved through the use of appropriate technology, (3) landowners are fully involved in CFM schemes, and (4) policy and planning guidelines for CFM are in place (Figure 2). Participatory data collection, data management and analysis, and information dissemination are central components of all the project goals above. The following section outlines key strategies to achieve these goals and the role that information management will serve in each.

Figure 2: Full project outcomes and activities



The implementation strategies are summarized in Figure 3 as they are related to each project partner. The section that follows highlights a few cross-cutting strategies that shape the technical components of this project.

Figure 3: Implementation strategies by project partners

PNG Forest Authority	Local Partners
Integrate the "national CFM platform" with existing national forest management systems and projects using open source software (free, flexible, regularly updated) for collecting data that can be exported in a compatible format for each national system, including the: ❑Forest Resource Monitoring Project (JICA); ❑Decision Support System Project (AusAID); ❑Multi-purpose National Forest Inventory Project (EU & UN-REDD)	❑Use a phased approach that suits each local partner; ❑Build on local partner strengths and encourage dialogue between partners (e.g. data referencing / publication and property rights); ❑Use open source software for collecting and exporting data that can be operated using simple and readily available technology (e.g. Android smart-phones and tablets); ❑Use open source software for exporting data in a compatible format for each local system, including Excel and KML (for ArcGIS and Google)
Participating communities	**All partners**
❑Pilot community groups (number and type) to be selected by each local partner; ❑Build landowner capacity to become as autonomous as possible over time (using a phased approach that suits each group); ❑Use open source software for collecting data and viewing summary findings offline using simple, available technology (e.g. Android smart-phones) with the necessary extras (e.g. rugged casings and solar powered battery chargers); ❑Use open source software for exporting data offline (to be uploaded online later by local partner).	❑Efficient data sharing mechanisms and arrangements need to be carefully developed from national level down (data sharing overseas needs to be carefully discussed and managed); ❑Seven priority data collection forms identified to encourage participation & collaboration (Land-use / land tenure; Forest biomass; Land cover; Clan membership; FPIC; Socio-economic; Biodiversity).

Participatory Geographic Information Systems (PGIS)

Participatory GIS practice is designed to promote community empowerment through involving local people in gathering data as well as determining the variables that are to be measured and mapped and interpreted. Maps created through participatory GIS can be used as a platform upon which local issues can be discussed (McCall 2011). Engaging with forest communities in PNG, and using PGIS to record, interpret and mobilize spatial information is an integral project strategy. Through participatory GIS, this project will generate original data regarding land tenure (Activity 1.3), land use and forest resources (Activity 2.1).

Participatory GIS builds upon the strengths of local communities. When using digital data collection tools to record spatial information, participatory GIS can provide a framework for documenting traditional forms of knowledge in a format that is accessible and easily utilized by formal scientists and other professionals.

Participatory GIS is an ideal approach for collecting land use and forest information in PNG for several reasons. The national constitution recognizes customary land ownership, and indigenous groups own the vast majority of the country's lands.[1] Over 70% of the country is forested (Shearman et al 2008) and over 80% of the population relies directly upon natural resources for survival through (Dam and Trines 2011). The road network in PNG is relatively nascent and most villages and forest areas are difficult to access. Considering PNG's unique characteristics, indigenous communities are uniquely positioned to record their own land tenure and forest information. It would be extremely difficult and expensive to collect this information on a large scale through other means.

Participatory GIS requires capacity building. Empowering indigenous communities to record spatial information will involve training individuals in the use of new forms of technology. This may contribute to the local development of transferable skills that extend beyond community-based forest management (Larraza'bal 2012).

Participatory GIS also requires 2-way flows of information throughout the design, implementation and conclusion of the project. Data collection software should be designed with reference to language, perceptions and priorities of the communities involved in the project. Some data collection requirements, such as those associated with measuring forest carbon stocks, are prescribed at a national and international level. However, data related to land use and land tenure should draw upon locally defined land categories. In both instances, the ultimate aim is to bridge the gap between new technology and traditional spatial knowledge through adequate use consultation and software customization.

This project partners will utilize digital data collection forms to record spatially explicit information related to (1) land use and land tenure, (2) forest biomass, (3) land cover, (4) landowner group membership, (5) socio-economic monitoring, (6) free, prior and informed consent, and (7) biodiversity.

[1] The oft-cited estimate is that 97% of Papua New Guinea's land is owned by indigenous groups. However, a growing percentage of PNG's land area has been removed the indigenous control and leased for a long-term period (up to 99 years) to national and international companies for oil palm, cacao and coffee production. Recent literature has attempted to total this large-scale industrial agriculture development in PNG (Filer and Wood 2012), but the percentage of land owned and implicitly controlled by indigenous groups has not been adjusted to account for these land use decisions and/or appropriations.

PGIS for Land Tenure Mapping

Customary land tenure is recognized by the PNG Constitution under Schedule 2.1. Under the National Land Development Programme, the laws on Incorporated Land Groups (ILGs) and voluntary customary land registration were amended in 2009 to enable landowner units to (i) have proper control of their customary land (ILGs registered before 12 March 2012 have until 12 March 2017 to re-apply) and (ii) do business with their chosen development partners using a non-transferable land title (CLRC 2009). Holznecht (2012) emphasizes the need to examine each amendment to ensure sufficient resilience to illegal developments, such as SABL issues. The Land Group Incorporation Act (2009) requires the following ILG application documents:

(i) A completed ILG incorporation form
(ii) The proposed ILG constitution
(iii) A list of the members of the new ILG along with copies of each persons' birth certificate
(iv) A sketch map of the boundaries of the land which the applicants are claiming. When GPS technology is available, this technology may be used to prepare the map. The map should include:
    a. Natural features such as mountains, valleys, rivers, creeks, etc
    b. Boundaries of disputed lands that are also claimed by neighboring communities
(v) A list of members of the Management Committee
(vi) A list of names of the proposed dispute settlement authority for the settlement of any internal disputes of the ILG
(vii) Any additional information recommended by the Registrar of ILGs.

Completing steps ii, iii, iv, v, and vi digitally may expedite the registration process reducing the data entry burden of the registrar. Official documents such as (i) the ILG incorporation form and (iii) birth certificates of each proposed ILG member can be photographed and potentially (pending approval from the Lands Department) submitted electronically to further expedite the process and reduce transportation and/or postage expenses.

Simple sketch maps (step iv) drawn with pen and paper are less time- and resource-intensive. However, using participatory GIS to gather precise spatial data including the coordinates of the community boundaries, may help clans to demarcate their land in a more comprehensive way and exercise their customary and constitutional land rights. Sketch maps are subjective. They may vary depending on the spatial perception of the individuals involved in its creation. Adding natural features to the map, as required for the ILG registration process, can help identify absolute locations, but challenges may arise when landmarks referred to for orientation are not be easily viewed in satellite imagery or in official maps. Thus, traditional sketch maps introduce two likely areas of human error: during the map's creation and subsequent interpretation into an official GIS.

With appropriate participatory GIS tools and time devoted to walking along land boundaries, landowner groups can easily record the coordinates of customary land in a robust manner. As social, cultural and economic interests are closely intertwined with the use of land and natural resources, it is within the landowner groups' best interests to use the most accurate tools available to map their land. Submitting precise spatial information may help the Lands Department identify overlapping land claims and areas of concern early, and avoid land conflicts.

Allowing community members to map their own land boundaries in a participatory manner is less contentious and more cost effective than hiring experts. It strengthens local capacity to engage in and oversee the ILG registration process - if clans opt to pursue this legal process - with the support of official surveyors from the Lands Department.

Participatory GIS is not intended to replace necessary non-technical processes. Instead, PGIS provides a platform for avoiding some conflicts associated with lack of transparency. GIS also provides the tools to efficiently and accurately amalgamate data from a wide variety of sources and automatically identify overlaps and potential areas of conflict. This project will use two digital data collection forms to record information required for the ILG registration process: (1) Land use and land tenure form, and (2) Landowner group membership form.

PGIS for Forest Resource Assessments

Community-based forest monitoring to support improved forest management and REDD requires two-way communication; capacity building at multiple levels; data collection, analysis and dissemination; and improved coordination. PGIS and an online data management platform can provide a strong foundation for linking communities, NGOs and governmental officials to achieve shared resource management goals.

A key priority identified by partners during the September project development workshop is the need for improved land use planning and informed decision-making regarding forest resources. Helping indigenous communities understand the multiple values of their forest resources is critical to both of these endeavors. Local communities in PNG often have an intimate knowledge of forest resources and some of the long-term ecosystem services that directly support their livelihoods. Communities are increasingly aware of the short-term financial benefits of other land uses, although the long-term environmental consequences of such uses may be less well known. The PNG Forest Authority and local CFM partners possess a different, yet complementary, knowledge of forest resources, including a long-term and large scale understanding of how forest resources benefit communities throughout PNG. Project partners are increasingly aware of REDD, payment mechanisms for ecosystem services, and numerous other land use options that may benefit communities and be less degrading to natural environments overtime. Two-way communication is a key project strategy to foster knowledge sharing between indigenous communities, NGOs and government officials and facilitate sustainable development.

Participatory GIS encourages two-way flows of information and information sharing when (a) designing a data collection system, (b) gathering and interpreting spatial information, and (c) producing maps and other summary documents that can be understood by partners and used to achieve project goals.

The design of a PGIS data collection system involves identifying the data collection needs and creating data collection prompts that system users understand. Some data requirements for the project will invariably be top-down. The monitoring requirements for demonstrating reduced emissions from deforestation and forest degradation are negotiated and standardized at the international level. Communication and capacity building is necessary to translate these requirements into locally applicable concepts to enable landowner groups to record the necessary information.
This project will use 3 data collection forms related to CFM (including PES and REDD): (1) Forest biomass, (2) Land cover and (3) Biodiversity. The Land use and land tenure form (4) is also related to the management and monitoring of forest resources.

Data requirements for CFM and land use planning are more community-driven or bottom-up, since land-use planning processes for CFM require the active participation of the landowner groups involved. Some land uses may be region or culture-specific. Landuse planning and decision-making will ideally make use of information regarding current land use (categories and extents) and the tangible and intangible values of forests and other land use categories. Development plans at the Ward, landowner group and family level will also shape decisions. Project partners can consult with participating landowner groups to understand the data collection needs for local land use decision-making processes.

Data requirements for PES and REDD are more externally driven, or top-down from the IPCC, UNFCCC SBSTA, FSC, CCBS, VCS or other internationally recognized institutions and certification schemes working to establish globally consistent and scientifically robust protocols for forest management and monitoring. At the national level, the PNGFA has already begun a national forest inventory, which includes biomass measurements, the second phase of which will begin in 2014 with EU and UN REDD support. PNGFA has also embarked upon a remote sensing-based forest monitoring program in collaboration with JICA. Integration with PNGFA's two forest monitoring initiatives is a key project strategy for sustainability. The forest biomass, land use and land cover data collected by landowner groups can help calibrate and interpret remote sensing data with support from local partners until such time local people are capable of generating accurate data independently. It can also be used to assess the accuracy of land cover maps. On a large scale, ground-based forest information and local knowledge from indigenous communities can help PNGFA improve its forest carbon reporting, identify leakage from conservation efforts and devise better forest management strategies.

There is a wide variety of forest resource information that cannot be gathered through remote sensing techniques. Below-canopy forest degradation, selective logging, regeneration and reforestation are difficult or impossible to detect with medium resolution satellite imagery. Forest communities are well position to gather this type of information (Skutsch 2011). Research has also shown that communities are more likely to make sustainable forest management decisions, and implement them more efficiently when they are involved in monitoring and managing their own forest resources (Larraza'bal 2012).

Community engagement strategy

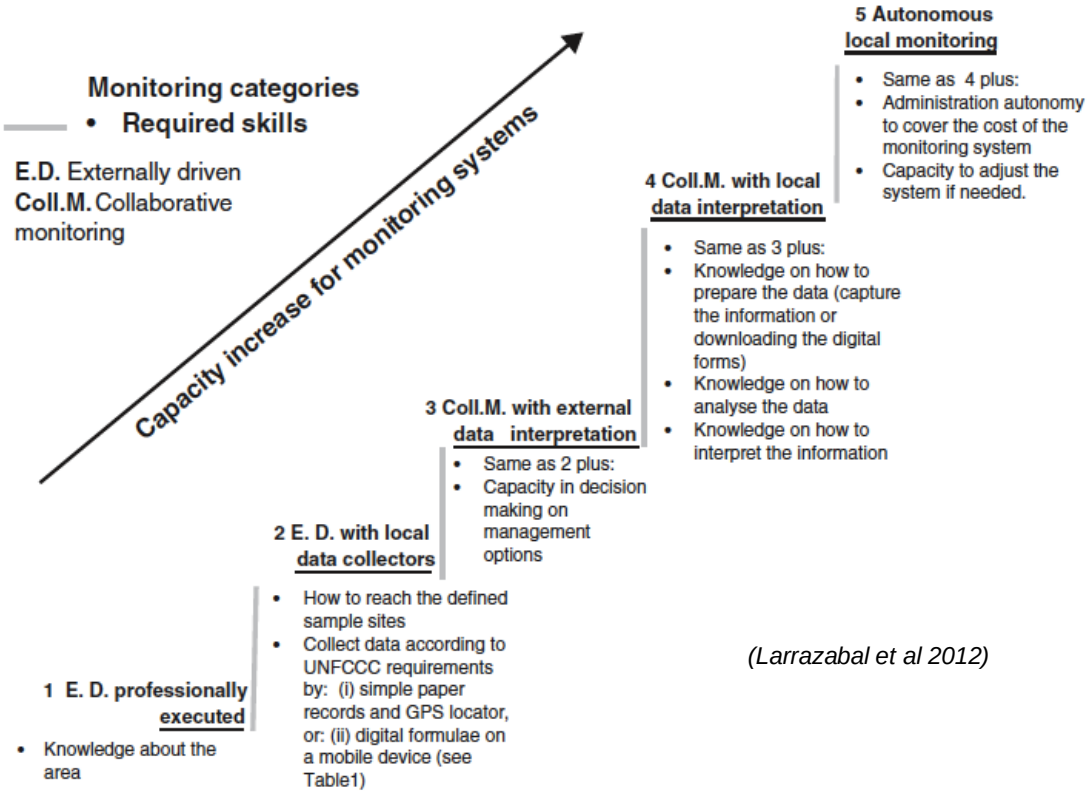
This project is geared toward providing multiple benefits for participating landowner groups. Project partners can use three digital data collection forms to safeguard the rights of communities and assess the benefits they received from the project: (1) landowner group membership, (2) video FPIC and (3) socio economic monitoring.

Many of the partners involved in the project have already completed a process to inform communities of the potential risks and benefits of participating in the project and received some form of consent to proceed with the collaboration. Although the full-project aims to bolster some existing activities, it will also introduce some new components that may require additional consent from communities. Landowner groups collecting detailed information on their customary lands will have control over how the information is used. Sensitive information can be used for local land management plans, while land cover and forest biomass data will only be collected with the intent of sharing this data with other entities that can help communities benefit from this detailed assessment of their forest resources. Either way, the project video FPIC (free, prior and informed consent) form is intended to enable participating landowner groups to have control over the use of their original data.

The project also adopts a phased or tailored approach to project implementation. Some partner organizations and participating landowner groups are neither currently involved in, nor prepared to engage in PES or REDD project development. For this reason, the project's FPIC process and phased implementation strategies recognizes that REDD and other forms of payment for ecosystem services may not be a perfect match with the CFM and local land use and development plans of all communities. Rather than focus on one particular land use goal (e.g. forest conservation for REDD), the project aims to strengthen capacity for informed CFM and land use management. By the completion of the full-project, participating landowner groups will be more knowledgeable about the value of their forest resources and more capable of engaging in a PES or REDD project. This knowledge and capacity will empower indigenous communities to make informed decisions regarding potential and viable land use options such as forest conservation.

Capacity building is a core strategy for promoting sustainability. Participating landowner groups will learn more about the National Land Development Program, CFM, PES and REDD. They will also improve their skills to effectively engage in these endeavors. Through participatory GIS, this project will help landowner groups to be as autonomous as possible. In terms of levels of community engagement (Figure 4), the fifth level, Autonomous local monitoring, is the long-term goal.

Figure 4: Levels of Community Engagement in Forest Monitoring



(Larrazabal et al 2012)

Most project partners are currently at the first level. Land tenure mapping and forest resource assessments are largely externally driven by the local partners, with local landowners providing their knowledge of the area to facilitate. Within the context of this project, Level 3: Collaborative monitoring with external data interpretation, is the goal for forest resource assessments supporting PES and REDD. For land tenure and land use mapping, Level 4: Collaborative monitoring with local data interpretation, is targeted.

Data collection and mobilization

This project will use open source software for data collection and visualization as a key part of the strategy for promoting sustainability and enabling project partners and landowner groups to be as autonomous as possible. Open source software can be used for data collection and visualization. It is widely available, free to download and it does not incur expenses for the license fees associated with proprietary software. The open source software considered for this project, Open Data Kit and Google Earth, are regularly updated and improved by developers. This software is also used for numerous other forest monitoring projects worldwide.

Software options, requirements and recommendations are discussed in more detail in the following section (Technical Specifications).

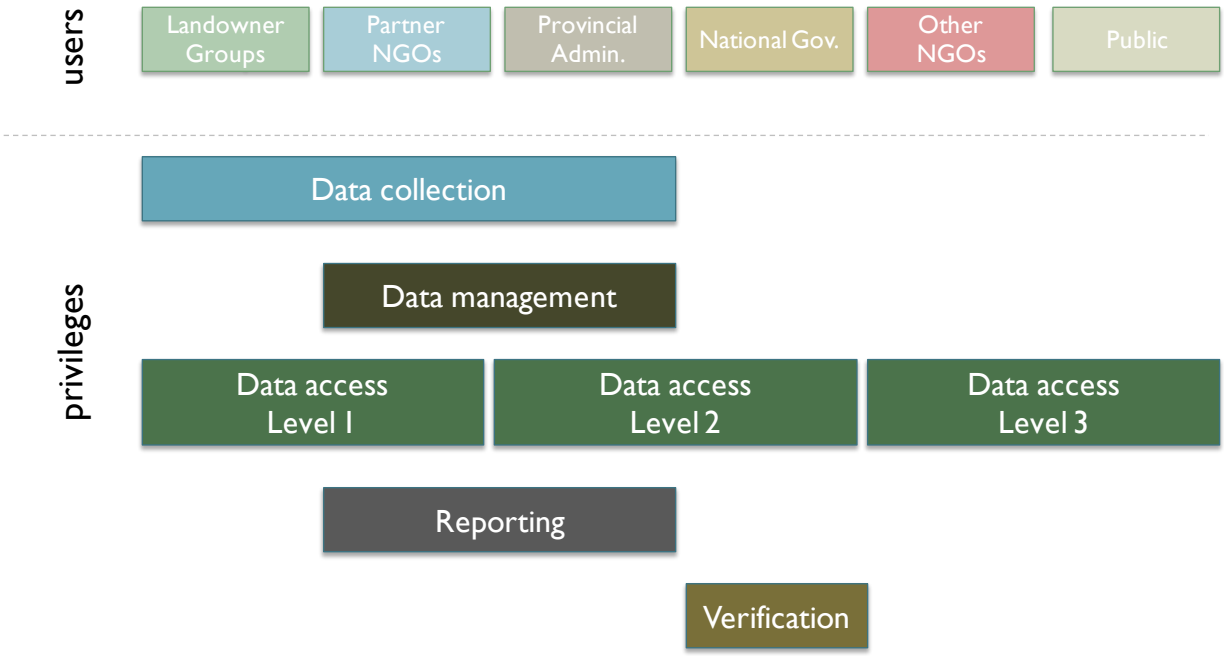
5. Technical Specifications and Information Mobilization Processes

This section presents (a) the data collection and data management requirements for fulfilling project objectives, (b) the software and hardware options considered for the project and (c) recommendations for achieving the technical goals of the full project.

Technical components

The PNGFA, project partners and participating landowner groups will utilize five technical components during the implementation of the full-project (Figure 5): (1) mobile data collection, (2) data management on a web-based platform, (3) data verification, (4) dissemination of data, maps and summary documents and (5) accessing and downloading information required for local and national land tenure and forest management processes.

Figure 5: Data management system users and technical components



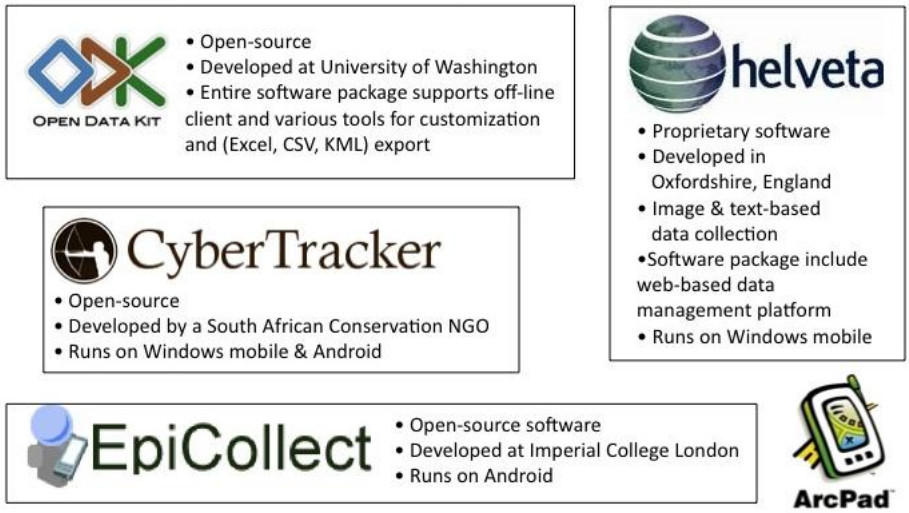
The technical components will ideally be linked with supporting procedures. Prior to data collection, participating landowner groups will be consulted to identify data collection priorities related to land tenure, land use and forest resource assessments. Local partners will serve a critical role in helping landowner groups upload information onto an online data management platform. This procedure will be built into existing procedures of transportation and communication that partner organizations already have with the landowner groups they support. By accesses and uploading information onto the online platform, PNGFA and provincial officers will be able to engage with landowner groups, download ground-based data and provide useful information to the local level. After validating a portion of the data gathered by landowner groups, PNGFA and OCCD may use the data to feed into reporting of forest carbon stocks and emissions from deforestation.

Landowner groups may also wish to determine the members of their monitoring team, a schedule for their work on the project, and protocols for compensating members who are involved.

Data collection software

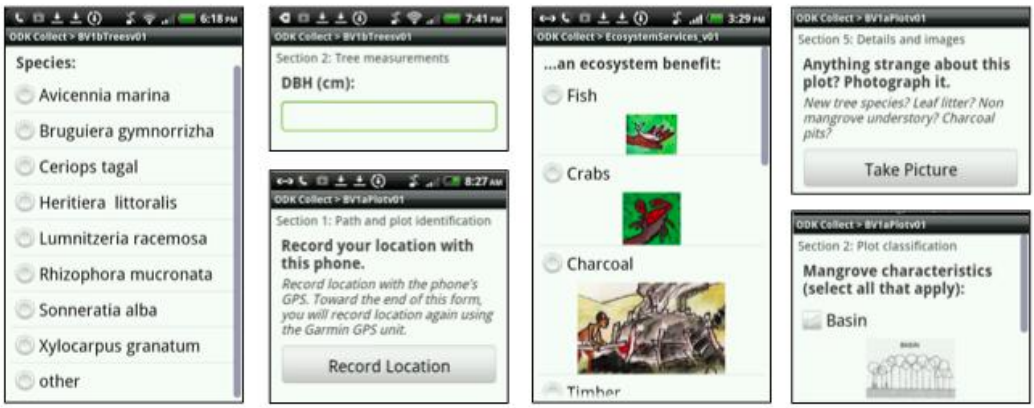
The project partners have considered a variety of open source and proprietary software options for the project's data collection needs including Open Data Kit, Cyber Tracker, Helveta CI World, ArcPad, and EpiCollect (Figure 6).

Figure 6: Data collection software options



Open Data Kit (ODK) was selected as the best suited for the project for several reasons. This open source software is freely available and can be downloaded from the internet. ODK has customizable data collection prompts that support different forms of data capture such as text or number entry, multiple choices questions, GPS coordinates, images, audio and video. ODK also allows for multi-language data collection. The full-project will utilize image-based prompts and multi-language text prompts to record geo-referenced data.

Figure 7: Sample Open Data Kit data collection screens



Additional benefits of ODK include efficient data entry and convenient data export options, such as KML (Google Earth compatible) and Excel formats. Data collected in the field using android devices can be uploaded to a private space online, where ODK web-based software aggregates and organizing the information. Data can also be uploaded and saved on a computer without the use of internet. Later, when internet is available, data can be uploaded directly from the computer without further need of the original device used for data collection.

Data collection hardware

ODK software can run on almost any device with an Android operating system and the capacity to store data (e.g. microSD). The ideal device for this project would be rugged (e.g. shock and water resistance) with a long battery life, excellent GPS reception (even under forest canopy), a large screen size with good screen resolution and clarity. Balancing these specifications with price and PNG availability, the full project will include field testing of android devices during the initial phase.

Figure 8: Sample data collection hardware options

Many project partners already posses an android device, some of which were purchased locally, that be used for testing. After compiling information on locally available devices and comparing the price and specifications with those of other accessible phones (e.g. sold in Australia), the project management team will choose with most suitable device for the project. Solar powered battery chargers and waterproof casing for the phones will most likely be essential equipment for the project.

Data management

While participating landowner groups will record data on their customary lands, their local partners will serve a critical role in linking data collection with local and national processes through data management. The key processes associated with project goals are ILG registration, land use planning and PES/REDD (Figure 9).

Figure 9: Digital data collection forms and formats

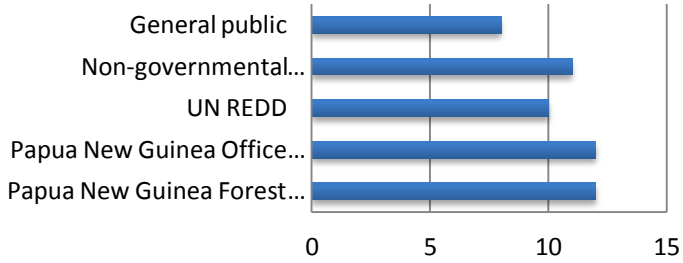
Format	Digital forms	Process
Image	Land tenure	ILG Registration
Text	Forest biomass	REDD
Image	Land use and and cover	Land use planning & REDD
Text	Clan membership	ILG Registration
Image	Video FPIC	REDD
Text	Socio-economic	Land use planning & REDD
Video	Biodiversity	Land use planning & REDD

Data management tasks for the project include maintaining the data collection devices, getting the devices to and from the field, uploading data online, analyzing the information and preparing maps and other summary documents, and conveying resource information to the relevant stakeholders online (national partners) or in person (participating landowner groups). Local partners will also provide training to enable landowner group members to assume as many data management tasks as they are able to absorb over the course of the project (see Community Engagement Strategy and Figure 4).

Access

The project will establish a web-based platform to facilitate the dissemination of data, maps and summary documents. Caution will be exercised with regards to sensitive information. Overall, project partners and other organizations in PNG are willing to share data with PNGFA, OCCD and other stakeholders (Figure 10). There is also a wide spread desire to receive data such as satellite imagery, forest ecosystem services information and socio-economic data (Annex C, Figure 18).

Figure 10: Willingness to share data



During the full-project, local partners will inform participating landowner groups of the potential risks and benefits of sharing data, before members document their consent to share some or all of the data collected. Depending upon the results of the FPIC process, there may be varying levels of access to data (See Figure 6). Whilst local partners will have access to all of the data collected, provincial and national government entities may only have access to land tenure and forest carbon MRV data. Supplementary information gathered for land use planning purposes may not need to be disseminated widely. Efficient data sharing mechanisms need to be developed from national level down. Project partners have indicated that data sharing overseas needs to be carefully discussed and managed during the full-project (i.e. during the design of the data management system).

According to the CFM-REDD questionnaire sent to project partners and other relevant stakeholders, ArcGIS and Excel are the most commonly used software packages for data analysis and data management.

Figure 11: Software used for data analysis

Software	*Use (# of respondents)*
ArcGIS	6
Excel	5
eCognition	1
Map Info	1
Map Source	1
MARXAN	1
PNGRIS	1

The data generated by this project will be disseminated in kml and xls formats compatible with the preferred software. However, data management capacity building for landowner groups will focus on Google Earth, free open source software for visualizing spatial information. After downloading background imagery, Google Earth can be used on- or off-line to make basic maps. Google Earth software is relatively easy to learn and it has been used (in conjunction with Open Data Kit) for participatory GIS in other parts of the world. More complex software such as Excel and ArcGIS can incorporated into training as and when needed.

Verification for REDD MRV

For quality control and capacity building purposes, it is recommended that PNGFA verify a certain portion (e.g.10%) of the data collected by communities for forest carbon accounting purposes. Through verifying data, PNGFA will be able to identify potential methodological discrepancies or errors that could comprise the data. This verification process will facilitate community integration with PNGFA's ground-based forest biomass survey and remote sensing-based forest monitoring initiative.

Reporting

After periodically verifying forest carbon data, PNGFA can make approved datasets available to the Office of Climate Change and Development for international reporting purposes. The PNGFA could potentially use the data to attract investors to support REDD projects with participating landowner groups, particularly those that have completed land tenure mapping and ILG registration, with prior agreement from project partners and other data management system users.

6. Conclusions

PNG's *Forestry and Climate Change Policy Framework for Action* emphasizes the need for a multi-stakeholder approach to CFM (including PES and REDD) that engages customary landowners at the local level and enhances the capacity of government institutions at the national level. PNG's indigenous forest communities posses a wealth knowledge about the quality of their forests, but most have historically been excluded from forest resource assessment activities, forest management decision-making processes, and associated development opportunities such as PES and REDD.

This ITTO funded pre-project has used a thoroughly participatory approach to fully understand these challenges and to develop a strategy that address them. The full-project will extend this collaborative planning process to participating landowner groups to develop a model community-based land ownership mapping and forest resource assessment system that supports CFM (including PES and REDD) schemes in PNG. Through participatory GIS, two-way communication and broad information dissemination, PNGFA, its project partners and pilot landowner groups will set a new standard for improved forest management, land use decision making. The strengths of this model will inform future CFM policy developments in PNG.

7. References

CLRC. 2009. *Recent changes to the law on incorporated land groups and voluntary customary land registration: information booklet.* Constitutional Law Reform Commission, Port Moresby.

Dam, P., & Trines, E. (2011). *Can Carbon Compete with the Loggers in Papua New Guinea?* Community Forest Monitoring for the Carbon Market: Opportunities Under REDD, 158.

DFID. 1999. *Sustainable Livelihoods Guidance Sheets*. Department for International Development: London, United Kingdom.

Filer and Wood 2012. *The creation and dissolution of private property in forest carbon: a case study from Papua New Guinea.* Human Ecology, 40(5), 665-677.

INA. 2011. *REDD and forest land use in PNG: overview report on the INA/IGES Workshop on REDD and Forest Land Use and Issues arising.* Institute for National Affairs, *Port Moresby.*

Larrazábal, A., McCall, M. K., Mwampamba, T. H., & Skutsch, M. (2012). *The role of community carbon monitoring for REDD+: a review of experiences.* Current Opinion on Environmental Sustainability, 4(6), 707-716.

McCall, M. (2011). *Local Participation in Mapping, Measuring and Monitoring for Community Carbon Forestry.* Community Forest Monitoring for the Carbon Market: Opportunities Under REDD, 31.

Shearman, P. L., Bryan, J. E., Ash, J., Hunnam, P., Mackey, B., & Lokes, B. (2008). *The state of the forests of Papua New Guinea.* University of Papua New Guinea Press, Port Moresby.

Skutsch, M., Torres, A., Mwampamba, T., Ghilardi. A. and Herold, M. 2011. *Dealing with locally-driven degradation; a quick start option under REDD+.* Carbon Balance Management 6:16.

8. Annex A: Annotated Bibliography

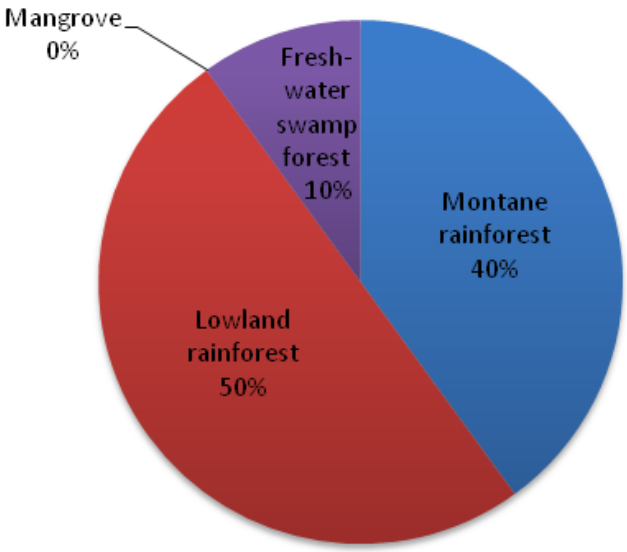
Attached separately

9. Annex B: Organization Review

Attached separately

10. Annex C: Overview of CFM-REDD Questionnaire Results

Figure 12: Forest types included in project areas

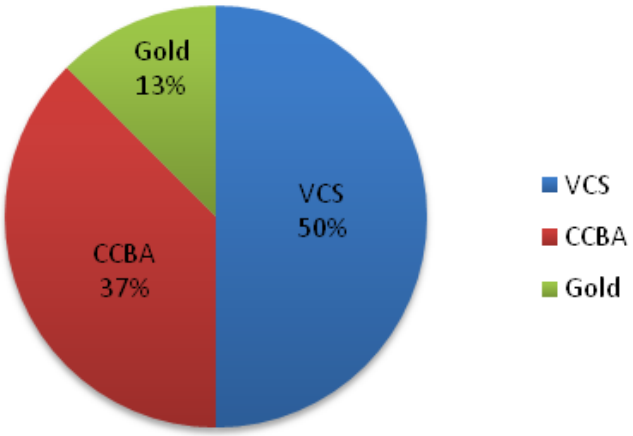


Project partners are mostly working in lowland and montane rainforest environments. Freshwater swamp forest is also represented.

WCS also works on rehabilitating/protecting mangroves in Manus and New Ireland Provinces (i.e. outside their selected project area) Although mangroves are not targeting for large-scale timber production, they are exploited for fuel wood and local timber needs in some parts of PNG.

N = 5. This question was only included in the web-form.

Figure 13: Intended certification scheme of REDD projects



N = 5. This question was included in all of the forms, but only 5 respondents indicated an intended certification scheme.

Figure 14: Programmatic scope of stakeholder organizations

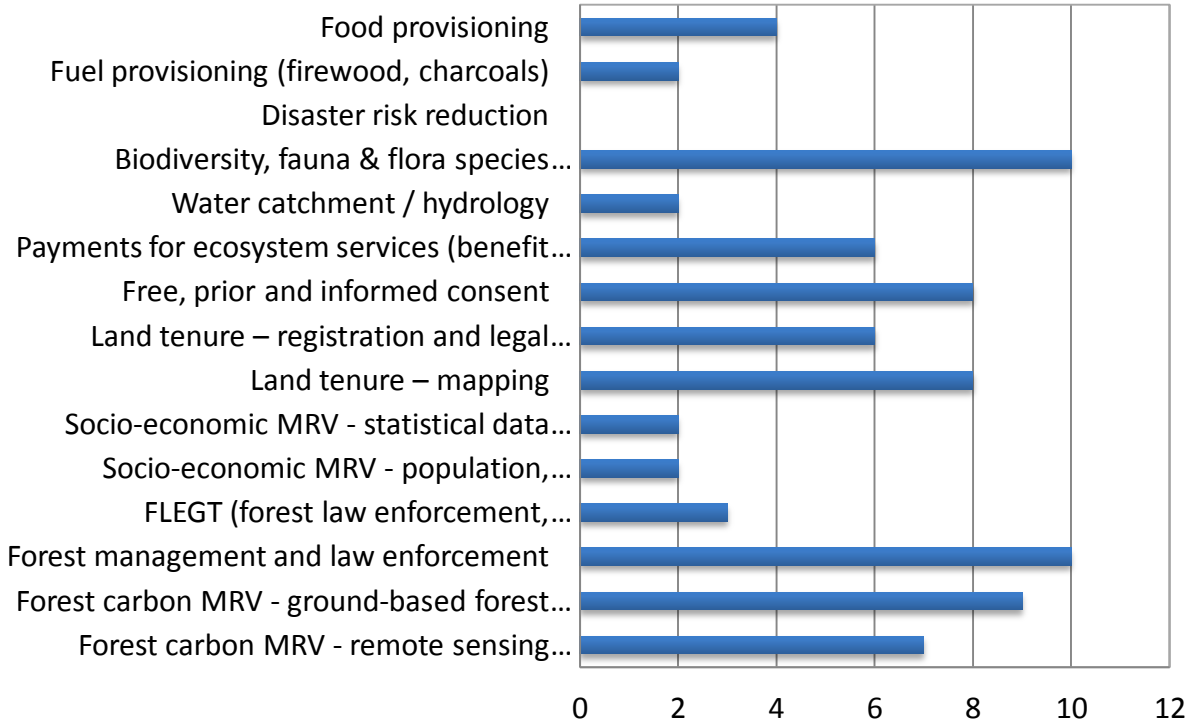
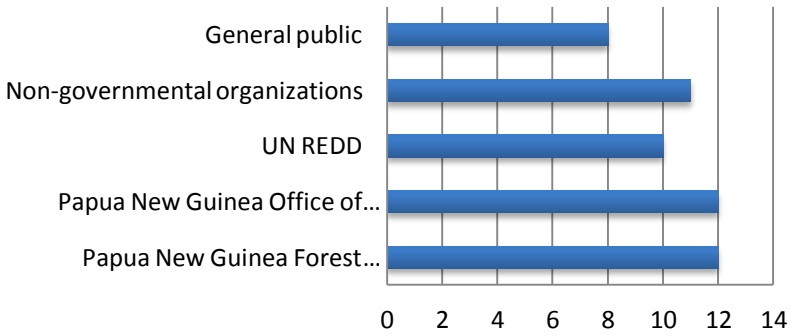


Figure 15: Software used for data analysis

Software	*Use (# of respondents)*
ArcGIS	6
Excel	5
eCognition	1
Map Info	1
Map Source	1
MARXAN	1
PNGRIS	1

Figure 16: Willingness to share data



Almost all organizations surveyed are willing to share data with government entities and non-governmental organizations. Fewer organizations are willing to share data with the general public.

Figure 17: Interest in receiving data from other organizations

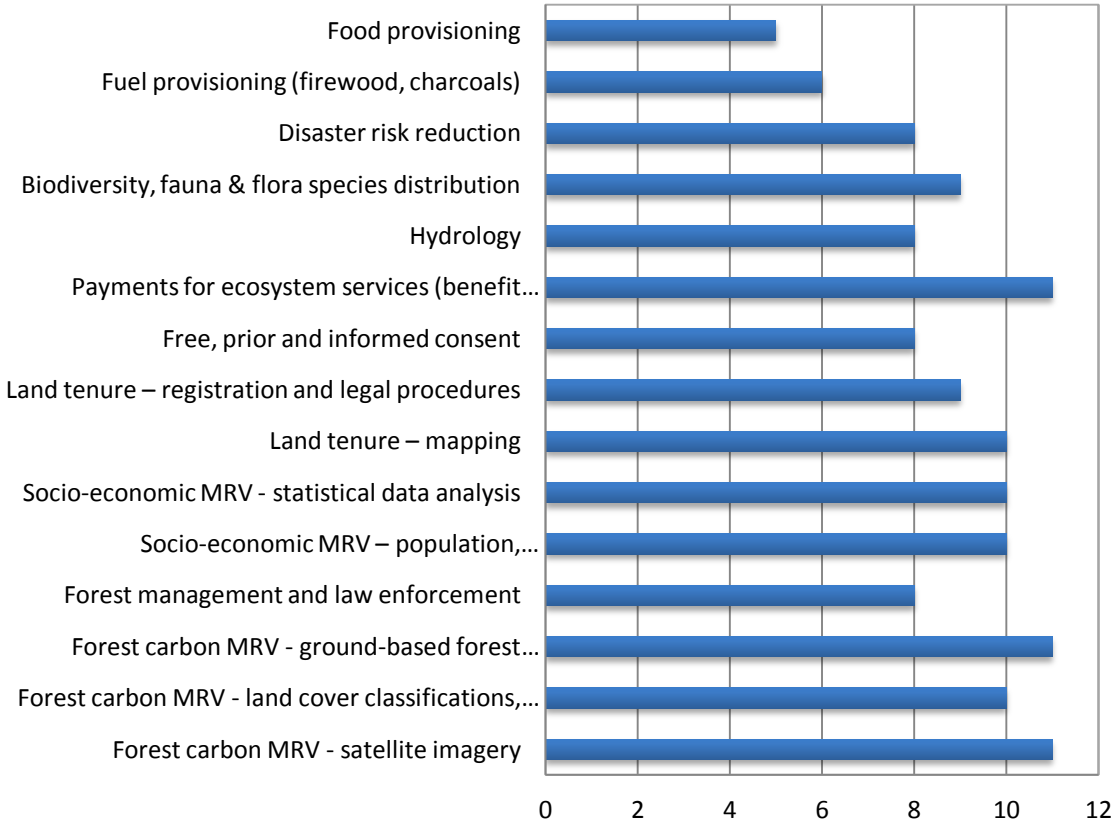


Figure 18: Preferred data formats