COMMUNITY BASED FOREST BIOMASS MONITORING

TRAINING OF TRAINERS MANUAL

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TRAINING OF TRAINERS MANUAL

The Institute for Global Environmental Strategies (IGES) is an independent think tank and strategic policy research institute that focuses on the development – environment nexus. Through policy research, capacity building, networking and outreach, IGES aims to contribute to sustainable development solutions in the Asia-Pacific region and globally.

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FOREWORD

In many countries governments have put in place legislation and support programmes to facilitate the participation of local communities in forest management. About 30 per cent of the forests in developing countries are now thought to be owned or designated for use by indigenous peoples and communities.

As many communities are harvesting timber and non-timber forest products from their forests, the assessment and monitoring of values in these forests is needed to ensure their harvesting is fully sustainable. If an appropriate monitoring design is created and the capacity of communities on this design is built, then the communities themselves can do the necessary monitoring. This also applies to REDD+ (Reducing Emissions from Deforestation and forest Degradation and enhancing forest carbon stocks). Communities can be engaged in the measurement and monitoring of forest carbon stocks by generating data on commercial timber volumes and through additional measurements on significant non-tree carbon pools. Community monitoring could also extend to biodiversity and other forest values, and would make sense when the conservation and enhancement of these values is linked to payments for ecosystems services.

With this general understanding, the Institute for Global Environmental Strategies (IGES), together with some of our key partners and local communities, launched an action research project in five countries – Papua New Guinea, Cambodia, Indonesia, Lao PDR and Viet Nam – beginning in 2010, to develop and test approaches to engage local communities in forest biomass monitoring. One of the products of this project is this trainer of trainers' manual on community-based forest biomass monitoring. The manual aims to build the capacity of facilitators to support communities in designing and implementing forest biomass monitoring systems. The manual reflects knowledge acquired during the action research, published guidance on technical aspects of forest assessments, as well as best practice in community facilitation.

I anticipate that this manual will be useful for organisations interested in incorporating monitoring into community-based forest management systems to ensure they are fully sustainable and generate maximum benefits for the communities, and for organisations interested in supporting community involvement in the monitoring of forest biomass and other forest values in and outside community forests.

I would like to congratulate the authors and key IGES partners for seeing this manual through to its completion. Further editions of the manual can be expected as our knowledge on how communities can best be engaged in monitoring forest values grows over time.

Hideyuki Mori
IGES President
March 2014

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ACRONYMS

ACR	American Carbon Registry
AFOLU	Agriculture, Forestry and Other Land Use
CAR	Climate Action Reserve
CBD	Convention on Biological Diversity
CBFBM	Community Based Forest Biomass Monitoring
CBPF	Community-based Production Forestry
CCB Standards	Climate, Community and Biodiversity Standards
CCBA	Climate, Community & Biodiversity Alliance
CDM	Clean Development Mechanism
CO_2	carbon dioxide
COP	(UNFCCC) Conference of the Parties
CSR	corporate social responsibility
DANIDA	Danish International Development Agency
DBH	diameter at breast height
DKN	National Forestry Council of Indonesia
FPCD	Foundation for People and Community Development
FPIC	free prior informed consent
FSC	Forest Stewardship Council
GHG	greenhouse gas
GIS	Global Information System
GPS	Global Positioning System
ha	hectares
IGES	Institute for Global Environmental Strategies
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
LEI	Indonesian Ecolabeling Institute
NGO	non-governmental organisation
QA	quality assurance
QC	quality control
P3DM	participatory three dimensional models
PNG	Papua New Guinea
POM	point of measure
PSP	permanent sample plot
RECOFTC	The Centre for People and Forests
REDD+	Reducing Emissions from Deforestation and Forest Degradation, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks
RS	remote sensing
SD	standard deviation
SE	standard error
ToT	Training-of-Trainers
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard

This section provides a practical overview of how the manual can be used by a trainer and introduces the concept, rationale and approach to CBFBM.

INTRODUCING THE MANUAL

INTRODUCING THE MANUAL

WHAT IS COMMUNITY BASED FOREST BIOMASS MONITORING AND WHY IS IT RELEVANT?

Community Based Forest Biomass Monitoring (CBFBM) is the monitoring of forest biomass by communities. It is a form of monitoring that ultimately aims to be "driven" and "owned" by the local communities and "guided" and "facilitated" by outside experts. The information that is generated from the monitoring aids the communities in making wise decisions about their forest management. CBFBM could also provide information for district, provincial and national level forest monitoring systems. Community involvement in forest monitoring particularly makes good sense when the communities themselves are forest managers. Through the generation of scientifically verifiable data, communities can explore various forest management options and will be better informed in their internal discussions and in dealings with outsiders.

Communities who for many generations have relied upon forests for part of their subsistence, cultural, financial and other needs, self-regulate their use of forest resources and, to do so, are constantly assessing and monitoring them. They observe who enters their forests and for what purposes, even if they are not always able to control this. The concept of forest monitoring is thus not something new to these communities. It is part of their traditional systems of knowledge generation.

Scientific studies of forest resources may use sophisticated equipment and are conventionally conducted by people with a high level of formal education. In these studies, local people, at most, may be assigned menial roles in assisting with the logistics of field work, e.g. providing food, cutting paths and carrying equipment. However, with adequate training and follow-up support, communities can take and record accurate forest measurements. Communities can also contribute to land use mapping by using their local knowledge to interpret features in remotely sensed images and by participating in ground-truthing for the validation of land use maps.

CBFBM is a particularly timely concept as Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed that developing countries could receive payments for their efforts to protect and enhance forest carbon stocks. This concept is known as REDD+ and could present opportunities for communities to receive payments for undertaking management activities to protect and/or enhance the carbon stocks in their forests. CBFBM would provide a strong framework for providing accurate assessment and monitoring of forest carbon stocks, which is required for REDD+ payments.

CBFBM should be understood as one of a group of approaches that support community-based monitoring of natural resources and ecosystems services. The Global Workshop on Community-Based Monitoring and Information Systems, held on 26-28 April 2013 in Bonn, Germany, noted that governments and international bodies have begun to recognise the importance both of indigenous peoples' traditional knowledge and of the information generated through community-based monitoring. The workshop concluded that international agreements whose implementation could benefit from community monitoring include the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), the Convention on Biological Diversity (CBD) and the UNFCCC.

WHAT DOES THE MANUAL PROVIDE?
Not every CBFBM system will be the same. Each must be based on clear objectives defined by communities themselves as well as the context (e.g. community institutions and forest conditions). The CBFBM process shared through this manual highlights the strengths of using a locally-driven action research approach to the design, testing and training of each CBFBM system with local level facilitators and communities.

Through the experience of the Institute for Global Environmental Strategies (IGES) and its partners in developing and testing approaches to CBFBM in five countries in Asia and the Pacific since 2010, it has been discovered that designing the most appropriate and relevant monitoring system requires local level knowledge and insights generated from testing and adapting the initial CBFBM design with communities. It is therefore not the trainer using this manual who will design the monitoring system but local level facilitators through testing and adaptation with the communities. This manual primarily provides process guidance on how to do that building on the experience of local context, adaptive testing and clear objectives of the community for their monitoring system.

As Figure 1.1 indicates, the manual guides the training-of-trainers to build the capacity of the local level facilitators on selecting, testing and adapting the technical parameters and measurement methods for the forest monitoring, and on how to design an effective field training and practice effective facilitation skills that are essential for any participatory methodology with local communities.

Figure 1.1. Basic concept for effective facilitation of community-based forest monitoring

WHO IS THIS MANUAL FOR?
Ultimately this manual is about building capacity of local communities to monitor their own resources. However it has been designed for use by individuals and teams from external agencies who have had requests from the local level to assist with forest monitoring through local level facilitators.

This manual is thus for external technical practitioners, forest assessment experts, researchers, and trainers who would like to train local level facilitators in establishing CBFBM at the community level (Fig. 1.2). It is often the case that outside agencies will not be in a position to train local communities directly, and so training local level facilitators in an action research role can build sustainable capacity at the most appropriate level.

The manual assumes the following basic foundation knowledge and skills of the trainer who will train the local level facilitators. To become a trainer, you should have:

- Good knowledge and practical experience of forest inventory and management
- Basic knowledge of the current climate change and REDD+ discourse

Figure 1.2. Who the manual is for

- Practical experience in working with communities preferably in the context where communities themselves are managing the forest resource
- Basic knowledge of adult learning principles and participatory facilitation skills

This implies that without good knowledge of forest assessment and inventory and experience of community forestry, other resources may need to be consulted or other expertise brought into the training team. This manual will enable a trainer with the above skills and knowledge to help others to adapt and test their own experience and knowledge to make it appropriate to design and test a CBFBM system that can be used by communities based on their demands and purposes.

WHO CAN THIS MANUAL BE USED WITH?

This manual can be used by external trainers for training groups of field facilitators or forest practitioners at the local level (Fig. 1.3). It is assumed that once local level practitioners have been trained in designing and testing an appropriate CBFBM system and have practiced training communities using appropriate methods, they will then be able to continue by themselves in developing CBFBM systems with other communities who are also interested. All the materials have been written in such a way that assumes that the training to be conducted is at the level of training facilitators, not communities directly. However, if you are a local level practitioner who has received requests from communities to establish a CBFBM system, some of the materials and tips if selected appropriately could be useful for you.

Figure 1.3. Who the manual is to be used with

INTRODUCING THE CBFBM PROCESS

The CBFBM process that is the focus of this manual includes several key elements and different levels of process design (Fig. 1.4). It is critical that you are familiar with these before using the manual.

The key elements and steps of the CBFBM development process are as follows and within specific steps there may be one or more activities depending on the final design.

- Element 1 (E1): Feasibility assessment and stakeholder engagement
- Element 2 (E2): Agreeing on the objectives, technical parameters and building a community based forest biomass monitoring design
- Element 3 (E3): Designing and delivering community level training whilst testing the forest biomass assessment design
- Element 4 (E4): Reflecting on the testing, and adapting the design of the forest biomass assessment and the community training
- Element 5 (E5): Agreeing on next steps

The key elements show that the design of a CBFBM system includes feasibility assessment of CBFBM in the initial phases, design and testing of both a biomass monitoring system and a programme to train communities on the monitoring, reflection and adaptation as lessons are learned, and agreement with communities on next steps. Once the CBFBM system has been designed, tested and adapted as necessary, it can be fully rolled out, the data analysed, and the knowledge generated integrated into forest management decision-making processes.

Figure 1.4. Key elements and steps of the CBFBM development process

In some cases, some aspects of the biomass monitoring may already be decided, e.g. it may have been decided that the monitoring will incorporate national guidelines for forest inventory. Nevertheless, the CBFBM designers may have some scope to innovate and simplify the methods.

The process of designing a CBFBM system is an action research process in which local level facilitators work together with local communities in designing, testing, reflecting on and adapting a system that aims to assist the communities in managing their forests wisely (Fig. 1.5). Action research involves cycles of planning, action, observation and reflection, with one cycle leading into another. Key Elements 1 through to 5 can be considered the first cycle of action research. After reaching Element 5: Agreeing on Next Steps, the local level facilitators and communities embark on a second cycle of action research, e.g. full roll-out of the CBFBM system, and this will be followed by further cycles, e.g. decision to protect or enhance forest carbon stocks, etc.

Figure 1.5. Action research process

TRAINING-OF-TRAINERS OUTPUTS

It is important for the external expert or trainer using this manual to envisage that by the end of their training the local level facilitators who attend will have a number of outputs to proceed with. The outputs will depend on the training scenario. These will be produced as far as possible during the learning process that is guided by this manual, and may take the form of design tables and notes that are completed by the participants after the training. The outputs could include:

- A clear, justified and tested forest biomass assessment and monitoring design including a quality control plan and

adapted measurement methodologies. This will be in a simple tabular form that will be built up during the training and field-testing process. In theory this could be used and/or adapted by the local level facilitators in different sites.

■ A community-training design and a set of training notes. These will be appropriate for the context and based on the testing of teaching methods for the CBFBM proposed by the local level facilitators.

■ A field manual or guide on forest monitoring for future community use.

HOW TO USE THE MANUAL?

The manual is divided into four key learning blocks that integrate the key elements and levels of the CBFBM process. The annexes of the manual provide a supporting function and aim to improve the effectiveness of how the trainer can use the materials.

The manual uses the following terminology throughout:

■ Trainer: used primarily to refer to the user of this manual or individuals who will be training a group of locally experienced facilitators to establish and set up CBFBM with communities.

■ Local level facilitator: in practice, the primary target learners and participants from these materials. They will perform facilitation and training roles with communities that agree to apply CBFBM. In this manual, the term local level facilitators is used interchangeably with participants.

■ Community members: the ultimate beneficiaries of the manual are the community members who will be trained by the local level facilitators.

Every learning block section of this manual provides a selection of training session plans and hand-outs for reference by the trainer. Each session plan sets out clear learning objectives, a learning process and timeframe for each session. Sessions have been framed and divided to gradually build up participants' knowledge and skills step by step using reflection and experience as a basis for learning. Some session plans include guidance for specific learning exercises and/or case studies. These are positioned immediately behind the session before the hand-out. The hand-outs can be copied and distributed to participants when you feel this will be useful. Hand-outs may need to be translated into the local language.

Training of community level facilitators, Seima, Cambodia

Actual design of the training-of-trainers will not follow the order in which the sessions are presented in the manual, and there are too many sessions in this manual to cover them all in a single training-of-trainers. You can select a number of sessions from this manual and combine them in different ways for participants. Examples of different training design scenarios are given in Annex 1: Training scenarios.

Learning Block Three is unique in structure as it has a specific set of materials behind the session plans that explain the technical protocol of specific forest assessment tools and methods.

These are to help you ensure that the minimum technical protocol is achieved and the scientific rigour of the methodology is maintained. Learning Block Three also offers community training tips that the local level facilitators can adapt. Careful integration of Learning Block Three and Learning Block Four to link the sessions on technical protocols with sessions on designing and testing of the community trainings on these protocols is suggested.

Being familiar with the Elements of CBFBM and the structure of these materials will assist you as a trainer in designing and delivering your own training. An overview of the structure and the four learning blocks is given below.

Table 1.1. Manual structure and the four learning blocks

SECTION	OVERVIEW
Introducing the Manual	This section provides a practical overview of how the manual can be used by a trainer and introduces the concept, rationale and approach to CBFBM.
Preparing for Your Training	This section provides advice on criteria to select participants and how to increase the effectiveness of your training.
Learning Block One: Basic Fundamentals of CBFBM	This section addresses the current context, fundamental principles and justifications for a CBFBM approach. It integrates key concepts and practical implications with examples so trainers have the foundation knowledge on CBFBM to train others. This section provides choices to trainers; depending on the background of their participants it may not be necessary to include all sessions in this section if the group already has strong foundation knowledge.
Learning Block Two: Feasibility and Stakeholder Engagement for CBFBM	This section focuses on the importance of engaging and understanding all stakeholders at different stages in the CBFBM process including as part of a feasibility assessment. It includes a session on Free Prior Informed Consent from communities engaged in CBFBM as a key social safeguard. This section captures key knowledge and skills linked with Element 1 of CBFBM and steps 1-4 of the CBFBM process.
Learning Block Three: Technical Tool Box: Design and adapt an appropriate forest biomass assessment and monitoring framework (including technical community training tips)	This section includes sessions and materials that are the core to the training. It provides an overview framework for setting objectives and quality assessment and control, and guides the step-by-step development of a tabular format design by the participants for detailing the forest biomass assessment and monitoring framework that will be used. This table will include any changes to measurement methods and tools made on the basis of experience from the testing process. It includes basic session plans to facilitate the reflection of participants in translating their own technical knowledge into simple procedures and tools for use by a community based on specific objectives and scientific standards. This section also provides community training tips linked to each technical protocol. These can be used most effectively as part of the technical sessions where, after each session, the participants consider and record how they would train communities as part of their CBFBM design table format. This section refers to key steps and knowledge required for Element 2 of CBFBM and steps 5-10 of the CBFBM process but of course includes aspects of Element 3 in terms of technical training tips.
Learning Block Four: Design CBFBM Community Training	This section provides a range of core and optional sessions depending on the previous experience and existing capacities of the participants in your training and the time available. The core sessions focus on the design of an effective community training that will relate to the design of the forest assessment and monitoring framework. This section also includes other optional sessions that are central to being an effective local level facilitator in CBFBM. They focus on providing a conceptual basis to adult learning and linking the need for facilitation skills with the participatory values central to the success of CBFBM. This section refers to Element 3 and testing the overall forest assessment and training process with communities.
Annexes	This section provides supporting materials and guidelines including examples of training design scenarios that can be adapted by trainers using this manual.

This section provides advice on criteria to select participants and how to increase the effectiveness of your training.

PREPARING FOR YOUR TRAINING

PREPARING FOR YOUR TRAINING

HOW TO ADAPT THE TRAINING TO DIFFERENT GROUPS AND SETTINGS

CBFBM training of trainers, Vietnam Forestry University

To some extent these training materials can be adapted for purpose and target group. Primarily the materials have been designed for use with local level facilitators over a one to two week period including a session of community training at a specific site. However, the same materials could be used to design a half-day training on the value and role of CBFBM in forest management or a one year learning process that documents field learning and use of the monitoring system by a local community. Some specific training scenarios are provided in Annex 1: Training scenarios.

BUILDING COMPETENT LOCAL CBFBM FACILITATION TEAMS
It is critical that there is some experience of technical forestry assessment and management among the participants of your training. It will not be possible to take local level facilitators with no background in forestry and build their competence in CBFBM through the use of this manual. Key areas of competence for participants include:

- basic experience of forest assessment and inventory
- local knowledge of forest type and dynamics
- some experience in working with local communities

It may be challenging to find participants who are both competent with technical forest assessments and community facilitation. If selecting participants who fulfil all the experience criteria is difficult, you can select individuals with specific competencies and combine them as a team. The most important factor is to ensure that all the competencies are present at a team level and that the local facilitation team performs, reflects and learns well together and as one unit when interacting with the community.

SELECTING THE LOCATION FOR THE CBFBM TRAINING
The most effective way for people to learn how to design, test and train communities in CBFBM is through them actually designing a system, then testing some of their proposed measurement methods and training ideas with a local community, and reflecting on the experience. This has implications for how you design and locate the training. The training commonly takes place in two distinct locations: a

classroom and a field site. In a classroom environment, you will conduct the training you have designed from this manual for the local level facilitators. During this training, the facilitators will develop their CBFBM design and the methods for teaching the communities on this design. They will then test some of their proposed measurement methods and training ideas with a local community. You will accompany the participants and observe the testing, then later you will guide the participants in reflecting on their testing and on making any changes to the design that they feel are necessary.

The testing with a community should have been prepared before the training starts. Ideally, this community will be one of the communities participating in the CBFBM, so a feasibility assessment with the community should have been conducted and Free, Prior, Informed Consent principles followed when the community agreed to participate in the CBFBM (see Sessions 2a Conducting Feasibility Assessment for CBFBM and 2d Free Prior Informed Consent and Social Safeguards for CBFBM). The following criteria should be considered when deciding the location for the testing:

- Distance and accessibility to forest from village or classroom facility
- Availability of communities to participate in field training sessions
- Other criteria relating to specific contexts or conditions

Further guidance on selecting an appropriate location and other aspects of preparing the field testing is provided in 4g Why and how to test your initial CBFBM design. If the testing is to be conducted in a location where there may be some risks to the local level facilitators and community members, note should be taken of the guidance in Annex 3: Field safety.

MATERIALS
The session plans in the Learning Blocks list the materials that you will need for each session.

This section addresses the current context, fundamental principles and justifications for a CBFBM approach. It integrates key concepts and practical implications with examples so trainers have the foundation knowledge on CBFBM to train others. This section provides choices to trainers; depending on the background of their participants it may not be necessary to include all sessions in this section if the group already has strong foundation knowledge.

LEARNING BLOCK 1

FUNDAMENTALS OF COMMUNITY BASED FOREST BIOMASS MONITORING (CBFBM)

1A   SESSION: WHAT IS CBFBM?

LEARNING OBJECTIVES:

By the end of the session, participants

- have reflected on and shared their own experiences and assumptions about forest monitoring with communities
- have identified the differences between professional forest monitoring and CBFBM
- can explain the key characteristics of CBFBM in different contexts

MATERIALS:

copies of case studies; copies of hand-out or meta cards with Table 1A-1 headings (optional); flip chart or whiteboard and markers

TIME:

90 minutes

STEPS:

1. Explain that in this session, participants are going to learn about the concept of CBFBM, and that this concept may require them to challenge some of their assumptions about how forest monitoring should be conducted.
2. Ask the participants how they define CBFBM and what they think is the basic difference between professional forest monitoring and community-based forest biomass monitoring. Write down their answers on a flip chart but do not discuss them at length. Explain you will come back to them later.
3. Break the participants up into groups of 4-5 people and give them one of the case studies on "CBFBM in practice". Give the groups 25 minutes to read through and discuss their case study. Explain that there are 3 questions listed at the end of the case studies for them to answer, and that they should write their answers briefly on flip charts or cards.
4. Ask the groups to report back their answers.
5. Reflect on this exercise using the following questions:
    - *What characteristics were the same between the two case studies and why?*
    - *Which characteristics were different and why?*
    - *Based on these case studies, what are the key characteristics of a CBFBM system and how would they change in different contexts?*
6. Using the table format (Table 1A-1) in the hand-out, present the key differences between professional forest monitoring and CBFBM using the meta-cards you have prepared earlier. Build up your explanation in the form of a large two-column table that you can keep on the wall throughout the training for visual reference. Relate back to the characteristics of CBFBM identified by the participants and the flip charts from Step 2.
7. Ask the participants "What are some of the key assumptions often made about communities in relation to their capacity for forest monitoring?" Give participants a chance to share their different assumptions (inconsistent, inaccurate, too technical, unfamiliar with equipment, illiterate, etc.).
8. Illustrate the success of CBFBM by sharing the results of the example from Table 1A-2 in the hand-out.
9. Explain that building community teams to undertake forest monitoring requires skilled trainers. Ask the group to sit in pairs and brainstorm what specific skills they think they have from their previous experiences that may assist them when training community teams in CBFBM. Ask each pair to share their ideas with the group.
10. Collate the answers so you have a list of key skills on a flip chart. Ask them which of the skills they think is the most important and why.
11. Wrap up the session by explaining that local level facilitators must have the necessary knowledge and technical skills for forest biomass sampling as well as expertise to train communities and

build local institutions on forest monitoring. Explain that it is common for some facilitators to be better with the technical side of forest sampling, while others will be better with community engagement. They will be able to recognise these skills in each other. Most importantly, the local level CBFBM facilitators must collectively have all the skills necessary for designing and facilitating implementation of a CBFBM system.

TRAINING TIPS:

Take your time to explain Table 1A-2 carefully as participants with conventional forestry backgrounds may require some convincing that CBFBM can produce accurate and precise forest biomass estimates. At the same time, be careful not to give the impression that the communities can do everything. Explain that professionals continue to have important roles to play, and that quality assurance and quality controls must be built into CBFBM systems.

Be careful not to go into too much detail in this session on roles of experts and communities as this is covered in 1h The Role of Experts and Communities in CBFBM.

| 1A | HAND-OUT: WHAT IS CBFBM? | HAND-OUT |

RECONSIDERING THE ROLES OF COMMUNITIES IN FOREST MONITORING

Scientific studies of forest resources are conducted by people with a high level of formal education. Local people, at most, may be assigned menial roles in assisting with the logistics of field work, e.g. providing food or carrying equipment. Therefore, it can be difficult for conventionally trained scientists to imagine a forest monitoring system in which community teams play important roles by actually taking and recording measurements and other information.

The concept of "monitoring" itself is not something foreign to local communities; monitoring is something communities do as part of their normal day-to-day activities. They monitor the seasons and weather, how their crops perform, who enters their land and how they behave, the flowering of plants, the movement, numbers and condition of wildlife, and much more, and they transfer the knowledge they accumulate amongst themselves and from one generation to the next.

Monitoring by professionals is different from the monitoring that communities do as part of their daily lives however, as it requires monitoring protocols to be precisely described and adhered to, the correct use of carefully calibrated instruments, and careful data recording. Nevertheless, if communities are taught how to use the measurement instruments, the monitoring protocols, and how to record their observations, they can generate scientifically valid data to monitor forest values. Many initiatives can now be found around the world in which local communities conduct forestry inventory and planning under community-based forest management models, as well as participate in biodiversity and biomass assessments.

WHAT IS COMMUNITY-BASED FOREST BIOMASS MONITORING?

Community-based forest biomass monitoring (CBFBM) is the monitoring of forest biomass by communities, with local level facilitators supporting this process. It is a form of monitoring that ultimately aims to be "driven" and "owned" by the local communities and "guided" and "facilitated" by outside experts. The information that is generated from the monitoring is intended to aid the communities in their decisions on forest management options, but a CBFBM system could also provide information for district, provincial, regional or even national level monitoring systems.

Biomass is a general term that refers to the total amount of living material in a given habitat. The term forest biomass is used to refer to the total amount of living and dead above and below ground vegetative forest matter over a specific area, and is usually measured as tonnes of dry matter per hectare.

The monitoring of biomass can be integrated with monitoring on commercial timber volumes, biodiversity, etc. In fact, it is preferable that community-based forest monitoring does not focus solely on biomass as this could place communities at risk through over-reliance on one potential future income stream (i.e. financial payment for REDD+ activities) that may or may not eventuate.

DIFFERENCES BETWEEN FOREST MONITORING BY PROFESSIONALS AND CBFBM

Table 1A-1 lists the major differences between conventional forest monitoring by professionals and CBFBM. CBFBM aims to generate knowledge that the communities themselves can use when deciding on forest management options, whereas professional surveys are normally carried out to produce data for outside organisations. Professional surveys are likely to use some expensive and sophisticated equipment, whereas CBFBM prefers simplified but nevertheless reliable equipment and methods. Ideally the communities will hold all the equipment required for the monitoring and will not have to rely on facilitators to bring this equipment each time forest sampling is conducted.

Professionals (local level facilitators) play important roles in CBFBM. In addition to providing training, they set up the spreadsheets that are used for data processing and assist the communities in understanding the results of the analysis. They may also undertake technical work to improve biomass estimates, e.g. developing diameter-height relationships and allometric equations.

Table 1A-1: Differences between conventional forest monitoring and CBFBM

	CONVENTIONAL FOREST MONITORING BY PROFESSIONALS	CBFBM
Aim	Generates data for research, government departments, companies . . .	Generates data for communities to consider forest management options Can also contribute to district/provincial/ national forest monitoring
Capacity	Already exists	Must be built, but utilises local knowledge and skills
Methods/ Equipment	Sophisticated (e.g. laser distance measuring tools)	Simplified methods and equipment that provide reliable measurements preferred Ideally, equipment is held by the communities
Awareness	Professionals understand the purpose of the monitoring, but it remains largely a mystery to local people	Communities have identified the need and make a choice to develop CBFBM, and have a strong ownership of the system, the process and the results
Participants	Professionals conduct monitoring; local people may be recruited for menial tasks, such as track clearing and carrying equipment	Community monitoring teams are self-organised and competent to generate and record data Facilitators train communities and assist in building and coaching community institutions for forest monitoring Facilitators provide technical inputs, such as setting up spreadsheets for data processing, development of allometric equations, etc.

CAN WE RELY ON CBFBM TO PROVIDE SCIENTIFICALLY VALID MEASUREMENTS?

A number of projects are implementing CBFBM approaches in countries in Africa, Asia, Oceania and the Americas. They report that biomass estimates from the measurements by communities are comparable with those in published literature, and that when communities and scientists have independently measured the same sample plots, there are no significant differences in the results.

Table 1A-2 compares the results of forest biomass estimates from community measurements with those of professionals.

Table 1A-2: Biomass estimates from forest measurements by communities and professionals

PROJECT SITES	FOREST TYPE	ESTIMATES FROM COMMUNITY MEASUREMENTS	ESTIMATES FROM PROFESSIONAL SURVEYS
IGES CBFBM PROJECT*			
Mondulkiri Province, Cambodia	Deciduous forest	75.5 ± 19.6 (SD) tC/ha for rectangular plots 72.2 ± 23 (SD) tC/ha for circular plot	73.8 ± 8.6 (SE)tC/ha (Vathana, 2010) Same forest patch
Yogyakarta & Central Java Provinces, Indonesia	Home gardens	34.2 ± 20.6 (SD) tC/ha	35.3 ± 21.2 (SD) tC/ha (Roshetko, Delaney, Hairiah, & Purnomosidhi, 2002) Different province

PROJECT SITES	FOREST TYPE	ESTIMATES FROM COMMUNITY MEASUREMENTS	ESTIMATES FROM PROFESSIONAL SURVEYS
Madang Province, PNG	Mostly lowland and montane primary moist tropical forest (Hm class)	127.7 ± 40 (SD)tC/ha Biomass estimate for living trees with DBH > 5 cm and lying deadwood (~7% of tree carbon pool)	106.3 ± 22.7 (SD)tC/ha (Fox et al., 2010) Same province and forest type Biomass estimate for living trees with DBH > 10 cm
KYOTO THINK GLOBAL ACT LOCAL PROJECT**			
Dhaili, India	Even aged Oak forest	426.4± 36.6 (SE) tC/ha	453.3± 36.7 (SE) tC/ha
Dhaili, India	Dense oak forest	279.93.4± 40.5 (SE)tC/ha	283.4± 40 (SE) tC/ha
Dhaili, India	Degraded oak	38.1± 3.7 (SE) tC/ha	41.7± 4.6 (SE) tC/ha
Kitulangalo, Tanzania	Savanna woodland (miombo)	42.2± 4.4 (SE) tC/ha	43.2± 1.9 (SE) tC/ha***

Source:*(Scheyvens, 2012); **(Skutsch, Zahabu, Karky, & Danielsen, 2011)
Note: SD = 1 standard deviation; SE = standard error; *** Lower SE due to larger plot size

The estimates in Table 1A-2 are from two projects – the IGES Community-based Forest Biomass Monitoring Project, and the Kyoto Think Global Act Local Project. Both projects report that there are no statistically significant differences in the estimates from the community and professional measurements. The variance in the mean carbon stock estimates, reported either as one standard deviation (SD) or the standard error (SE), are also mostly similar for the community and professional measurements. There is thus no indication that the communities are less consistent with their measurements than professionals.

In another study, in Papua New Guinea 80 sample plots were measured by four communities and then re-measured by scientists. The communities received three days training and used compasses, tree diameter tapes, clinometers and survey tapes to set up and measure the plots. Figure 1A-1 presents some of the carbon stock estimates from the measurements by the

Figure 1A-1. Forest biomass estimates derived from measurements by communities and scientists, Huon Peninsula, PNG

Source: (Venter, 2013).

communities and the scientists of the same sample plots. The study concluded that the communities produced accurate biomass inventory data, as can be seen by comparing the heights of the orange and red bars in Figure 1A-1. One community missed one large tree in one plot and the communities tended to under-estimate the height of large trees, but the scientists conclude that the errors could be addressed by improving the quality of the training. It is important to note that even professional foresters make mistakes when measuring and recording data during inventory work, and that these mistakes are sometimes found when "cleaning" data sets (e.g. see Fox et al., 2010).

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1A | CASE STUDIES: CBFBM IN PRACTICE

1. CBFBM IN MADANG PROVINCE, PAPUA NEW GUINEA

Approximately 60% of Papua New Guinea (PNG) is covered by natural forests, making it one of the most significant areas of largely intact tropical forest in the world. 97% of the land, including the forests on it, is owned by communities (not the government) who live adjacent to the forests. Even when their customary ownership is not legally registered, it is recognised by the Constitution. Forest ownership is handed down from one generation to the next, either along patrilineal or matrilineal lines, i.e. from father to sons, or mother to daughters. The area of forest held by a community is determined by its customary claims and its informal agreements with its neighbouring communities.

Figure 1A-2. Papua New Guinea location map

The customary forest owners are interested in earning an income from their forest resources. While they are mostly able to provide for their subsistence needs through shifting agriculture, hunting and gathering, fishing, etc., they require cash to pay for school fees, transportation and medical expenses, and to purchase some basic commodities. However, their capacity to derive income from their forests is limited mostly to the sale of some non-timber forest products. There is thus a temptation for communities to hand over the rights to their forest to logging companies or agricultural developers in return for royalty payments. These models of forest and land development do not build community capacity and institutions, and have mostly been found to be unsustainable.

The Foundation for People and Community Development (FPCD) was established as a national non-governmental organisation with the vision of "improved livelihoods and greater self-reliance for Papua New Guineans through community development initiatives and sustainable resource use including Forest Stewardship Council (FSC) certified forestry." FPCD has been assisting communities in Madang Province through capacity building programmes on forest resource assessment, forest boundary mapping, land-use planning, land group registration, forest management planning, timber harvesting and milling, marketing and business management.

The communities supported by FPCD hold between 270 and 6,300 hectares of land, most of which is forested. Most of the forest is low altitude pristine natural tropical rainforest, though some has been disturbed by human activities, e.g. shifting cultivation and, to a lesser extent, commercial logging, and by natural events such as storms. The forests have high species diversity, making estimation of biomass challenging, but local people are able to identify many species using local tree names.

The Japan-based Institute for Global Environmental Strategies (IGES) conducted a training of trainers on CBFBM for the FPCD foresters (the local level facilitators). Through this training, the local level facilitators designed and tested a CBFBM system that would provide data to estimate and monitor both commercial timber volumes and forest biomass. Information on commercial timber volumes is important to ensure that the communities harvest their forests at sustainable levels, while the information on forest biomass will be combined with a study of land use change to assess whether REDD+ could be another viable forest management option for the communities. In this way, the communities can continue to earn income by selling some of the timber they harvest, and ideally they could at the same time receive REDD+ payments for maintaining high carbon stocks in their forests.

The local level facilitators requested each of the participating communities to select about 8-10 of their members for the forest monitoring training. The trainings were conducted separately with each community. The training programme runs over three days. Day 1 is spent in and around the villages and involves training on (i) the purpose and principles of forest monitoring, (ii) the monitoring variables, methods and equipment, (iii) data recording, and (iv) team management. Days 2 and 3 are spent in the forest, where the trainers guide the teams in locating, setting up, measuring and recording data from permanent sample plots (PSPs).

Climbing tree buttresses to correctly measure DBH

Local level facilitators discuss satellite images and land cover map with the Gnait clan

The community forest monitoring teams are trained on how to locate and set out nested square plots; tree marking and tagging; and on the use of handheld GPS devices, compasses, distance measurement tapes, diameter (DBH) tapes and clinometers. The community teams also measure lying dead wood and, together with the tree measurements, this data is used to monitor commercial timber volumes and forest biomass. The local level facilitators found that other carbon pools, such as standing dead wood and soil organic matter, were not significant and therefore these were excluded from the monitoring.

The community-based forest monitoring teams record tree species in their local languages, and also record site conditions, such as altitude, slope, aspect and disturbance (natural and human causes), which helps in understanding the spatial variations in biomass that are observed. In addition to the forest measurements, the communities also participate in the interpretation of features in satellite images (using their local knowledge of land cover and use) and in ground surveys to validate the maps created from these images.

CASE STUDY QUESTIONS

1. What was the main purpose of using CBFBM in this case study?
2. What were the contextual factors that made CBFBM an appropriate methodology in this case?
3. How did the data collected relate to the purpose of the CBFBM and what are the implications for other sites?

CASE STUDY

2. CBFBM IN SEMOYO AND TERONG VILLAGES, YOGYAKARTA, INDONESIA

In the first half of the 20th century the region of Central Java, Indonesia went through a period of heavy deforestation and much of the area became bare land. In the 1970s the government launched a reforestation and afforestation programme. Local communities were able to turn much of the degraded land into agroforestry systems. Vegetation has been re-established in the form of home gardens and estate crop plantations.

Figure 1A-3. Yogyakarta location map

Semoyo and Terong villages are located in the regencies of Gunung Kidul and Bantul, respectively, on the island of Java. In these regencies more than 60% of the land is used for agriculture and agroforestry for both subsistence and cash generation.

Land use management in the villages takes place within a traditional Javanese institution (*wonodusun*) in which a unit of land is managed for multiple purposes including agriculture, animal husbandry and forestry. *Wonodusun* is practiced in lands classified by the government as people's forests. People's forests are usually privately titled in the name of the household heads. These land units contain wood and fruit trees, seasonal crops, spices, fodder and a variety of other vegetation.

Planted trees can be found as both woodlots on dry land, which are normally located at a distance from the houses, and in home gardens, which are normally found around the houses. Home gardens play a significant role in a household's economy as they provide fruits, coffee, fodder and medicinal plants. The variety of crops contributes to a relatively stable income. When the price of one product drops, villagers have others to sell to compensate.

Forests managed by communities are dominated by albicia (*Paraserianthes falcataria*), mahogany (*Swieteniam acrophylla*) and teak (*Tectona grandis*). Community forestry is a fundamental element of the local economy, providing raw materials for local industries making furniture, handicrafts and other products. Community forestry in Semoyo is certified by the Indonesian Ecolabeling Institute (LEI) under its scheme for community-based forest management. Certification by LEI requires a detailed forest inventory and monitoring plan. Terong is now undertaking efforts to become LEI certified.

ARuPA (a local NGO) and the National Forestry Council of Indonesia (DKN) identified a strong interest in the villages of Semoyo and Terong to explore the possibility of generating additional income from their forests. In 2010, ARuPA and DKN launched a training and support programme in Semoyo and Terong on CBFBM. The capacity-building efforts followed a four-stage process:

STAGE 1. CONSULTATIONS WITH VILLAGE LEADERS
The village leaders were consulted informally about the idea of forest biomass monitoring.

STAGE 2. SOCIALISATION ON CLIMATE CHANGE, REDD+ AND BIOMASS MONITORING AT THE VILLAGE LEVEL
Basic information on climate change, REDD+ and biomass monitoring was shared at village meetings. Villagers were encouraged to raise any concerns or doubts they had and these were fully discussed.

STAGE 3: TRAINING OF VILLAGE FACILITATORS AND TRAINING OF ALL PARTICIPATING VILLAGERS

Ten villagers participated in a 4-day training of village facilitators that included: a) an introduction to climate change and discussion on various indicators of climate change using local examples, b) introduction to biomass monitoring – purpose, significance, main components, methods, recording and analysis of the data, and c) field exercises.

The village participants, supported by ARuPA and DKN, provided the training to villagers on CBFBM following the same syllabus used for the earlier training they had themselves received.

STAGE 4: FOREST SAMPLING

After the trainings, 100 permanent sample plots (PSPs) were established in each village, in both home gardens and dry land woodlots. 20 m X 20 m single square plots were used. Trees planted on the edges of agricultural areas were sampled across 10 metre intervals (i.e. trees along the first 10 metre interval were sampled, the trees along the next 10 metre interval were skipped, the trees along the next 10 metre interval were sampled, and so on). The variables measured were DBH, total tree height and thickness of the litter. The communities were trained on the use of measurement tapes, Haga Meter, Christen hypsometer, and GPS.

Field exercise on setting up sample plots

The CBFBM has two objectives. First, the CBFBM will provide a more accurate understanding of timber stocks and tree growth, enabling the villagers to time the harvest of their trees to maximise income. Second, the CBFBM provides an estimate of forest biomass, which can be used to calculate REDD+ payments the communities could receive by delaying their harvesting to achieve a higher time-averaged carbon stock in their forest.

CASE STUDY QUESTIONS

1. What was the main purpose of using CBFBM in this case study?
2. What were the contextual factors that made CBFBM an appropriate methodology in this case?
3. How did the data collected relate to the purpose of the CBFBM and what are the implications for other sites?

1B SESSION: WHY CBFBM?

LEARNING OBJECTIVES:
By the end of the session, participants
- can explain a range of purposes for which CFBFM could be valuable to a community
- can explain the potential benefits of CFBFM for local communities and other stakeholders

MATERIALS:
copies of case studies; small box (or any type of container); card (post-its); flip chart or whiteboard and markers

TIME:
70 minutes

STEPS:
1. Start by explaining that that this session will unpack the rationale and value of CBFBM for both communities and other stakeholders.
2. Write the question "Why CBFBM?" on a blank flip chart. Run a short brainstorming exercise on the rationale for using CBFBM techniques and write the answers of the group on the flip chart. Do not explore the answers in too much detail but explain you will come back to them at the end of the session.
3. Explain that in order to explore the benefits of CBFBM you are going to give the participants a short case study to read.
4. Divide the participants into smaller groups of 4-5 people and distribute the case studies. Ask them to read and discuss their case study considering why CBFBM was used and features of the CBFBM. Give them 15 minutes to read and discuss.
5. Ask each group to report back on the purpose of CBFBM in their case study. Try to draw out the broad purposes of CBFBM and refer back to their ideas from the flip chart in Step 2.
6. Ask the participants to form pairs or small groups. Explain that each pair should draw a folded meta-card from the box that you have prepared randomly (see Exercise). After each pair has drawn a card explain that on each card is a potential benefit of CBFBM and that they should consider whether they agree with this potential benefit.
7. Ask the pair to take 10 minutes to discuss how CBFBM could provide the benefit and under what conditions. For example, for the benefit "CBFBM supports effective payment distribution", the pair should discuss if they agree that CBFBM can achieve that benefit, how and under what conditions. Provide them with two new blank cards so they can make notes on the how and conditions.
8. Make a format of a large table on the training wall with three column headings: "Benefit of CBFBM", "How" and "Conditions". Ask each pair to come up and explain what they discussed and paste their cards according to the original benefit card they received.
9. After each pair has shared their discussion reflect on the range of benefits that can be achieved through CBFBM by asking the following questions:
   - *Which of these benefits are most important in your own context and why?*
   - *Which of these benefits could not be achieved through professional forest monitoring and why?*
   - *What conditions need to be in place to ensure that the value of CBFBM can be realised?*
10. Wrap up the session by explaining that there is a range of objectives and potential benefits from CBFBM but that it may only be appropriate in specific conditions.

TRAINING TIPS:

There is a choice of two case studies. If needed, have more than one group doing the same case study to keep the groups small.

Explain that while CBFBM offers a number of benefits, there are also risks with CBFBM, especially in weaker community settings. These are discussed in Session 2a Conducting feasibility assessment for CBFBM.

HAND-OUT

THE RATIONALE FOR CBFBM
The rationale for CBFBM and the benefits it potentially offers are set out below.

CBFBM GENERATES KNOWLEDGE THAT COMMUNITIES CAN USE TO MAKE WISE DECISIONS ON FOREST MANAGEMENT
Through CBFBM, communities generate new knowledge that places them in a more informed position to manage their forests sustainably and consider different forest management options. For example, with knowledge on commercial timber stocks, communities can develop management plans to ensure they do not extract timber beyond sustainable rates. With knowledge on their forest carbon stocks and how different activities might impact these stocks, communities are better able to understand and consider options for protecting and/or enhancing carbon stocks as a REDD+ activity.

Through CBFBM approaches, there is increased community understanding of the role of forests in climate change mitigation. Carbon is no longer an alien concept for them on which ridiculous stories are circulated (e.g. in Papua New Guinea, one person was heard to tell others that carbon could be extracted from trees by boring a hole into the tree bole, putting a plastic pipe into the hole, and allowing the carbon to flow into a plastic bag placed at the other end of the pipe; the carbon in the plastic bag could then be sold on carbon markets). Without the knowledge on biomass that CBFBM can generate, local communities may be vulnerable to exploitation by the so-called "carbon cowboys", i.e. people who make impossible promises of benefits to secure forest rights from local communities for their own profit (see Sanchez, 2012). CBFBM will give them a better understanding of how REDD+ payments are calculated (i.e. according to each tonne of CO_2 emissions avoided or sequestered).

Local level facilitators can couple CBFBM with awareness on adaptation and this can raise community understanding of the important contribution that forests make to their resilience (i.e. ability to cope with shocks) and adaptive capacity (i.e. ability to adapt to changing climate conditions).

CBFBM BUILDS COMMUNITY CAPACITY AND INSTITUTIONS FOR THEIR SELF-RELIANCE
Through the training and support provided by facilitators, CBFBM can lead to social and institutional strengthening in the community. New skills are developed, new technical knowledge is acquired, and abilities to deal with strong external agencies can be strengthened. This strengthening of community institutions is sometimes revealed when communities use the knowledge or skills they have obtained for other purposes. In Cameroon, for example, community members who had participated in the Kyoto Think Global Act Local project on community forest monitoring used the skills they had acquired with handheld GPS and GIS (Global Information Systems) to initiate a case against a neighbouring oil palm plantation, which they claimed had encroached their ancestral land (McCall, 2011).

CBFBM SUPPORTS EFFECTIVE PAYMENT DISTRIBUTION
Depending on the approach taken, only some of the community members may be trained for CBFBM (this is the more common approach, rather than training the whole community). They will form community forest monitoring teams who will be responsible for the forest sampling. For communities who are able to generate income through their forest management, e.g. through the sale of timber from sustainable forestry operations or payment for ecosystems services such as REDD+, some of the income can be distributed to the forest monitors as a wage. CBFBM thus provides a way of distributing some of the payments to people for playing important roles in ensuring that forests are managed well.

CBFBM COULD REDUCE THE COSTS OF MONITORING

There are several types of costs associated with CBFBM. Training and building the community forest monitoring teams requires time and financial resources. Refresher trainings as well as on-going support, e.g. some guidance during monitoring, may also be required, and these too incur costs. For the community, there are opportunity costs associated with the time that they must spend on the initial training and forest monitoring that they could have used for other activities. Another set of costs are associated with the equipment required for the mapping and measurement of forests, and for data processing and management, though these costs would be incurred regardless of whether the monitoring is conducted by professionals or communities.

The initial costs to set up the CBFBM system are likely to be high but will decline over time. The Kyoto Think Global Act Local project estimated the costs of community forest monitoring for project sites in Tanzania and Nepal. Opportunity costs for the community were included by using the average daily wage (opportunity cost), but costs for equipment such as GPS were excluded. The costs were found to be highly variable, ranging from US$2.50 – US$5.50 per hectare per year. It was estimated that if the surveys were conducted by professional teams, the costs would have been 50-70% higher (Skutsch, Zahabu, Karky, & Danielsen, 2011). Another observation of this study was that the larger the forest area, the lower the costs per hectare.

CBFBM SUPPORTS IMPLEMENTATION OF SOCIAL SAFEGUARDS

The United Nations Framework Convention on Climate Change (UNFCCC) is a global agreement that aims to keep climate change below levels that would be considered dangerous for human life. The countries that signed the UNFCCC agreed that developing countries could receive payments for their efforts to protect and enhance forest carbon stocks. They called this concept REDD+ (reducing emissions from deforestation and forest degradation, and enhancing forest carbon stocks). It was agreed that REDD+ should have a set of safeguards to ensure that while protecting or enhancing forest carbon stocks, no harm is done to communities or the environment. One safeguard requires full and effective participation of indigenous peoples and local communities in REDD+ activities, while another safeguard calls for transparent and effective national forest governance structures. CBFBM contributes to the respect of both of these safeguards. Through CBFBM, communities can play an important role in REDD+ by providing information on carbon stocks and drivers of forest change, and their knowledge on biomass will put them in a better position to participate in national REDD+ dialogues and policy development through consultations and public submissions.

Respect for the knowledge and rights of indigenous peoples and local communities is another REDD+ safeguard that is clearly promoted through CBFBM. In CBFBM, full use is made of local and traditional forest knowledge, including on species, ecosystem types and drivers of land cover change.

CBFBM CAN CONTRIBUTE TO THE DEVELOPMENT OF NATIONAL FOREST MONITORING SYSTEMS

CBFBM could be integrated into national forest monitoring systems to provide biomass data. Because they reside adjacent to forests and because of their local/traditional knowledge, communities implementing CBFBM could also contribute to national land-use mapping activities. For example, communities with good knowledge of landscape features can assist with the interpretation of remotely sensed images, and could participate in the ground-truthing of land cover maps.

Local communities who have over many generations lived within or close to forests have intimate knowledge of forest ecosystems, tree species distribution, age distributions and plant associations. Hence, even for biomass assessments outside of community managed forests, the involvement of local people can add to the accuracy, as well as relevance and applicability of the information gathering (McCall, 2011).

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1. ODDAR MEANCHEY COMMUNITY FORESTRY REDD+ PROJECT, CAMBODIA

The Oddar Meanchey REDD+ Project is the first and most advanced of all REDD+ demonstration projects in Cambodia. It has been validated against the Climate, Community and Biodiversity Standards (CCB Standards) and the Verified Carbon Standard (VCS), and aims to generate and sell carbon credits from REDD+ activities.

The Project was developed by Pact (an international environmental NGO that has been working in Cambodia for many years), Terra Global Capital (a US-based consultancy specialising in carbon modelling with remote sensing systems and in carbon markets) and the Forestry Administration of the Royal Government of Cambodia. It is expected to sequester and store 8.3 million tonnes of CO_2 over 30 years and provide sustainable financing to local forest protection efforts, while providing lessons and ideas to support national REDD+ development.

The Oddar Meanchey Community Forestry REDD+ Project works with local communities in Oddar Meanchey province. Forests in the province face huge threats from illegal logging, resettlement, and agricultural concessions for plantation crops for export like rubber. The Project involves 13 Community Forestry Groups across 58 villages managing over 60,000 ha of forest. The Project aims to address the multiple drivers of deforestation and forest degradation through a range of activities including reinforcing land tenure, land-use planning, forest protection, awareness raising, agricultural intensification and assisted natural regeneration of degraded land. The key strategy of the Project is to secure forest management rights for communities, and support them in developing and implementing forest management plans.

Figure 1B-1. Oddar Meanchey location map

The monitoring requirements for the Oddar Meanchey project have been established by a) the CCB Project Design Standards Second Edition, b) VCS Methodology VM0006, and c) the validated Oddar Meanchey VCS project design.

The Community Forest Management Committees are the basic operational unit for implementing the project and collect a range of activity data at the ground level. As part of the Project design process, the communities participated in the establishment and measurement of sample plots to estimate the anticipated impact of the project activities on forest carbon stocks. The monitoring responsibilities of the Community Forest Management Committees once the project is implemented are to:
- Report 'forest violations' (i.e. illegal activity)
- Provide annual operations reports to local Forestry Administration staff
- Report natural disturbances in project area
- Undertake biodiversity monitoring in accordance with the biodiversity monitoring plan
- Provide project activity reporting and documentation (i.e. patrol logs, labour hours etc.).

The development of this participatory monitoring system is expected to play a central role in facilitating project ownership among community members and contribute to project sustainability, and thus better ensure that "communities assume major responsibility" for the project.

FURTHER READING:
http://www.pactcambodia.org/Programs/FPCC/CCB_OddarMeancheyMonitoringPlanv1-0.pdf

2. COMMUNITY-BASED PRODUCTION FORESTRY PILOT PROJECT, CAMBODIA

The Community-based Production Forestry (CBPF) pilot project seeks to demonstrate that a community-based enterprise is a realistic model for future forest management in Cambodia. It aims to provide timber for the market, satisfy government stakeholders and address community concerns. The Project is a joint activity of the Forestry Administration, the Wildlife Conservation Society and local communities. Support is also being provided by The Centre for People and Forests (RECOFTC) and the Institute for Global Environmental Strategies (IGES).

The CBPF Project is unique in Cambodia as the only community forest area to focus on sustainable harvesting of high value timber. The CBPF model was designed with the underlying belief that Cambodia is best served by developing medium-sized forestry businesses that are able to operate legally, with social and ecological integrity, and that meet the standards required by responsible buyers in the international or domestic markets.

The Project operates in 12,000 ha of the buffer area of the Seima Protection Forest, which is a Permanent Forest Estate under the jurisdiction of the Forestry Administration. The area has been chosen as the national pilot site for the CBPF approach in the National Forestry Programme.

Following the Cambodian Community Forestry Guidelines, the CBPF-Management Committee has been set up as the top level and central management

Figure 1B-2. CBPF project location map

body for the project. Since different communities are involved in the same project, one Sub Committee has been established in each village. Following the general scheme provided by the Government, CBPF Regulations have been developed for the project. The CBPF Regulations protect the area from deforestation and allow only careful planned harvesting and other biomass removal.

The inventory work will eventually cover more than 12,000 ha and take more than a year to complete. Teams from the local communities are being trained to conduct the inventory. Work is underway on a 300 ha training area, representative of the wider forest, where community members can develop their skills. It is also an opportunity for the Community Forestry Office of the Forestry Administration to test enhanced inventory methods, building on the existing national guidelines.

Sustainable timber harvesting by the communities is the main goal of the project, but it was recognised that REDD+ could potentially provide an additional incentive for forest management, without stopping the timber harvesting activities. The inventory was thus designed to provide data not only for commercial timber harvesting but also on carbon stocks. The community forest monitoring teams are thus setting up and measuring sample plots to both plan their timber harvesting and to enable the project partners to assess the potential for REDD+ in their forests. In addition to the living trees, bamboo culms and standing dead wood are also measured.

FURTHER READING:

http://programs.wcs.org/cambodia/ConservationChallenges/NaturalResourceManagement/CommunitybasedProductionForestry.aspx

Enlarge and cut the following into individual slips or reproduce on meta cards

CBFBM generates knowledge that communities can use to make wise decisions on forest management	CBFBM builds community capacity and institutions for their self-reliance
CBFBM supports effective payment distribution	CBFBM could reduce the costs of monitoring
CBFBM supports implementation of social safeguards	CBFBM can contribute to the development of national forest monitoring systems
Fill in your own…………………………..	Fill in your own…………………………..

1C SESSION: WHAT IS REDD+?

LEARNING OBJECTIVES:

By the end of the session, participants

- will have shared their own perceptions and experience of REDD+
- can explain the key principles of REDD+ (including additionality, leakage and permanence)
- will have identified the role of the CBFBM process in the context of REDD+

MATERIALS:

Flip charts with paper and pens; printed hand-outs

TIME:

75 minutes

STEPS:

1. Explain that this session will explore participants' experience of REDD+ and how it is related to CBFBM.
2. Give everybody a blank piece of coloured card and ask them to draw a picture of what they think REDD+ is. Explain to them that they should not use words. Give them about five minutes to complete their individual drawings.
3. Ask them to form groups of 4-5 people and share their pictures. After they have shared the story behind their pictures ask them to discuss based on their pictures and their experience what are the basic components of REDD+ and write down their answers on a flip chart.
4. Ask each group to paste their flip chart and pictures on the training room wall. Give the participants an opportunity to read all the flip charts and look for similarities and differences across the groups.
5. Try to draw out the key features of REDD+ whilst reflecting with the group and write the answers on a flip chart. Use the following questions to reflect with the group:
   - *What can we extract as the key purpose of REDD+ from this exercise and your pictures?*
   - *What are the key defining features of REDD+ and why?*
   - *What makes REDD+ different from other forestry programmes or activities?*
   - *What is the role of CBFBM in relation to REDD+?*
6. Explain that three key principles are associated with REDD+: Additionality, Leakage and Permanence. Ask the participants if they can explain the difference between the three principles. After they have shared their understanding present the three principles based on the content of the hand-out. Try to relate back your explanation to their ideas and their flipchart presentations earlier.
7. Wrap up the session by asking participants how they see the role of CBFBM in relation to these three principles and the overall purpose of REDD+.

OVERVIEW OF REDD+

Forests play a number of important roles in climate change. For example, deforestation and forest degradation releases the carbon that is stored in trees into the atmosphere as carbon dioxide and other gases that contribute toward global warming. Scientists estimate that deforestation and forest degradation account for around 10% of global carbon emissions per year (Bulter, 2012). However, healthy forests absorb carbon dioxide from the atmosphere at approximately 2.4 billion tons of carbon dioxide a year (USDA, 2011).

So, when forests are damaged and destroyed we lose not only the carbon storage provided by the trees, but also the forests' ability to absorb carbon dioxide from the atmosphere. It's a double loss. When combined with other important climatic functions that forests play, such as regulating and maintaining atmospheric moisture, the loss is even greater.

Reducing Emissions from Deforestation and Forest Degradation or REDD is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. 'REDD+' goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks" (UN-REDD Programme, 2011).

Five possible REDD+ actions were agreed by UNFCCC Parties. These are:

1.   Reducing emissions from deforestation;
2.   Reducing emissions from forest degradation;
3.   Conservation of forest carbon stocks;
4.   Sustainable management of forests;
5.   Enhancement of forest carbon stocks

Some developed countries and multilateral initiatives such as UN-REDD and the World Bank's Forest Carbon Partnership Facility are providing support to developing countries for them to establish their national REDD+ systems (a process which is called "REDD+ readiness"). Through a number of decisions, the UNFCCC Conference of the Parties (COP) has already set out some components that these systems must contain. These include a national REDD+ strategy, a forest monitoring system, reference emissions levels and a safeguards information system (Fig. 1C-1).

Voluntary carbon markets exist outside of the UNFCCC and carbon offsets/credits from REDD+ projects are being traded through these. A number of different voluntary standards exist for REDD+ projects that provide third party verification of emissions reductions from voluntary activities.

In order to estimate these emissions reductions, two basic steps are required. First, there needs to be a credible

Figure 1C-1. Elements of a national REDD+ system

projection of what would happen if the proposed REDD+ activities were not implemented. This is called the baseline or the reference emissions level. The first step in calculating a baseline is estimating how much biomass there is per hectare and the total area of forest. Combing these two estimates provides an estimate of the total carbon stock. The second step is to estimate future emissions in the most likely without-REDD+ scenario, based on an understanding of the drivers of forest cover change. The third step is to calculate emissions in the with-REDD+ scenario, which requires consideration of how effective the REDD+ activities are likely to be (e.g. they may be expected to stop 90% of the deforestation). The likely impacts of the proposed REDD+ activities on CO_2 emissions is then estimated by subtracting the CO_2 emissions expected in the without-REDD+ scenario from the emissions expected in the with-REDD+ scenario, and this estimate becomes the basis for the REDD+ payments.

FUNDAMENTAL PRINCIPLES OF REDD+

1. ADDITIONALITY (OR 'PERFORMANCE')

Voluntary markets require proof of additionality. The term 'additionality' is not used in the REDD+ negotiations under the UNFCCC, which prefers the expression 'performance-based payments'. The additionality principle requires that the forest carbon stocks protected or enhanced by REDD+ activities are additional to the stocks that would exist without the activities. Figure 1C-2 shows the business as usual, or without-REDD+, scenario as the orange line, and the with-REDD+ scenario as the green line. The 'additionality' provided by REDD+ is captured by the red 'emissions reduction' arrow.

Figure 1C-2: Demonstrating additionality in REDD+

Source: Forestry and Forest Products Research Institute (2013) (http://www.ffpri.affrc.go.jp/redd-rdc/en/redd/basics.html)

CBFBM and additionality

Additionality is important for CBFBM, as this should guide where and when CBFBM activities take place. CBFBM should be carried out in or around forest areas where additionality can be demonstrated, i.e. where forest carbon stocks are threatened or there is potential to enhance forest carbon stocks that is not being realised, otherwise there is a risk that time and resources, both from the CBFBM local level facilitators and the community, are misallocated.

Once the REDD+ project or programme is implemented, CBFBM contributes to estimating the 'amount' of additionality by periodically monitoring carbon stocks.

2. LEAKAGE

One concern about REDD+ is that by putting protective measures in one forest project area, deforestation pressure is displaced to another forest area. Leakage or 'emissions displacement' occurs when emissions in an area outside of the REDD+ activities occur because of the REDD+ activities.

Leakage is one of the UNFCCC REDD+ safeguards.

Voluntary REDD+ standards require likely leakage to be estimated and monitored. Leakage monitoring can involve monitoring changes in forest carbon stocks in a "leakage belt", i.e. an area near the project site where deforestation/degradation drivers are likely to shift to. REDD+ activities can also include actions to reduce leakage. For example, unsustainable timber harvesting to supply local markets could be taking place in an area where REDD+ activities have been proposed. The REDD+ activities include stopping the timber harvesting, but this might just result in the loggers harvesting trees in another area. To reduce the likelihood of this leakage, the REDD+ project could support the planting of woodlots to meet the needs of the local market for timber.

Under voluntary REDD+ methodologies, 'buffers' may also be included in the carbon calculations, i.e. a certain percentage of the carbon credits are put aside, rather than being sold, as a type of risk insurance for leakage.

CBFBM and leakage

CBFBM can be an effective tool for monitoring leakage, as often local communities have the most detailed knowledge of local deforestation drivers and where these are likely to shift to because of REDD+ activities.

3. PERMANENCE

It can never be guaranteed that a forest area where REDD+ activities are being implemented will remain healthy and intact for the duration of the activities. There are many external threats that may be beyond the control of the people responsible for the REDD+ activities, such as tree disease, forest fire and illegal encroachment. Any of these factors may undermine forest protection efforts and compromise the REDD+ activities. A famous example of this phenomenon is the Amazon Drought of 2010, when the entire Amazon Basin – usually referred to as the 'lungs of the planet' became a net source rather than a sink of carbon due to large-scale tree die-off caused by drought.[1]

The permanence of emissions reductions is one of the REDD+ safeguards. REDD+ policies and activities need to take permanence into account, which is one of the reasons why most voluntary carbon standards specify a maximum project duration of around 30 years and also include permanence risk buffers to account for threats from natural disasters or other external threats.

CBFBM and permanence

CBFBM contributes to both the monitoring and likelihood of permanence. CBFBM systems can include reporting on disturbances to forests, such as extraction of fuel wood, etc. that cannot be detected with remote sensing, which will assist with the monitoring of permanence. By involving communities in meaningful ways in REDD+ implementation, CBFBM can also build the commitment of communities living in and around the forests to the REDD+ activities and thereby contribute to permanence.

REFERENCES

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[1]   http://www.bbc.co.uk/news/science-environment-12356835

1D SESSION: LINKING CBFBM WITH VOLUNTARY CARBON AND OTHER STANDARDS AND MONITORING REQUIREMENTS

LEARNING OBJECTIVES:

By the end of the session, participants
- can explain the meaning of standards in relation to carbon and monitoring
- can list the most important voluntary standards for carbon and the implications for CBFBM design

MATERIALS:

copies of the hand-out

TIME:

90 minutes

STEPS:

1. Explain that this session will explore standards and their implications for CBFBM design.
2. Ask the group what they understand by the term "standards" and to give you one example outside of the context of carbon or climate change. Write their ideas and examples on a flip chart. Have them consider minimum standard requirements and how the standard is used. Examples can include building standards, nutritional standards, educational standards, etc.
3. Ask the participants if they have experience in using standards for carbon monitoring in their own work and ask them to explain why standards for carbon monitoring have been created. Discuss the importance of consistency, reliability, verification of estimates, etc.
4. If participants do not have experience with carbon standards, give a short overview of existing standards based on the hand-out and then divide the participants into pairs and ask them to discuss the following questions:
   - *What are some of the benefits for a REDD+ project to subscribe to international standards?*
   - *What is the potential for integrating CBFBM into projects with international standards?*
   - *What are the implications for the CBFBM design?*
5. Bring the participants back together and go through each question asking each pair for their ideas.
6. Wrap up the session by reminding the participants that when REDD+ activities are being designed for specific standards, if CBFBM is included in the project, then it must meet the requirements of the standards for carbon monitoring.

TRAINING TIPS:

To illustrate the application of standards, examples of projects that have been validated against the standards could be given. These can be found on the project databases for each standard. Many profiles of validated REDD+ projects can also be found on the IGES REDD+ database.

USEFUL LINKS:

VCS Project Database: http://www.vcsprojectdatabase.org/
CCB Alliance Project Database: http://www.climate-standards.org/category/projects/
IGES REDD+ Database: http://redd-database.iges.or.jp/redd/

LINKING CBFBM WITH VOLUNTARY CARBON AND OTHER STANDARDS AND MONITORING REQUIREMENTS

There are two types of carbon schemes: compliance and voluntary. In a compliance market, emitters of greenhouse gases are required to reduce their emissions and are allowed to purchase carbon credits to achieve their emissions reduction targets. In a voluntary market, organisations also purchase carbon credits to achieve emissions reduction targets, but they have taken on these targets voluntarily, e.g. to improve their public image.

Carbon credits (or offsets) from forest projects are mostly traded in the voluntary carbon markets. There are several voluntary carbon schemes/standards that could be considered by REDD+ project developers. CBFBM could be used for any of these.

The **Verified Carbon Standard (VCS)** claims to be the world's most widely used voluntary greenhouse gas (GHG) reduction programme. The VCS was among the first global standards to develop requirements for crediting AFOLU (Agriculture, Forestry and Other Land Use) projects, which include REDD projects. Today VCS is the most widely used standard by AFOLU projects (VCS, 2012).

The **Climate, Community & Biodiversity Alliance (CCBA)** is a partnership of international NGOs that was founded in 2003. The CCB Standards identify land-based projects that are designed and implemented using best practices to provide GHG reductions while also providing net positive benefits to local communities and biodiversity.

The **Gold Standard** was established in 2003 by the World Wide Fund for Nature and claims to be endorsed by 80 NGOs worldwide. It is used to certify projects to ensure that they provide GHG reductions and sustainable development benefits for local communities.

The **Plan Vivo Standards** are part of a broader Plan Vivo System, which is a framework for supporting communities to manage their natural resources more sustainably, with a view to generating climate, livelihood and ecosystem benefits. The participants are rural smallholders and communities dependent on natural resources for livelihoods. Activities are implemented on smallholder or community land (owned or long-term user rights).

COMPARING THE STANDARDS

Each standard places a different level of emphasis between the monitoring of carbon, social and/or biodiversity/ecosystem service factors. This will impact the design of CBFBM, as the data monitored should match the requirements of the standard being used. In practice, projects often combine the standards so that they are covering carbon, social and biodiversity/ecosystem factors adequately. For example a dual VCS/CCBA certification is often the goal for voluntary REDD+ projects.

Table 1D-1 provides an outline of each of the schemes.

Table 1D-1: Key features of voluntary carbon schemes

	VERIFIED CARBON STANDARD (VCS)	CLIMATE, COMMUNITY & BIODIVERSITY ALLIANCE (CCBA)	GOLD STANDARD	PLAN VIVO
Aim	▪ Provide quality assurance in voluntary carbon markets that projects are actively reducing emissions	▪ Guide and evaluate performance of projects on reducing GHG emissions and providing benefits to communities and biodiversity	▪ Provide good governance in carbon markets and guide best practice	▪ Support communities to manage their natural resources more sustainably, with a view to generating climate, livelihood and ecosystem benefits

HAND-OUT

	VERIFIED CARBON STANDARD (VCS)	CLIMATE, COMMUNITY & BIODIVERSITY ALLIANCE (CCBA)	GOLD STANDARD	PLAN VIVO
Standards	▪ Focuses on GHG emission reductions and removals	▪ Covers climate, community and biodiversity impacts, but cannot be used to issue carbon credits ▪ Provides guidance and templates for CCB Standards to be used together with VCS	▪ Cover GHGs and sustainable development benefits in local communities	▪ Design of Plan Vivo projects is community-led, but must conform with Plan Vivo Standards
Validation	▪ Validation conducted by independent, approved auditors ▪ Project developers either use existing VCS methodology or apply to have their own methodology validated ▪ Approved methodologies cover deforestation in peatlands, mosaic deforestation and degradation, etc.	▪ Validation by independent, approved auditors	▪ Validation by independent, approved auditors	▪ Project coordinator checks land management plans developed by community and calculates carbon credits
Verification	▪ Carbon credits issued after independent verification of project impacts by approved auditor	▪ Approved auditor verifies project impacts ▪ CCB certification enables the addition of a 'CCB label' to carbon credits issued by VCS	▪ Approved auditor verifies project impacts	▪ Payments for carbon credits based on monitoring of project by project coordinator
Prospects for CBFBM	▪ CBFBM can be incorporated so long as integrity of carbon accounting is maintained	▪ Projects are advised to avoid sophisticated monitoring methods which aim for high levels of precision, since these are not required by the CCB Standards ▪ As CCB Standards promote community development, CBFBM should be considered favourably. ▪ However, CCB Standards do not lead to issuance of carbon credits so for REDD+ projects they are often used in conjunction with the VCS. In these cases, the VCS standard determines the level of precision of the carbon stock monitoring.	▪ CBFBM can be incorporated so long as integrity of carbon accounting is maintained	▪ CBFBM may be easy to integrate in projects because project design is community-led. Some Plan Vivo projects incorporate CBFBM.

REFERENCES

VCS. (2012). *The VCS AFOLU Program: Crediting GHG Emission Reductions from Agriculture, Forestry, and Other Land Use projects.*

LEARNING OBJECTIVES:

By the end of the session, participants

▪ can explain the key five generic elements of the CBFBM process

▪ have identified and sequenced the 14 key steps for each generic element and their justification as relevant steps for their own context

▪ have used the CBFBM design table format to identify proposed actions for each step in their own context

Materials:

copies of hand-out; paper slips or cards with key elements and steps; flip charts and markers

Time:

60 minutes

STEPS:

1. Introduce the session by explaining that this session will focus on building an overall process framework of key elements and steps for a CBFBM design and that participants will be given an opportunity to start designing their own system based on that process framework.

2. Divide the participants into groups of 3-4. If you already can differentiate functional working field teams use those functional working teams as a basis for grouping.

3. Explain that the process framework for CBFBM has elements and steps and that the steps need to be sequenced under the key elements. If necessary draw a simple diagram on the white board or flip chart indicating the order of elements and steps.

4. Explain that you will give each group an envelope or pile of printed slips/cards and that the group should sort out the cards and identify the key elements and steps that go under the key elements.

5. After they have sorted out the key elements, ask them to share the five key basic elements and what steps are relevant under which element. Make sure they have the order of elements and steps correct.

6. Introduce the CBFBM design table format. Explain that this table will be used throughout the course at different levels to unpack, adapt and plan for their own design. Explain that we will add different columns to unpack different issues for each step as we move through the learning process.

7. Give the participants a pre-prepared flip chart template with an empty column for the key elements and steps and an additional column for proposed actions and options.

8. Explain that the groups should stick their cards or slips on the chart in the sequence they propose and if they consider the step would be relevant in their design with a justification. Emphasise that the design can be modified for different sites so they may need to adapt or re-sequence. Ask them to think about specific proposed actions that they will have to think about for each step and write them in the following column.

9. After each group has finished their design ask the groups to paste their flip chart designs on a wall side by side so everyone can compare the designs and justification for each step. If there are differences between groups highlight and discuss the rationale for them.

10. After you have compared the different outputs of the group, use one of the group's flip chart outputs as a master for agreement between all the participants on the key design elements and steps for their own design. Either you can use a flip chart or you could use an excel spreadsheet projected on the wall from a laptop computer.

11. Wrap up the session by emphasising the key design elements and steps and explain that different parts of the training will zoom in on key elements and steps. Provide an example of a step where there are also several sets of activities that need to decided and selected as part of the design

process. Emphasise that this is just the broad framework and that this will be fleshed out more and more as the participants proceed through the learning process.

TRAINING TIPS:

This exercise works well with a laptop computer and projector because once the participants have created their design table using MS Excel, it is easy for them to add as much information as they feel necessary, and to make modifications and corrections as they move through the training sessions. However, flip charts on a wall are also useful to record the CBFBM design as it evolves because they can provide participants with an invaluable continual reminder of how their design process is progressing. It may be better in the early stages to remain with flip chart design tables and as the table becomes more complex, build it up in an Excel file.

You can show an example of a completed design table so that participants get a feel for what they are aiming for through the course of your training (an example is given in Table 1E-2 of the hand-out). However, you may want to wait until the participants have discussed the parameters required for a carbon stock assessment (Session 3a Developing a Robust Carbon Stock Assessment and Monitoring Plan) before handing out this table.

How you organise the session depends on the participants. If the participants are from different areas/projects, divide them into sub-groups according to their areas/projects to work on their designs. In this case there is no need for Step 10.

Figure 1E-1 shows that there are five key design elements and 14 generic steps involved in the design of a CBFBM system. These steps are presented in chronological order. Some can be undertaken at the same time, and the order can be changed as required.

Experience with CBFBM systems shows that more steps need to be added as the CBFBM progresses. The design and implementation of CBFBM systems is in fact a type of action research in which the support organisations and the communities are learning together. Additional steps evolve as progress is made and new opportunities and challenges arise.

There are five key elements and 15 process steps to the CBFBM process:
- Element 1 (E1): Feasibility assessment and stakeholder engagement
- Element 2 (E2): Agreeing on the objectives, technical parameters and building a community based forest biomass monitoring design
- Element 3 (E3): Designing and delivering community level training whilst testing the forest biomass assessment design
- Element 4 (E4): Reflecting on the testing, and adapting the design of the forest biomass assessment and the community training
- Element 5 (E5): Agreeing on next steps

Figure 1E-1. Basic steps for designing a CBFBM system

KEY STEPS FOR CBFBM

ELEMENT ONE (E1): FEASIBILITY ASSESSMENT AND STAKEHOLDER ENGAGEMENT

1. **CONDUCT FEASIBILITY STUDY**
   A feasibility assessment should be conducted to reduce the risk of wasting time and resources, to provide an early indication of potential risks, and to compare and select project sites.

2. **DO STAKEHOLDER ANALYSIS**
   Stakeholder analysis will help determine what your process for engaging with stakeholders will

be, and from whom and in what order you may need to gain consent or approvals in order for the project to go ahead.

3. **INCORPORATE FPIC**
    Free Prior Informed Consent (FPIC) is a collective right of indigenous groups and local communities to agree or disagree to any intervention, including a forest management initiative. FPIC must be fully incorporated into CBFBM.

4. **ASSESS COMMUNITY-BASED INSTITUTIONS**
    The strength of existing community institutions to lead CBFBM needs to be assessed before any community training on CBFBM takes place.

ELEMENT TWO (E2): AGREEING ON THE OBJECTIVES, TECHNICAL PARAMETERS AND BUILDING A COMMUNITY BASED FOREST BIOMASS MONITORING DESIGN

5. **AGREE ON OBJECTIVES**
    The CBFBM objectives will have to be clearly defined and shared with and agreed upon by the communities. The communities may have some additional objectives they may wish to add to those proposed by the local level facilitators.

6. **DESIGN A QA/QC PLAN**
    A quality assurance and quality control (QA/QC) document should be drafted to explain the strategies to ensure that the CBFBM system provides reliable biomass estimates.

7. **DECIDE HOW DATA WILL BE STORED, ARCHIVED AND PROCESSED**
    A reliable system will need to be created to ensure that data is secure and easy to access.

8. **DEVELOP A ROBUST CARBON STOCK ASSESSMENT AND MONITORING PLAN**
    Decisions will have to be made about how forests boundaries will be mapped, how forests will be stratified, what carbon pools will be sampled, etc.

9. **ELABORATE THE DETAILS OF EACH ACTIVITY FOR CARBON STOCK ASSESSMENT**
    Once decisions have been made on each major element of the forest sampling, how each of these elements will be implemented needs to be detailed. Often there will be more than one option. These will have to be spelt out and decisions taken. For example: If plots are located systematically, how will their exact location be determined? If tree diameter or height will be measured, what measurement instruments will be used? And so on.

10. **IDENTIFY ROLES OF EXPERTS AND ROLES OF COMMUNITIES**
    The expected role of experts and the role of communities in each step of the biomass assessment process should be discussed and proposed. The assignment of roles can be adjusted later after reflecting on early field experiences.

ELEMENT THREE (E3): DESIGNING AND DELIVERING OF A COMMUNITY LEVEL TRAINING WHILST TESTING THE FOREST BIOMASS ASSESSMENT DESIGN

11. **PROPOSE COMMUNITY TRAINING METHODS**
    For each role that the communities take on in the monitoring, they will need to understand the purpose of the activity and they will need the skills to carry out the activity competently. Teaching methods on both conceptual issues and practical skills must be proposed and tested for each major activity.

12. **TEST**

The proposed CBFBM system, including options suggested for each step in the biomass assessment process, and the proposed training methods, should be tested (ideally) with a community that will participate in the CBFBM.

ELEMENT FOUR (E4): REFLECTING ON THE TESTING, AND ADAPTING THE DESIGN OF THE FOREST BIOMASS ASSESSMENT AND THE COMMUNITY TRAINING

13. **REFLECTION AND ADJUSTMENTS**

After the testing, it is important for the local level facilitators to come together and discuss their experiences and observations. The local level facilitators should discuss both what worked well and what did not work so well regarding the elements of the CBFBM system and the proposed training methods that were tested. Adjustments to the system and the training methods can then be made.

ELEMENT FIVE: (E5): AGREEING ON NEXT STEPS

14. **AGREE ON NEXT STEPS**

After the testing and refinement of the CBFBM system, the support organisations will need to develop a plan with the communities on how CBFBM should progress.

CBFBM DESIGN TABLES

Design tables can be created and used to aid the initial design and testing of elements of the CBFBM system and can be built up step by step. Eventually you will have a set of CBFBM design tables that identify your key tools, methodologies and community training methods.

CBFBM designers can set out the tables to best reflect their needs. There is no rigid set of templates for the tables. Table 1E-1 below provides a basic design template to start with that can be used as is, or modified. This table is further elaborated in Session 3a Developing a Robust Carbon Stock Assessment and Monitoring Plan specifically for designing the carbon stock assessment.

Table 1E-2 below was developed by the Institute for Global Environmental Strategies (IGES) and the Foundation for People and Community Development (FPCD) to organise the field sampling elements of their CBFBM design for communities in Madang Province, Papua New Guinea. It includes information on both the initial proposed elements and changes that were proposed after field testing.

HAND-OUT

Table 1E-1: Table to organise the initial design of a CBFBM system

CBFBM ELEMENTS	PROPOSED ACTIONS/OPTIONS	ROLE OF EXPERTS	ROLE OF COMMUNITIES
Feasibility study			
Stakeholder analysis			
FPIC			
Assess community institutions			
Objectives			
QA/QC plan			
Data storage, archiving and processing	Storage: Archiving: Processing:		
Mapping of project boundaries and strata	Forest boundaries: Describe how mapping will be conducted Stratification: Describe initial idea for stratification		
Sampling design	Process to decide no. of sample plots; Stratified or random design, etc.		
Locating sample plots in the field	Describe protocol for locating sample plots		
Setting up sample plots	Describe dimensions of sample plots and the protocols for setting up the sample plots		
Recording site conditions	List what site conditions will be recorded		
Selection of carbon pools for sampling	List carbon pools selected		
Measurement of carbon pools	Use each carbon pool as a sub-heading and provide details for how it will be measured		
Field data recording	Provide information on what field sheets are required		
Interpretation of results	Describe data analysis and process of feeding back results to communities		
Agreement on next steps	Describe how next steps will be discussed with communities		

Table 1E-2: IGES-FPCD design table for CBFBM, PNG (Note this table focuses on design of CBFBM Element 2)

CARBON STOCK ASSESSMENT ACTIVITIES	PROPOSED OPTION	DETAILS	FIELD EQUIPMENT	ROLE OF EXPERTS	ROLE OF COMMUNITIES	COMMUNITY TRAINING NEEDS	OBSERVATIONS DURING TESTS	PROPOSED ADJUSTMENTS
1. Mapping of project boundaries and strata	▪ Boundary demarcation ▪ No stratification of forest		▪ GPS ▪ Spare batteries	▪ Walk boundaries ▪ Mapping using RS and GIS ▪ Design ground truthing	▪ Walk boundaries ▪ Assist with image interpretation ▪ Participate in ground truthing	▪ Explanation of mapping purpose ▪ Measurement tape use ▪ GPS use ▪ Map interpretation	▪ Boundary survey has cultural significance as sacred areas and other important sites visited	▪ Video and photos to be taken during boundary survey
2. Sampling design	▪ Systematic; using baselines as references			▪ Decide plot number and system for locating plots	▪ NA	▪ Basic explanation on forest sampling	▪ NA	▪ NA
3. Placing sample plots in the field	▪ Use compass and measurement tape to locate plot start points	▪ Place plots equidistance along existing baselines	▪ Compass ▪ *Measurement tape	▪ Training and guidance, but communities will do	▪ Locate the plot start points ▪ Record the plot start points	▪ Measurement tape use ▪ Compass use ▪ GPS use	▪ Takes too long to drag tape through forest	▪ Replace compass and tape with GPS
4. Setting up sample plots	▪ Nested rectangular plots		▪ Compass ▪ *Measurement tape ▪ *Sledge hammer ▪ *Flagging tape ▪ *Metal pickets ▪ *Bush knife	▪ Training and guidance, but communities will do	▪ Mark plot location ▪ Set up the plots ▪ Ensure metal stakes are not removed	▪ Basic explanation on forest sampling ▪ Measurement tape use ▪ Compass use ▪	▪ No problems with compass use to set out plots. ▪ Important to have all team together when reaching plot sites and preparing to leave plots	▪ Protocols to be written in field manual on organising team on arrival at plots and when leaving plots
5. Recording site conditions	▪ Record altitude, slope, aspect, position on slope, disturbance ▪ Refer to procedures in national guidelines	▪ Measure slope across entire plot using clinometers on 1 m sticks	▪ Compass, Clinometer, Bush knife	▪ Training and guidance, but communities will do	▪ *Do all, guided by one forester	▪ Explanation on why record site conditions ▪ Training on GPS (altitude), clinometer (slope), slope position, compass (aspect), and disturbance types and extent	▪ Helpful for forester and community to work together on recording disturbance	▪ No adjustment

CARBON STOCK ASSESSMENT ACTIVITIES	PROPOSED OPTION	DETAILS	FIELD EQUIPMENT	ROLE OF EXPERTS	ROLE OF COMMUNITIES	COMMUNITY TRAINING NEEDS	OBSERVATIONS DURING TESTS	PROPOSED ADJUSTMENTS
6. Measurement	▪ Carbon pools: Living trees, Standing and lying deadwood ▪ Parameters	Parameters: Living trees: Species, DBH, Height; Standing deadwood: Diameter at ground level, Height; Lying deadwood: Diameter, Decomposition class	Equipment ▪ Nylon string, ▪ Aluminum cans to be cut as tags, ▪ Scissors, ▪ Paint ▪ Paint brushes ▪ Measurement tape ▪ DBH tape ▪ Clinometers ▪ Bush knife	▪ Training and guidance, but communities will do	▪ Do all, guided by one forester	▪ Explanation of carbon pools ▪ Training on all equipment	▪ Estimating tree height in dense forest most difficult task, but community very good at spotting tree tops. Not all community can use clinometers well, so only most competent should work on height. ▪ Some better than others at tree identification ▪ Young boys can climb buttressed trees for correct DBH measurement	▪ Remove standing deadwood from measurement; initial plots show this to be insignificant ▪ Develop database to link local tree names with botanical names ▪ Develop system for old men to pass on their tree knowledge
7. Data recording	▪ Use field sheets		▪ Clip boards ▪ Field sheets, ▪ Pens	▪ Design and provide sufficient copies of field sheets ▪ Train on use	▪ Do field data recording	▪ Training on careful data recording	▪ Mistakes made when community members call out their measurements to data recorders	▪ Training to include practice on calling out and confirming measurement ▪ Team Leaders to check and sign off all sheets before departing plots
8. Data input, management and analysis	▪ Use MS Excel spreadsheet		▪ MS Excel and virus free laptop	▪ Design spreadsheet ▪ Input data ▪ Do quality check during input ▪ Store hard and soft copies following standard protocols	▪ Potential to do data input needs to be explored			▪ Consider using MS Access to make simple "forms" for communities to enter data
9. Interpretation and sharing of results and next steps	▪ All materials and analysis shared with communities and next steps discussed							

LEARNING OBJECTIVES:

By the end of the session, participants
- have listed key strengths and weaknesses of experts and communities in the CBFBM process
- have identified and can explain the key roles of experts and community members in CBFBM

MATERIALS:

copies of hand-out; flip chart or white board and markers

TIME:

40 minutes

STEPS:

1. Explain that in this session the participants will unpack the different roles involved in CBFBM and differentiate between the role of the experts and the role of the community.
2. Divide the participants into groups of 4-5. Give each group either the role of an expert or a community in designing and implementing a CBFBM system for monitoring the biomass in a forest.
3. Ask each group to discuss and write on a flip chart what roles they think they should have in the design and implementation of the CBFBM system.
4. Call the participants together. Ask each group to elect one person to explain the roles the group identified for itself and why it feels it should play these roles. If there is more than one group discussing each role discuss the groups with the same roles first.
5. After the groups have explained their roles ask the following reflection questions.
   - *What are the key strengths of a community in forest biomass monitoring?*
   - *What are the constraints of communities in forest biomass monitoring?*
   - *What are the key strengths of the experts in forest biomass monitoring?*
   - *How do the relative strengths relate to the different roles?*
   - *What are the implications for the design of the CBFBM system?*
6. Using Table 1F-1 in the hand-out and flip charts or a white board, explain any strengths that experts and communities have in forest biomass monitoring that were not covered in the reflection.
7. Explain Table 1F-2 in the hand-out and ask the participants whether they see the same or different roles for communities and experts in their projects or areas.
8. Summarise by explaining that in this session the participants have shared some ideas on the roles of communities and of experts in a CBFBM design. When they begin working on their CBFBM design tables, they will have to specify the roles for communities and experts in each component of the design. They should keep an open mind as they may redefine these roles after learning lessons from field testing.

TRAINING TIPS:

Some participants may find it difficult to accept that communities can play important roles in mapping and forest measurement, especially when it comes to using sophisticated instruments such as a handheld GPS device. Prompting them with questions can help open up their thinking (e.g. Do community members use mobile phones? What is more difficult to use, a mobile phone or a GPS?).

| 1F | HAND-OUT: THE ROLES OF EXPERTS AND COMMUNITIES IN CBFBM | HAND-OUT |

It is normally assumed that forest measurement can only be done by people who specialise in forestry. It is easy to understand why. Sampling is necessary as it is impractical to measure all trees in a forest, so knowledge on sampling design is required. Expertise is needed to determine efficient sample plot sizes, shapes and dimensions, how to locate plots to avoid bias, how to map and stratify a forest according to management types and carbon densities, which carbon pools to focus on, what measurement instruments can be used, and how to minimise errors and present uncertainties as part of the results.

Given this complexity, little thought is usually given to involving local people in forest assessments, beyond the menial tasks of carrying equipment, cutting tracks, etc.

However, experience with CBFBM shows that fresh thinking is required on what roles communities can play in forest biomass monitoring. Some of the most important measurements for carbon stock assessment, such as tree diameter, are not technically difficult, though correct use of equipment, adherence to protocols to ensure consistency, and careful data recording are necessary. Moreover, in communities that traditionally manage and use forests, local people have intimate knowledge of forest resources, are skilled in identifying different tree species, have knowledge of past disturbances, and are aware of ecosystems boundaries, which can all benefit carbon stock monitoring. Table 1F-1 presents some of the strengths of experts and communities in forest monitoring.

Table 1F-1: Examples of strengths of experts and communities in forest monitoring

	EXPERTS	COMMUNITIES
Design of monitoring systems	▪ Knowledge on sampling design and carbon pool selection	▪ Local knowledge on landforms and land use, ecosystems, disturbance, access routes through the forest, etc.
Forest knowledge	▪ Scientific knowledge on forest ecosystems, landforms, hydrology, soils, etc.	▪ Local knowledge on forest ecosystems (including animal populations, habitats and behaviour), and uses of flora and fauna ▪ Located next to the forest so have good knowledge on drivers of forest change, e.g. can observe removals of wood and non-wood forest products, and other disturbances
Mapping	▪ Knowledge of mapping requirements for biomass monitoring ▪ Skill with mapping techniques and software	▪ Local knowledge of land cover and land use (useful for interpreting satellite images and stratification) ▪ For ground-truthing and sampling in difficult terrain, have knowledge on easiest ways to travel through the forest and physical strength to cover large areas on foot
Measurement and data recording	▪ Knowledge of equipment and protocols for correct use ▪ Understand data storage and archiving protocols ▪ Understand how to implement quality assurance and control quality systems	▪ Are comfortable being in the forest (can handle the heat, mosquitos, etc. and are physically fit), meaning they can be patient when taking measurements
Analysis	▪ Understand how the data generated should be analysed ▪ Skills for setting up systems for data entry, analysis and storage	
Interpretation and presentation of results	▪ Able to interpret and present the results, including uncertainties	▪ Local knowledge may assist with the interpretation of some results (e.g. on reasons for variations in biomass at different sites)

Note: This table involves a certain amount of generalisation.

In a CBFBM system, both experts and communities have important roles to play. Table 1F-2 provides an example of the roles that experts and communities might play for the major components of a CBFBM system. In this case we are assuming that the CBFBM system is part of a REDD+ project, so we have included land cover and land use mapping and the analysis of future carbon scenarios as additional activities.

Table 1F-2: Possible roles of experts/local level facilitators and communities in CBFBM systems

	EXPERTS/LOCAL LEVEL FACILITATORS	COMMUNITIES
Deciding CBFBM sites	▪ Responsible for analysing feasibility of CBFBM at sites, and for ensuring FPIC principles are fully implemented	▪ Decides whether to participate or not
Design of CBFBM system	▪ Facilitates a participatory design process	▪ Provides local knowledge on forest that may be relevant to design
Land cover / land use mapping and stratification	▪ Decides on technical issues and responsible for mapping using remote sensing and GIS ▪ Encourages communities to share their ideas for the mapping and facilitates sketch map drawing by the community ▪ Provides training on GPS and map reading ▪ Maps boundaries with communities ▪ Maps land cover and land use ▪ Designs the ground-truthing (ground-based survey to validate the maps)	▪ Shares expectations for the mapping ▪ Provides sketch maps ▪ Assists with interpreting features in satellite images ▪ Participates in ground-truthing ▪ Demarcates boundaries using GPS ▪ Can be involved in GIS when participatory GIS tools are used (see Session 3d Mapping of land cover / land use)
Position, set up and measure sample plots	▪ *Provides training on concepts and techniques, guidance and on-going support	▪ Leads (when competency is sufficiently built)
Additional technical work: destructive sampling, etc.	▪ Leads – explains purpose to communities	▪ Participates in field activities
Spread sheet design	▪ Leads	
Data entry and storage	▪ Usually responsible for data entry (If communities are responsible for data entry, experts must provide instruction on quality control, i.e. checking whether measurements recorded in the field are reasonable) ▪ Determines system for data storage and archiving	▪ May be responsible (can do data entry if some members have computer skills)
Quality assurance and quality control (QA/QC)	▪ Integrates into all aspects of CBFBM system ▪ Builds community awareness on importance of QA/QC	▪ Responsible for careful plot positioning and layout, measurement and recording
Analysis of future carbon scenarios (baseline vs alternative management options)	▪ Leads	▪ Provides local information for modelling scenarios (e.g. on extraction of fuelwood)
Interpreting results	▪ Leads – Explains results to communities	▪ May be able to assist with interpretation using local knowledge on forest conditions (e.g. spatial variation in biomass)
Deciding actions	▪ Agrees with communities on any actions	▪ Agrees with experts on any actions ▪ Can choose to withdraw consent for actions at any time
Future monitoring	▪ Proposes monitoring frequency and plays supporting role, including refresher trainings, if needed	▪ Continues to play key roles in monitoring

This section focuses on the importance of engaging and understanding all stakeholders at different stages in the CBFBM process including as part of a feasibility assessment. It includes a session on Free Prior Informed Consent from communities engaged in CBFBM as a key social safeguard. This section captures key knowledge and skills linked with Element 1 of CBFBM and steps 1-4 of the CBFBM process.

LEARNING BLOCK 2

FEASIBILITY ASSESSMENT AND STAKEHOLDER ENGAGEMENT FOR CBFBM

2A   SESSION: CONDUCTING FEASIBILITY ASSESSMENT FOR CBFBM

LEARNING OBJECTIVES:

By the end of the session, participants

- can explain the importance of a feasibility assessment to improve the probability of success of CBFBM
- have identified examples of the pre-existing and desirable conditions that need to be in place before proceeding with CBFBM
- have preliminarily assessed their own sites and listed steps to gather more information, if needed

MATERIALS:

copies of the '20 Feasibility Elements' slips for each group in a container or envelope; PowerPoint slide of the '20 Feasibility Elements'

TIME:

60 minutes

STEPS:

1. Introduce the session by referring participants to the CBFBM process flip chart on the training wall. Explain that this session will focus on the first step of Element 1 and will determine whether CBFBM is suitable or likely to be successful by analysing the existing context.
2. Ask the participants why they think it's important to have a feasibility assessment. Briefly write their answers on a flip chart.
3. Explain that the objective of the next exercise is for participants to think critically about what elements need to be in place for CBFBM to succeed. Split the participants into small groups of 4-5 members. Place cut-out slips of each of the '20 Feasibility Elements' from Exercise 1 in an envelope or container. Give each group a set of slips and explain that they must discuss which of the slips they think are essential pre-conditions for CBFBM and which are only desirable.
4. Instruct the groups to stick the slips on a flip chart under the headings "Essential" and "Desirable" and provide a clear reason to justify how that element will contribute to the success of CBFBM.
5. Ask the groups to paste their charts side by side on the wall. Go through each element and where each group placed it with their reasons and clarify the position according to the hand-out.
6. Explain that it is important that each participant can understand how to apply a feasibility assessment to their own context. Tell them that next they will be using the '20 Feasibility Elements' to assess a site or project that they are working on or familiar with. If they are not directly involved in a project or site, they can choose to either use a project/site they are familiar with, or join with another participant who is directly involved in a project/site.
7. Distribute Exercise 2 and ask each participant to fill Tables 2A-1 and 2A-2 carefully, following the exercise instructions. Any participants working within the same project site should work together on this exercise. If all participants are from one project, it may be worthwhile breaking them into two groups to ensure each person fully participates.
8. Explain that the exercise is used for personal planning and assessment so you won't be going through everyone's exercise in detail. In plenary go around the groups asking one or two participants to each share:
    - *A feasibility element they felt was already in place in their project, and why they felt it was already in place*
    - *A feasibility element they felt wasn't yet in place, and the corrective actions that could be taken to remedy this*

> ▪ *A feasibility element they didn't know whether or not was in place and the methods or tools they might use to find this out*

9. This isn't a 'right or wrong' exercise, though if the reasoning described by participants doesn't seem logical, probe a little further and propose an alternative perspective if appropriate.

10. Wrap up the session by emphasising the importance of feasibility assessment for enhancing the probability of success of a CBFBM initiative.

WHY IS A FEASIBILITY ASSESSMENT FOR CBFBM NEEDED?

Assessing the feasibility of CBFBM in a structured manner prior to implementation is important for the following reasons:

To target time and resources effectively

Conducting a feasibility assessment will almost certainly save time and resources later. Moving forward with CBFBM without a feasibility assessment runs the risk that all actors invest time and resources in starting up CBFBM activities, only to find there are barriers arising which can delay, reduce the effectiveness or stop the CBFBM process altogether. If this happens then time and resources have been wasted, and it may erode goodwill and trust amongst all the actors involved.

To reduce the potential risks from CBFBM and improve project design

Even if a feasibility assessment determines that the project is feasible, there may still be risks present and a feasibility assessment can provide an early indication of what these risks may be. This in turn can inform the design of the CBFBM project to take these risk areas into account.

To compare and select project sites

If there is more than one potential site to implement CBFBM, a feasibility assessment is a useful way to compare potential sites.

HOW DOES FEASIBILITY ASSESSMENT FIT INTO THE CBFBM PROCESS?

Feasibility is the first step of the CBFBM process as it determines whether or not it is viable to continue the process. However feasibility needs to be continually monitored.

Figure 2A-1. CBFBM design elements and steps

THE 20 FEASIBILITY ELEMENTS

Below are 20 feasibility elements for CBFBM – 13 of which are considered as 'essential' prerequisites to the implementation of CBFBM and seven of which are considered to be 'desirable' but not fundamental to the feasibility of CBFBM. Print a copy of each of these in enlarged font and place in an envelope for each group.

ESSENTIAL ELEMENTS

1. Legal and political feasibility

Agreement from the national or local government to conduct community consultations and trainings in the target area

The community has legal tenure rights over the target forest resource

The community has management rights over the target forest resource

2. Resource and financial feasibility

The community has sufficient time available to attend CBFBM meetings and trainings

The community has legal tenure rights over the target forest resource

The community has management rights over the target forest resource

3. Operational feasibility

The project is in an area where REDD+ activities would be additional and likely to lead to carbon emissions reductions

There is a designated contact person available within the community to lead the CBFBM process

There is access to the appropriate translation or local language staff in order to communicate effectively with the community

Free, Prior and Informed Consent has been given by the community for CBFBM activities

4 Cultural feasibility

There are no identifiable or significant cultural, political or social divisions or conflicts amongst the community which may be reinforced by a CBFBM project

The prevailing cultural norms or values do not prohibit the quantification or commercialisation of forest resources

The community is willing to work together on common interests

DESIRABLE ELEMENTS

5. Legal and political feasibility

A legally registered community forestry user group or equivalent is in place

6. Resource and financial feasibility

The community currently keeps forest inventories

The community actively manages their forest resources

7. Operational feasibility

There are local intermediaries, such as local civil society organisations or NGOs currently working with the community

The community has worked with civil society organisations and NGOs before

8. Cultural feasibility

Cultural norms and values allow access to most or all of the forest resources at any time of the year

Cultural norms or values allow women to actively engage in public meetings, forest management activities and trainings provided by people outside of the community

2A | EXERCISE 2: CONDUCTING FEASIBILITY ASSESSMENT FOR CBFBM

EXERCISE

FEASIBILITY ASSESSMENT FOR YOUR OWN PROJECT/SITE

Fill in the following tables for your own project site or one that you are familiar with.

If the feasibility element is present (Y (=yes)) then no further action is required. However if the answer is no (N) please suggest what actions you propose taking in the third column. If you do not know whether this feasibility element is in place or not, write down how you propose finding out whether or not it is in place.

Table 2A-1: Self-assessment of essential feasibility elements

FEASIBILITY ELEMENT	PRESENT? (Y/N/ NOT KNOWN)	PROPOSED ACTIONS IF ELEMENT NOT PRESENT OR INFORMATION ABOUT ELEMENT IS LACKING
ESSENTIAL		
Legal and political feasibility		
Agreement from the national or local government to conduct community consultations and trainings in the target area.		
The community has legal tenure rights over the target forest resource		
The community has management rights over the target forest resource		
Resource and financial feasibility		
The community has sufficient time available to attend CBFBM meetings and trainings		
The community has legal tenure rights over the target forest resource		
The community has management rights over the target forest resource		
Operational feasibility		
The project is in an area where REDD+ activities would be additional and likely to lead to carbon emissions reductions		
There a designated contact person available within the community to lead the CBFBM process		
There is access to the appropriate translation or local language staff in order to communicate effectively with the community		
Free, Prior and Informed Consent has been given by the community for CBFBM activities		

FEASIBILITY ELEMENT	PRESENT? (Y/N/ NOT KNOWN)	PROPOSED ACTIONS IF ELEMENT NOT PRESENT OR INFORMATION ABOUT ELEMENT IS LACKING
Cultural feasibility		
There are no identifiable or significant cultural, political or social divisions or conflicts amongst the community which may be reinforced by a CBFBM project		
The prevailing cultural norms or values do not prohibit the quantification or commercialisation of forest resources		
The community is willing to work together on common interests		

Table 2A-2: Self-assessment of desirable feasibility elements

FEASIBILITY ELEMENT	PRESENT? (Y/N)	PROPOSE ACTIONS IF ELEMENT NOT PRESENT OR INFORMATION ABOUT ELEMENT IS LACKING
DESIRABLE		
Legal and political feasibility		
A legally registered community forestry user group or equivalent is in place		
Resource and financial feasibility		
The community currently keeps forest management inventories		
The community actively manages their forest resources		
Operational feasibility		
There are local intermediaries, such as local civil society organisations or NGOs currently working with the community		
The community has worked with civil society organisations and NGOs before		
Cultural feasibility		
Cultural norms and values allow access to most or all of the forest resources at any time of the year		
Cultural norms or values allow women to actively engage in public meetings, forest management activities and trainings provided by people outside of the community		

2B SESSION: FACILITATING STAKEHOLDER MAPPING FOR CBFBM

LEARNING OBJECTIVES:

By the end of the session, participants

- can explain the definition of stakeholder in the context of CBFBM
- have shared their experience of the value of stakeholder analysis in the past and differentiated it for the context of CBFBM
- have used the 4Rs matrix and relationship mapping diagram to analyse stakeholders in their own CBFBM sites based on existing knowledge
- have identified implications for CBFBM design and implementation based on stakeholder analysis and framework for ongoing stakeholder engagement

MATERIALS:

flip chart or PowerPoint slide with templates for the tables in steps 4 and 7 pre-prepared

TIME:

90 minutes

STEPS:

1. Introduce the session by writing the word "stakeholder" on a flip chart and asking the participants what it means in the context of CBFBM. Ask participants to share their own experience of conducting stakeholder analysis and for what purposes they have done it in the past.
2. Refer the participants to the CBFBM process diagram with the Elements and the Steps. Highlight that stakeholder analysis is the second Step of the first Element and that this session will zoom in on that Step.
3. After the group has answered and there is a clear understanding of the term "stakeholder" ask each participant to individually list all of the different stakeholder groups in their project site that have a 'stake' in CBFBM. Ask participants to work in pairs or trios based on common project sites to identify a list of key stakeholders for their project.
4. Explain to the participants that you will now be introducing a tool that is helpful to analyse the different stakeholder groups in a specific situation. This tool is called the 4Rs. Ask participants if anyone has heard of the 4Rs. Explain that the 4Rs stand for 'Rights', 'Relationships', 'Responsibilities' and 'Revenues' for stakeholder groups.
5. State that in practice 4Rs analysis comprises two components: assessment of the balance of three of the Rs (rights, responsibilities and revenues) between stakeholders and assessment of the status of the fourth R – relationships-between stakeholders. Explain that you will start with the first component.
6. Take one example from the list of the stakeholders identified by the participants and in plenary work through one example applying the first component.
7. Break into groups and have the participants note down the 3Rs for each stakeholder on their list using a flip chart format that you provide of the 3Rs table (refer to Table 2B-1 in the hand-out).
8. After the participants have finalised their 3Rs table or at least completed a number of examples, have each report back in plenary.
9. Give each group a format for the relationships table (Table 2B-2 in the hand-out) and tell them to fill in the table according to the stakeholders they have already analysed explaining that the stakeholders should be written across the top and down the side of the table in the same order. Ask them to assess the quality of the relationship between "good", "fair" and "poor". Give them 20 minutes to complete this as far as they can in the time allocated.
10. Ask the groups to display their outputs on the wall with the 3Rs and the relationship analysis next to one another. Provide a few minutes for the participants to look at the other groups' outputs.
11. Bring all the groups back into plenary and ask the following reflection questions. From the analysis using the 4Rs framework:

- *How did you feel using this tool and what made you feel that way?*
- *What did you find difficult and what did you find easy?*
- *How could this analysis help us with designing our engagement process for CBFBM?*
- *Which stakeholders should we engage first and why?*
- *Which stakeholders would support CBFBM and how could we use them in the engagement process?*
- *Which stakeholders might be less supportive, why and how could we engage them?*
- *Which relationships may influence the success or failure of the CBFBM process and why?*
- *What do you see as the main practical benefits of stakeholder analysis for CBFBM?*
- *At what stage in the CBFBM process should the stakeholder analysis be conducted?*
- *What could be the implications of not conducting a stakeholder analysis? If you know the site very well do you still need to conduct a stakeholder analysis?*
- *Who should conduct the stakeholder analysis in the context of CBFBM?*

12. Conclude by mentioning that each participant is encouraged to go through the 4Rs tool more thoroughly when they return to their project and facilitate the process with others, as often stakeholder analysis is best done with the participation of key stakeholders. Further guidance on the tool is provided in the hand-out. While ideally stakeholder analysis will be done before a project is implemented, it is also very useful to use mid-way or even at the end of a project to help analyse challenges the project has faced and develop effective solutions for stakeholder engagement.

2B   HAND-OUT: FACILITATING STAKEHOLDER MAPPING FOR CBFBM

HAND-OUT

CBFBM STAKEHOLDERS

WHO ARE CBFBM STAKEHOLDERS?

The key stakeholder groups in CBFBM include the following:

- Community leaders (could be several and may not always share common interests)
- Community members (should be broken down into smaller stakeholder groups that will be affected differently by the CBFBM, e.g. women, men, youth, ethnic minorities)
- Implementing organisations
- District/municipal/province/state governments
- Forestry departments
- Local civil society groups
- Local NGOs
- Project funders or investors
- Surrounding communities

THE IMPORTANCE OF STAKEHOLDER ANALYSIS IN CBFBM

Conducting a stakeholder analysis prior to the planning and implementation of CBFBM is very important, as the results of the analysis will inform and greatly improve the planning process for CBFBM and increase its chances of success. Stakeholder analysis will help determine what your process for engaging with stakeholders will be, and from whom and in what order you may need to gain consent or approvals in order for the project to go ahead.

For this reason stakeholder analysis is included as an explicit step in the CBFBM process. However it is important to be clear that stakeholders are being analysed with a focus on the CBFBM rather than general "project" engagement. If the stakeholder analysis is not focused on CBFBM it will be less valuable in designing a stakeholder engagement plan.

Figure 2B-1. CBFBM design elements and steps

Once the stakeholder engagement plan has been completed, information from the stakeholder analysis can then inform and improve the design of how CBFBM is actually implemented. For example if it is found that there is an active and capable local civil society organisation already working in the area, it may make sense to partner with them in order to deliver CBFBM training to the target community.

Presentation on community-based forest monitoring to Gunung Kidul forestry office, Java, Indonesia

Following on from implementation planning, stakeholder analysis has an important role to play in forming plans for the sustainability of CBFBM and how the project may be expanded in the future. For example, if there is a local government extension and training service, it could be engaged to continue providing the target community with technical guidance and advice on CBFBM.

THE 4RS TOOL
(Adapted from the International Institute for Environment and Development (IIED), 2005. The Four Rs)

The 4Rs is a tool for analysing stakeholder roles in a given situation. It unpacks the role of each stakeholder into rights, responsibilities and revenues, and then assesses the relationship between stakeholder groups.

In practice 4Rs analysis comprises two components: assessment of the balance of three Rs (rights, responsibilities and revenues/returns) both within and between stakeholders; and assessment of the status of the fourth R – relationships – between stakeholders.

ANALYSIS OF THE BALANCE OF STAKEHOLDERS' 3RS
It is important to assess the 3Rs together rather than separately, and both within and between stakeholder groups. This is because it is the balance between stakeholders' rights, responsibilities and revenues that provides a good indication of the underlying power structures and of the current incentives or disincentives for stakeholders to engage in CBFBM. For example high levels of responsibility without a parallel increase in incentives (e.g. returns, revenues and rights) is unlikely to be sustainable in the long term as community members become de-motivated to continue with CBFBM. Table 2B-1 shows a summary analysis of the 3Rs in the context of a hypothetical CBFBM project.

Table 2B-1: Example summary of rights, responsibilities, revenues and relationships in a CBFBM project

STAKEHOLDERS	RESPONSIBILITIES	RIGHTS	REVENUES
Community leaders	▪ Welfare of community including stewardship of community resources for future generations ▪ Overall leadership on CBFBM ▪ Decision-making on whether and how to participate in CBFBM ▪ Assigning community members to participate in the CBFBM training, and others to take over their normal responsibilities	▪ *To make decisions on CBFBM on behalf of the community ▪ *To organise the community for CBFBM	▪ Income from forest management, including REDD+, as per agreements within community and with outsiders

STAKEHOLDERS	RESPONSIBILITIES	RIGHTS	REVENUES
Community members	▪ Maintaining and improving the wellbeing of their households ▪ Roles they have agreed to take on in CBFBM ▪ Roles they have agreed for forest management	▪ To contribute to and be heard in the discussion on CBFBM design and implementation	▪ Income from forest management, including REDD+, as per agreements within community and with outsiders
Facilitating organisation	▪ Executing the FPIC process for CBFBM properly ▪ Adequately engaging all stakeholders ▪ With consent, designing CBFBM in a participatory, fair and effective manner ▪ Reporting to project donors and government agencies	▪ To be treated in accordance with national law	▪ Income from donors ▪ Income from forest management, including REDD+, as per any agreement with community
Forestry Department	▪ Ensuring the effective and sustainable management of forest resources ▪ Providing guidance and support to community members according to their mandate ▪ Providing support for CBFBM according to any agreement with community and facilitating organisation	▪ To be treated in accordance with national law	▪ Funding allocated from the national government budget
District government	▪ Governing the district ▪ Ensuring the well-being of district citizens, including checking the appropriateness of CBFBM	▪ To govern the district in accordance with the rules and laws of the country	▪ Funding allocated from the national government budget and local taxation
Local civil society group	▪ To promote the interests and well-being of local community members	▪ To carry out their work free from harassment ▪ To be treated in accordance with national law	▪ Income from donors
Bilateral donor	▪ To provide timely funding resources as agreed with the facilitating organisation	▪ To receive accurate project and funding reports of sufficient detail in a timely manner ▪ To reserve or withdraw funding if conditions of the funding agreement are not met	▪ Budget allocated from the donor country treasury

ANALYSIS OF THE RELATIONSHIPS BETWEEN STAKEHOLDERS (THE FOURTH R)

In order to plan the implementation of a CBFBM project it is important to assess the basic nature of the relationships between different stakeholders. This will help show where there are opportunities to collaborate, and positive relationships that can be used for the project's benefit. It will also help identify where relationships are poor and where cooperation or agreement between different stakeholders may not be possible in the short term, and where extra work may be required. To start with it is worth mapping out where relationships are 'Good', 'Fair' and 'Poor' between the different stakeholders. Table 2B-2 provides a summary of stakeholder relationships in a hypothetical CBFBM project.

Table 2B-2: Example summary of stakeholder relationships in CBFBM

RELATION-SHIPS	COMMUNITY LEADERS	COMMUNITY MEMBERS	IMPLEMENT-ING ORGAN-ISATION	FORESTRY DEPART-MENT	DISTRICT GOVERN-MENT	LOCAL CIVIL SOCIETY GROUP	BILATERAL DONOR
Community leaders							
Community members	Fair						
Implement-ing organisa-tion	Good	Good					
Forestry department	Poor	Poor	Fair				
District government	Fair	Poor	Good	Poor			
Local civil society group	Good	Good	Fair	Poor	Poor		
Bilateral donor	-	-	Good	-	-	-	

Once this basic analysis has been done, further analysis of relationships can be carried out to determine the following:

- *Strength of relationships*, relating to the frequency and intensity of contact
- *Formality of relationships*; certain types of informal relationships may allow stronger groups to impose their views on more vulnerable groups, and may make external interventions less likely to achieve tangible impacts
- *Dependence* between stakeholders: for example, in a business-type dependency, a 'referee' may be required to ensure that parties with less bargaining power are not cheated.

ANALYSING THE RESULTS OF THE 4RS TOOL

Results from the 4Rs tool can then be used to inform how you plan and implement a CBFBM project. Initial questions to ask yourself include:

i. From the findings of the shared 4Rs analysis, in what order should the different stakeholder groups be engaged? (you may wish to engage with different stakeholder groups at the same time)
ii. From which stakeholders do we need approval or consent?
iii. Which stakeholders are likely to support the CBFBM process? How might we engage them to take full advantage of their support?
iv. Which stakeholders might oppose the CBFBM process? Does this matter and if so how we might engage them to reduce their opposition and encourage their support of CBFBM?
v. How might the relationship between different stakeholders affect how we implement the project? (E.g. if a civil society organisation has a good relationship with the community, but a poor relationship with the district government, should we partner?)

Background on the 4Rs tool: The 4Rs framework was developed as part of the Capacity Development for Sustainable Development in Africa Project carried out by the International Institute for Environment and Development (IIED) and collaborating partners in six African countries, supported by the Danish International Development Agency (DANIDA). IIED and its partners developed and tested the framework with a view to clarifying the roles of stakeholders as a prerequisite to developing capacity needs. (http://pubs.iied.org/7537IIED.html)

2C SESSION: INTRODUCING COMMUNITIES TO CLIMATE CHANGE, CARBON, AND REDD+

LEARNING OBJECTIVES:

By the end of the session, participants
- have reviewed their experience of communicating with communities based on adult learning principles
- have identified key technical principles on climate change, carbon and REDD+ that are essential for communities to understand in relation to CBFBM application
- have designed a presentation/activity to ensure understanding of key technical principles by all stakeholders including communities in relation to explaining the objectives and CBFBM process
- have received feedback on the presentation/activity and revised accordingly.

MATERIALS:

flip charts; marker pens; hand-outs

TIME:

90 minutes

STEPS:

1. Explain that this session will focus on providing communities with the introductory knowledge they need to have to fully understand the purpose of CBFBM. This introductory knowledge could include knowledge on climate change, carbon and REDD+.
2. Refer the participants to the CBFBM process diagram with the Elements and the Steps and ask the participants where they think they should spend time introducing this knowledge to the communities. Explain that the information may be presented and discussed at different times in the process as it will help communities provide their initial consent (Element 1 Step 3), and it will also help communities better define their own objectives for the CBFBM (Element 2 Step 1). Explain that towards the end of the session how and when different information should be presented will be discussed for the participants' own CBFBM design table.
3. Prior to this session, you may have taken the participants through the principles of adult learning that are covered in Session 4a Linking adult learning principles and CBFBM. List the principles on a flip chart.
4. Explain that you would like to use a visualisation exercise to explore participants own understanding of climate change and explore a different technique for sharing ideas and knowledge. Give each participant a blank piece of A4 paper and a marker and ask them to draw a picture of climate change based on their own experience. Tell them they are not allowed to use words.
5. Ask them to form groups of 4-5 people and share their pictures and after 5-10 minutes ask them to explore what their drawings had in common and formulate a statement of not more than 10-12 words to describe what climate change is.
6. Ask them to paste their pictures and their statements on the wall of the training room and compare theirs with others.
7. Reflect with the group in plenary asking the following questions:
   - *What is similar between your pictures and why?*
   - *What is different and why?*
   - *Do the statements reflect the pictures? How?*
   - *What is the emphasis of your pictures and why?*
   - *What do these pictures tell us about your collective understanding of climate change?*
   - *How different would these pictures be if we had asked a group of community members to draw?*
   - *What could be the value of asking communities to visualise and share their experience to help improve their shared understanding of a science behind a process like climate change?*

- *How can we ensure communities accurate understanding of climate change building on their own experience?*

8. After reflecting on the visualisation exercise ask the participants in the same groups to think about the kind of knowledge communities will need to have to help them better understand the purpose and potential benefits and risks of CBFBM.

9. Ask the participants in the same group to brainstorm all the information they think the community must know and write one specific fact or area of knowledge on one meta card. Explain that they should just freely brainstorm and that there will be a filtering process later on. Have the group to write down their ideas on to cards.

10. After the brainstorming explain that the participants should use a critical filter to consider what the community really "needs to know" versus what is "nice to know" in relation to explaining the context and concept of CBFBM.

11. After they have filtered the cards and have a number of cards which are "essential" explain that you would like them to make a storyboard of a presentation that they would make to explain to a community the essential knowledge they identified. (Refer to the template provided in the Exercise).

12. Explain that to do this they should have a beginning, middle and an end, and limit the panes in their storyboard to 6 panes.

13. Using the 6 pane format of a storyboard that you provide as a trainer demonstrate to the participants how they can sequence their meta cards to ensure the information they provide communities flows in relation to telling the story about CBFBM and covers the essential knowledge listed earlier. Emphasise that this stage is just about sequencing of information not methodology.

14. After each group has made their storyboard, paste all the flip charts on the wall and ask the groups to circulate giving comments on the filtering of essential information and checking the logic of the story and information flow. Each group can provide key questions or feedback on the others' work.

15. After circulating, give each group a chance to respond to the comments provided and then ask the groups to think about what activities or method they would use based on adult learning principles to ensure effective communication and participation of the communities during the session.

16. Ask each group to build up their storyboard further incorporating their ideas for methodology. Before the participants split ask the group what timeframe would be appropriate for a session or sessions with communities of this type and to bear this in mind during their design.

17. Give each group 15 minutes to think about how they would interact with communities in the different panels of their storyboard. After they have identified some methods and ideas bring them together to present to each other.

18. After they have shared between the groups ask the participants which ideas they like the best and why? If the group has the scope to practice making a presentation to a potential CBFBM community try to come to consensus on the storyboard and methods and provide time for the group to prepare based on clear roles and responsibilities in their field team.

19. Wrap up the session by emphasising the need to apply adult learning principles at all stages during the CBFBM process but highlighting the need to prepare well for any basic foundation explanation that will be laid at the beginning of the process.

TRAINING TIPS:

Use your discretion based on the background of the group in terms of shaping the context of the presentation for the communities. The materials and the process will need to be as simple and focused as possible. If you think the participants may find it difficult to come up with ideas for teaching communities on more technical issues such as carbon and REDD+, you might wish to prepare some

ideas in advance to share with them during the session to prompt their thinking. You can refer to *A training of trainers manual for REDD+: For community level facilitators* (see Further Resources below).

You can also ask participants to fill in their finalised ideas for what information should be presented where in their CBFBM design tables depending on the specific training scenario at hand.

FURTHER RESOURCES
A training of trainers manual for REDD+: For community level facilitators.
Shambhu D., B.H. Paudyal, & Luintel, H. (2012).
Bangkok: RECOFTC - The Centre for People and Forests.
http://www.recoftc.org/site/resources/REDD-ToT-Manual-for-Community-level-Facilitators.php
Note: This training manual has been prepared to address the needs of facilitators, helping them understand and explain REDD+ in simple language.

Beginning
What will you start with…………..
List the key learning points in the
storyboard format.

What methods will you use for each
pane of the story board?

End
How will you finish?

2D SESSION: FREE PRIOR INFORMED CONSENT (FPIC) AND SOCIAL SAFEGUARDS FOR CBFBM

LEARNING OBJECTIVES:

By the end of the session, participants

- can explain what is Free Prior Informed Consent and why it's important in CBFBM
- have identified and shared some potential key risks to the community from CBFBM
- have identified potential strategies to address the risks that can be integrated into the CBFBM process
- have reflected on and completed an assessment of FPIC in their own field sites including corrective actions to be taken in the future

MATERIALS:

copies of the case study (optional); copies of the hand-out; flip chart or white board and markers

TIME:

90 minutes

STEPS:

1. Introduce the session by asking participants if any of them has experience or knowledge of the principle of Free Prior Informed Consent and/or Social Safeguards. If the participants have experience, ask them to share some examples relating to REDD+, other projects or CBFBM.
2. Ask the participants if they can explain the key values behind the principles of social safeguards and ask them why such principles are important in relation to CBFBM? If there is no relevant experience, explain that social safeguards are sets of agreed principles and practice that are used to "prevent and mitigate undue harm in a development process". Explain that Free Prior Informed Consent is an important form of social safeguard that ensures the power of decision-making is with the communities concerned.
3. Briefly explain the principle of FPIC based on the hand-out, emphasising the difference between consultation, participation and consent. Ask participants why FPIC is an important element of CBFBM?
4. Explain that communities and other stakeholders can only make an informed decision on whether CBFBM should go ahead if they are aware of the risks as well as benefits of CBFBM. Emphasise that unpacking both risks and benefits of CBFBM is part of the "informed" element of FPIC.
5. Ask the group to split into pairs and list the potential risks or negative impacts of CBFBM relating it to their own experience or project context. Reiterate that you are not asking them to identify "risks of project failure" but risks to specific stakeholders from conducting CBFBM.
6. After a few minutes ask each pair to share one risk from their list and write it down on a flip chart. Explain that if a risk has already been mentioned there is no need to mention it again. After all the pairs have shared one risk you can add further risks from the group or yourself. Discuss the risks in plenary and ask the participants what kind of strategies need to be in place to eliminate these risks. Link this back to feasibility assessment if you have already covered this session.
7. Ask the participants in the same groups to assess their own project's experience of implementing FPIC. Provide a template (FPIC Assessment Table in the hand-out) written on a flip chart and ensure all participants have a common understanding of the four key elements before you start the exercise.
8. Ask each group to go through each of these four FPIC components, reflecting on where their project has performed well and the areas that require corrective action. Ask them to identify specific actions that have been carried out or could be done by the project to ensure consent is achieved.
9. After about 20 minutes ask the groups to paste their flip charts on the wall next to one another. Encourage the other participants to view other groups' work.
10. Bring the group back into plenary and ask the following reflection questions:

- *What aspects of FPIC do we agree we have done well in our project and what have been the benefits?*
- *What aspects of FPIC do we need to improve and why?*
- *What do we need to prioritise in the future and why?*
- *Whose responsibility is it to implement FPIC adequately in your project and why?*

11. If all your participants are from the same project area it is worth spending some time on collective reflection as the tables can form the basis of an FPIC strategy for the future. Note the agreed key strategies and agree a timeframe and responsible position/organisation for follow up.

12. Wrap up the session by asking participants to summarise what they consider to be the key benefits of gaining FPIC in relation to CBFBM. Revisit the CBFBM design process chart and highlight that FPIC is Step 3 of Element 1 so should be raised at an early stage although in practice consent would need to be monitored throughout the process. Emphasise that FPIC is considered international best practice and should be an integral part of the participatory process that is the foundation for CBFBM. Communities themselves can be engaged in a participatory risk analysis in the early stages of the CBFBM process.

TRAINING TIPS:

Participants may find it difficult to think of the risks that CBFBM itself poses to communities, and instead may just refer to the risk that the CBFBM process itself fails. A case study could help and is provided in the hand-out for optional use in Step 5.

2D | HAND-OUT: FREE PRIOR INFORMED CONSENT (FPIC) AND SOCIAL SAFEGUARDS FOR CBFBM

HAND-OUT

WHAT IS FPIC AND HOW DOES IT APPLY TO CBFBM?[1]

Village radio raising awareness on climate change and community-based forest monitoring, Semoyo, Java, Indonesia

WHAT IS FREE, PRIOR, AND INFORMED CONSENT (FPIC)?

FPIC can be described as the establishment of conditions under which people exercise their fundamental right to negotiate the terms of externally imposed policies and activities that directly affect their livelihoods or wellbeing, and give or withhold their consent.

FPIC is about indigenous communities and local people having a specific right that others should respect. It is a collective right. This means a community as a whole has the right to give or deny its Free Prior and Informed Consent.

Each part of the term has important meanings for a community. The following is an explanation of what each term means:

FREE
Free means free from force, intimidation, coercion, or pressure by anyone.

PRIOR
Prior implies that consent has been sufficiently sought in advance of any authorisation or commencement of any project. Also, local communities must be given enough time to consider all the information and make a decision.

INFORMED
Informed means that the community must be given all the relevant information to make its decision about whether to agree to the project or not.

CONSENT
Consent requires that the people involved in the project must allow indigenous communities and local people to say "Yes" or "No" to the project. This should be according to the decision-making process of their choice.

WHAT IS THE DIFFERENCE BETWEEN FPIC AND STAKEHOLDER CONSULTATION AND NEGOTIATION?
Consent is an outcome of a process. The process may involve consultation and negotiation, but consent itself is an opportunity to say 'yes' or 'no' to a proposal or project. Consent may be required at several points in a project cycle, and when consent is not reached, negotiation will be required. Consultation involves facilitating a process to both inform and receive feedback from the people about

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[1]   Extracted form Edwards, K, Triraganon, R, Silori, C and Stephenson, J (2012). *A Training Manual: Putting Free, Prior, and Informed Consent into Practice in REDD+ Initiatives.*

the proposal; negotiation is where conditions are proposed and compromises are made by different parties. Consent remains the point at which people have the power to say 'yes' or 'no.'

FPIC AND CBFBM

Community-based monitoring provides the communities with information on their forest resources, which enables them to make informed decisions about the management of these resources. In this sense, CBFBM provides the communities with the information for FPIC (it is the "I" in FPIC) in relation to their decisions on forest management. At the same time, FPIC principles also apply to the design and implementation of the CBFBM itself. When local level facilitators and communities are working together to develop any community-based monitoring system, efforts are required to ensure that the communities fully understand all elements of the system. Some elements will be highly technical and unfamiliar to the community members, and without a proper understanding of the reasons for these elements, the communities cannot participate in the design process and the monitoring in a fully informed manner.

FPIC is Step 3 in the first Element of the CBFBM design process but it is likely that it will be ongoing throughout the process and the project managers will need to ensure consent is continually monitored.

Figure 2D-1. CBFBM design elements and steps

Some possible risks to communities from CBFBM initiatives that were identified by facilitators of existing CBFBM systems include:
- Misunderstanding of the project
- Expectations too high
- Lost opportunities and income as carbon markets are unreliable
- Reduced confidence in partners because of lack of tangible benefits
- Conflict within and between communities

FPIC ASSESSMENT TABLE

For a project you are involved in, or one you are familiar with, use the FPIC Assessment Table to note areas where you believe the project has performed highly against each FPIC component and areas for improvement.

FPIC ELEMENT	WHAT HAS YOUR PROJECT DONE WELL?	WHAT NEEDS TO BE IMPROVED?
FREE Free means free from force, intimidation, coercion, or pressure by anyone (it can be a government, company, or any organisation).	List your actions………….	List potential actions……….
PRIOR Prior implies that consent has been sufficiently sought in advance of any authorisation or commencement of any project. Also, local communities must be given enough time to consider all the information and make a decision.	List your actions………….	List potential actions……….
INFORMED Informed means that the community must be given all the relevant information to make its decision about whether to agree to the project or not	List your actions………….	List potential actions……….
CONSENT Consent requires that the people involved in the project must allow indigenous communities or local people to say "Yes" or "No" to the project. This should be according to the decision-making process of their choice.	List your actions………….	List potential actions……….

CBFBM RISKS CASE STUDY

An international NGO is funded to carry out community awareness raising and training on CBFBM in a remote area of Peru they haven't worked in before. There is no current REDD+ project or other forest climate mitigation projects in or near the area they are targeting. The forest in the target project area is not suffering from significant deforestation or degradation pressure apart from sustainable non-timber forest product extraction. The area is mountainous and 10 hours' drive from the nearest town with only dirt roads leading to it.

The NGO decides against partnering with local civil society organisations, as they feel they don't have sufficient capacity to help. Instead they go directly to the largest village they have identified on the map, without sending letters or communications beforehand. On entering each village they ask to speak to the village leader and explain that they will give a training course on community monitoring for REDD+. Each village leader is happy to see NGO support and welcomes them, though they don't have the English language skills to be able to fully understand them. The village leader handpicks the participants in the training, all of whom are either sons or nephews of the leader.

Over the course of the next week, trainers from the NGO implement a course of CBFBM training for the participants, using training materials they have developed themselves, without external peer review. Each participant is very happy to receive the training and to know how to count all the carbon they can sell from their forests. The NGO trainers complete their course and return to their HQ office, agreeing to come back in six months' time for follow-on training.

Six months later the NGO returns to the village and can see fences around forested areas near the village that weren't there before. When they come to meet the village leader he is very proud to tell them that they have successfully kept other villagers out of the forest for the past six months and ask the NGO to now pay them for the carbon credits they are owed. The NGO workers are surprised, and reply that there has been a misunderstanding; all they were doing was training the community on how to account for forest carbon, so that in the future they would be prepared for REDD+.

The village leaders are furious, and accuse the NGO of deceiving them, explaining they have stopped all extractive activities in the forest and have been working hard to keep all the other villagers out. They emphasise how much time has been spent doing this and demand for compensation. The NGO workers say they will go back to their HQ to discuss with superiors, though the village leaders vow never to allow NGOs back into their village again. When back at HQ the Executive Director of the NGO is angry to hear that the planning for the training had been so poor, and that the content of the training was not fit for purpose. The lead trainer is sacked and the junior trainers receive negative performance evaluations at the end of the year.

QUESTIONS

1. *Where the principles of FPIC followed by the NGO?*
2. *What were the negative outcomes for the community?*
3. *What were the negative outcomes for the NGO?*
4. *What strategies could the NGO have used to avoid these negative outcomes?*

This section includes sessions and materials that are the core to the training. It provides an overview framework for setting objectives and quality assessment and control, and guides the step-by-step development of a tabular format design by the participants for detailing the forest biomass assessment and monitoring framework that will be used. This table will include any changes to measurement methods and tools made on the basis of experience from the testing process. It includes basic session plans to facilitate the reflection of participants in translating their own technical knowledge into simple procedures and tools for use by a community based on specific objectives and scientific standards. This section also provides community training tips linked to each technical protocol. These can be used most effectively as part of the technical sessions where, after each session, the participants consider and record how they would train communities as part of their CBFBM design table format. This section refers to key steps and knowledge required for Element 2 of CBFBM and steps 5-10 of the CBFBM process but of course includes aspects of Element 3 in terms of technical training tips.

LEARNING BLOCK 3

TECHNICAL TOOL BOX

3A

SESSION: DEVELOPING A ROBUST CARBON STOCK ASSESSMENT AND MONITORING PLAN

LEARNING OBJECTIVES:

By the end of the session, participants
- can explain the key steps that need to be considered in developing a carbon assessment and monitoring plan
- have reflected on how these steps can be applied in their own CBFBM site
- have started to fill out their CBFBM design table for the carbon stock assessment plan

MATERIALS:

copies of hand-out; flip charts or whiteboard and markers

Optional: Copies of
- Standard Operating Procedures for Terrestrial Carbon Measurement (Winrock International, 2012)
- Sourcebook for Land Use, Land-Use Change and Forestry Projects (BioCarbon Fund; Winrock International, 2005)

TIME:

90 minutes

Steps:

1. Refer the participants to the flow diagram of the CBFBM design process on the training wall and highlight that the following sessions will zoom in on the design, rationale and details of Element 2 and specifically Step 8. Highlight that this session will introduce the basic steps for developing a plan for carbon stock assessment and will use the CBFBM design tables introduced earlier.
2. Explain that you cannot cover in detail how all these steps can be implemented in one session. Further guidance on the steps related to the establishment and measurement of forest sample plots will be provided during later sessions (i.e. other sessions in Learning Block 3: Techincal Tool Box).
3. Provide the participants with the hand-out and explain that this will be an important reference for them when designing their CBFBM system. Point them to the two references discussed at the beginning of the hand-out and explain that these can be very useful when designing the technical elements of the system. (Consider providing these two references to the participants as part of the training materials)
4. Write the words "accuracy" and "precision" on a flip chart and ask the participants if they can explain the difference to you. Provide an explanation of these terms using Figure 3A-1 in the hand-out.
5. Referring to Figure 3A-2 in the hand-out, write the respective steps for developing a robust carbon stock assessment and monitoring sampling plan on the whiteboard/flip chart.
6. Using the technical details provided in the hand-out explain "Step 1 Define the forest boundary". Ask the participants how this step might be applied to their area/project. If necessary, prompt them with the following questions:
   - *What are the boundaries of the area and are these accurately mapped?*
   - *If not, how could they be mapped?*
7. Repeat the above process for each of the remaining forest carbon stock assessment steps described in the hand-out. The following questions can be used to prompt discussion on each of the steps:
   - *Step 2 Stratify the forest: Should the forest be stratified for the sampling of their area? If so, why and how?*
   - *Step 3 Decide which carbon pools to measure: What carbon pools would you recommend for including and excluding from measurement in your area/project? Why?*
   - *Step 4 Determine type, number and location of measurement plots: Do you think permanent*

or temporary plots would be better suited to your area/project? Why?

- ▪ *Step 5 Determine measurement frequency: How frequent should the measurement be for your area/project? Why?*

8. After the participants have considered the details behind the five key steps for their sites, guide them through the key columns of the CBFBM design table for the carbon stock assessment activities which is provided in the Exercise. Explain that this table will be at the heart of their own design process. Provide them with the key carbon assessment activities that are in the first column of the table and ask them to fill in their proposed options, based on the discussions during the session. Tell them that at this early stage in the design, they only need to jot down their basic ideas. They may be unsure about how to approach some of the activities that are listed in the design table, but explain that they should not worry about this as later sessions will go through each of these activities in detail. Also, explain that they can modify the CBFBM design table to reflect their own situation and can feel free to add additional activities. Be clear that they will fill the remaining column on details in the following technical sessions.

TRAINING TIPS:

This session will determine the overall plan for the participants' own CBFBM carbon assessment design. From this session, you will find out which technical parameters need to be the focus of future sessions that are covered in Learning Block 3 Technical Tool Box.

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same areas/project should work together in designing the protocols and community trainings.

The CBFBM design tables can be built up on flip charts on the wall and replicated on computer using MS Excel. Use cards as far as possible when working with flip charts on the wall so that participants can easily change ideas or move them around between columns and rows.

You can show an example of a completed design table so that participants get a feel for what they are aiming for through the course of your training (an example is given in Table 1E-2 of the hand-out for 1e Introducing the design elements of the CBFBM process).

3A EXERCISE: DESIGN TABLE FOR CARBON STOCK ASSESSMENT

EXERCISE

CARBON STOCK ASSESSMENT ACTIVITIES	PROPOSED OPTION	DETAILS	FIELD EQUIPMENT	ROLE OF EXPERTS	ROLE OF COMMUNITIES	COMMUNITY TRAINING NEEDS	OBSERVATIONS DURING TESTS	PROPOSED ADJUSTMENTS
1. Mapping of project boundaries and strata								
2. Sampling design								
3. Placing sample plots in the field								
4. Setting up sample plots								
5. Recording site conditions								
6. Measurement (Further divide this row according to carbon pools (one row for each carbon pool))								
7. Data recording								
8. Data input, management and analysis								
9. Interpretation and sharing of results								

1. INTRODUCTION

To develop a CBFBM system requires good understanding of the fundamentals of forest carbon stock assessment. Two useful references that provide guidance on forest carbon stock assessment are listed below. These references avoid complexity without compromising scientific rigour, so are particularly useful for designing CBFBM systems.

Pearson, T., Walker, S., & Brown, S. (2005). Sourcebook for Land Use, Land-Use Change and Forestry Projects: BioCarbon Fund; Winrock International.
Can be downloaded from: http://www.winrock.org/ecosystems/files/winrock-biocarbon_fund_ sourcebook-compressed.pdf

Walker, S. M., Pearson, T. R. H., Felipe, M. C., Harris, N., Petrova, S., Grais, A., . . . Brown, S. (2012). Standard Operating Procedures for Terrestrial Carbon Measurement: Winrock International.
Can be downloaded from: http://www.winrock.org/ecosystems/files/Winrock_Terrestrial_Carbon_ Field_SOP_Manual_2012_Version.pdf

2. UNDERSTANDING THE CONCEPTS OF ACCURACY AND PRECISION

To understand the steps in forest carbon stock assessment, we must first understand the concepts of accuracy and precision.

For practical reasons it is normally impossible to measure everything in a forest that contains carbon, i.e. every tree, shrub, herb, cubic metre of soil, etc., so we sample these to derive an estimate of the carbon stock. When sampling, we study a subset of the total population. The total population might be all the trees in the forest, all the soil in the forest land containing organic matter, etc., depending on what carbon pools we have decided to measure. From our study of the subset we are able to make an estimate for the total population, and we use statistics to give us an idea of how close our estimate is to reality.

Accuracy and precision are two important statistical concepts for carbon stock assessment. Accuracy is how close our sample estimate is to the actual value. Precision is how well a value is defined. It refers to how closely the results from the various sampling points or plots are grouped. Figure 3A-1 illustrates the concepts of accuracy and precision using shots fired at a bull's eye. In the left bull's eye, the shots are grouped around the centre of the bull's eye, so they are accurate, but they are widely spaced out, so they are imprecise. In the middle bull's eye, the shots are grouped tightly, so they are precise, but they are far from the centre, so they are inaccurate. In the right bull's eye, the shots are both accurate and precise, as they are tightly grouped around the centre.

Figure 3A-1. Understanding accuracy and precision

1. Accurate but not precise

2. Precise but not accurate

3. Accurate and precise

Source: Pearson et al. (2005)

When sampling to estimate carbon stocks, we want measurements to be both accurate (close to the actual value of the entire population) and precise (tightly grouped), so we can have a high level of confidence in our estimates. The number of plots used in the sampling is predetermined to provide the necessary level of precision (more on this below). To understand how accurate our estimate is, we look at the confidence interval. For example, if we use a 95% confidence interval, which is quite common and appropriate for carbon stock assessment (Pearson et al., 2005), we know that 95 times out of 100, the true carbon value lies within the interval.

3. FIVE STEPS FOR DEVELOPING A ROBUST CARBON STOCK ASSESSMENT AND MONITORING PLAN

There are five basic set of steps for developing a robust carbon stock assessment and monitoring plan. These are listed in Figure 3A-2.

Figure 3A-2. Basic steps for assessing and monitoring forest carbon stocks

DEFINE PROJECT BOUNDARIES → STRATIFY PROJECT AREA → DECIDE WHICH CARBON POOLS TO MEASURE → DETERMINE TYPE, NUMBER AND LOCATION OF MEASUREMENT PLOTS → DETERMINE MEASUREMENT FREQUENCY

Source: Modified from Pearson et al. (2005)

If a specific regulatory or voluntary market carbon standard such as the Clean Development Mechanism (CDM), Climate Action Reserve (CAR), American Carbon Registry (ACR), Verified Carbon Standard (VCS), CarbonFix, PlanVivo or other is being targeted, these steps must be elaborated accordingly.

STEP 1. DEFINE THE PROJECT BOUNDARY

The boundaries of the project area in which the carbon assessment will take place need to be clearly defined and properly documented to aid accurate measuring, accounting and verification. The boundaries can be delineated using features on an existing map or a GPS. Carbon standards provide definitions of the project area and these must be followed if targeting a specific standard. For example, for the VCS, the project area must be 100% forested for at least 10 years prior to the start of the project and minimum crown cover must comply with internationally accepted forest definitions, namely the UNFCCC host country forest definitions or the FAO forest definitions.

STEP 2. STRATIFY THE PROJECT AREA

If there are forest areas where you have good reason to believe that carbon densities are different, then stratifying the forest can increase the efficiency of sampling, i.e. lower the costs by reducing the number of sample plots required. This occurs because there is smaller variation in carbon stocks in each stratum than there is in the whole area.

Forest carbon stocks can vary with forest type, soil, disturbance, climate conditions, altitude, etc., so these are the types of factors you should look at when considering stratification. In some cases stratification may be conducted using existing maps, e.g. of vegetation or soils, and in other cases the boundaries of the strata may be demarcated in the field using GPS.

In stratification, the area is first divided into homogenous groups. Monitoring, including sampling and calculations, is then applied to each stratum separately and the results are later compiled to provide a total estimate of the carbon stock.

Stratification should only be conducted up to a point where sampling efficiency increases. For example, if stratifying the forest into four strata increases sampling efficiency, but increasing the number of strata to five decreases sampling efficiency, then the stratification should not exceed four strata.

STEP 3. DECIDE WHICH CARBON POOLS TO MEASURE

Following IPCC Good Practice Guidance, forest carbon pools are divided into three groups and six types (Figure 3A-3):

▪ Group 1: Living biomass. This group includes (1) above-ground trees and (2) non-tree biomass and (3) below-ground biomass or roots.
▪ Group 2: Dead organic matter. This group includes (4) dead wood and (5) litter.
▪ Group 3: (6) Soil organic carbon. This group includes soil carbon.

Figure 3A-3: Forest carbon pools

Which carbon pools are included in the measurement will depend upon any voluntary or regulatory standard that is being used. In general, less significant carbon pools can be excluded using a conservative approach that underestimates the impacts of forest management activities in protecting or enhancing forest carbon stocks. There are two basic rules:

1. Carbon pools can be excluded if the pool will not decrease because of the forest management activity;
2. Carbon pools can be excluded if the pool will not increase as part of the baseline.

For REDD+ and afforestation/reforestation activities, it makes sense to measure and estimate the carbon pool in live trees and their roots for all project activities. The measurement of trees is relatively straightforward and most of the forest carbon is typically located in the living trees. The carbon in tree roots can be estimated using a suitable root-shoot default ratio, so separate sampling of the below-ground living biomass is not necessary.

Above-ground non-tree or understory pools may be worth measuring in cases where they are a significant component of the biomass, such as when the density of trees is low (e.g. savanna), but non-tree vegetation is generally not a significant biomass component in mature forest.

Whether forest litter and dead wood are worth measuring again depends on the state of the forest. They can be significant components of the carbon pool in mature forests, but less significant in young planted forests. In tropical forests, the litter layer is typically thin due to the rapid rate of decomposition. Dead wood is divided into standing and lying dead wood for the purposes of measurement, and a precursory examination of the forest should provide an understanding of whether there are sufficient quantities to merit measurement.

Soil organic carbon can be an expensive pool to measure. Its inclusion will depend upon the amount of carbon in the soil and the rate at which this is expected to change with and without REDD+ activities. The amount of soil organic carbon in mineral soils under tropical forests is typically quite small, but peat soils can contain many times more carbon than the above-ground biomass.

A consideration for CBFBM approaches is that local communities will not be able to measure some of the carbon pools because of the technical difficulty. For example, communities could participate in the collection of soil samples but analysis to estimate soil carbon content would have to be conducted by a professional laboratory.

STEP 4. DETERMINE TYPE, NUMBER AND LOCATION OF MEASUREMENT PLOTS

a. Type of plots

Tree carbon pools

Permanent or temporary plots?
The first decision to take is whether to use permanent or temporary plots. Permanent plots are considered to have more advantages than disadvantages for trees (Pearson et al., 2005). They are statistically more efficient in estimating changes in forest carbon stocks than temporary plots, because there is high co-variance between observations at successive sampling events. In other words, it is easier to distinguish actual trends from differences that are only due to changed plot selection. Permanent plots are also useful when a third party wishes to verify the measurements.

A risk with permanent plots is that the people who receive the payments for enhancing or protecting the carbon stocks may make extra efforts to ensure there is no disturbance of the forest within the plots. In these cases, the plots would no longer be representative of the changes taking place over the entire forest. This risk should be assessed, and, if considered significant, some additional monitoring outside the permanent sample plots could be included in the monitoring design. The IPCC considers it good practice to assess some temporary plots as a control sample in order to determine if the conditions on these plots deviate from the conditions on the permanent plots (IPCC, 2003).

Shape and size of plots
There are various options that should be considered when deciding on the shape and size of plots. Plots can either be circular, rectangular or square shaped, and either single or nested (smaller plots located, or 'nested', within one larger plot). These options are described further in the session on plot dimensions and set up procedures.

Non-tree carbon pools
For the tree carbon pool, the change in carbon stocks can be monitored by re-measuring the trees at future periods. For the non-tree vegetation, litter and soil, re-measurement of the sample is not possible as the process of measurement destroys the sample, because it is it is collected, weighed

and dried in an oven. The samples for the non-tree carbon pools are therefore temporary samples. The sampling location is moved at each census.

b. Number of plots

The number of plots required to reach the desired accuracy and precision in the results must be estimated. To estimate the number of plots required, a pilot sampling survey is conducted to generate information on the variance in carbon stocks in the forest (or in each stratum). The basic steps for estimating the number of sample plots required are as follows:

Step 1: Identify the desired precision level

Pearson et al. (2005) explain that the lower the precision, the more difficult it is to say with confidence that a change has taken place in carbon stocks between two periods. However, the higher the precision, the higher the monitoring costs. They suggest that accurate estimates of the net change in carbon stocks can be achieved at a reasonable cost to within 10% of the true value of the mean at the 95% confidence level. Thus ±10% of the mean is often used as the precision level.

Step 2: Conduct a pilot survey of variance

The number of sample plots used in the pilot survey depends on the conditions of the forest. For 15-20 year old plantation forest, six to ten plots would be sufficient (Pearson et al., 2005). For natural forest, about 15 sample plots should be established in each stratum for the pilot survey (Verplanke & Zahabu, 2009).

Step 3: Estimate carbon stock, standard deviation, and variance from the preliminary data

Step 4: Calculate the required number of plots

When there is more than one stratum (for L strata), the following formula is used:

$$n = \frac{(\sum_{h=1}^{L} N_h \times s_h)^2}{\frac{N^2 \times E^2}{t^2} + (\sum_{h=1}^{L} N_h \times s_h{}^2)}$$

Where:
E = allowable error or the desired half-width of the confidence interval.
Calculated by multiplying the mean carbon stock by the desired precision (that is, mean carbon stock x 0.1, for 10% precision, or 0.2 for 20% precision),
t = the sample statistic from the t-distribution for the 95% confidence level. t is usually set at 2 as sample size is unknown at this stage,
N_h = number of sampling units for stratum h (= area of stratum in hectares or area of the plot in hectares),
n = number of sampling units in the population
s_h = standard deviation of stratum h.

For one stratum, the formula used to calculate the total number of sample plots required is:

$$n = \frac{(N \times s)^2}{\frac{N^2 \times E^2}{t^2} + N \times s^2}$$

This formula can be simplified to:

$$n = \frac{CV^2 t^2}{E^2}$$

Where: n = number of samples,

CV = coefficient of variation,

t = student's t value for the specified confidence interval at a specified degree of freedom,

E = acceptable level of error of the true mean.

Box 3A-1 provides an example of how the total number of sample plots is calculated.

Box 3A-1: Example for single stratum project (using second formula)

Area = 5,000 ha

Plot size = 0.08 ha

Mean stock = 101.6 t C/ha

Standard deviation = 27.1 t C/ha

N = 5,000/0.08 = 62,500

Desired precision = 10 %

E = 101.6 x 0.1 = 10.16

$$n = \frac{(62,500 \times 27.1)^2}{\frac{62,500^2 \times 10.16^2}{2^2} + 62,500 \times 27.1^2}$$

=29 plots

Source: Pearson et al. (2005).

For a forest with more than one stratum, the following formula can be used to distribute the number of sample plots across the strata:

$$n_h = n \times \frac{N_h \times s_h}{\sum_{h=1}^{L} N_h \times s_h}$$

Where:

n = the total number of plots,

n_h = the number of plots in stratum h,

N = the number of sampling units in the population,

N_h = the number of sampling units in stratum h,

s = the standard deviation,

s_h = the standard deviation in stratum h.

For a worked example, see Pearson et al. (2005, p. 17).

For the non-tree carbon pools, the number of sample plots can be estimated by linking them with the tree plots. This is a reasonable approach as the trees are usually the most significant carbon pool (hence most of the total variation in carbon stock is associated with this pool). Pearson et al. (2005) suggest that for each tree plot, a single 100 m line intersect survey for lying dead wood, four clip plots for herbaceous vegetation and the forest floor, and four soil samples would be sufficient (see relevant sessions in 3: Technical Tool Box).

c. Locating the plots

Once the forest boundaries are determined, the sample plots must be located without bias. The plots can be located either randomly or systematically. GIS can be very useful in determining the plot locations and in mapping the locations after the plots are established in the field. Guidance on options for locating plots is provided in session 3e Locating sample plots.

d. Determine measurement frequency

For CBFBM, there are at least two factors that should be considered when deciding the frequency of measurement. First, the measurement frequency should reflect the expected rate of carbon stock change. Forest processes are usually measured over 5-year intervals, but if there are threats to the forests that the REDD+ activity aims to avoid, then the measurement frequency may be much higher.

Second, it is important for the communities to be regularly involved in monitoring in order for them to retain the skills they learnt during the initial training. From this perspective, more frequent monitoring may be considered desirable.

REFERENCES

IPCC. (2003). *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (J. Penman, M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe & F. Wagner Eds.). Hayama: Institute for Global Environmental Strategies.

Pearson, T., Walker, S., & Brown, S. (2005). *Sourcebook for Land Use, Land-Use Change and Forestry Projects:* BioCarbon Fund; Winrock International.

Verplanke, J. J., & Zahabu, E. (2009). *A Field Guide for Assessing and Monitoring Reduced Forest Degradation and Carbon Sequestration by Local Communities*: University of Twente.

3B SESSION: QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

LEARNING OBJECTIVES:
By the end of the session, participants
- will have shared experiences in quality assessment and control in their own projects
- can explain the value of a quality assessment and control strategy in CBFBM
- have identified key strategies on quality assurance and quality control that could be applied in their own situation
- will have drafted a basic plan for their own QA/QC strategy

MATERIALS:
sufficient copies of the technical considerations and protocols; flip charts or whiteboard and markers; laptop computer or exercise book

TIME:
60 minutes

STEPS:
1. Ask participants what they think quality assurance (QA) and quality control (QC) mean. Provide definitions from the Technical Considerations and Protocols. Explain that QA/QC is critical for any forest biomass assessment and monitoring system, and especially important for CBFBM as some people will question the ability of communities to take and record accurate measurements. Explain that the participants must have QA/QC at the forefront of their minds when they are designing every element of their CBFBM system.
2. Ask participants in pairs to brainstorm and consider what could be the potential quality problems arising in a CBFBM process and carbon stock assessment based on their own experience in any team conducting a forest assessment. Ask each pair to share one potential pitfall. This is a short exercise to warm up the participants to think about where quality could be compromised if not closely monitored with various checks and balances.
3. Now that the participants understand what QA means and why it is valuable, ask them what measures they would use to ensure QA is part of their CBFBM system. Ask what measures could be implemented when conducting sampling in the forest and when entering the data into computer software. After they have shared their ideas, take them through the QA section in the technical protocol.
4. Use the same approach for QC.
5. Give the participants about 20 minutes to discuss how they will incorporate QA/QC in their CBFBM designs. Ask them to present their ideas and provide feedback.
6. Have the participants draft notes using a laptop computer or exercise book that they will use later to formulate a procedural document that explains the QA/QC measures they will be implementing in their CBFBM system.

TRAINING TIPS:
The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same areas/project should work together in designing the protocols and community trainings.

QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

Quality assurance refers to the collection and recording of data, whereas quality control refers to checks to ensure the data recorded is accurate or (based on good judgment) appears reasonable. Showing that quality assurance and quality control measures (QA/QC) are in place and are put into practice is particularly important for CBFBM because there are always likely to be some people, especially those from a purely technical forestry background, who will question the ability of local community teams to conduct forest sampling. A procedural document that describes the quality assurance and quality control steps should be developed. Verification records that show that the data recorded is reliable should also be kept.

Bunong communities show that a year after receiving training they are able to set up and measure both square and circular plots, Seima, Cambodia

QUALITY ASSURANCE (QA)
Keys to QA for CBFBM are (i) well-structured training programmes for the communities, (ii) supervision of the community teams when they first begin to do the sampling, and (iii) the establishment of procedures to ensure that data is correctly entered into field sheets, and again into computer software. Other sessions in Learning Block 3 provide guidance on QA when designing the specific protocols and training activities for different elements of the forest sampling. General guidance is provided below based on experiences with implementing CBFBM.

Assign two people to the technically more difficult tasks and put in place systems for double-checking each measurement

In CBFBM systems, two people can be assigned to each of the more complex measurement tasks and they should be taught to check each other's measurements. For example, two people can be assigned to work together in measuring diameter at breast height (DBH). They work together in identifying the point of measure for DBH, placing the DBH tape correctly around the tree (or positioning the calipers), and in reading the measurement. If clinometers are used for height measurement, two people work as a pair with both taking readings of the same points using clinometers. One person drags the distance measurement tape from the tree to the point where the clinometer readings are taken, then the person holding the measurement tape takes the distance reading and this is double-checked by the clinometer users. Other arrangements can be considered, but the main point is to ensure double-checking of measurements.

Confirming measurements prior to entry into field sheets

It is easy for mistakes to be made when entering data into field sheets. The main reason for this is that the people assigned to filling in the field sheets do not clearly hear what the people responsible for taking the measurements are telling them. When both height and DBH measurements are being taken, the measurement team can be spread out over a large area and the data recorders may find it difficult to hear the measurements being called out to them. All measurements should be confirmed by the data recorders calling back the data to the other team members who provided the information. This procedure is described in detail in session 3l Field sheets and data recording.

Checking data prior to departing from plots

A check of the field sheets for any obvious errors and legibility must be conducted before the community team departs each plot. This is the responsibility of the team leader, who is required to sign the field sheets after the check (the roles of the monitoring team members are discussed further in session 3m: Organising the monitoring teams). The team leader and the data recorder must be different people.

Supervision and "Hot Checks"

A decision must be made on whether the community forest monitoring teams can operate entirely independently, which is ideal, or whether they will require ongoing guidance and supervision. In complex forest ecosystems with high species diversity, it may be desirable that a forester continues to work with the community teams during future monitoring. Alternatively, supervision may initially be provided, and then gradually reduced as the community teams become more experienced. In less biologically complex systems, e.g. monocrop plantations or natural forest dominated by a few species, well-trained community teams may be able to operate independently soon after the training is completed.

Hot checks should be conducted after the community teams begin to conduct the monitoring independently. In a hot check, a forester occasionally checks on the performance of the community team/s. If any errors or misunderstandings are detected, the forester provides guidance on how to correct these.

Data entry

Data entry may be conducted by the community forest monitoring teams or by an outside organisation supporting the community. Data entry must be done carefully. The person entering the data must be trained to first enter all the data from one field sheet, to then check the entered data against the field sheet, and only then to move on to the next field sheet. If the field team does not enter the data, the person responsible for data entry must be able to communicate with the field team leader when they have any questions about the data recorded in the field sheets. If there are any obvious problems with the plot data (that cannot be resolved), the plot should not be used in the analysis, or should be re-measured.

QUALITY CONTROL (QC)

QC should be conducted on field measurements and data entry.[1]

Field measurement error estimation

A complete and careful re-measurement of a number of plots by foresters or others competent in forest measurement should be conducted to quantify the amount of error due to field measurement techniques. 10% of the plots should be audited in this way. Any errors discovered could be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error. If any systemic problems with the measurements by the community teams are identified (e.g. they are commonly under-estimating tree height), a refresher training session to address these issues should be conducted.

Data entry

Ten per cent of all data sheets should be selected randomly and checked for consistency and accuracy in data entry. Data sorting, verification of resulting estimates and other techniques should be used to ensure that the data entered properly corresponds to the field sites sampled. Any numbers that look odd – too larger or too small – should be investigated through discussion with the community forest monitoring teams.

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[1]   See Standard Operating Procedures for Terrestrial Carbon Measurement (Winrock International 2012) for guidance on quality control for laboratory measurements.

LEARNING OBJECTIVES:

By the end of the session, participants

- have shared their experiences with forest inventory data storage and archiving
- can explain how to ensure that data is safe and easily accessible in a CBFBM context
- have drafted a basic plan for data storage and archiving for their CBFBM initiative

MATERIALS:

sufficient copies of the technical considerations and protocols; flip charts or whiteboard and markers; laptop computer or exercise book

TIME:

30 minutes

STEPS:

1. Ask participants to share their experiences with forest inventory data storage and archiving.
2. Take them through the Technical Considerations and Protocols and point out key issues in the field and in the office that should be considered.
3. Give the participants 10 minutes to discuss their ideas for data storage and archiving for their CBFBM system.
4. Have them present these ideas and provide feedback. Stress the importance of having procedures for the management of field sheets, backing up the data as soon as possible, storing the data in both hard and soft forms in different locations, and an archiving system for logical organisation and easy retrieval of the data.
5. Give the participants 10 minutes to document their plan for data storage and archiving using a laptop computer or exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same areas/project should work together in designing the protocols and community trainings.

TECHNICAL CONSIDERATIONS AND PROTOCOLS: DATA STORAGE AND ARCHIVING

Data must be stored and archived in a simple yet safe and retractable way. The procedures for storing and archiving data should be decided before forest sampling begins. Figure 3C-1 illustrates the process of recording and storing data in both hard and soft formats.

Figure 3C-1. Recommended process of storing data in hard and soft formats

Source: Walker et al. (2012)

In the field

A procedure must be put in place to ensure that field sheets are kept safe and dry before transporting to the office. One person should be assigned to managing the field sheets and that person should take charge of the sheets as soon as they are filled in or, if this is not possible, at the end of each day. A digital camera can be carried as part of the field equipment and can be used to record a digital image of each field sheet before departing each plot. This provides a backup in case the original sheet is lost or damaged. The person responsible for the field sheets should also make sure that the digital images are transferred to the office.

In the office

All the field sheets should be filed. If digital images were taken in the field, they should be stored electronically in appropriately labelled folders; if not, all the field sheets should be scanned. The original sheets should be photocopied and the two hard copies stored in different secure locations, using an appropriate filing method.

After data entry, the electronic files should be organised appropriately and backed up on a server. Folders can be organised with the following labels: Field Data (scanned field sheets, photos, etc.), Data Analysis (data entered and processed by analysis software), Templates (the templates used for field sheets, etc.), Project Documents, Reports, etc. Backup should be conducted at the end of each day.

Further guidance can be found in Standard Operating Procedures for Terrestrial Carbon Measurement, Winrock International, 2012.

REFERENCES

Walker, S. M., Pearson, T. R. H., Felipe, M. C., Harris, N., Petrova, S., Grais, A., . . . Brown, S. (2012). *Standard Operating Procedures for Terrestrial Carbon Measurement*: Winrock International.

LEARNING OBJECTIVES:

By the end of the session, participants

- have shared their experiences on mapping land cover / land use
- have agreed the objectives of mapping in their own CBFBM design and how the communities can be fully engaged in the mapping processes
- have practiced training others on map reading and sketch mapping

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; examples of maps (land cover and land use maps, maps produced by communities); laptop computer or exercise book

TIME:

90 minutes

STEPS:

1. Introduce the session by asking the participants to share their experience with land cover and land use mapping. What were the objectives, information collected and methods used (e.g. hands-on mapping, using scale maps, or using mapping tools such as GIS). Ask the participants to explain whether/how local communities have been involved in the mapping process.

2. Ask the participants to think about the objectives and the key features of mapping in CBFBM design. Ask the following questions to stimulate discussion:
    - *Why do we need mapping for CBFBM?*
    - *What do we want to illustrate on the maps?*
    - *Who will generate the maps?*
    - *Who are the users of the maps?*

3. Referring to the Technical Considerations and Protocols explain the three common mapping tasks for carbon stock assessment. Explain that mapping in CBFBM not only aims to provide accurate assessments and projections of carbon stocks, but also aims to fully engage the participating communities in the mapping processes. Ask the participants to discuss how communities could be involved in the mapping tasks.

4. Introduce the concept of participatory mapping. Provide copies of Table 3D-1 in the Technical Considerations and Protocols and introduce each mapping tool in terms of type, description, use for CBFBM, strengths and weaknesses. It may be helpful to provide pictures of how these tools have been used (examples can be taken from IFAD (2009). Good practices in participatory mapping: International Fund for Agricultural Development (http://www.ifad.org/pub/map/pm_web.pdf) to help participants visualise them. Ask the participants whether any of these mapping tools could be useful for their CBFBM design.

5. Tell the participants that they now understand (i) what mapping is required for CBFBM, (ii) the importance of involving communities as fully as possible in the mapping, and (iii) participatory mapping concepts and tools. Using a flip chart or MS Excel, ask them to create a table that lists the mapping tasks in their CBFBM design, the equipment that will be required, and the roles of CBFBM facilitators and the community. Depending on numbers, consider breaking the participants into groups. Have them present their mapping design table to you.

6. Explain that CBFBM facilitators must be skilled in training communities on how to read geo-referenced maps and how to create simple maps. Give the participants an existing geo-referenced map and have them discuss amongst themselves what mapping conventions are (North point and map orientation, scale, symbols, legend, etc.), and how they propose teaching communities these conventions. Have them present to you a mock training session for communities on mapping

conventions and map reading. Provide feedback, referring to Community Training Tips: Sketch Mapping.

7. Ask the participants how they would prepare a training programme for communities on land use sketch mapping. Ask them who should participate, what difficulties they can foresee and how they might avoid these, and whether any sensitive information could be generated (refer to Community Training Tips: Sketch Mapping).

8. Give the participants time to develop a mock training session for communities on land use sketch mapping. Have them present this to you and provide feedback (refer to Community Training Tips: Sketch Mapping).

9. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same areas/project should work together in designing the protocols and community trainings.

PARTICIPATORY MAPPING

CBFBM approaches make fullest use of participatory mapping. For CBFBM, we define participatory mapping as the creation of maps through the collected efforts of experts trained in cartography, remote sensing, etc. and the communities.

Why do participatory mapping? In terms of the technical mapping requirements for carbon stock assessment, communities can contribute important knowledge that outside mapping experts do not have. For example, they will be better able to interpret some of the ground features displayed in satellite images than mapping experts from outside their area, and their knowledge can contribute to the mapping of the boundaries of customary land and of historical and current land use. Participatory mapping can also benefit the community by creating cohesion amongst its members, raising awareness on important land issues, and helping them to engage in land related decision-making. Engaging communities in mapping will increase their understanding of the purpose and meanings of the maps created, and this could make an important contribution to the success of any initiatives to protect or enhance carbon stocks in their forests.

COMMON MAPPING TASKS FOR CARBON STOCK ASSESSMENT

The common mapping tasks for carbon stock assessment are (1) mapping project boundaries, (2) mapping land cover and use (this includes stratification of the forest), and (3) assessing map accuracy. Methodologies approved under voluntary carbon schemes may also require the setting out and mapping of leakage and reference areas. When combined with the ground-based measurement, this mapping allows carbon stocks to be estimated and contributes to the estimation of future emissions under different forest management scenarios.

DEFINING AND MAPPING THE PROJECT BOUNDARIES

The purpose and mapping of boundaries needs to be agreed as this will influence the scope of the mapping activities. As explained in 3a Developing a robust carbon stock assessment and monitoring plan, if a voluntary standard is being targeted, it will provide a definition of the "project area" that must be observed. In addition to mapping the boundaries of the project (or accounting) area, the mapping might involve demarcation of the entire boundaries of the land under community tenure. The mapping of boundaries may also have to include the mapping of reference and leakage areas, if this is required by the standard being targeted. A key issue in mapping boundaries is to ensure that members of the participating communities and their neighbouring communities agree on the outcome. When the registration of land title is one of the aims, the participating communities should be fully informed about the relevant laws and their rights and responsibilities.

Features on an existing geo-referenced map (e.g. rivers) or locations recorded with a GPS device, or a combination of both, can be used to delineate boundaries. When boundaries are to be walked as part of the mapping process, a suitable boundary demarcation team must be put together. The community should select people for the team and they can be accompanied by a CBFBM facilitator. The team must have knowledge of the boundaries and the conditions on the boundaries, ability to communicate well with neighbouring communities, ability to use the mapping equipment, the required level of fitness, etc. Training should be provided to the community participants on the equipment to enable them to fully understand all aspects of the survey. This may include training on GPS, map reading, camera use, etc. Training tips for handheld GPS devices are provided in session 3e Locating sample plots.

Useful tools for recording the project boundaries include a handheld GPS device, compasses, existing large-scale topographical maps and a digital camera. The GPS can be used to record both "tracks" and "waypoints". Generally, "tracks" will provide more accurate mapping of the actual path walked, as

locations are recorded frequently and automatically. Recording "waypoints" may also be useful as this allows the names of locations or basic geographical feature (e.g. hilltop) to be recorded.

Since community land boundaries are usually determined and identified by landscape features (e.g. roads, rivers, valuable trees, valleys, hills, rocks), taking pictures during the boundary survey can be helpful for others not participating in the survey to visualise the locations. Some GPS can be used to record geo-referenced still images; however the quality of the images may be poor, especially under tree cover where light is low. It may be better to use a digital camera, rather than relying solely on a GPS for these.

When boundary delineation is a major exercise in terms of the effort and duration required, the survey should be carefully prepared to ensure its success. In addition to basic supplies, additional GPS devices, cameras, spare batteries etc. should be carried. Consideration should also be given to the safety of the demarcation team.

MAPPING LAND COVER AND USE

A preliminary study on land cover, including forest stratification, can be conducted through visual interpretation of satellite images and aerial photos, using existing vegetation, soil and other maps as references. Often, interpretation of remotely sensed images is used to produce the final land cover maps. While this is a highly technical task and requires people skilled in remote sensing applications, hard copies of the satellite images can be shared with the communities and they can be asked to identify any ground features that the mapping experts are having difficulty understanding.

Careful thought must be given to the selection of land cover classes. The classification scheme has to be mutually exclusive and exhaustive. All possible and relevant types of forest or other land cover that can appear in the sites have to be taken first into consideration and then classified each in their own class, or in classes that contain groups of land cover types. A hierarchical classification scheme can be useful. When classes are found to not be distinguishable in the analysis, they are merged into a higher order class. An example is given in Figure 3D-1.

Figure 3D-1. Proposed working hierarchical classification of land cover classes in FPCD-IGES CBFBM project study sites in PNG

Facilitators and community members conducting ground survey for land use map accuracy assessment, Bangapala, PNG

Stratification

Stratification is explained in Session 3a: Developing a robust carbon stock assessment and monitoring plan. Stratification may be conducted using remotely sensed images, tracing from existing maps, or using GPS to demarcate stratum boundaries in the field.

ASSESSING MAP ACCURACY ("GROUND TRUTHING")

Once a preliminary map is produced, an accuracy assessment must be conducted. Local communities can point out any obvious errors in the preliminary maps and can participate in the ground survey to verify map accuracy (often referred to as "ground truthing"). Training would have to be provided to ensure the community participants fully understand the purpose of the ground truthing and the land cover classification being used.

Ground truthing data should be collected in a statistically appropriate manner. Field sheets will need to be prepared for recording of important information. At every sample point visited, the coordinates should be recorded using handheld GPS with the positional error noted. Photos should also be taken to assist the remote sensing experts.

There are also practical considerations that should be kept in mind. A "walking plan" should be made setting out the best routes and the order of moving through the sampling points.

MAPPING FOR PARTICIPATORY LAND USE PLANNING

For CBFBM initiatives that aim to generate carbon offsets, participatory land use planning can be a useful tool for communities to set out and commit to actions to protect and enhance their forest carbon stocks. Through participatory land use planning, communities create their own land use plan that identifies different land use zones where only certain activities will be permitted. For example, land use zones might be created for subsistence gardening, cash crops, community-based forestry operations,

Figure 3D-2. Land use planning map, Urinite clan, Papua New Guinea

Source: Scheyvens, Poruschi, Bun, Fujisaki, & Avtar (2013).

settlements, etc. Figure 3D-2 provides an example of a community land use planning map. The boundaries of the land use zones agreed by the community have been recorded using handheld GPS, enabling the land use plan to be mapped with GIS. For guidance on how to facilitate participatory land use planning, see:

FAO. 2009. Mapping our community's future: Why and how to practice participatory land-use planning, Module 2 of Sustaining communities, livestock and wildlife: A guide to participatory land-use planning. Rome: FAO. ftp://ftp.fao.org/docrep/fao/011/i0821e/i0821e02.pdf

NAFRI. 2012. Handbook on Participatory Land Use Planning: Methods and tools developed and tested in Viengkham District, Luang Prabang Province. Vientiane, Lao PDR: NAFRI-IRD-CIFOR. http://www.forestcarbonasia.org/wp-content/uploads/2012/05/PLUP_Handbook2012_NAFRI-IRD-CIFOR_Eng.pdf

EXAMPLES OF PARTICIPATORY MAPPING TOOLS

Participatory mapping tools include hands-on mapping, mapping using scale maps and images, 3-D models, participatory GIS, and multimedia and Internet-based mapping. Table 3D-1 provides a brief description of each tool and their strengths and weaknesses. For further information on these tools, see: IFAD. (2009). Good practices in participatory mapping: International Fund for Agricultural Development (IFAD). (http://www.ifad.org/pub/map/pm_web.pdf)

Table 3D-1: Examples of participatory mapping tools

TYPE OF MAPPING TOOL	DESCRIPTION	USE FOR CBFBM	STRENGTHS	WEAKNESSES
Hands-on mapping	▪ Community draws map from memory on the ground (ground mapping) or on paper (sketch mapping) ▪ The maps represent key features on the land identified by the community from a bird's eye view	▪ Contribute to community land use planning ▪ Provide important local knowledge to facilitators ▪ Can help community understand subsequent mapping of land cover, etc.	▪ Low cost/ low technology ▪ Can be produced quickly with short-term tangible outcomes	▪ Maps are not geo-referenced ▪ Impermanent and fragile, though can be photographed
Participatory mapping using scale maps and images	▪ Local knowledge is transferred through discussions and then directly copied onto photocopied maps or remotely sensed images	▪ Spatially accurate information on land use can be incorporated into maps	▪ A low cost and quick method to generate information ▪ Local people likely to be interested in viewing and discussing satellite images and aerial photographs of their area	▪ May be difficult to acquire up-to-date accurate maps ▪ Local people may have difficulty understanding the protocols of scale maps (e.g. scale, orientation, and coordinates)

TYPE OF MAPPING TOOL	DESCRIPTION	USE FOR CBFBM	STRENGTHS	WEAKNESSES
Participatory three dimensional models (P3DM)	▪ P3DM models are scale relief models created from the contours of a topographic map. Sheets of cardboard are cut in the shape of the contour lines and placed on top of each other.		▪ The 3D aspect of the model is intuitive and understandable ▪ Data depicted on the model can be extracted, digitalised and incorporated into GIS	▪ Labor intensive and time consuming ▪ Storage and transportation of the model to share with decision-makers can be difficult
Participatory GIS	▪ The digitalising of data from participatory mapping for analysis and communication using GIS software	▪ Facilitates analysis of carbon stock assessment and projections of carbon stock changes	▪ Enables storage, retrieval, replication, presentation and analysis of spatial information ▪ Additional information can easily be added to maps and corrections made ▪ Maps produced by GIS convey a sense of authority for influencing decision-makers	▪ Expensive hardware and software ▪ Steep learning curve ▪ Electrical supply required
Multimedia and Internet-based mapping	▪ Combines maps with other embedded digital media, such as video, images, and audio	▪ Helps community to record and share information important to them (e.g. information about the land which is incorporated in stories and legends, etc.)	▪ Cheaper than GIS ▪ Facilitates communication of land-related traditional knowledge with outsiders and within community in an engaging format (especially video)	▪ Expensive for many communities ▪ Electrical supply required

3D | COMMUNITY TRAINING TIPS: SKETCH MAPPING

COMMUNITY TIPS

Creating a ground or sketch map of community land use can be useful for the community to think through and organise its planning of natural resources, as well as contribute to the creation of a geo-referenced land use map. Even if spatially the outcomes are not highly accurate, the information can be used to check the forest type and land use classification proposed for the geo-referenced maps. Furthermore, if coordinates of certain points of the features presented on the map are recorded by handheld GPS in the field, these features can be incorporated into the geo-referenced land use maps.

In ground mapping, a map is drawn on the ground using raw materials such as soil, pebbles, sticks and leaves. In sketch mapping, large sheets of paper and coloured markers are used. This community training focuses on sketch mapping.

When you (the local level facilitators) are facilitating participatory mapping, you need to make sure that there is a clear recognition of the importance of mutual trust, understanding of local customs and sense of ownership, and respect for community information. You should consider both positive and negative impacts that outcomes could have. The mapping, for example, might show the location of valuable resources that outsiders may be interested in exploiting.

The objectives of the training are:
- to build the capacity of the community to be able to read geo-referenced maps
- for the community to develop a sketch map of socio-cultural features and land use that can later be incorporated into a geo-referenced map
- (Optional) for the CBFBM facilitators to have a better understanding of land use and land use changes

The training process is divided into the following steps.

1. PREPARATION
As part of the logistical preparation, an appropriate venue, a suitable number of community members, the composition of the group (e.g. gender, professional experiences), the mapping space and how the community members arrange themselves e.g. sitting in circle, working around a table, etc., all need to be determined. The mapping materials also need to be prepared and can include large sheets of paper, markers, etc.

Ideally, various community groups (e.g. adults and youth, men and women, long-time residents and new settlers, etc.) will take part in the activities. If the mapping process is leading towards community-based land use planning, then the whole community should participate. To maximise participation, consider breaking a large group into smaller groups of 5-6 people to work on the mapping. If women show deference to men, then consider organising separate women's and men's groups.

Women's group sketching map of land use, Hoa Binh, Viet Nam

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2. EXPLANATION OF OBJECTIVES AND IMPORTANCE OF THE MAPPING

Explain the objectives and importance of the mapping, including how the maps produced will be used in the CBFBM. Examples of sketch maps created by other communities and geo-referenced maps created from these using GIS could be used for illustrative purposes.

3. MAP READING

Using an existing map of the area or a simple map you have created for this purpose, provide guidance on map reading. Explain the basic conventions and elements of maps, including:

- Orientation
  a   *In most maps, North is at the top, South at the bottom, West to the left, and East to the right (explain that the sun rises in the East and sets in the West).*
  b   *Orientation: Teach the participants how to place a compass on the map to correctly orient it.*
- Scale: Explain that a map has a scale to ensure that the relative size of features and the distances between them are correct. Explain how to read the scale on the map. For example, on a map of 1/100,000 scale, 1 cm on the map corresponds to 1 km on the ground; and on a map of 1/250,000 scale, 1 cm on the map corresponds to 2.5 km on the ground.
- Symbols and colours: Point out the symbols and colours used to represent selected information, such as houses, gardens, forests, rivers, etc.
- Legend: Explain how a legend shows what each symbol means.

3. MAP MAKING

Have the community members trace the map boundaries on to the paper from an existing scale map. This will allow a more accurate spatial representation of local knowledge. Ask the community members to add the North point and to correctly orient the map using a compass.

Assist the community members to decide what information will be displayed on the map. Provide them with prompts if they miss important information. On a separate sheet of paper, have them begin creating a legend using symbols that they agree upon for various themes (e.g. land cover/use, infrastructure) and features (e.g. lines, points and areas).

Community land use sketch map

Ask the community members to sketch the features they are all easily familiar with, e.g. settlements, landmarks, agricultural areas, waterways, roads, sacred sites, etc. Begin with rivers or roads that can create a basic reference framework for the rest of the map. Then have them add further features. As a general rule, keep the maps simple by limiting the number of variables. Use questions to aid the community members in developing their map: "What is in this area?", "Where do you collect fire wood?", etc. Ask questions about changes in land use and events such as forest fires to increase your understanding of historical land use and land use change drivers.

4. PRESENTATION OF MAP

Ask the community members to present and explain their map.

5. NEXT STEPS

Remind the community members of the next steps in the mapping process for the CBFBM. Consider visiting various features of the project area identified in the maps with some of the community. This can generate further discussion on land use (for example, extent of the area under swidden agriculture and the period of rotation), and the location of features can be recorded using handheld GPS.

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LEARNING OBJECTIVES:

By the end of the session, participants

- have shared their experiences on locating sample plots
- can explain the options for locating sample plots without bias
- have proposed a method for locating sample plots for their CBFBM system
- have designed a training activity for communities on this method

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

FIELD EQUIPMENT/PREPARATION:

GPS

TIME:

90 minutes

STEPS:

1. Ask the participants to share their experiences with sample plots, particularly on where they put the plots in the forest and what the purposes of the plots were.
2. By going through the Technical Considerations and Protocols, explain the decisions that they will have to make and the protocols they need to agree on to ensure plots are located correctly.
3. Give the participants about 10 minutes to discuss whether they will locate plots systematically or randomly, and whether they will use clustered of non-clustered plot designs. Ask them to report back their ideas. If there are any key issues they have not considered in their discussion, prompt them with questions.
4. Give the participants 15 minutes to discuss amongst themselves what instruments and materials they will require to locate the plots. Have them discuss the following questions:
   - *Will they use GIS to locate the plots? If so, how?*
   - *Will they use GPS?*
   - *Will they use physical markers on the ground to permanently mark the plots? If so, what type of marking do they propose?*
5. Ask them to report back their ideas. If there are any key issues they have not considered in their discussion, prompt them with questions. Have them summarise their proposed ideas for plot location on flip charts.
6. Explain to participants that their training programme for communities will have to provide a simple explanation on forest sampling, and if the communities are going to be using GPS, they will have to (i) provide a basic explanation on how GPS works, (ii) simplified instructions for using GPS that the communities can understand and (iii) sufficient practice for the communities to become competent with GPS. Explain that they will also have to set up the GPS so displays are standardised across different GPS units and unnecessary information is hidden. Write all these points on a white board or flip chart, then take the participants through Tips for Community Training, which discusses all of these issues.
7. Optional: Go outside and practice the Treasure Hunt exercise. Some participants can act as the community trainers who give the instructions and some can act as community members who will do the Treasure Hunt exercise described in Tips for Community Training.
8. Back in the classroom, give the participants 20 minutes to discuss their ideas for the community training on locating plots. Have them present these to you and provide feedback.

9. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:
The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

LOCATING SAMPLE PLOTS

The basic steps for locating plots are:

Step 1: Prepare a map of the project, with the project boundaries and boundaries of strata within the project clearly delineated.

Step 2: Decide whether plots will be distributed systematically or randomly.

AVOIDING BIAS

Standard sampling theory relies on random selection of a sample from the population and this requirement is met when sample plots have been distributed entirely at random within an area, or when plots have been distributed in a systematic grid system (Fig. 3E-1), as long as the positioning of the grid is random (IPCC, 2003). It is considered more efficient to use systematic sampling, since in most cases this will increase the precision of the estimates, as sample plots will be distributed evenly to all parts of the target area (ibid.). To avoid selection bias, the positioning of the grid can be randomised by using a random start point.

Figure 3E-1. Random plot layout (left) and systematic plot layout (right)

Source: IPCC (2003)

CLUSTERED PLOT DESIGNS

Clustering of plots can be considered as a way to reduce travel times between plots when sampling a large area. Clustering of plots at each sampling unit is often recommended for logged over forests and natural forest areas (Walker et al., 2012). All plots within a cluster sampling unit must fall within one land cover stratum. Figure 3E-2 presents two cluster plot designs that are recommended for biomass monitoring:

Figure 3E-2

LAYOUT A. For each cluster, four plots are established at each of the cardinal points. The plot center is established 300 m away from the cluster center.

LAYOUT B. For each cluster, four plots are established. At initial point, one plot is established. A random compass is chosen to determine location of the next plot.

Source: Walker et al. (2012, p. 15).

NON-TREE CARBON POOL PLOTS

When they are less significant, the location of the non-tree carbon pool plots can be based on the location of the original tree plots for the first census. However, these plots should be outside the original plot to minimise disturbance and all subsequent re-measurement censuses should occur in a new location.

SETTING PLOT COORDINATES AND NAVIGATING TO PLOT SITES

GIS software can be used to determine where the plots will be located both for random and systematic plot distribution. Once the plot locations have been set out on a map of the area, the plot coordinates can be entered into handheld GPS devices. The FIND function on the GPS device is then used in the field to navigate to where the plots will be established.

Note that at best the locational accuracy of the GPS will be about 3 metres, and under dense canopy will be far less. Because of inaccuracies, it will be impossible to exactly locate the predetermined coordinates. For example, a GPS reading of 5 metres to destination, might be followed by another reading of 10 metres past destination after the user has walked the additional 5 metres. It is thus important to develop and document a standard procedure for locating the plot. For example, the plot may be located as soon as the GPS shows the user has travelled past the destination. To reduce bias, another 10 steps in the direction of travel can be taken (Walker et al., 2012).

RECORDING AND MARKING PLOT START/CENTRE POINTS

Once the plot site has been located, the GPS is used to record a "waypoint" for the plot starting corner (for a square/rectangular plot) or plot centre (for a circular plot). The GPS provides a reading of accuracy and this will improve the longer the GPS is held at one point. A reading should be taken after 5 minutes and a minimum accuracy level of ±5 m should be used. If under heavy canopy, moving a little might allow the GPS to receive a stronger signal. Latitude, longitude, accuracy and altitude should be read from the GPS and recorded in the field sheets.

If a Garmin GPS Map60 or similar is being used, the following steps are recommended:
a. Prior to saving a new waypoint, press MENU
b. Highlight 'Average Location' and press ENTER
c. Let the GPS sit for many minutes until 'Estimated Accuracy' stabilises
d. Press ENTER to save location.

(See manuals at www.garmin.com for more information) (Walker et al., 2012).

If permanent plots are used, the plot start or centre points need to be marked. It may also be desirable to mark temporary points to enable auditors to visit these. Issues to consider when marking plot start/centre points are visibility and permanence. One option is to use a metal stake with flagging tape attached to the top or painted at the top with a bright colour. The stake should be driven deep into the ground to make it difficult to remove. If there is a high risk of the metal stake being removed, a metal plate can be placed underground and later found using a metal detector (this approach has been used in some projects) though this adds further complexity, making it less suitable for CBFBM.

The community training starts with a simplified explanation of why we do forest sampling. Local level facilitators explain the purpose of using GPS in a simplified manner. The training then provides basic instruction on how to use GPS. This must cover (i) how to hold the GPS, (ii) how to turn the GPS on, (iii) how to shift through the displays on the GPS, (iv) what information the displays show, (v) how to read latitude and longitude, (vi) how to read the accuracy data, (vii) how to mark a waypoint, and (vii) how to find a way point. The training will also have to explain the protocol used for locating plots in the forest.

SIMPLIFIED WAY TO EXPLAIN FOREST SAMPLING TO THE COMMUNITIES

Begin by explaining that in the forest there are too many trees for us to measure all of them, so we just measure some of the trees. If we measure enough trees we can make a good estimate of the total amount of wood and carbon in all the trees in the forest. Explain that some trees in the forest are large, some are small. If we want to show that there is a lot of wood or carbon in our forest, we may be tempted to only measure the large trees, but other people would soon realise that there is a problem with our estimate. For a good estimate, we should measure all different sizes of trees and the different species in the forest. To do this, we set out small areas in different parts of the forest and we measure all the trees in these small areas. We call these small areas "plots". A plot is a small area of land.

Sketches could be used to illustrate what a sample plot is, and how they are used to show the general forest condition.

SIMPLIFIED WAY TO EXPLAIN THE FUNCTION OF GPS

Local level facilitators could use or modify the following explanation to explain the function of a GPS to the communities in a non-technical way:

We need a system to place the plots in different parts of the forest. We do this using a GPS. A GPS is similar to a mobile phone, radio or television as they all receive signals that travel through the air. The signals that the GPS receive come from satellites. When a GPS receives strong signals from satellites, it gives us information about its location. If we record and share this information with someone else who has a GPS, they can use it to find the location. So, if you have used a GPS to record the location of your house, and you give the information to someone else who has a GPS, that person can come from anywhere (even thousands of kilometres away or many days of travel) and find your house. GPS are now used for many purposes. For example, they enable pilots to fly aeroplanes from one airport to the next, even in the dark.

PREPARING THE GPS UNITS

You must prepare the GPS in advance of the community training. Any unnecessary displays on the GPS should be hidden to allow the communities to focus on the most important information for their monitoring activities. The most important displays are those that provide information on reception of satellite signals, a map of the location, a compass and stored waypoints.

If more than one GPS is being used, it is important that the displays are standardised across the GPS as much as possible in order to avoid confusion.

SIMPLIFIED INSTRUCTIONS ON GPS USE

Basic instructions must be provided to the communities for them to acquire three skills to use GPS for forest monitoring. These skills are 1) be able to read and understand latitude, longitude and accuracy; 2) be able to mark a location and to give it an appropriate name, and 3) be able to retrieve a location (waypoint) that is stored in the GPS memory and navigate to it. (You must explain the protocol for waiting until the accuracy reading has dropped to a suitable level before recording the location.)

Community level facilitator providing training on GPS use, Bangapala, PNG

After basic instructions have been provided, run the following exercise for the community to develop and demonstrate their skills with GPS.

"TREASURE HUNT"

In this exercise the communities will practice marking and finding waypoints. Participants are separated into small groups of 3-4 people and each is given a GPS. They are taken to an open area (without heavy tree cover). They are then given the following instructions:

1. Turn on your GPS and find the locational accuracy reading. Wait until the locational accuracy reading drops to ±5 metres, then mark a waypoint. Give the waypoint the name "Training Area".
2. Take a "treasure" and walk for 5 minutes in any direction and place the treasure on the ground. Mark the waypoint for this location and give it an appropriate name.
3. Come back to the Training Area and swap your GPS with another group. Using the GPS you have just received, find the treasure waypoint that was marked by the other group. Bring the treasure back to the Training Area.

The treasure hunt exercise can be run several times to make sure each community member has sufficient hands on practice. The "treasure" could be something prepared by the trainer or it could be something that the communities are asked to provide. Examples could be an item of food or a piece of clothing. Instruct the community members to make the treasure not too easy, but also not too difficult, to find. Remind community members that a GPS is at best accurate to a few metres, so if the treasure is place under a stone or leaves, the GPS alone may not be enough to find it.

REFERENCES

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LEARNING OBJECTIVES:
By the end of the session, participants
▪ have shared their experiences on plot design and set up
▪ can explain what needs to be considered when deciding plot dimensions and the options available
▪ have proposed plot dimensions and procedures for plot set up for their CBFBM system
▪ have designed a training activity for communities on setting up sample plots

MATERIALS:
sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

FIELD EQUIPMENT/PREPARATION:
Metal pickets, sledge hammer, compasses, flagging tape, distance tape measure, etc.

TIME:
90 minutes

STEPS:
1. Ask the participants to share their experience with different plot designs. Have they worked mostly with rectangular, square or circular sample plots, and with single or nested plots?
2. Explain that they will have to consider what the most efficient plot shape and size is for biomass assessment in the forests they are working in. They will need to be aware of all the options that are available.
3. Take them through the Technical Considerations and Protocols as far as Correction for Slope. Give them about 15 minutes to discuss their ideas for plot design and set up. Ask them to share their ideas with you, provide feedback to prompt further thinking where necessary, then have them summarise their ideas on flip charts.
4. Ask the participants whether slope will be a consideration for the sampling (i.e. are some plots likely to be on 10% or greater slopes?). Referring to Technical Considerations and Protocols, explain that it will be easiest to do slope adjustment during data processing, rather than in the field. Use a flip chart to provide a worked example (see Walker et al. (2012, p. 22)).
5. Take the participants through the correct procedures for plot labelling in Technical Considerations and Protocols.
6. Optional: Have the participants go outside the classroom and practice setting up a plot using the plot design and method they have proposed.
7. Take the participants through Community Training Tips, then given them 20 minutes to design their community training activity. Have them explain this to you and provide feedback.
8. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:
The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

TECHNICAL CONSIDERATIONS AND PROTOCOLS: PLOT DIMENSIONS AND SET UP PROCEDURES

TECHNICAL

For forest sampling, a decision must be made about the size and shape of plots and how they will be set out in the forest. A protocol for plot labelling also needs to be developed and adjustments are required for plots on sloping ground.

PLOT SIZE AND SHAPE

The size and shape of plots used is influenced by trade-off between accuracy, precision, time and cost for measurement, and may also be influenced by the type of vegetation found in the sampling area. The size of plot used will reflect the purposes of the monitoring. For example, for monitoring the recovery of forests after selective logging, a plot size of 1 ha or greater might be used. However, for carbon stock assessment, such large plots are not likely to be efficient, so smaller plot sizes are preferred. The most efficient plot size will be determined by the number of plots, the amount of time spent at each plot and the time travelling between the plots. Smaller plots have an advantage in that they give a better geographic representation of the forest for the same sample fraction than larger plots.

Plots can either be circular, rectangular or square shaped. For carbon stock assessment, circular plots have generally been found to be more efficient than square and rectangular plots, as they are usually quicker to set up. However, when deciding on plot shape, careful thought has to be given to the ease of plot set up for the communities and the suitability of plot shape to the vegetation in the sampling area. In some cases, e.g. dense forests, square or rectangular plots may be a better choice.

SINGLE OR NESTED PLOTS

The plots can either be single plots (just one plot) or nested plots (smaller plots located, or "nested", within one larger plot). Nested plots consist of several full plots (typically two to four, depending upon forest structure). Circular, square and rectangular plots can all be nested.

Single plots are appropriate when there is low variability in stem diameter, e.g. a single species plantation. For biomass assessment in forests with various ages of trees, nested plots have been found to generally be more efficient than single plots. In a natural forest there are many more small diameter trees than large diameter trees, and most of the stand basal area is contained in the few large trees. Therefore the nested sample design has a wider sampling area to cover the few large trees with decreasing sample areas for the lower diameter class ranges.

PLOT AND NEST SIZES

The plot and nest sizes should reflect the diameter class distribution observed in the forest. Each nest should capture a sufficient number of trees. When a single plot is used, the plot should capture at least eight to 10 trees (Pearson, Walker, & Brown, 2005).

As general guidance, Table 3F-1 presents plot-size rules that have been found to provide a reasonable balance of effort and precision for carbon forestry projects. These plot designs can be used for forest types that have mature trees and when diameter at breast height (DBH) will be measured. Figure 3F-1 shows how 3-nest circular and rectangular sampling plots look in plan view.

Table 3F-1. Generally applicable plot-sizes

STEM DIAMETER	CIRCULAR PLOT	SQUARE PLOT
†< 5cm DBH	2m	3m x 3m
5–20cm DBH	4m	7m x 7m
20–50cm DBH	14m	25m x 25m
> 50cm DBH	20m	35m x 35m

† stems < 5cm DBH would only be measured in very young forest. Source: Pearson et al. (2005).

If there are few trees with DBH>50cm, then the minimum stem diameter measured within the largest nest will need to be adapted.

Figure 3F-1. Schematic of possible nested plots

LARGE PLOT:
RADIUS 20M
TREES > 50CM DBH

INTERMEDIATE PLOT:
RADIUS 14M
TREES 20-50CM DBH

SMALL PLOT:
RADIUS 4M
TREES 5-20CM DBH

LARGE PLOT:
20M X 50M
TREES > 50CM DBH

INTERMEDIATE PLOT:
17M X 35M
TREES > 50CM DBH

SMALL PLOT:
5M X 20M
TREES 5-20CM DBH

Source: Pearson et al. (2005)

Another option is to use variable radius plots using what is called the k-tree approach. In the k-tree approach, the number of trees (k) to be measured rather than the plot size is predetermined. The k-tree approach has two major advantages of (1) allowing an automatic adjustment to tree spacing (this means that each plot will have a different size) and (2) being less time consuming since the outer perimeter of the plots do not have to be marked. The value of k can be chosen by the inventory designer; 6 is often found to be an optimal number. K-tree plots can nested with the k trees in each plot measured according to the diameter class for each plot. The design for 6 trees in a single plot is shown in Figure 3F-2.

Figure 3F-2. Plot lay-out of k-tree sampling

Caution is required as k-tree sampling designs have an inherent bias by overestimating (up to 15%) plot volume since the kth tree is always located on the plot perimeter (Magnussen, Kleinn, & Picard, 2008). Various methods for correcting for this bias exist (e.g. see Kleinn & Viclko (2006)).

PLOT ORIENTATION

Orientation is not an issue for circular plots, but it is important for rectangular or square plots. For rectangular/square plots, to avoid bias a systematic or random method can be used to orientate the sides of the plots. In a systematic approach, plots sides are set out with the plot outer boundaries oriented towards predetermined compass points. For a random method, select a random number using the second hand on a watch and multiply this number by six. Set the first plot boundary reading this number as degrees on a compass. Which way the second plot boundary will be established (to the right or left of the first plot boundary) must be predetermined to avoid potential bias.

TECHNICAL

SETTING OUT PLOT BOUNDARIES

There are different procedures for setting out circular and square or rectangular plots. For CBFBM, it is important that the approach used is easy to understand and systematic.

For square or rectangular plots, a metal stake, PVC pipe or other permanent marker is driven into the ground to mark the start point of the plot and a GPS reading for the plot is taken at this point. The first outer boundary of the plot is set up using a tape measure, compass and flagging tape. A stake or other marker is driven into the ground at the second plot corner, and the same procedure is followed to set up the remaining outer plot boundaries. If nested plots are used, the two remaining boundaries for the smallest nest are then set up and the trees in this nest are measured. The two remaining boundaries of the second nest are then set up and the trees in this nest are measured. This procedure is continued, until all the trees have been measured.

Another approach for square plots is to locate the plot centre using GPS and to mark this with a plastic pole or other physical marker. The center points of the plot boundaries are located by measuring the distance out from the plot centre along North, East, West and South bearings.

Pre-cut lengths of rope can be used instead of measurement tape to establish the plot boundaries, but the rope length should be checked periodically as some ropes stretch over time or when wet.

The 3-4-5 method (Fig. 3F-3) can be used by the communities to check that the plot corners are at right angles. In this method, at the plot corner 3 metres is measured along one boundary, 4 metres along the other boundary, then a measurement is taken between the two measured points. To form a right angle, this last measurement must be 5 metres. If it is not, either of the plots boundaries must be adjusted.

For circular plots, when tree density is high it may be useful to divide the plot into sections (like pieces of a pie) using flagging tape, or ropes cut to the length of the plot boundaries. All trees in the first section are measured before moving to the second section. This reduces the likelihood of missing any trees.

The steps for setting up a circular plot with 8 sections (Fig. 3F-4) are:

Step 1: Locate the plot centre point
Step 2: Using flagging tape (or rope) and distance tape measure, set up the 1st line out from the center point
Step 3: Set up the 2nd line heading in the opposite direction
Step 4: Set up the 3rd and 4th lines at right angles to the first 2 lines
Step 5: Set up line 5 between lines 1 and 3, and line 6 between lines 2 and 4
Step 6: Set up line 7 between lines 2 and 3, and line 8 between lines 1 and 4

Figure 3F-3. 3-4-5 method to check plot corners

5 M

4 M

RIGHT ANGLE = 90⁰

3 M

Figure 3F-4. Illustration of sectioning of a circular plot

CORRECTING FOR SLOPE

The estimates of biomass in each plot will be expanded to a one hectare value. An adjustment must be made when plots are on sloping ground because carbon measurements are reported on a horizontal projection basis. When plots on sloping ground are projected on a map as being flat, their size is actually less than their true field size. Correction is only required if the slope is 10% or greater.

A correction can be made in the field by measuring slope and adjusting the dimensions of the plot, but to avoid unnecessary complexity it is better for CBFBM systems to always keep the same plot size. The correction should be made during data processing and this can be done by including a column on slope in the spreadsheet and building in an adjustment calculation. The adjustment formula is:

$$L_{horizontal} = L_{field} \times \cos(slope)$$

Where:
$L_{horizontal}$ = True horizontal length in metres (for circular plots, this will be the radius. For square/rectangular plots, this will be the side parallel to the slope)
L_{field} = Length measured in the field, parallel with the slope in metres (for circular plots, this will be the radius. For square/rectangular plots, this will be the side parallel to the slope)
Slope = Slope in degrees

PLOT LABELLING

The plot labelling system should be decided prior to the field sampling. Each plot requires a unique name and number. The character denoting the number of the plot should include at least as many digits as total numbers of plots expected to be sampled. In other words, if the number of plots is expected to be greater than 100 but less than 1,000, the number of characters must be at least three integers e.g. 001 to 999. A good system is to name plots with multiple characters defining the type of sampling conducted, the area, the number of the plot and any other relevant information. The following is an example of a recommended plot labeling format: number/letter/number/three numbers.

BEGIN WITH A NUMBER THAT INDICATES THE PARCEL OR LOCATION.

Follow with one letter that describes the strata. For example, S could be used for secondary forest, P for primary forest, etc. The letter is accompanied by a unique number that corresponds to the same stratum.

Follow with numbers that identify the specific plot within the strata and project area. All plots must be numbered uniquely after the first number for the stratum. For example, if all plots in stratum 1 are numbered 1001 through to 1020, then plots in stratum 2 are numbered 2021 onwards; if all plots in stratum 2 are numbered through 2104, then plots in stratum 3 are numbered starting with 3105, etc. Using this system, if a plot is found to be in the wrong stratum after the field phase, the letter and stratum number can be changed but the plot will still have a unique number based on the last three digits.

Examples of plot numbers:
7-Y1-001 (location 7, Young secondary, strata number 1, plot 001)
7-D4-125 (location 7, Degraded mature, strata number 4, plot 125).

(These protocols on plot labelling are from Walker et al. (2012)).

COMMUNITY TRAINING TIPS: PLOT DIMENSIONS AND SET UP PROCEDURES

COMMUNITY TIPS

The objectives of the community training are to ensure that the communities:
- understand the shape, size and orientation of plots
- understand and can implement the procedure for setting up the plots
- understand how they should behave in the plots during and after the sampling

SHAPE, SIZE AND ORIENTATION OF PLOTS

Start by explaining the shape, size and orientation of plots using sketches on A0 paper or flip charts. Explain that it is important that the plots are always set up correctly because the estimates of the total amount of biomass (timber or carbon) in the forest will be based on the measurements in the plots. If the plot is not measured carefully and if the shape is not correct, there could be a large error in the estimate.

Explain the protocols you have developed for setting up the plots, and introduce the equipment that will be used and its correct use.

MEASUREMENT TAPE

Explain that when using measurement tape to measure distance, we first lay the tape measure along the ground between the two points that are being measured, making sure that the tape measure is straight, and without twisting or stretching. Once the measurement tape is laid out between the points, we look back along the tape measure to the nearest metre reading. We then read the cm reading at our target.

Figure 3F-5 (left). Correct holding of measurement tape. Figure 3F-6 (right). Correct reading of measurement tape

Keep the measurement tape straight

First, read the nearest metre

Second, read the centimetres

In this example, the reading is 9.1 metres

Divide the participants into pairs, give each a measurement tape, and ask them to measure the distance between several points. Bring them back together to report their measurements.

COMPASS

Explain that we use a compass to measure the direction between two points. Using a compass, we can know exactly where North, South, East and West are, and we can know where any direction in between is. A compass has a needle that always points to magnetic North, and below this is a circular scale divided into 360 degrees. Using the compass needle and the circular scale, we can always know which direction we are facing.

Provide a sketch of a compass with the four cardinal points and explain the compass readings for each of these points.

Provide a simple explanation on compass use. This will depend on the type of compass, but the following protocols apply to all compass types:

- Always hold the compass level and always check that the needle is moving freely.
- As the compass needle is attracted to metal objects, such as vehicles and bush knives, make sure there are no metal objects near the compass when using it.

Ask the participants where North, South, East and West are. Then, give them the compasses to check whether they are correct.

PLOT CORNERS

For rectangular and square plots, explain the importance of setting square plot corners. Explain how this will be done using the compasses, then explain the 3-4-5 method for checking that plot corners have right angles. Use Figure 3F-8 to explain a right angle.

Figure 3F-7. Cardinal points

PRACTICAL EXERCISE ON PLOT ESTABLISHMENT

It is important for the community members to practice setting up plots before they begin the forest sampling. An open area that is suitable for training purposes should be used. This could be an area in the forest where the trees are not dense, making it easy to see across the entire plot and to move around the plot, or it could be outside the forest.

Depending on the number of local level facilitators and the number of community members, decide the best way to give the community members sufficient hands on practice in plot set up. Either divide the community members into groups and have each group work with a local level facilitator who guides them in setting up a plot, or keep the group together and guide them in setting up one plot.

BEHAVIOUR IN PLOTS

After the practical exercise, bring the community members together to discuss how they behave in the plot when doing the sampling, and how they behave towards the plot once the sampling is completed.

During the measurement in the plot, it is important that any disturbance of the vegetation is kept to a minimum. People should not cut vegetation to make it easier to walk through and work in the plots, and they should step carefully in order to avoid damaging the vegetation. For permanent plots, once the plot has been measured, community members can continue to walk through plots and gather non-timber forest products as they normally might do.

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LEARNING OBJECTIVES:

By the end of the session, participants

▪ have shared their experiences with tree marking

▪ can explain key points that should be considered when designing a tree marking system

▪ have designed a simple, robust tree marking method for their CBFBM system

▪ have designed a training activity for communities on tree marking

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

FIELD EQUIPMENT/PREPARATION:

Optional: All equipment that will be used for tree marking (aluminum soft drink cans and scissors for cutting tags, aluminum nails, hammers, nylon string, acrylic paint and brushes, etc.)

TIME:

30-40 minutes

STEPS:

1. Link this session back to the participants draft CBFBM design table developed during session 3a Developing a robust carbon stock assessment and monitoring plan. The design table has a row on measurement of carbon pools that can be split into further rows for each carbon pool. A row can be created for the living tree carbon pool and the protocol and teaching methods developed by participants in this session for tree marking can be noted in this row.

2. Ask the participants to share their experiences with tree marking.

3. Explain that for their CBFBM system, they will have to design a tree marking system that captures the information required, is low cost and durable, and does not include parts that are likely to be stolen. Take them through the Technical Considerations and Protocols and ask them to keep these points in mind.

4. Give the participants about 15 minutes to discuss and propose a system for tree marking. Provide feedback and have them summarise their ideas for tree marking on flip charts.

5. Optional: Have the participants go outside and practice marking a few trees.

6. Back in the classroom, take the participants through Community Training Tips and then ask them to plan a training activity for the communities on tree marking. (Note: This training activity could be combined with the training on diameter at breast height (DBH) measurement).

7. Have them present their proposed training activity to you and provide feedback.

8. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

TREE MARKING

When permanent sample plots are used, trees must be marked or mapped to measure the growth of individual trees at each time interval in order to track the growth of survivors, mortality and ingrowth of new trees. For temporary plots, there is no need to mark the trees.

DEFINING MINIMUM TREE SIZE THRESHOLDS

Before trees can be marked, the minimum size of trees to be measured must be defined (e.g. minimum DBH of 5 cm and minimum height of 1.3 m). Saplings below the minimum thresholds can be measured, but using different methods to trees. (One option for saplings is to calculate the average weight of a sapling and to multiply this by the number of saplings counted in a small plot. Another approach is to measure the biomass of all trees below a minimum size in the non-tree biomass measurements. See Walker et al. (2012) for further guidance on how to measure saplings).

BOUNDARY TREES

Before trees are marked, they must be identified as being inside the plot and within the diameter class for the plot. Some trees may fall on the plot boundaries. Trees are considered in the plot when more than 50% of the base of the trunk is within the boundary of the nest. Conversely, trees are considered out of the plot when more than 50% of the base of the trunk is outside of the boundary. For rectangular or square plots, it is not so difficult to determine whether a tree is in or out of the plot as this can usually be decided when setting up the plot boundaries. For circular plots, to be sure whether a tree is in or out of the plot, use a tape measure to measure out from the plot centre to the base of the tree. If a tree is sitting exactly on the plot boundary, flip a coin to determine if it is in or out.

DECIDING HOW TO MARK THE TREE

For biomass monitoring the only information required is a unique number for each tree in the plot. Tags with sequential numbers have to be prepared. The tags can be attached with an aluminium nail or with strong nylon fishing line or similar.

A standard procedure should be developed for marking each tree. If tags are attached with aluminium nails, the nail and tag should be placed 10 cm below the DBH mark, as a bump could form and affect future DBH measurements. If trees might later be harvested, the tag can be placed near the base of the tree to avoid chainsaw or other accidents. The aluminium nail should be inserted deeply but not fully to allow the tree to grow.

Instead of using an aluminium nail, a hole can be punched in the tag and the tag attached with wire, fishing line or nylon string. The tag should be tied loosely to allow for tree growth.

For CBFBM, the communities can prepare the tree tags using aluminium cans. Using scissors they can easily cut tags from the cans and numbers can easily be inscribed into the cans using a nail or other sharp point.

In addition to tagging, the tree number can also be painted on to the tree stem using acrylic paint. This can be done at the same time as the point of measure for DBH is painted.

Example of tag cut from aluminum can and attached with nylon string

Local level facilitators explain the reason for marking trees and the protocols to the community members. Sufficient tools and materials are prepared for the community members to practice marking trees. Several trees should be selected in advance for the practice. These trees can later be used for practice on DBH and height measurement. These become the "practice trees" for the community training. It is normally enough for each of the community members to practice marking one or two trees.

REFERENCES

Walker, S. M., Pearson, T. R. H., Felipe, M. C., Harris, N., Petrova, S., Grais, A., . . . Brown, S. (2012). *Standard Operating Procedures for Terrestrial Carbon Measurement*: Winrock International.

3H SESSION: IDENTIFYING TREE SPECIES

LEARNING OBJECTIVES:

By the end of the session, participants

- have shared their own experiences with respect to community knowledge on tree species
- have designed a simplified technique for identifying and remembering species building on local knowledge that can be shared with all community members
- have designed a training activity for communities on tree identification

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts and markers or whiteboard; laptop computer or exercise book

TIME:

15 – 30 minutes

STEPS:

1. Link this session back to the participants' draft CBFBM design table. The design table has a row on measurement of carbon pools that can be split into further rows for each carbon pool. A row can be created for the living tree carbon pool and the protocol and teaching methods developed by participants in this session for tree species can be noted in this row.
2. Ask the participants about how many tree species in the forests are being sampled. Ask them whether they think that the local communities can identify all the species.
3. Based on their answers, take the participants through relevant sections of Technical Procedures and Protocols and Community Training Tips. Point out that they will have to construct a standard tree species list. If the communities are going to use local names for identifying the species, the species list should include both the local and botanical names.
4. Give the participants 15 minutes to design a training activity on species identification for the communities. Have them present this to you and provide feedback.
5. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:

This session can be shortened significantly in the case of a mono crop planted forest or natural forest stands dominated by one or a few species.

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

Accurate recording of tree species increases the precision of forest biomass estimates as wood specific gravity can differ by large amounts between species.

For forests with high tree species diversity, it may not be possible to identify all species. The unidentified species should be named as such, and a single default wood density can be used for them.

A standard tree name list and tree name abbreviation list should be created and when there are a large number of species, these lists should be brought to the field for reference and for filling out data sheets. The tree names may be based on the species, genus or family, depending on the biomass regression equation(s) used.

It may be easiest for communities to identify tree species using local names they are familiar with. A sheet can be drawn up matching local names with the botanical names, allowing the communities to record the local names of species, and their botanical names to later be used for data analysis. The ability of community members to identify tree species would need to be checked carefully. Some may be much more capable than others, depending on how much time they spend in the forest, and for what purpose.

COMMUNITY TRAINING TIPS:
IDENTIFYING TREE SPECIES

COMMUNITY TIPS

In forests with only a few species, there may be no need for training on species identification if a check shows that the communities can readily identify all the species. The situation is more complex for forests with high species diversity; however, even in such cases local communities who have a history of forest resource use will have traditional knowledge for identifying tree species and their uses. Any training should build on this traditional knowledge. Some people within the communities, e.g. the older men and women, may have the best knowledge on species and they can be encouraged to act as trainers for other community members.

In highly species-diverse forest, community members may not be able to identify all the species. Community members must be instructed not to "guess" the species when they are unsure. Instead, they should enter "unsure" or another appropriate term into the field sheet.

"WHAT TREE AM I" EXERCISE
The community members are divided into small groups. Each is asked to think of one tree they know in the forest well. They then discuss amongst themselves the features they use to recognise the trees, e.g. its size, shape, bark, leaves, seasonal changes, distribution in the forest, uses, etc. Each group then describes the tree they have selected to the other groups without giving the name of the tree. The other groups guess the name.

"PASSING ON KNOWLEDGE FROM OLD TO YOUNG" EXERCISE
For species diverse forests, the following exercise is suggested. First, several older village members are asked to walk with the group to different trees in the forest. At each tree, the community training participants are asked to give the name of the tree, to explain how they identify it, and what its uses are, if any. The older village members are then asked to share their knowledge on the tree species. Local level facilitators record any information shared and includes this in the field manual for the communities.

SESSION: MEASURING TREE DIAMETER AT BREAST HEIGHT (DBH)

LEARNING OBJECTIVES:

By the end of the session, participants

- have shared their own experiences on how to measure DBH
- can explain the technical fundamentals of measuring DBH
- have proposed a method for DBH measurement for their CBFBM design
- have designed a training activity for communities on the DBH measurement method

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

FIELD EQUIPMENT/PREPARATION:

calipers, DBH tape, etc.

TIME:

60-90 minutes (will be shorter if DBH measurements are not complicated by buttresses and fluting)

STEPS:

1. Link this session back to the participants' draft CBFBM design table. The design table has a row on the measurement of carbon pools that can be split into further rows for each carbon pool. A row can be created for the living tree carbon pool and the protocol and teaching methods developed by participants in this session for DBH can be noted in this row.
2. Ask the participants what equipment and protocols they normally use when measuring tree diameter.
3. Take the participants through the sections on rules for locating the point of measure (POM) for DBH and on measurement instruments in Technical Considerations and Protocols.
4. Give the participants 15 minutes to discuss which rules are particularly important for the forests being sampled (e.g. some forests have many buttressed trees while others have none) and to propose DBH measurement procedures and instruments for their CBFBM system.
5. Optional: Outside the classroom, have the participants measure DBH of a few trees using their proposed procedure.
6. Back in the classroom, take the participants through Tips for Community Training.
7. Give the participants 25 minutes to draft a community training activity on DBH measurement. Tell them that their training activity will need to include explanation of why DBH is measured, the rules for DBH measurement, and a practical exercise.
8. Ask them to describe their training activity to you and provide feedback.
9. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

3I TECHNICAL CONSIDERATIONS AND PROTOCOLS: MEASURING TREE DIAMETER AT BREAST HEIGHT (DBH)

TECHNICAL

Tree diameter measurement is the most important measurement for estimating tree biomass, so care must be taken to ensure correct technical procedure and protocols are always used.

RULES FOR LOCATING THE POINT OF MEASUREMENT FOR DIAMETER

The point where we measure the diameter of the tree is sometimes called the point of measure, or POM. For "normal trees", the POM is the diameter at the height of our breast. This is called diameter at breast height, or DBH. DBH is standardised at 1.3 metres above the ground from the base of the tree (USA, New Zealand, Burma, India, Malaysia, South Africa and some other countries set the POM at 1.4 m for their timber inventories) and we use this for estimating the total biomass in each tree. Ground level excludes loose leaves and litter that is not incorporated into the soil, so this should be cleared away before locating the POM.

There are some exceptions when the POM is not set at 1.3 m. Rules are needed to deal with these to ensure consistency in measurement and to ensure tree biomass is not over-estimated. Different inventory manuals may provide slightly different rules for locating the diameter POM, but the following rules are fairly standard for biomass assessment.

Rule 1: For normal trees, use 1.3 m for the POM

Rule 2: If the tree has some type of swelling at 1.3 m, then measure just above the swelling. (This provides a conservative estimate, but note that some inventory manuals advise measuring the smallest part of the stem below the swelling).

Rule 3: For forked trees, if the fork starts below 1.3 m, measure as if for two trees. If the fork starts above 1.3 m, measure one tree

Rule 4: For trees on slopes, the POM is 1.3 m on the upslope side of the tree stem

Rule 5: For buttressed trees, measure 30 cm above where the influencing of the buttressing stops. For fluted stems, measure above where the fluting stops, or measure diameter over the fluting and make the following deductions:
1. If the fluting occurs at various points around the bole and extends vertically to the top of the bole: Deduct: 2 x average depth of fluting, from the measured DBH.
2. If the fluting extends all the way round the bole and half way up the bole: Deduct: 1/2 x (2 x average depth of fluting), from the measured DBH.
3. If the fluting extends half way round the bole and half way up the bole: Deduct: 1/2 x (average depth of fluting), from the measured DBH.

Rule 6: For leaning trees, measure at 1.3 m on the inside of lean

MEASUREMENT INSTRUMENTS

Diameter is read to the nearest 0.1 cm and can be measured accurately with diameter tapes, regular measurement tapes or callipers. Diameter tapes have an advantage over regular measurement tapes in that diameter is read directly from the tape. For regular measurement tape, the measured

POM
1.3M
NORMAL

POM
1.3M
FORKING STEM

POM
1.3M
SLOPE

FLUTED STEM

POM
1.3M
LEANING TREE

circumference is converted to diameter by dividing by 3.14 (π). Fibreglass measurement tapes are preferred over cloth tapes as the latter can become distorted.

A systematic approach must be applied when using DBH tape or any other forest measurement instrument. Once the POM has been located, the DBH tape is always drawn around the tree from left to right, then placed under the start of the tape to aid reading. The tape must be held level (or on perpendicular plane to the stem axis) and firmly, but not stretched. It should not be allowed to wander loosely around the tree. The tape should be passed under any vines. The numbers should always be kept right side up.

Correct placement of DBH tape

Pull the tape to the right and around the tree

Read at the point where the tape below hits the zero point of the tape above

For callipers, the fixed arm of the calliper is placed along one side of the tree and the moveable arm is then placed flush against the other side of the tree and the scale is read directly, after checking that the calliper is positioned perpendicular to the stem axis. Take two measurements of diameter at right angles to one another and use the average. Callipers with an arm length at least half that of the tree diameter should be used. Shorter arm lengths will result in underestimates.

The choice of measurement tape or callipers will depend partly on the ability of the communities to use these instruments, so a firm decision on which instrument will be used should not be made until after testing with the communities.

In tropical forests, buttresses and flutes can run several metres up the tree stem. It may be possible to climb up the buttresses, and carrying a collapsible ladder could be useful in some circumstances. Steps can be cut into fluted buttresses to aid climbing.

If it is too difficult and time consuming to climb above the buttresses, then the diameter can be estimated from the ground. This can be done two ways. The first method is to place two poles against the tree and align them with the edges of

Facilitator trains community member on calliper use, Hoa Binh, Viet Nam

the tree stem at a point 30 cm above the buttressing. Once the poles are properly aligned, the linear distance between the two poles is measured. Two measurements should be taken on opposite sides of the tree using this method, and then averaged to estimate DBH.

The second method is to use variable scales (either small callipers or transparent rulers) with a fixed distance to the observer´s eye at tape-measured distances to the trees. To simplify the method further, the reading used on the calliper or transparent ruler can be fixed, or an angle gauge could be used. The observer then walks back from the tree to a point where the tree stem fits with the predetermined calliper or ruler reading or angle gauge, then records the measurement to the tree.

Testing simplified methods to estimate DBH with variable scales, Seima, Cambodia

HOW TO EXPLAIN WHY WE MEASURE TREE DIAMETER, THE NEED TO HAVE RULES THAT EVERYONE FOLLOWS AND THE NEED FOR EVERYONE TO USE THE EQUIPMENT CORRECTLY

▪ Explain that we can never know perfectly how much wood is in a tree, but we can make a good estimate of this by measuring some parts of the tree. The most important part of the tree to measure is diameter. If a tree has a large diameter, we know that it will have a large amount of wood; if it has a small diameter, it will have a small amount of wood. This is similar to measuring the waist of a person to estimate how much they weigh. If we measure a person's waist and see that it has increased, we know that their weight has probably increased (maybe from eating too much good food!). If we measure the diameter of a tree today and then again in one year's time and we find that the diameter has increased, we know that the tree has grown and the amount of wood in it has increased.

▪ Explain that to estimate the amount of wood in a tree and to know whether it is growing or not, we must have rules for where we measure diameter, and everyone must follow these rules. For example, if someone measures the diameter near the ground, and someone measures the diameter after climbing high up the tree, they will have very different results. Provide a sketch to illustrate this point. Ask, in this case who will measure the largest diameter?

▪ Referring to the Technical Considerations and Protocols, explain what the POM is and the rules for locating the POM. Provide sketches for how to deal with trees on slopes, leaning trees, trees with forked stems, etc., according to the forest context you are working with.

▪ Introduce the equipment that will be used and demonstrate the correct way to use this on one tree.

SUGGESTED PRACTICAL EXERCISE

▪ Ask the community members if they can think why internationally 1.3 m is used as a standard for the POM (it's easy, avoids stretching, bending, etc.).

▪ Ask them to each cut a stick of 1.3 m and compare this to their own height. Tell them to identify where the stick reaches on their body and to make a temporary mark on their body. Tell them that this mark can be used to confirm that the point of measure for DBH is at the right place.

▪ Invite the community members to stand by a tree in a position where everybody can see.

▪ Demonstrate how to measure the DBH according to the steps in the technical protocol for the instrument you are using, taking care not to miss any steps.

▪ Call each participant one-by-one to measure a second tree that you have already measured. Once they have measured the tree, ask them to give you their reading. Make sure others in the group cannot hear this, otherwise they may intentionally repeat the same reading as the person in front of them. If they are making obvious mistakes, correct them, but only after the participants have attempted their first measurement.

▪ After all the group feels confident in measuring DBH, explain that now they are going to go on a DBH quiz trip around the forest where they will find different forms and sizes of trees that you have marked (these trees can be marked by the community members as part of the earlier training on tree marking). Give them a clear time frame when they should come back to a common meeting point.

▪ After an appropriate time period call the group back together. Compare the recorded measurements with your measurements and if there are any large discrepancies discuss the possible reasons for these. If you feel it is necessary, ask participants to go back and re- measure some of the trees.

▪ As a group, have the participants reflect on the exercise using the following questions:

▪ How did you feel practicing measuring the trees?

  ▪ *What did you find easy and what did you find difficult?*

  ▪ *What did you do to help each other remember you are doing it in the right way?*

  ▪ *How can you make sure in the future that you keep measuring the right way?*

3J | SESSION: MEASURING TREE HEIGHT

LEARNING OBJECTIVES:

By the end of the session, participants

▪ have shared their own experiences on how to measure tree height
▪ can explain the technical fundamentals of measuring tree height
▪ have proposed a method for height measurement for their CBFBM design
▪ have designed a training activity for communities on the proposed height measurement method for their own CBFBM design

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

FIELD EQUIPMENT/PREPARATION:

clinometers, Blume Leiss, distance tape measure, etc. depending on what instruments will be used for tree height measurement

TIME:

60-90 minutes

STEPS:

1. Link this session back to the participants draft CBFBM design table. The design table has a row on measurement of carbon pools that can be split into further rows for each carbon pool. A row can be created for the living tree carbon pool and the protocol and teaching methods developed by participants in this session for measuring tree height can be noted in this row.
2. Ask the participants to share their experiences with tree height measurement, such as the objectives of the height measurement and the instruments used.
3. Take the participants through the Technical Considerations and Protocols pointing out the different options that are available, but do not go through the step-by-step protocols for each instrument. Ask the participants what option they propose for their CBFBM system and provide feedback, focusing on the need to use relatively low cost, reliable equipment that the communities will be able to use.
4. Using Technical Considerations and Protocols, take the participants through the user protocols for the instrument they propose.
5. Optional: Outside the classroom, have the participants measure the height of a few trees using their proposed procedure.
6. Back in the classroom, take the participants through Community Training Tips.
7. Give the participants 25 minutes to discuss a community training activity on height measurement. Tell them that their training activity will need to include explanation of why height is measured, the rules for height measurement, and a practical exercise.
8. Ask them to describe their training activity to you and provide feedback. Have them record their proposed protocols and community training activity using a laptop or exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

Tree height is an important tree variable. It is well correlated with other important tree and stand parameters such as tree volume and the quality of site conditions.

For CBFBM, total tree height must be measured if height has been included as a tree variable in the allometric equation/s that will be used. Merchantable height, while not important for biomass assessment, would also be measured if commercial timber volume is being estimated.

DEFINITIONS

Total tree height is the distance along the axis of the bole of the tree from the ground to the uppermost point of the tree. For biomass assessment, this definition also applies to leaning trees, i.e. regardless of the lean, the total height is the distance from the base of the tree along the axis of the bole to the uppermost point of the tree. The height of a leaning tree can be estimated by imagining where the top of the tree would be if it were not leaning and estimating

Figure 3J-1. Total and merchantable height

the height of this imaginary point. Unless the lean is severe, it will not make such a large difference in height measurements. The tree must be leaning by more than 18 degrees off vertical before the difference exceeds 5%.

Merchantable height is normally defined as the lowest point on the main stem, above the stump, where utilisation of the stem is limited by branching or other defect, or the highest point on the main stem where the stem diameter is not less than some specified value.

INSTRUMENTS FOR MEASURING TREE HEIGHT

Tree height can be measured using a variety of instruments. For CBFBM, the choice of instrument will depend upon its suitability to the forest being measured, price, ease of use, robustness and accuracy. See http://fennerschool-associated.anu.edu.au/mensuration/toolshgt.htm for a good description of various instruments and their relative merits. Four instruments that have been found to be well-suited to CBFBM are discussed below.

Height sticks (graduated poles)

Height sticks are a reliable technique for directly measuring the height of trees less than about 25 m, with errors typically less than about 1%. Extendable graduated poles are very useful in measuring small trees in young plantations and in dry woodlands where trees are relatively short. A cheaper alternative that could be considered for CBFBM is to attach a measurement tape to a bamboo pole or similar and to raise the pole to the top of the tree.

Three people are normally required when using height sticks. One person stands away from the tree in a position from where they can observe the height stick and talk to the stick person. One person (the "stick person") feeds the sticks up the tree. One assistant puts the sticks into the stick person's hands so she/he does not need to take concentration away from feeding the sticks up the tree. The steps for using height sticks are:

1. Observe the branching and other features of the tree and choose a position for erecting the sticks that will facilitate the measuring process. Do not erect the sticks from a position at which you will face into the sun.

2. Feed the sticks up the tree and count the number of sticks used.
   - *If upward movement of the sticks is impeded by a branch or cone, simultaneously shake the sticks laterally and push upwards to guide the tip onto a new path.*
   - *Whenever pressure is felt when pushing up the sticks, stop, retrieve at least one stick and seek a new path before proceeding further.*
   - *To correct sticks which begin to splay outwards on the side of the tree opposite to the stick person, retrieve several sticks, move closer to the tree and re-erect the sticks.*
   - *To correct sticks which begin to splay outwards behind the stick person, retrieve several sticks, move back 30 to 100 cm from the tree base, hold the basal sticks vertical and proceed to re-erect the sticks.*
   - *If the sticks splay to the point where they begin to fall out of the tree, do not fight them but guide them down so that they fall flat on the ground.*

3. The observer finds a position at right angles to the plane of tree bole and upper set of sticks.

4. Place the graduated pole against the base of the tree and record the measurement when the height sticks have reached the tip of the tree.

5. Count the number of height sticks as they are retracted to ensure no mistakes were made and to ensure none are left hanging in the tree.

Safety is a concern when there is a possibility that height sticks could fall on people standing around the tree being measured.

Hypsometers

Standing trees are mostly measured indirectly using hypsometers, rather than height sticks, because hypsometers can be used for tall trees.

Hypsometers do not measure height directly. Instead height is calculated from the measurement of angles and distances to points on the tree. Depending on the type of hypsometer, the calculations either use geometric (similar triangles) or trigonometric (sin, cos and tan of angles) relationships.

Sophisticated hypsometers use lasers or sonic pulses to measure distance. These are not necessarily difficult to use, but because of costs they are less well-suited to CBFBM than some of the alternatives. Hypsometers that have been found to be well-suited to CBFBM include the Blume Leiss, clinometers and the Christen hypsometer.

When using indirect height measurement methods, a point to consider is whether height will be calculated in the field or whether height will be calculated later after the data has been entered into a spreadsheet. This depends on the instruments used and on whether the measurements are on flat or steeply sloping ground. If the height calculations are complicated by the need to account for sloping ground, then leaving the calculations to the data processing stage may be the best option. In other cases, calculation of height in the field may be straightforward and thus can be conducted during the field work.

Blume Leiss

Blume Leiss are robust and only moderately expensive. They are well-suited to CBFBM because the height reading is on an external scale that can easily be viewed by the user and others. For training purposes this is useful as the local level facilitator can check the reading to determine whether the user understands where the top of the tree or other target is, and whether the user reads the scale correctly.

(left) Use of Blume Leiss by community member, Hoa Binh, Viet Nam. (right) Facilitator (on right) checking a Blume Leiss reading taken by community member, Hoa Binh, Viet Nam

Steps for using the Blume Leiss
1. Find a location preferably 15, 20, 30 or 40 meters horizontal distance from the base of tree where the required measurement points on the tree can be seen.
2. Push the button on the side of the Blume Leiss and check that the needle above the external scale is moving freely.
3. Sight at the required point on the tree, wait for a couple of seconds for the needle to settle, then pull the trigger.
4. Read the height directly from the appropriate scale for the distance (15, 20, 30, or 40 metres) from the tree. If you were unable to find a position at one of these distances:
    a. If the horizontal distance is a simple fraction of one of the scale distances (e.g. 10 m is half of 20 m), read from the scale distance and multiply by the appropriate fraction, or
    b. Read from the percent scale and multiply this percentage by the horizontal distance measured in the first step.
3. Site to the base of the tree and repeat steps 2, 3 and 4.
4. Combine the heights from steps 4 and 5 to determine total tree height
    a. Add the 2 heights together if you looked up to the required point in step 3 and down to the base of the tree in step 5.
    b. Subtract the height to the base of the tree from the height to the required point if you are on sloping ground and had to look up or down to both the required point and the base of the tree.

Clinometers
Clinometers are small, lightweight, robust and inexpensive, making them well-suited to CBFBM, though they are more difficult to use than the Blume Leiss. When used correctly, a Suunto Clinometer has an accuracy of about +/- 0.5 m for a 20 m tall tree (i.e. about 2.5%).

The steps for using a clinometer will depend upon the model used. Some clinometers are similar to a Blume Leiss in that the readings are taken at fixed distances and height is read from these. When flexibility is required to find the best points for viewing the trees, it is better to use a clinometer that has a percent or degrees scale. In the latter case, height is not estimated in the field; rather the formula for actual height calculations is built into the spreadsheet used for data processing. It is important that the readings are recorded as either positive or negative.

Correct use of clinometers by young village men, Awane, PNG, with facilitator (on left) observing.

Simplified steps for using a clinometer

1. Measure the distance from the base of the tree to the point where the clinometer reading will be taken.
2. Sight at the top of the tree:
    a. *Using one eye:* Close one eye and simultaneously look through the Suunto at the scale and 'beside' the Suunto at the tree. Judge where the horizontal line on the Suunto scale would cross the tree.
    b. *Using both eyes:* With one eye looking at the Suunto scale and the other looking at the tree, allow the images to appear to be superimposed on each other and read where the horizontal line on the Suunto scale crosses the tree. Note: If you suffer from astigmatism (a common situation where the eyes are not exactly parallel), use the one eye approach.
3. Read the percent scale.
    a. To read the scale properly, start above or below the target point and then move the clinometer sight towards it. When aiming upwards, the clinometer reading is positive, when aiming downwards, the reading is negative.
    b. You should be able to take a reading after about 5 seconds. You will get a sore eye if you look longer than this through the clinometer. Once you have taken the reading, give your eye a rest for a few seconds, then use the clinometer again to check your first reading.
4. Site to the base of the tree and read the percent scale. (Alternatively, if the POM for DBH has been marked on the tree and its

Figure 3J-2. How to read the clinometer scale

THE READING FOR TOTAL HEIGHT IS POSITIVE 72 PER CENT

height measured, this can be used instead of the base of the tree. In dense forest, this may be a better approach as the POM can be made visible by holding a bright object in front of it).

5. Call out the distance and percent readings to the data recorder. Each reading should be called out as either positive or negative.

On sloping ground in dense forest, stand somewhere above the tree base (up the slope from the tree) when using the clinometer. It is usually easier to see the tree tops from an upslope position.

Christen hypsometer

There are a number of instruments that use the geometric relationships between similar triangles to indirectly measure tree height. The Christen hypsometer is one of these and is potentially well-suited to CBFBM as it can be manufactured locally.

Simplified steps for using a Christen hypsometer

1. Hold a 4 metre pole upright against the base of the tree.
2. Hold the hypsometer at a distance from the eye such that the two inside edges of the flanges are in line with the top and base of the tree. Move closer or further from the tree as necessary to achieve this.
3. Read the graduation on the scale that is in line with the top of the pole to obtain the tree height.

Figure 3J-3 (left). Example of a Christen hypsometer. Photo (right). Facilitator (left) instructing on use of Christen hypsometer, Semoyo, Java, Indonesia

Figure 3J-4: Use of a Christen hypsometer

In Figure 3J-4, the distance A-d is a set distance at which the Christen hypsometer is held from the eye. The viewer holds the hypsometer so that the flanges of the hypsometer align with the top and base of the tree, and he/she takes the height from the top of the vertical staff using the scale on the hypsometer.

If the Christen hypsometers are manufactured locally, the following formula can be used for graduating the instruments:

$$\frac{A'C'}{AC} = \frac{A'B'}{AB}$$

For a given length of instrument A'B' and a given pole length of AC, the graduations A'C' can be obtained by substituting different values of height AB in the equation.

Christen hypsometers and other height instruments using geometrical relationships are less precise than instruments using trigonometric relationships, such as the Blume Leiss and clinometers. Their accuracy should be assessed in the field against alternative methods.

Adjustment for sloping ground

The trigonometric relationships used by the Blume Leiss and clinometers are based on the horizontal distance between the user and the tree. This distance is measured using a tape measure held across the ground between the user and the tree, but on sloping ground this does not provide the true horizontal distance. The horizontal distance must be calculated from the slope and the measured slope distance, and then total height can be calculated. Figure 3J-5 explains how this is done when the user is downslope of the tree.

Figure 3J-5: Adjusting for sloping ground

Calculate the horizontal distance OC (from slope distance OB and angle BOC) and subtract the length BC from AC:

AB = AC – BC

= OC x (TAN(AOC) – TAN(BOC))

Where:

OC = OB x COS(BOC)

These equations can be built into the spreadsheet used for data processing. In addition to the readings that would normally be taken for height measurement, the slope between the user and the tree must also be measured and recorded. Another alternative is to make the slope adjustment in the field using a slope correction table.

FURTHER READING:

http://fennerschool-associated.anu.edu.au/mensuration/home.htm

The following steps are suggested for the community training on height measurement:

1. Using sketches on A0 paper, explain the meaning of total height, tree base and any other terms/ concepts that will be used.
2. Introduce the community members to the measurement equipment and provide a basic explanation of how they are used. Explain common mistakes or problems with the use of the equipment and how they can be avoided.
3. Provide the community members with guided practice on measuring tree height (see below for suggested practical exercise).
4. After the practice, bring the community members together to reflect on their experiences. Present and discuss the results of the practice measurements. Explain that when different people are measuring tree height, small differences in their measurements are to be expected and are acceptable.

SUGGESTED PRACTICAL EXERCISE

Prior to the exercise, identify 5 – 10 trees that will be used for height measurement practice. Use trees with different crown forms, including some where the tree top is not so obvious. Prepare sheets to record the measurements provided by each community member. The following exercise is for practicing clinometer use to estimate tree height, but can easily be modified for other equipment:

1. Explain to the community members that to measure the height of trees requires two readings to be taken using the clinometer. The first reading is taken while aiming the clinometer at the top of the tree and the second reading while aiming at the base of the tree. In addition the community members will have to measure the distance from the point where they use the clinometer along the ground to the base of the tree. So they will be using clinometers and measurement tape.
2. Begin by taking the community members to several trees and ask them to point to the top of the tree. If you are measuring merchantable height, also ask them to identify this point on each tree. Make sure each person has confidence in identifying these points.
3. Show the community members the correct way of holding, aiming, looking through and reading the scales of the clinometers. Remind the community members of common problems, such as forgetting to note whether the readings are positive or negative. Share the clinometers amongst the community members and have them practice looking through them. Ask them to provide the reading for one target (any target is fine). Community members will initially find it difficult to use the clinometers, so allow sufficient time for this.
4. Demonstration: Using one tree, provide a demonstration of the correct procedure for measuring tree height. Assign one community member to be the data recorder. First, demonstrate that a point from which it is easy to view the top and base of the tree must be found. Tell the community members that for the height measurement to be accurate this point should not be close to the tree. If they find that the reading on the clinometer is above 90%, they should move further way from the tree. Next, demonstrate how to measure the distance from this point to the tree and take the percentage readings for total height and tree base. Call the distance and clinometer readings out clearly and have the data recorder write these in a prepared sheet. The data recorder must use the call-back-confirm procedure described in the session 3l Field sheets and data recording.
5. Explain to the community members that they will follow the procedure you demonstrated for five trees you have identified and numbered. Break the community members into groups of three or four and have them move from one tree to the next, taking and recording the height measurements, and rotating roles. During this exercise, be prepared to move with the groups and provide guidance if community members are still finding it difficult to use the clinometers. An alternative is to keep all community members together and to take the whole group to each tree. At the tree, have one person walk up to the measurement point for the tree, give them a clinometer and ask them to read total height and tree base. If they have problems, provide

guidance. Make sure that when one person gives a reading, the others in the group cannot hear this (there may be a risk of them just repeating what the person in front of them has said).

6. Using the data recorded on the prepared sheets, discuss the results of the height estimates with the community members at the end of the practical exercise.

LEARNING OBJECTIVES:

By the end of the session, participants

- have shared their own experiences in measuring the non-live tree carbon pools
- can explain the fundamental technical protocol involved in measuring the non-live tree carbon pools
- have agreed on simplified techniques for measuring the non-live tree carbon pools with community members
- have designed training activities for communities on these simplified techniques

MATERIALS:

sufficient copies of the technical considerations and protocols, and community training tips; flip charts or whiteboard and markers; laptop computer or exercise book; copies of Standard Operating Procedures for Terrestrial Carbon Measurement (Winrock International 2012)

FIELD EQUIPMENT/PREPARATION:

Dependent on the carbon pools selected for sampling and the measurement methods applied

TIME:

30 minutes – 180 minutes, depending upon the carbon pools selected for sampling and the time needed outside the classroom to make sure all the local level facilitators are competent with the measurement and sampling methods

STEPS:

1. Link this session back to the participants draft CBFBM design table. The design table has a row on measurement of carbon pools that can be split into further rows for each carbon pool. Rows can be created for any non-living tree carbon pools that are included in the monitoring and the protocol and teaching methods developed by participants in this session can be noted in this row.
2. Ask participants to share their experiences, if any, measuring non-live tree carbon pools, including objectives and methods.
3. Take the participants through Technical Considerations and Protocols, but avoid unnecessary details at this stage, such as equations used to process data. Rather, focus on helping them make decisions on which non-live tree carbon pools to include in the biomass monitoring. You can refer to guidance in session 3a Developing a robust carbon assessment and monitoring plan, and remind participants that their selection of carbon pools for sampling will depend upon any voluntary or regulatory standards they are using, and whether omitting a carbon pool results in a conservative or over-estimate of net climate benefits of any forest management activity they propose.
4. Give the participants 15-30 minutes to discuss which non-live tree carbon pools they will sample and what methods they will use. Ask them to present their ideas and provide feedback.
5. Optional: Outside the classroom have the participants practice the methods they have proposed for the non-live tree carbon pools.
6. Back in the classroom, take the participants through Community Training Tips.
7. Give the participants 10-30 minutes to discuss community training activities for the non-live tree carbon pools.
8. Ask them to describe their proposed training activities to you and provide feedback.
9. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings.

TECHNICAL CONSIDERATIONS AND PROTOCOLS: MEASURING THE NON-LIVE TREE CARBON POOLS

A basic description of how the non-live tree carbon pools are sampled is given below. If any of these carbon pools are to be included in the forest sampling, Walker et al. (2012) or similar technical manuals should be referred to when designing the protocols.

Thought must be given to simplified measurement and sampling techniques that can be implemented by communities for the various carbon pools. The lying dead wood pool can be measured by communities using the line intersect method. There are several options for measuring the standing dead wood pool that do not require sophisticated field measurements and could be undertaken by community teams. The measurements and tagging for palms is the same as for living trees so they too can be sampled by communities. The simplified methods described below also make it possible to include lianas and bamboo in the sampling. The community forest monitoring teams should also be involved in measuring and gathering samples for non-tree woody vegetation, herbaceous vegetation, litter layer and soil carbon, to the extent feasible.

LYING DEAD WOOD
Lying dead wood is defined as all woody material on the ground with a diameter ≥ 10 cm. Smaller diameter pieces of wood are sampled as part of the litter pool.

In the line intersect method, straight-line transects of a set distance and bearing are set out from the same plots that are used to measure the living tree carbon pool. The diameter of any dead wood that lies across the transect is measured and the dead wood is struck with a machete to check the extent of decomposition. The data that needs to be recorded is the wood diameter at the point where the line crosses the wood, the decomposition class, and the diameter of significant hollows in the wood (where present).

The steps to measuring lying dead wood are:
1. Locate the transect start point
2. Walk along the first bearing and identify the first piece of dead wood
3. Measure the diameter of the dead wood (and measure the diameter of the hollow, if present)
4. Apply the "machete test" to assign the wood to a density class
5. Move to the next piece of dead wood and measure
6. After the first transect is completed, return to the transect start point and follow steps 2- 5 for the second 50m transect.

Length and location of transects
Two straight-line transects of 50 m each are normally used. Variations of this are possible, as long as the total length is 100 m.

Before measuring the dead wood, a protocol must be established to locate the start of the transects. One option when using square or rectangular plots is to start the transects at right angles from a predetermined plot corner. One transect is set away from the plot following the same direction as one of the plot boundaries, and the other transect is set at 90 degrees following the direction of the adjacent plot boundary (Fig. 3K-1).

A second option that is particularly suited to circular plots is to set the start point randomly. A random compass point is determined from the plot centre using a random number table or the secondhand of a watch (At a random moment a participant can look at his/her watch and then the direction the second hand is facing is used for setting the compass bearing). The start point of the transects is set by walking 100 paces from the plot centre along the bearing, and walking an additional 5 paces to avoid bias. One 50 m transect is then set along the bearing from this point and another by adding 90 degrees and laying a transect along the second bearing (Figure 3K-1).

Figure 3K-1. Options for laying out dead wood transects

Equipment for measuring diameter

Diameter is measured using either calipers or tape. One problem when using tape is that it must be placed around the circumference of the dead wood and it may be difficult to place the tape beneath large pieces. This could be dealt with by placing two rods against the edges of the dead wood, then measuring the distance across the top of the dead wood between the rods.

Identifying what pieces to measure

A piece of dead wood should only be measured if: (a) more than 50% of the log is above ground, and (b) the sampling line crosses through at least 50% of the diameter of the piece). Only measure dead wood when more than 50% is not buried. If the transect crosses the edge of the dead wood, only measure when the transect crosses 50% or more of the circumference of the wood.

Assigning a density class

The "machete test" is used to assign a density class to each piece of dead wood. This involves striking the dead wood lightly with a machete. The classes used are:
Sound – the machete does not sink into the wood (it bounces off)
Intermediate – the machete sinks partly into the wood
Rotten – the blade fully sinks into the wood and the wood is crumbly

Data analysis

Step 1:
For the data analysis, the density of each class must be measured. It is recommended that representative samples of the 3 density classes for each of the tree species measured are collected for determining density (dry weight per green volume). A handsaw or chainsaw is used to cut a complete disc from the selected piece. Density is determined by measuring the average diameter and thickness of the disc to give volume, and weighing the disc after oven drying to a constant weight. The formula is:

$$\text{Density (g/m}^3) = \frac{\text{mass (g)}}{\text{volume (m}^3)}$$

Where:
mass = mass of oven dried sample
volume = π x (average diameter/2)^2 x average width of the fresh sample

The densities are averaged to obtain a single density for each class.

STEP 2:

For each density class the volumes (m³/ha) are calculated separately using the following formula:

$$\text{Volume (m}^3\text{/ha)} = \pi^2 \times \left(\frac{d_1{}^2 + d_2{}^2 .... d_n{}^2}{8^L} \right)$$

Where:

d_1, d_2 etc. = diameter of dead wood in cm

L = length of the transect in m.

STEP 3:

"Biomass of lying dead wood (t/ha) = volume × density"

Note: A worked example of Steps 1 to 3 is provided on p.29 of Pearson, Walker & Brown (2005).

STANDING DEAD WOOD

Standing dead wood refers to trees that have died but are still upright. The minimum diameter for measuring standing dead wood is the same as for live trees (e.g. trees greater than 5 cm DBH and taller than 1.3 m). However, standing dead wood generally also includes dead wood stumps from trees that were greater than 5 cm DBH when alive but have a current height of less than 1.3 m.

The standing dead wood is measured in the same plots used to measure the live trees. It can be measured at the same time as the live tree pool is measured, following the same diameter classes set for the live trees for each nest.

The standing dead wood is classified as follows:

Decomposition Class 1 – Dead tree with branches and twigs, and which resembles a live tree except for absence of leaves (make sure tree is dead and not deciduous)

Decomposition Class 2 – Trees ranging from those containing small and large branches to those with bole only

For Class 1 trees, biomass is estimated by following the same protocols for measuring the live trees and applying a suitable allometric equation. They are marked in the field sheets as Dead.

For Class 2 trees, biomass is estimated by calculating the volume of the remaining tree and multiplying the volume by the wood density. The measurement steps are:

1. Measure diameter at the base of the tree and, if required by the equation used, measure DBH
2. Measure the height of the stem
3. Measure diameter at the top of the stem (This could be done by climbing the stem or using variable scales as described in Session 3i Measuring diameter at breast height, or alternatively do not take a measurement.)

Data analysis

The method involves estimating volume, then multiplying volume by density and expanding the calculated mass to a per hectare value. The simplest approach is to measure the diameter at the base of the tree and to measure the height of the stem, then to estimate the volume assuming the tree is a cone. This approach is conservative. A second option is to assume the tree is a truncated cone, and to measure diameter at the base of the tree and DBH, and from these measurements to estimate the diameter at the top of the tree using a taper equation. A third option is to measure the diameter at the base, the height of the stem, and the diameter at the stem top, then to estimate the volume, again assuming the tree is a truncated cone.

In order of simplicity, the options are:

Option 1: Diameter at top is assumed to be zero.
Volume estimated assuming tree is a cone

$$Volume = \frac{1}{3} * \pi * \left(\frac{D_{base}}{2}\right)^2 * height$$

Option 2: Diameter at top estimated using a taper equation

$$D_{top} = D_{base} - \left[height * \left(\frac{D_{base} - dbh}{130 * 100}\right)\right]$$

Volume estimated assuming tree is a truncated cone:

$$Volume = \left(\frac{\pi * height}{12}\right) * (D_{base}^2 + (D_{base} * D_{top}) + D_{top}^2)$$

Option 3: Equation when diameter of the stem top is measured
Volume estimated assuming tree is a truncated cone:

$$Volume = \left(\frac{\pi * height}{12}\right) * (D_{base}^2 + (D_{base} * D_{top}) + D_{top}^2)$$

Where:
D_{base} = diameter at tree base
D_{top} = diameter at top of stem
height = height of stem

PALMS, LIANAS AND BAMBOO

A field survey should first be conducted to determine whether these vegetation types are common and dominant. If the vegetation type is not common and it is conservative to underestimate forest biomass, it is recommended that the vegetation type not be measured. Prior to plot establishment and measurement, the regression equations to be used to estimate the palm, liana and bamboo biomass must be selected from existing equations and field verified for applicability or newly developed for the land use type of interest. See 'SOP Destructive sampling of trees, saplings, palms, and bamboo' in Walker et al. (2012) for guidance.

Prior to field data collection, a standard list of palm, liana and bamboo names must be developed reflecting the biomass regression equations used, and the size classes to be measured in each nest will need to be determined. The biomass of individuals below a certain size threshold can be estimated by counting the number of individuals within a certain area and multiplying that by the average weight of an individual sapling.

For palms, a minimum height threshold of 1.3 m is normally used, with smaller palms included as shrubs or herbaceous vegetation. Lianas are measured in the smallest plot nest, while the nest used for measuring bamboos depends upon their frequency. The parameters measured will depend upon the allometric equations used. Palms and lianas should be tagged following the same protocols as for trees.

NON-TREE WOODY VEGETATION

A decision must first be made as to whether non-tree woody, herbaceous and tree seedling vegetation will be measured, and if so whether they will be measured separately. Certain regulatory and voluntary standards and methodologies may provide explicit rules on how shrubs and herbaceous vegetation may be measured. If these vegetation classes will be measured separately, very clear rules will need to be created delineating what will be defined as a 'non-tree woody vegetation' and what will be defined as 'herbaceous vegetation'.

Non-tree woody vegetation such as shrubs can be measured using two methods – destructive sampling and applying allometric equations. Destructive sampling is best used when shrubs are small and uncommon, whereas allometric equations are best used when shrubs are very large and a dominant vegetation type.

Destructive sampling

Destructive sampling involves the setting of four clip plots (these can be made easily from PVC tubing) randomly located around each of the plots used for tree sampling. The vegetation in the plots is clipped at ground level and weighed in the field. A representative sample is weighed and brought to a laboratory and weighed again after drying to derive a wet-to-dry ratio.

Allometric equations

Shrubs are measured in the tree plots. The nest that will be used for sampling must be decided in advance and is normally the second or third nest. The vegetation parameters to be measured will be determined by the allometric equation used.

HERBACEOUS VEGETATION

Herbaceous vegetation needs to be clearly differentiated from other vegetation classes so it can be readily identified and sampled. It is sampled using the same destructive method as for non-tree woody vegetation.

LITTER LAYER

The litter layer is defined as all dead organic surface material on top of the mineral soil and includes dead wood with a diameter of less than 10 cm. The sampling is conducted by removing and weighing all the litter that falls within clip plots. Sampling can take place at the same location as sampling for herbaceous vegetation and a wet-to-dry ratio is derived using the same method as for herbaceous and non-tree woody vegetation.

SOIL CARBON

Soil carbon is estimated by collecting soil to a certain depth and then analysing it in a laboratory for carbon content. This information is then combined with a collected bulk density measurement to estimate the average mass of carbon within the soil to a certain depth. Four locations for collecting the soil samples are randomly determined around the tree plots. The soil can be collected either using a standard soil corer or digging a small pit. Separate samples are taken for soil carbon and bulk density estimation.

The community training session should start with an explanation of how forests store carbon not only in the living trees but also in other forms of vegetative matter and soils.

Measurement of the lying dead wood pool could be explained using sketches of how the transects are set up, and sketches of when dead wood should be measured following the rules set out in Technical Considerations and Protocols (refer to Walker et al. (2012) for useful sketches). The machete test should be demonstrated and the purpose of the test should be explained. For a practical exercise, supervise the participants while they set up and conduct the measurements for one transect.

For standing dead wood, sketches can be provided to explain the two classes of trees (refer to Walker et al. (2012) for useful sketches). Practical training will depend on the variables selected for measurement and could follow the same basic structure used for the living trees, with several standing dead trees used for practice.

Similar practical exercises will be required for any other carbon pools included in the sampling.

REFERENCES

Pearson, T., Walker, S., & Brown, S. (2005). *Sourcebook for Land Use, Land-Use Change and Forestry Projects: BioCarbon Fund*; Winrock International.

Walker, S. M., Pearson, T. R. H., Felipe, M. C., Harris, N., Petrova, S., Grais, A., . . . Brown, S. (2012). *Standard Operating Procedures for Terrestrial Carbon Measurement*: Winrock International.

3L SESSION: FIELD SHEETS AND DATA RECORDING

LEARNING OBJECTIVES:

By the end of the session, participants
- have decided what specific field sheets are required for their CBFBM system
- have designed the respective field sheets in a logical way that is easy for communities to use
- have designed a training activity for communities on managing and filling in the field sheets

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

FIELD EQUIPMENT/PREPARATION:

mock tree sampling data on small pieces of paper for suggested practical exercise in Community Training Tips

TIME:

60-80 minutes

STEPS:

1. Link this session back to the participants draft CBFBM design table.
2. Take the participants through Technical Considerations and Protocols. Stress the importance of having a well-structured set of field sheets that will be easy for community members to follow.
3. Give the participants 10-30 minutes to draw preliminary sketches of the field sheets for their CBFBM designs (they will later refine these using computer software), and to discuss ideas for managing the field sheets, and for implementing QA/QC for data recording. Have them present their ideas and provide feedback.
4. Take the participants through Community Training Tips. Ask them to share their observations of common errors when filling in field sheets. Explain the common errors that community members make.
5. Outside the classroom, have the participants practice the Whisper game and the Call-back-confirm procedure.
6. Back in the classroom, give the participants 15 minutes to propose a community training activity for data recording, and provide feedback
7. Have the participants document their proposed protocols and community training activity by noting them in their CBFBM design table, and recording them on a computer or in an exercise book.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the protocols and community trainings

A set of field sheets must be developed for recording plot data. The set should be organised systematically and follow the chronological order in which data will be gathered. Separate sheets may be needed on:

- General Information (Plot ID No., Location (latitude, longitude), Team Leader, Data Recorder, Team Members, Time to Reach Plot, Survey Start Time, Survey Finish Time, and space for Team Leader signature)
- Site Conditions
- Carbon Pools (separate sheets for each)

An example of a set of field sheets (from Walker et al. (2012)) is given below.

Data recorders should be equipped with sufficient field sheets to cover each day's monitoring schedule, plus a few spare sheets in case some are lost or damaged, clip boards and pens, and some type of water resistant case to carry the sheets in.

As part of QA/QC, field sheets should be checked for any omissions, anomalies and legibility by the Team Leaders prior to departing each plot. The Team Leader and Data Recorder should not be the same person. See Session 3m Organising the monitoring teams.

CALL-BACK-CONFIRM PROCEDURE

The following procedure is recommended to ensure correct entry of measurements and other information into field sheets. First, the data recorder finds the best position from which she/he can hear information being called out by other team members. Second, the community members responsible for measurement call out their measurements in loud, clear voices. Third, the data recorder repeats the measurement in a loud, clear voice. Fourth, the community members responsible for measurement either call out "confirmed" or "correct" to confirm that the data recorders have correctly heard the data provided, or call out "not correct" and call out the measurements a second time. (This process may sound tedious but it has been found to be very important for avoiding mistakes in data recording in the field. In some communities, people are not used to calling out information in loud voices and they require practice to be comfortable with this.)

Plot ID #: _____

CLASS 1 STANDING DEAD WOOD MEASUREMENTS

NON-TREE VEGETATION CLIP PLOTS
Plot dimensions: _____

LITTER PLOTS
Plot dimensions: _____

LYING DEADWOOD MEASUREMENTS
(wood greater than 10 cm diameter) Transect length (m): _____

SOIL

IDENTIFY THE BEST DATA RECORDERS

Clan leader checking field sheets, Madang, PNG

Before providing any training on the field sheets and data recording, it is important that you understand the level of literacy of the community members. Begin by asking the community members how many have certain levels of formal education. Ask questions such as "Who has 3 years or less of primary school education?", "Who has graduated from primary school?", "Who has graduated from secondary school?", "Who has attended a training institution after graduating from secondary school?" Tailor the questions in such a way that you understand which community members are likely to be most adept at data recording. You can even ask them directly "Who do you think would be the best data recorders for your community forest monitoring team?" The training can then focus on the community members who have been selected by their team for data recording, and on ensuring good communication between the data recorders and the other team members.

An alternative approach is to have all community members practice data recording and during this process, you can observe who is most adept at this task.

EXPLAINING THE FIELD SHEETS

Distribute sets of field sheets to the community members, then take them through the sheets carefully explaining the content of each one, why each piece of data is recorded, and how to fill in the sheets. Stress that it is important that the field sheets are filled in neatly and correctly. The writing must be easy for others to read. If mistakes are made or if the writing is unclear, then all the time spent in the forest could be wasted.

COMMON MISTAKES

If you know of common mistakes that are made when filling in field sheets, or you think are likely to be made, explain these mistakes and how to avoid them using examples on flip charts or A0 paper. Examples of common errors include:

- When writing is not neat, difficulty in distinguishing between seven (7) and one (1), four (4) and nine (9), the letter S and the number 5, the letter O and the number 0
- Forgetting to record whether clinometer readings are positive or negative.

WHISPER GAME

Tell the participants that they are going to play a game to highlight the importance of good

communication between the data recorders and other team members. Begin by whispering a number with one decimal place (e.g. 15.5) in the ear of one community member. This person then whispers the number in the next person's ear. This process is followed until the number has been passed on by all the community members. Each person is only allowed to whisper the number once and cannot repeat it. At the end of this process compare the number that was first passed on with the number the last person in the process thinks they heard.

After this exercise, explain the call-back-confirm procedure that is described in the Technical Considerations and Protocols, and that this procedure must be used for all data recording.

SUGGESTED PRACTICAL EXERCISE

- Preparation: Write down mock tree sampling data on small pieces of paper. The data could include: tree number; species; point of measure for diameter at breast height (DBH), and the DBH; and for height, distance from tree and clinometer readings. Prepare enough sheets of paper for each participant (minus the data recorders). Each participant will receive data for a different tree.
- Spread the group out over an area of about 40 metres with the data recorders standing in the centre.
- Call-back-confirm procedure: Have the first participant call out the tree number and species. Have the data recorders call this information back. Have the first participant confirm the information. Have the data recorders record the information. Then move on to DBH, and then to the height readings.
- Follow the call-back-confirm procedure until all the mock data has been called out, confirmed and recorded.
- Bring the group together and have a couple of community members check the recorded data for legibility and accuracy, then report to the group whether the data was recorded correctly.

REFERENCES

Walker, S. M., Pearson, T. R. H., Felipe, M. C., Harris, N., Petrova, S., Grais, A., . . . Brown, S. (2012). *Standard Operating Procedures for Terrestrial Carbon Measurement*: Winrock International.

LEARNING OBJECTIVES:

By the end of the session, participants
- can explain the key elements of managing the monitoring team
- have identified key roles and responsibilities to be allocated in a monitoring team
- have agreed how they will assist the monitoring teams in organising themselves

MATERIALS:

sufficient copies of the technical considerations and protocols and tips for community training; flip charts or whiteboard and markers; laptop computer or exercise book

TIME:

40 minutes

STEPS:

1. Ask participants to share how they normally organise forest monitoring teams.
2. Ask the participants what problems they can envisage if the community forest monitoring teams are not well organised.
3. Break the participants into pairs or small groups and using Table 3M-1 in the hand-out as a template drawn on a flip chart, have the participants list the different positions they expect in the forest monitoring teams (e.g. Team Leader, Data Recorder, etc.), and the number of people, roles and responsibilities for each position.
4. Have the participants report back their ideas in plenary and provide feedback.
5. Take the participants through the Community Training Tips.
6. Give the participants 15 minutes to discuss amongst themselves an appropriate community training activity for organising the community forest monitoring teams.
7. Have the participants present their proposed training, provide feedback, and ask them to record their proposed training using a laptop computer or exercise book.

TECHNICAL CONSIDERATIONS AND PROTOCOLS: ORGANISING THE MONITORING TEAMS

TECHNICAL

PROBLEMS WITH POORLY ORGANISED COMMUNITY FOREST MONITORING TEAMS

Before the community teams travel to the forest to begin the sampling, they should be well organised with all members made aware of their roles and responsibilities. The following problems have been observed with poorly organised community forest monitoring teams:

- Not all team members arrive on time to depart for the forest
- The team arrives at the first plot without some of the necessary equipment and supplies
- Some team members "disappear" during the day
- Some team members stand around idly while others work hard on the measurement
- Mistakes are made with measurement because of lack of supervision and guidance
- Mistakes are made with data recording because of lack of supervision and guidance
- Plot measurement is not closed properly with flagging tape left in the forest and the field sheets are not properly checked off

POINTS TO NOTE

The Team Leader

A Team Leader must be appointed. He/she will have to ensure all team members are present and that the team has the necessary equipment and supplies for the day's monitoring before heading out to the forest.

On arrival at each plot, the Team Leader must bring all the team members together and give them clear instructions. He/she will have to ensure that time to reach plot, measurement start time, plot location (latitude, longitude.), etc. are recorded before the measurement begins.

If site conditions are to be assessed, the Team Leader should organise the assessment before the measurement begins. He/she must assign roles to the team members for measuring slope, altitude, aspect, etc.

During the measurement, the Team Leader must observe the other team members and ensure they are carrying out their roles carefully.

Before departing each plot, the Team Leader must bring everyone together to ensure all equipment is collected, flagging tape, etc. is removed, and to check off the field sheet. This process of "closing the measurement" must not be rushed.

Data Recorders

Before heading out to the forest, the Data Recorders must check that they have enough field sheets, with spares, for the day's sampling.

In each plot the Data Recorders must be prepared to move around to positions where they can best hear information being called to them. This will usually be somewhere around the base of the tree being measured, but in dense forest where the height group must sometimes find a position far from the tree, they may have to move closer to this group.

Sub-group next to tree

One sub-group may work next to the tree on marking, identifying species, marking the POM for DBH, and measuring DBH. They should double-check each other's measurements.

Height sub-group

A second group may work on the height measurements. They too should double-check each other's measurements.

The positions, number of people assigned to each position, and roles and responsibilities must be clearly specified. This specification can be done in the form of a table (see Table 3M-1 for example).

Table 3M-1: Roles and responsibilities of community forest monitoring team members in FPCD Indigenous Community Forestry Programme, PNG

POSITION	NUMBER OF PEOPLE	ROLE	RESPONSIBILITIES

Team Leader	1	Gives direction and supervises the team	▪ Assign tasks to each team member before going to the forest
			▪ Check all the equipment before going to the forest
			▪ Organise the team to set up the boundaries of each plot
			▪ Supervise the team to make sure all members are doing a good job
			▪ When plot measurement is finished, organise the team to remove flagging tape and collect together all the equipment
			▪ Before leaving the plot, check
			  ▪ All the equipment has been gathered
			  ▪ The data sheets have been filled in neatly, that there are no obvious errors and no missing information
			  ▪ Sign the field sheets and make sure they are kept safely and handed over for data input

Data Recorder	1 or 2	Records all the data in the field sheets	▪ Take sufficient field sheets and pens to the field ▪ Sit in a good position to hear when measurements are called out ▪ Call back each measurement given by other team members and ask for confirmation ▪ Write neatly so the data is easy to read ▪ Check no information is missing from the field sheets ▪ Give the field sheets to the team leader at the end of the plot measurement
Sub-group next to tree	2 or 3	▪ Mark trees ▪ Identify species ▪ Measure DBH	▪ Paint numbers and POM carefully ▪ Identify species ▪ Carefully measure DBH ▪ Call out information clearly to data recorder
Height sub-group	3	Estimate tree height	▪ 1 person: Carefully measure distance from tree to measurement point for height ▪ 2 people: Carefully take percent readings for total height, merchantable height and POM ▪ Call out information clearly to data recorder

COMMUNITY TRAINING TIPS: ORGANISING THE MONITORING TEAMS

COMMUNITY TIPS

One training session with the community should be on organising the monitoring teams. The following structure is suggested:

1. PROBLEMS WITH POORLY ORGANISED MONITORING TEAMS
Begin by asking the community members what might happen if the monitoring teams are not well organised. Provide examples from Technical Considerations and Protocols.

2. SELECTING A TEAM LEADER
Tell the community members that they will have to select a Team Leader. Describe the roles and responsibilities of the Team Leader. Tell the community members that they should consider someone who is enthusiastic, enjoys outside physical work, and is someone they believe has leadership skills. Tell them that this does not have to be a traditional leader, but could be another person who could be a good leader for the monitoring. (Point to note: Communities may want to appoint traditional leaders as the monitoring Team Leaders. In some cases, they may not be the best choices. Preference should be for people who will be active in the forest).

3. TEAM LEADER ASSIGNS OTHER ROLES
Referring to the example in Technical Considerations and Protocols, draw up a table with the roles and responsibilities for the monitoring using flip charts or A0 paper. Provide one empty column for the names of the community forest monitoring team members. Ask the elected monitoring Team Leader to discuss with the rest of the community members who should play what role. If necessary, make suggestions on role assignment based on your own observations (e.g. if some people are better than others with clinometers, they should be assigned to tree height measurement). Ask the team leader to enter the names for each role into the table.

Point out that to build everyone's skills, the roles can be swapped during the monitoring, but that the Team Leader will have to provide guidance when people take on new roles.

This section provides a range of core and optional sessions depending on the previous experience and existing capacities of the participants in your training and the time available. The core sessions focus on the design of an effective community training that will relate to the design of the forest assessment and monitoring framework. This section also includes other optional sessions that are central to being an effective local level facilitator in CBFBM. They focus on providing a conceptual basis to adult learning and linking the need for facilitation skills with the participatory values central to the success of CBFBM. This section refers to Element 3 and testing the overall forest assessment and training process with communities.

LEARNING BLOCK 4

DESIGNING AND TESTING AN APPROPRIATE CBFBM COMMUNITY TRAINING

4A SESSION: LINKING ADULT LEARNING PRINCIPLES AND CBFBM

LEARNING OBJECTIVES:

By the end of the session, participants
- have identified adult learning principles from their own personal experience
- can explain the implications of applying adult learning principles in designing a community CBFBM training

MATERIALS:

flip charts, markers, flip chart with reflection questions

TIME:

60 minutes

STEPS:

1. Introduce the session by explaining that designing an appropriate training for community members in relation to the carbon stock assessment design is integral to the CBFBM process. Use the diagram in the hand-out to highlight this to participants.
2. Ask each participant to give you one quick idea on what makes a "successful" community training. Write down their ideas quickly as they are mentioned.
3. Ask the participants if they have ever heard of the term "adult learning principles" and what the term means to them.
4. Explain that in this session you would like to introduce the principles of adult learning by reflecting on their own experience as adults.
5. Invite each participant to reflect for a few minutes. Ask them to select one event or experience in their adult life that they remember as a very good learning experience. If needed give an example of a learning experience like learning to drive or to swim. Make sure they are selecting an experience after they have left school and one that they felt was successful.
6. After each participant has selected one event, ask them to share it in pairs by asking each other the following questions:
   - *What did you learn?*
   - *How did you learn it?*
   - *Who helped you to learn?*
   - *What was their relationship to you?*
   - *What was the situation in which you learned it?*
   - *Why did you learn it?*
7. While the participants are sharing their experiences, prepare a table on the board with five columns: what, how, who, where, why.
8. After 20 minutes ask at least six to ten pairs to answer the questions and record the answers in the table. When the table is filled with a number of examples, ask participants to summarise the how, who, where and why of their best learning events. Do not only ask one or two pairs but try to select very different learning experiences to show how the principles fit across different contexts.
9. Introduce the summary as the main adult learning principles: participatory/ reflective/ experiential, respectful, safe and comfortable environment, meets immediate needs (see hand-out). Try to ensure the linkages are clear between the participants' own reflection and the principles so they are not abstract.
10. After explaining the principles ask the group if they have any questions and invite them to reflect using the following questions:
    - *Do you think these principles are always true/universal?*
    - *What are the implications of applying these principles in our own CBFBM community training?*
    - *How can we ensure we are "experiential" and meet community needs?*

- *What is the most challenging aspect for you in applying adult learning principles in community training?*
- *Why do you think the principles are often weakly applied and what is the impact of not applying them?*

11. Wrap up the session by focusing on the importance of experience. Adults (in this case forest users) learn best when what they are learning is directly related to their own day-to-day experiences and when they can use most of what they discover themselves. Even if a community member does not yet have direct experience of CBFBM, you can relate it back to their own experience or create an experience for them to learn from within the training.

12. Revisit the flip chart of ideas that you gathered at the start of the session and see which ideas relate back to which principles reinforcing that you have also applied adult learning principles in your own training.

TRAINING TIPS:

Try to make sure that you extract the principles from the participants' own experiences rather than present the principles as abstract theory.

4A | HAND-OUT: LINKING ADULT LEARNING PRINCIPLES AND CBFBM

HAND-OUT

WHY IS EFFECTIVE COMMUNITY TRAINING IMPORTANT IN CBFBM?

An integral part of CBFBM is designing an effective community training to support the carbon stock assessment design and adapt as necessary. For this reason it is critical that local level facilitators are familiar with adult learning principles as most community members will be adults and will not respond to conventional training methods, as well as those based on a clear understanding of how adults learn.

Figure 4A-1. Key inputs for effective facilitation of community-based forest monitoring

HOW DO ADULTS LEARN?

Adult learning occurs best when it:

▪ **Is self-directed**
Adults can share responsibility for their own learning because they know their own needs

▪ **Fills an immediate need**
Motivation to learn is highest when it meets the immediate needs of the learner

▪ **Is participative**
Participation in the learning is active not passive.

▪ **Is experiential**
The most effective learning is from shared experience; learners learn from each other, and the trainer often learns from the learners.

▪ **Is reflective**
Learning from a particular experience is maximised when a person takes the time to reflect back upon it, draw conclusions and derive principles for application to similar experiences in the future.

▪ **Provides feedback**
Effective learning requires feedback that is both corrective and supportive.

▪ **Shows respect for the learner**
Mutual respect and trust between trainer and learner help the learning process.

- **Provides a safe atmosphere**
  A cheerful, relaxed person learns more easily than one who is fearful, embarrassed, nervous or angry.

- **Occurs in a comfortable environment**
  A person who is hungry, tired, cold, ill or otherwise physically uncomfortable cannot learn with maximum effectiveness.

Remember...

- Adults learn throughout their lives. Training is only a small element. A person who is 40 years old has 40 years of learning experience.

- Adults are more afraid to fail than children. A safe and open environment is needed and a lot of time should be spent getting to know each other and building group norms.

- Adults like their learning to be focused on their own specific situations. Try to relate to these during a training event. Give specific examples related to the working areas of participants.

- Adults decide for themselves what is important to learn. Give participants a say in the training agenda. Include a session on expectations.

- Adults draw from past experiences. Refer to those past experiences and encourage exchange among trainees by working in groups and by asking them to link things to their own working situations. Use reflection exercises.

- Adults question the truth or usefulness of information they receive. Before a session explain the necessity and usefulness of the session for the participants.

- For adults, participation in learning is voluntary. If they are convinced of the usefulness of the material they are more motivated.

- We can remember...

what we do and explain	90%	i.e. simulation game, exercise in class or in the field using new insights or skills and a presentation of results
what we explain	70%	i.e. participants are asked to present information
what we see and hear	50%	i.e. a lecture with visual aids and demonstration
what we see	30%	i.e. a poster with no explanation or a demonstration without an explanation
what we hear	20%	i.e. a lecture with no visuals
what we read	10%	i.e. training materials, hand-outs with no accompanying explanation (if read!)

4B SESSION: BEST PRACTICE IN SKILL TRANSFER WITH COMMUNITIES

LEARNING OBJECTIVES:

By the end of the session participants
- have reflected on and identified from their own experiences, advantages and constraints when training communities in practical skills
- have practiced unpacking one practical skill into simple realistic practical steps for teaching
- have practiced teaching, observing and giving feedback to another person who is practicing using that skill

MATERIALS:

at least three flipcharts and markers; if available, additional space for participants to practice training; (optional: copies of hand-out)

TIME:

60 minutes

STEPS:

1. Introduce the session by referring back to the session and principles on adult learning. Explain that this session will focus on transfer of specific skills. Ask the group for examples of specific skills that they may need to transfer during a community CBFBM training based on their carbon stock assessment design (e.g. using a clinometer or DBH tape).

2. Explain that we will now be practicing unpacking one practical skill into simple, realistic and practical steps for teaching.

3. Ask for a volunteer who is confident to teach somebody how to use a DBH tape. Ask for another volunteer to be taught how to use the tape. Request the other participants to be observers and write down the different steps taken by the "teacher".

4. Give the "teacher" five minutes to demonstrate and engage the learner in using a DBH tape.

5. After the five minutes has finished ask the "teacher" and the "learner" how they felt respectively about the process and what they would change if they did it again. Ask the whole group including the observers the following reflection questions:
   - *How do you think the "teacher" decided what steps to take in teaching the skill?*
   - *Did the teacher apply adult learning principles and what was the effect?*
   - *What assumptions did the "teacher" and the "learner" make and why?*
   - *What are the implications from this experience for you in teaching communities skills in the context of the CBFBM process?*

6. After reflection emphasise the need to clearly break-down the steps involved in teaching a skill without making assumptions before teaching it. Ask the group in pairs to use the same example of teaching a community member on how to use a DBH tape and to write down each explicit step of what they would do including the learner.

7. After ten minutes reflect with the group on how this would improve the quality of skills based teaching and the implications of not breaking a skill down clearly before it is taught.

8. After reflection ask each pair to find another pair and to brainstorm together the Do's and Don'ts when transferring skills to communities. Ask them to write them on cards.

9. After five minutes ask the groups to paste their cards under the key headings on the wall Do and Don't. Each group can share a new idea and explain it as the paste it up in plenary. In other words do not let groups repeat ideas that have already been shared.

10. Optional: Distribute copies of the hand-out. Explain the six steps involved in the learning process. Go through each of the bullets under Observations for effective community training from existing CBFBM projects, and explain each point, linking with the participants' Dos and Don'ts.

11. Conclude by mentioning that each particular situation and target community will require their own individual approach, but that it is worth bearing in mind these 'best practices' to adapt to the local conditions where participants will be helping communities learn specific practical skills.

TRAINING TIPS:

This session will be more effective if the "learner" is actually unfamiliar with the skill being taught as this is more realistic. However, to make it realistic it is more appropriate to demonstrate a relatively easy skill that will be part of the CBFBM process.

UNDERSTANDING THE LEARNING PROCESS

When teaching someone a new skill, people often get frustrated because the learner seems unable to pick up the skill immediately. In most cases, the fault is with the teacher, not the learner. This also applies to CBFBM. If a community member is unable to use an item of equipment after you have provided training, the fault is probably with your training methods.

The learning process includes the following steps:
- Exposure
- Application
- Feedback
- Correction
- Repeat steps 2-4 until…
- Mastery!

When we first encounter a new skill, it seems very foreign to us. We don't yet have the pathways in our brains to perform the skill. That is why our first time learning a new skill can often be an awkward and embarrassing experience. But this is a necessary step because that's when our brains are creating the pathways that allow us to get better.

As we continue to practice the new skill, our brains automatically strengthen these new pathways. We start to perform the skill faster and more accurately and our progress accelerates. This is the principle behind the simple idea that the more you do something, the better you get at it. In fact, if you perform a certain skill enough, it can even physically change your brain (Huang, 2012).

To effectively teach any skill related to CBFBM involves explaining and demonstrating the skill, and providing time for community members to repeatedly practice the skill to the point where they become competent with it. During the practice of the skill, the facilitator observes and only provides guidance when a community member is making an obvious error. Allowing people to make mistakes, rather than "rushing" to immediately provide guidance each time an error seems about to happen, is important to the learning process. If some community members have picked up the skill, but others are still having some problems, ask the community members with the skill to provide guidance to others. And so on . . . until mastery is achieved.

OBSERVATIONS FOR EFFECTIVE COMMUNITY TRAINING FROM EXISTING CBFBM PROJECTS
- Provide precise instructions in the form of steps to enable the learner to follow the process and to repeat the skill. Step 1: Do this, Step 2, Do this, . . .
- Ask participants why they think the skill is done this way. For example, for data transfer from measurer to recorder, demonstrate how to call out and have the measurements confirmed, then ask people to explain why we use this protocol.
- When demonstrating, show participants both the correct and incorrect way of using instruments. This will help participants separate good from bad practice.
- As the training progresses, people who are relatively quick in developing the practical skills being taught should be encouraged to assist others who are a little slower.
- Include checks after training of each practical skill to make sure the participants understand the protocols and have acquired the necessary skills.
- Keep the tone upbeat and lighthearted, and occasionally introduce some humor. Aim to make the training enjoyable for the participants.

REFERENCES

Huang, A. (2012). 6 steps to teach any skill. Retrieved from http://www.knewton.com/blog/teacher-tools/6-steps-to-teach-any-skill/

LEARNING OBJECTIVES:
By the end of the session, participants
- can explain the key roles of a facilitator
- can explain the value of facilitation skills in the context of CBFBM
- can explain key attitudes and skills required as an effective facilitator in CBFBM
- have reflected on their own strengths and weaknesses as a facilitator through a self-assessment tool

MATERIALS:
flip charts, markers, flip chart with reflection questions

TIME:
60 minutes

STEPS:
1. Introduce the session by linking back to the role of communities and experts in CBFBM covered in a previous session.
2. Explain that this session will focus on the role of the expert as a facilitator when the community members are driving the CBFBM activities.
3. Ask the participants why they think facilitation skills are important for CBFBM? (*promote participation and ownership of the process, promotes self-reflection and discovery in adult learning*)
4. Draw the axis of telling and asking questions from the diagram in the hand-out and build up the diagram using the four basic quadrants starting from observer, expert, extension officer and facilitator. Ask the participants what they think their main role is during the process of CBFBM and why?
5. Explain that in the CBFBM process they will play different roles at different points in the process but that if they are applying adult learning principles in the community training as covered in a previous session, then it is important that the community members discover and learn by themselves through experience and reflection. Give the example of how it is important that during the process of FPIC, they play the role of a facilitator whereas during the process of community training they may play the role of expert and facilitator.
6. Explain that the main difference between the role of a facilitator and the other roles is that a facilitator is content neutral and a process guide. Highlight that many skills of a facilitator can be used in different contexts and at different stages during a participatory process for decision-making or experiential learning.
7. Divide the participants into groups of 4-5 members. Ask the participants to brainstorm on post-its or cards all the key attitudes and skills they think are needed to facilitate CBFBM effectively. Ask them to draw a blank human figure on a flip chart and stick the cards for attitudes around the figure's heart, and the skills at the hands and feet. If there is time you can also ask them to list key areas of knowledge at the head of the figure.
8. After 10 minutes ask the groups to display their flip charts and compare the content and distribution of the cards across different groups. Reflect with the group asking the following questions:
   - *How did you feel doing this exercise?*
   - *Is the emphasis on attitudes or skills or knowledge?*
   - *Which skills do you think are the most important for CBFBM and why?*
   - *How can you use your skills more consciously and how can you improve your skills?*
9. After reflecting present the diagram in the hand-out, building the floors like a house and explaining that each floor strengthens the facilitation process and all the skills have to be integrated.

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[1] Adapted from Braakman and Edwards (2012).

Emphasise that it is important that participants start to consider "unpacking" skills they often refer to generally as "communication" and focus specifically on skills that they need to improve to help promote participation and learning in the CBFBM process.

10. Before wrapping up the session ask each participant to draw a self-assessment wheel format in their exercise book or on a sheet of blank payment. Ask them to divide the circle into quadrants using two lines across the diameter.

11. Explain that you would like each individual to choose four skills they think are the most critical personally for them to improve. They can write the name of the skill at the end of the line on the edge of the circle and give themselves a score between 1-5 (where 5 is perfect) to assess their own skill level and make a note of the reason for their score.

12. After ten minutes ask them to find a partner and share their circles and try to assist each other in identifying strategies of how they could improve that skill during the field practice of the CBFBM and in the future. They can make their own personal notes on the diagram.

13. Wrap up the session by explaining that improving facilitation skills is about becoming more conscious of your own practice through personal reflection and peer feedback.

TRAINING TIPS:
Participants are likely to focus on listing key areas of knowledge if emphasis is put on this. Be conscious that this session is about facilitation skills not technical knowledge as this is covered elsewhere.

WHY ARE FACILITATION SKILLS IMPORTANT IN CBFBM?

Figure 4C-1. Facilitator, observer, extensionist and expert skills

A facilitator has an important role in any participatory process to ensure that participatory values are applied among key stakeholders including the community whilst remaining content neutral and a process guide. There is an important role for a facilitator in Step Two of the CBFBM process concerning FPIC.

However, this does not mean that you will play the role of facilitator at all times in the process; sometimes it will be your expertise that is required. However, if you are working with adult community members you will often need to use selected facilitation skills to promote adult learning principles in your training so that community members can learn through experience and reflection between each other.

WHAT ARE THE KEY ATTITUDES AND SKILLS REQUIRED IN THE CBFBM PROCESS?

Many of the facilitation skills are considered basic life skills that we use every day. The key is becoming more conscious of how these skills are used by yourself and others to promote participation and learning in a group in the context of CBFBM.

Facilitation skills need to be unpacked in terms of personal self-assessment and can be improved through self-reflection and peer feedback from other trusted colleagues. Most of the skills in Figure 4C-2 are the basis for enabling a facilitator to remain content neutral and be an effective process guide. In the context of providing effective CBFBM community trainings these skills can help a group to effectively reflect on experience, promote mutual understanding and design an effective training flow. It is unlikely that adult trainings at community level will be effective with just "expert knowledge" and strong facilitation skills will enable more effective community participation and learning.

Figure 4C-2. Key attitudes and skills for CBFBM process

TRAINING PROCESS DESIGN SKILLS			
Formulating objectives and agenda setting	Designing a conducive learning environment	Creating a simple process flow	Designing and selecting tools

BASIC COMMUNICATIONS	
Verbal skills (questioning, probing, paraphrasing, summarising)	Non-verbal skills (listening, observing, managing space and group energy)

ATTITUDES AND VALUES			
Empathy	Real interest	Unconditional positive regard	Trust in self-discovery and experiential learning process

REFERENCES

Braakman, L., & Edwards, K. (2012). *The art of building facilitation capacities: A training manual.* Bangkok: RECOFTC - The Centre for People and Forests.

Figure 4C-3. Wheel with four spokes

Draw a wheel with four spokes and label the spokes with the skills you think are essential for you as a CBFBM facilitator to improve.

Score your own level of competence for each spoke with a cross or dot where the centre of the circle is 1 (least competent) and the outer circle is 5 (completely competent).

Reflect on your wheel. What areas are critical for you to enhance and why? How could you do it? Share your wheel in your peer pair.

4D

SESSION: PRACTICING LISTENING AND PARAPHRASING SKILLS

LEARNING OBJECTIVES:

By the end of the session, participants

▪ can explain why listening and paraphrasing are valuable skills as a facilitator in CBFBM community training

▪ have practiced listening to and paraphrasing the ideas of a peer group

▪ have identified common listening barriers and strategies to overcome those barriers

MATERIALS:

flip charts, markers, 10-12 blindfolds or eye masks

TIME:

75 minutes

STEPS:

1. Introduce the session by linking back to the Session 4c Unpacking facilitation skills for CBFBM. Explain that in this session you are going to invite the participants to practice two closely linked skills, verbal and non-verbal, from the facilitation skill set; listening and paraphrasing.

2. Ask the participants to recall when facilitation skills could be important in the CBFBM process.

3. Write the question "How can listening help a facilitator in a community training?" on the flip chart at the front and ask participants to form groups of three and brainstorm some answers to the question.

4. After a few minutes ask each trio to share their ideas and write them on the flip chart. Ask the group if they can explain the difference between "listening" and "hearing" and which one is more important as a facilitator.

5. Explain that you would like to give participants the opportunity to practice listening under different conditions. Ask them in their trios to pick one speaker, one listener and one observer. Ask the listener and the speaker to wear a blindfold.

6. Ask the speaker to tell the story of their most significant experience of working with communities. Explain that the observer should check the dynamics and what helped the speaker and the listener.

7. After 2 minutes stop the exercise and ask the group to switch roles, continue this until each participant has had an opportunity to play all three roles.

8. After all participants have played all three roles ask them to remove their blindfolds and repeat the exercise this time explaining about the challenges of working with communities.

9. After they have finished both rounds ask the following reflection questions:
    ▪ *What happened? Was it easier with or without the blindfold to listen and why?*
    ▪ *What helped you to listen well and what hindered you and why?*
    ▪ *How does this exercise relate to our own practice of listening as a facilitator?*

10. After reflection explain the key common barriers to effective listening (see hand-out) and ask participants which of these barriers most commonly effects them in their own experience.

11. After wrapping up on the listening exercise explain that now you would like to combine it with another useful skill called paraphrasing. Explain that paraphrasing is when, as a facilitator, you repeat the idea of the speaker using different words. Facilitators do this paraphrasing because in a participatory context sometimes people do not listen well to each other in a group because of the words or the way someone expresses themselves. Be clear that paraphrasing is not the same as summarising but it is a powerful tool played by a facilitator to bridge communication channels that are being blocked by listening barriers or other reasons.

12. Ask a couple of questions to participants in a plenary context and paraphrase their answers to give an example.

13. Invite the participants to return to their trios and practice listening and paraphrasing whereby the speaker explains a few lines and then the listener tries to paraphrase the key idea in different

words. You could give the speaker a subject, e.g. to explain what CBFBM is. Give the trio ten minutes for this exercise and ensure they take turns in the different roles.

14. After ten minutes stop the exercise and reflect using the following questions:
    ▪ *How did you find the paraphrasing? What made it difficult? What helped?*
    ▪ *How did you feel hearing your own ideas back in somebody else's words if it was done well? (good, respected, understood, etc.)*
    ▪ *How did you feel when you realised that your words were misunderstood? (frustrated, disappointed; that is why it is so important to check!)*

15. When do you think you need to use this skill? Is it possible to do it too often? If so what would be the result? (if you paraphrase too often, it gets boring and the people will become lazy listeners themselves)

16. After reflection ask the group what is the link between listening and paraphrasing and how these skills are important in the context of CBFBM.

17. Ask each participant to identify Do's and Don'ts of Listening as a facilitator within their trios (3 cards for each Do and Don't for each trio. After they have identified these compile and share these as a master list for the training room wall.

18. Wrap up the session by explaining that during the community trainings the participants will have continuous opportunities to practice these skills and get feedback from their peers.

TRAINING TIPS:
It is important each participant gets to experience the different roles as a speaker, listener and observer as each will provide different insights and experience. Manage the time accordingly to ensure this happens.

4D HAND-OUT: PRACTICING LISTENING AND PARAPHRASING SKILLS

HAND-OUT

GOOD LISTENING IS MORE DIFFICULT THEN WE THINK

Listening seems to be a very easy thing to do. But in reality, we think we listen, but we actually hear only what we want to hear! One of our biggest barriers to listening is that we make assumptions of what we think people are going to say. This is not a deliberate process: it is almost natural. To listen carefully and creatively, picking out positive aspects, problems, difficulties and tensions, is the most fundamental skill for facilitation and therefore we should try to understand what can hinder listening, so as to improve our listening skills.

LISTENING BARRIERS

On-off listening

This unfortunate listening habit comes from the fact that most people think about four times faster as the average person can speak. Thus the listener has about three quarters of a minute 'spare thinking time' in each minute of listening. Sometimes listeners uses this extra time to think about their own personal affairs and troubles instead of listening, relating and summarising what the speaker has to say. This can be overcome by paying attention to more than just the speech, but also watching body language like gestures, hesitation, etc.

Red-flag listening

To some people, certain words are like a red flag. When they hear them, they get upset and stop listening. These words may differ among participants, but some are more universal such as tribal, black, capitalist, communist, etc. Some words are so 'loaded' that the listener tunes out the speaker immediately. The listener loses contact with the speaker and fails to develop an understanding of that person.

Don't-rock-the-boat listening

People do not like to have their favourite ideas, prejudices and points of view overturned; many do not like to have their opinions challenged. So, when a speaker says something that clashes either with what the listener thinks or believes, they may unconsciously stop listening or even become defensive. Even if this is done consciously, it is better to listen and find out what the speaker thinks, in order to get the other side of the question so that the job of understanding and responding constructively can be done later.

DO'S AND DON'TS OF LISTENING

When listening you should try to do the following:
- Show interest
- Be understanding
- Express empathy
- Single out the problem if there is one
- Listen for causes of the problem
- Help the speaker to develop competence and motivation to solve any problems
- Cultivate the ability to be silent when silence is necessary.

When listening you should avoid doing the following:
- Rush the speaker
- Argue
- Interrupt
- Pass judgment too quickly in advance
- Give advice unless it is requested by the other speaker
- Jump to conclusions
- Let the speaker's emotions affect your own too directly

WHAT IS PARAPHRASING?

Paraphrasing = repeating what somebody has said, using your own words.

WHY TO USE PARAPHRASING?

Benefits for facilitator
The technique forces you to listen very carefully, since you know that when the person finished speaking, you will need to repeat what was said. In addition, you have the opportunity to find out whether you really understood what was said.

Benefits for the speaker
Paraphrasing has both a calming and a clarifying effect. It reassures the speaker that his or her ideas are worth listening to. It also provides the speaker with the chance to see that others are hearing his/her ideas. In other words, it supports people to think out loud.

Benefits for the other people listening
They get a second chance to understand what the speaker tried to share.

WHEN TO USE PARAPHRASING?
When a speaker makes very long, complicated or confusing statements, or when a speaker has problems phrasing his/her own thoughts clearly.

> [Do not paraphrase too often as it will slow down the interactions and eventually the group members will become lazy listeners themselves.]

HOW TO DO PARAPHRASING?
Use the following four-step model:

1. Listen carefully
2. Use your own words to say what you think the speaker said, starting with, for example:
   ' In other words…' or
   'Do you mean that…'or
   'It sounds like you are saying is…'
3. Check by saying something like:
   'Is that correct?' or 'Did I get it?'
4. If not, keep asking for clarification until you understand what the speaker meant.

Note: If the speaker's statement is one or two sentences, use roughly the same number of words when you paraphrase it. If the speaker's statement is many sentences long, summarise it.

REFERENCES

Braakman, L., & Edwards, K. (2012). *The art of building facilitation capacities: A training manual*. Bangkok: RECOFTC - The Centre for People and Forests.

4E   SESSION: PRACTICING QUESTIONING

LEARNING OBJECTIVES:
By the end of the session, participants

can explain how questioning skills are valuable in a community training for CBFBM
can explain the difference between open and closed questions
have practiced using a logical sequence of questions for probing purposes

MATERIALS:
flip charts, markers

TIME:
60 minutes

STEPS:
1. Introduce the session by linking back to Session 4c Unpacking facilitation skills for CBFBM and recalling that questioning is a verbal skill of a facilitator.
2. Ask the participants why they would use questions in a community CBFBM training? (to clarify, to understand values and positions, to create mutual understanding between parties, to confirm understanding, to promote engagement, to reframe and stimulate thinking from another perspective)
3. After the participants have listed the reasons for using questions ask the group if they can explain to you what is the difference between an open and a closed question. Make sure the group understands that a closed question can only be answered "yes" or "no" and ask the group to give you examples of a closed question. Reinforce that an open question can have many possible answers.
4. Ask the group to list for you the six helper questions that are used in open questioning (where, when, who, how, what, why). Write them in large writing on a flip chart for the group.
5. Explain to the group that you would like to do an exercise to compare the experience of using closed and open questions, and to do this you would like them to form pairs and turn their chairs to face each other.
6. After the participants all have a partner explain that you would like them to take it in turns to ask each other closed questions on a specific topic.
7. Give the group ten minutes to practice asking closed questions and give them a time reminder half way through so that each person has a chance to practice.
8. After ten minutes ask the group to now practice asking open questions but using the same topic.
9. After ten minutes is finished ask the following:
   - *How did you feel doing the reflection questions/exercise? Which was most difficult and why?*
   - *What happened when you asked closed questions?*
   - *What happened when you asked open questions?*
   - *How did the type of question influence the answer?*
   - *Which type of question should you use most as a community trainer in CBFBM and why?*
10. After reflection use the hand-out to explain some other types of questions that might be used in a community training and how the six helper questions can also be thought about in the form of a triangle using the hand-out as a guide. Ask the participants to think about how they could use the diagram to assist a community to reflect on a learning experience moving from facts to opinions and values.
11. Ask participants to think about when they might use a sequence of questions or probe as a facilitator in a CBFBM community training.

12. Wrap up the session by explaining that formulating simple clear questions and being able to probe is a fundamental facilitation skill for community trainers who are applying adult learning principles and promoting participation.

TRAINING TIPS:
If there is time you can ask participants to form pairs and use the triangle to explore a specific experience or reflection. This will make the triangle model more practical for the participants.

4E | HAND-OUT: PRACTICING QUESTIONING

HAND-OUT

Table 4E-1: Types of Questions you might use in a community CBFBM training

TYPES	USES	RISKS
GENERAL QUESTIONS: Addressed to the group as a whole, perhaps written on overhead or flip chart	▪ Stimulate thinking by everybody. ▪ Useful to start a discussion. ▪ Trend setting.	▪ Question is not directed at anyone in particular, it may not be answered. A wrong question can misdirect the process. Unless sufficient time is allowed for thinking, it may not work.
DIRECT QUESTIONS: Addressed to an individual by name, or a sub-group.	▪ Good chance that it will be answered. Useful to involve silent or shy members. ▪ Can break the monopoly of discussion by more vocal group members. ▪ Can tap specific resource person in the group, e.g. forester, gender specialist. ▪ Can be used to refer to a point that was lost due to irrelevant comments by others.	▪ It can embarrass unprepared group members. More effective if followed by a general question to put the focus back to the group as a whole.
OPEN-ENDED QUESTIONS: Start with who, what, when, where, how, why questions that cannot be answered by simple yes, or no.	▪ To get concrete feedback or information. ▪ It will make group members think. ▪ Quality of the discussion will improve as new details are discovered, ▪ Good for analysing problem situations (Why did this happen? What needs to change?).	▪ Such questions are more difficult to answer. ▪ Questions starting with why may be perceived as threatening. ▪ If facilitator cannot build on the responses, usefulness is reduced.
FACTUAL QUESTION: Asked to ascertain factual information	▪ To clarify factual "fogginess". ▪ To steer away from assumptions or generalisations. ▪ Valuable in initial stages of discussion.	▪ A few group members who know the facts may monopolise discussion.
RE-DIRECTED QUESTION: The facilitator throws a question asked of her/him back to the group.	▪ Ensures that the answers lie with the group members. ▪ Can provoke lively exchanges among group members.	▪ May give the impression that the facilitator is not knowledgeable. Can be perceived as an avoiding tactic.
LEADING QUESTION: The expected answer is implicit in the question.	▪ Useful in redirecting a discussion that has gone off track. ▪ Helpful in facilitating control and taking charge of the process.	▪ Can be manipulative. ▪ Good points can be lost due to facilitator's anxiety to maintain control.

Figure 4E-1. The 6 Helper Question Triangle

REFERENCES

Braakman, L., & Edwards, K. (2012). *The art of building facilitation capacities: A training manual.* Bangkok: RECOFTC - The Centre for People and Forests.

4F

SESSION: DESIGNING AN EFFECTIVE COMMUNITY TRAINING AND SESSION PLANS

LEARNING OBJECTIVES:

By the end of the session, participants
- have practiced formulating overall training objectives
- designed a community training process flow based on ideas from their CBFBM design tables and time frame available
- have developed overall session plans for each topic in the timeframe in relation to the process flow

MATERIALS:

flip charts, markers, completed CBFBM design table with ideas for community training methods, post-its or meta-cards, masking tape

TIME:

60 minutes

STEPS:

1. Introduce the session by revisiting the CBFBM process chart which illustrates that community training is a fundamental element of the CBFBM process.
2. Explain that this session will help the participants consolidate all their ideas for community training that they have formulated through the technical toolbox sessions and put it into a training flow with a time frame or programme.
3. Divide the participants into small groups and give each a copy of the hand-out. Ask them to discuss amongst themselves the guidance in the hand-out on planning the logistics and training programme. Ask each group to write what they think are the five most important guidance points for planning an effective training of communities on CBFBM on a flip-chart. Bring the groups back together and have each present their five points using their flip-chart.
4. Give each group a flip chart with a format for a 3-day training for a community CBFBM team (see Exercise). Divide up the page into three columns one for each day and then horizontally in half for the morning and the afternoon.
5. Explain that you will give each group 40 minutes to think about how they would sequence the different training activities that they have already identified in their CBFBM tables. Ask the group to write the key words for each session (cross referenced with the details in their CBFBM design table) on post-its and then paste them on the programme format in the most appropriate sequence. Explain that the group should also formulate training objectives.
6. After 40 minutes bring the teams back together and give each group the opportunity to present and justify the rationale for their design and present their training objectives. Allow the other groups to ask questions and comment on the training objectives in terms of specificity, measurability and practicality.
7. Reflect on the different designs in plenary with all the participants:
   - *What are the main differences between the different group's designs?*
   - *What factors did you consider when designing the course and flow?*
   - *How did the training objectives assist you in the design process?*
   - *Which design do you like the best and why? Which design reflects the factors mentioned at the start of this session?*
8. After reflection discuss with the group which design can be tested with the CBFBM community team and finalise the details of the programme and timing if necessary combining ideas from different designs.
9. Provide the team with the format (Table 4F-2) in the Exercise to finalise the details of their design.

TRAINING TIPS:

The participants can be divided into pairs or sub-groups at any time, depending on numbers and the areas/projects they are involved in. Participants from the same area/project should work together in designing the community training programme.

An example of a training design for communities is provided in Annex 2 Sample field trainers session plan, which can be used as a reference.

4F | HAND-OUT: DESIGNING AN EFFECTIVE COMMUNITY TRAINING AND SESSION PLANS

HAND-OUT

PLANNING YOUR COMMUNITY TRAINING

Best-practice tips for planning your CBFBM training include:

LOGISTICS PLANNING

- If possible, visit prospective training areas beforehand (both classrooms and field sites) to assess their suitability.
- Select a time and schedule for the training which allows for the broadest participation and minimal disruption to the community's routine. Training during planting and harvesting periods should be avoided.
- Agree with community leaders on the time, place and participants (if possible) well in advance of the training. Communities will have to fit the training in with their regular duties and they will also want to make preparations for receiving and accommodating the trainers.
- Identify key community members who may be able to assist facilitators whilst delivering training, and make appropriate arrangements for them to assist if possible. This should include familiarising them with the learning objectives and the training programme.
- Have the trainers meet before going to the community to draw up the training program and to agree on the roles each of them will play.
- For the classroom component of the training select a venue which is accessible, and as 'neutral' as possible. The "classroom" could take many forms, e.g. a community hall, a school building used during the school holidays, or a temporary shelter built from bush materials for the purpose of the training. Ensure that there is adequate space for the training and that the environment will be comfortable, with the appropriate facilities at hand. Budget for refreshments.
- For practical forest activities ensure that you will have access to a range of safe forest areas that represent the spectrum of forest types that will be covered by the CBFBM. Try to pick forest areas that are most accessible and that do not have cultural or political restrictions associated with them.
- Set up all the practical exercises to the extent possible in advance of the training. For example, if the community members are going to practice tagging trees and measuring DBH and height, identify a sufficient number of practice trees for them to measure with the types of characteristics they are likely to find across their forests, i.e. this could be trees with buttresses, trees with forked boles, leaning trees, trees on slopes, trees with different crown formations, etc.
- If required, ensure that you have all the interpretation equipment or personnel in place prior to the training.
- Have all equipment you will need prepared and ready to use to minimise time delays or breaks in the training process. Make sure there are sufficient numbers of equipment (several DBH tapes, GPS, etc. may be necessary) for community members to gain lots of hands-on experience. (Avoid having most of the community members standing around while only one or two of them practice with the one DBH tape you provided for the training.)

PLANNING THE TRAINING PROGRAM

- Make sure the community members you are training have the mandate or community role which will allow them to fully apply the skills you are delivering training on.
- Try to involve women in the training whenever possible. This can contribute to their development, but it is also good for women to participate as they often have specific knowledge about forests associated with their gender roles (e.g. they may collect herbs and plants used in traditional medicines from the forest). One study in Sierra Leone found that women could name 31 different uses for trees while men could name only eight (FAO, 1989).
- If possible make a formal assessment of the talents and skills of community members beforehand (if this isn't possible an informal assessment is also very useful). This will help to identify an 'entry point' for the training.

- Assess the cultural, social and political context of the community being trained. This will help you to contextualise the training and avoid any cultural taboos in the training style and approach used.
- Plan the training to incorporate local customs. For example, the community leaders may wish to make opening remarks, say a prayer, etc. to start the training.
- Be culturally sensitive in planning the training style to be used. Do not use examples that may cause offense and be conscious that not all cultures are open to certain styles of role or game-play.
- The training might also include information on existing community development activities that the local level facilitators might be involved in. For example, if the local level facilitators have been supporting community forestry activities, they may wish to provide some updates on these activities, before moving into the CBFBM training.
- Structure the training so that you begin with skills which community members are most likely to pick up quickly and which are most closely related to their existing competencies. This can help to build up confidence in the learning process.
- Prepare a training approach which takes into the account the preferences of more 'experiential' learners (i.e. learners who will want to quickly start the practical activity and learn by doing) compared with more 'theoretical' learners (i.e. learners who will want to make sure they understand all of the theory before starting to practice).
- When designing the training, use as many appropriate analogies and local examples as possible to explain concepts, protocols, and the use of equipment. For example, when discussing climate change, ask the community members whether they think they have observed climate change, e.g. long-term trends in seasonal patterns, in their area.
- Structure the training so that it follows a logical chronological order of progression, e.g. locating and establishing sample plots, doing the measurements and recording the data. Teaching GPS, which is used to locate the sample plots, may be left until the training on less sophisticated measurement instruments, such as measurement tapes and compasses, has been completed.
- Avoid spending long periods in the classroom. Mix up the classroom and practical exercises as much as possible. For example, after explaining in the classroom how a sample plot is set out, take the community members to an outside area near the classroom and have them practice setting up a plot. Then bring the community members back into the classroom for the next instruction on protocols or instruments (e.g. measuring DBH), then again take them outside the classroom for practice.

Temporary shelter constructed as "classroom" for CBFBM training, Dawen, PNG

4F EXERCISE: TRAINING DESIGN

EXERCISE

DESIGN YOUR OVERALL PROCESS FLOW

Table 4F-1: Basic template for 3-day community training programme

TRAINING OBJECTIVES: By the end of the training, community members ▪ … ▪ …			
	DAY 1	DAY 2	DAY 3
Morning			
Afternoon			

DESIGN YOUR DETAILED TRAINING SESSIONS IN RELATION TO YOUR PROCESS FLOW

By the end of the session you should have a clear training flow and session plans for each topic in your flow.

Table 4F-2. Basic template on session details

TIME	TOPIC	LEARNING ACTIVITIES	DURATION	EQUIPMENT/ PREPARATION	TRAINING AIDS	TRAINERS COMMENTS

LEARNING OBJECTIVES:

By the end of the session, participants

▪ can explain the importance of testing elements of their initial CBFBM design and their proposed community training methods

▪ understand how to design and implement an effective testing process

▪ have designed a test training for their project (optional)

MATERIALS:

copies of the case study and hand-out; flip chart or whiteboard and markers; laptop computer and projector (optional)

TIME:

90 minutes

STEPS:

1. Ask the participants what they think the objectives of testing their initial design might be.

2. Explain that the major elements of the initial CBFBM design that the communities will be playing key roles in, including both the technical and training elements, need to be tested with at least one of the communities participating in the CBFBM. Describe the objectives of the testing using Figure 4G-1 in the hand-out. Key aspects of the design to test would include setting up plots, identifying which trees should be measured, identifying tree species, measuring DBH and height, and recording the information on field sheets.

3. Divide the participants into groups of 4-5 members and ask them to read through the case study and answer the following questions.

   ▪ *What did the test training focus on?*

   ▪ *What preparation was made prior to the training?*

   ▪ *How and why was the agenda and process modified during the test day?*

   ▪ *What did the trainers learn from the test training?*

4. Have the groups report back their answers in plenary.

5. Ask the participants to go back into their groups and give each group a flip chart. Ask each group to discuss how they would prepare a test training programme and to write their ideas on the flip charts.

6. Have the groups report back on their ideas in plenary, referring to their flip charts. Explain any points in the guidance notes in the hand-out that they may have missed.

7. Explain how Table 4G-1 in the hand-out (a design table) and Table 4G-2 in the case study (a programme for the testing) could be used as templates to design the testing.

8. Break the participants into groups and give them 40 minutes to design a CBFBM test using the two templates. Tell participants that they can modify the templates to suit their purposes. Have them first draw table outlines on flip charts (or laptop computers with MS Excel could be used) and then fill in the tables.

9. Have the groups report back on their proposed test training programme in plenary, using their flip charts. Provide feedback.

TRAINING TIPS:

If your training programme includes testing of elements of the CBFBM design by the participants, this session should be run the day before the testing. The session plan will have to be organised in such a way that the participants will produce a test training design and programme that they will use the following day with a community that has agreed to participate in the testing.

OBJECTIVES OF THE TESTING

The CBFBM system will be developed based on expert knowledge on forest monitoring and on community facilitation and support. However, no matter how good this knowledge is, the first design

HAND-OUT: WHY AND HOW TO TEST YOUR INITIAL CBFBM DESIGN

HAND-OUT

of the system is unlikely to be perfect. The design must be tested, the experiences reflected on, and adjustments made.

The testing has two objectives (Fig. 4G-1):
- To test some of the major proposed elements of the CBFBM design
- To test some of the proposed community training activities

Figure 4G-1. CBFBM testing objectives

With respect to the first objective, the testing is to confirm the feasibility of the proposed measurement elements of the CBFBM design. With respect to the second objective, the testing can include both

training on concepts, e.g. on climate change, carbon, REDD+, CBFBM approach, etc., and training on the protocols and techniques for the forest sampling.

GUIDANCE FOR THE TESTING
The following guidance points are drawn from previous experiences testing initial CBFBM designs with local communities.

1. **Agree with community leaders on a suitable time for the testing of elements of the community training and forest monitoring design**
   A time when community members have lighter workloads, i.e. outside the planting and harvesting periods, is clearly preferable.

2. **Agree with community leaders on the process for selecting the participants and on the number of participants**
   With 3 to 4 trainers, 8 to 15 is a good number of participants for the test. Whenever possible, women should be encouraged to participate.

3. **Write and agree the programme for the testing with the community leaders**
   It is important to have a clear and do-able agenda for the duration of the testing, and this should be agreed with the community leaders in advance of the testing. The testing should focus on key concepts and on the elements of the CBFBM system that the communities will play major roles in. A one-day test programme might be broken down into:
   a *Explaining the purpose of the monitoring, and the concept of CBFBM*
   b *Setting up plots, marking trees, measuring DBH, measuring height, and recording the data, and*
   c *Reflecting on the day's activities.*

4. **Agree on the location(s) for the testing**
   The local level facilitators should agree on a suitable location(s) for the testing with the community leaders. Part of the testing needs to be conducted in a place where it is fairly comfortable for people to sit and listen, though this does not necessarily have to be indoors. An outdoor area

where there is shade and shelter from the wind, and where it is comfortable for people to sit, can be used to introduce the training objectives and programme, and to explain the key concepts. Another area will be needed where a test plot can be set up and some trees (and possibly other carbon pools) measured. This would ideally be in the forest being sampled, but could be in any area with trees.

5. **Prepare field equipment and other training materials**
Enough equipment will have to be prepared for the community members to be fully engaged in the testing. The community members should not be standing around for long periods of time waiting for equipment to become available. All community member participants should be active throughout the testing.

Other training materials that could be prepared in advance include sketches on A0 paper to assist the community members in understanding concepts such as climate change or REDD+, and sketches to guide the measurement, such as identifying the point of measure for DBH, or the tops of trees, etc.

6. **Prepare logistics**
Transportation, refreshments and other logistical issues will need to be discussed and prepared well in advance of the testing.

7. **Assign roles to each local level facilitator**
It is important that all local level facilitators are each assigned a role or roles before the testing begins and adequately prepares for their roles. At different times some local level facilitators need to be assigned to the training and other local level facilitators need to be assigned to observing and recording lessons learned on the activities being tested. The local level facilitators should take written notes for the recording of the lessons learned. These will later be referred to when refining the CBFBM design.

8. **Test options, not just one method**
When it makes good sense, more than one option should be tested for each element of the forest sampling. For example, both calipers and DBH tape could be tested for measuring tree diameter, and both square and circular plots could be tested. Based on the observations during the testing, the best option in terms of cost, precision, efficiency and community capacity can be selected.

9. **Observe teaching activities closely and build capacity of local level facilitators**
During the testing it is important that the effectiveness of the teaching activities is closely observed. If it soon becomes clear that a teaching activity is not effective, adjustments should be made and the new approach then tested. The more experienced local level facilitators should assist in guiding their less experienced colleagues.

10. **Encourage and provide opportunities for the community to contribute to the monitoring design**
The community participants should be made to feel that they are important to the design process. They will have been informed by the local level facilitators that they are part of the test. They should be encouraged to propose ideas for the monitoring during the testing programme. After the training on each monitoring element (e.g. plot establishment, DBH measurement, etc.), the local level facilitators should spend some time with all the community participants reflecting on experiences. The local level facilitators should ask the participants whether they found the concepts or skills they were taught difficult, and whether they have any suggestions for improving the training.

HAND-OUT

Near the end of the testing programme, the local level facilitators should sit down with all the community participants and review their experiences over the entire testing programme. This reflection should not be rushed. The community participants should be asked one-by-one if there are any issues that they are confused about and what they found most challenging during the testing.

Table 4G-1: CBFBM testing design table

CBFBM ELEMENTS TO BE TESTED	TEACHING ACTIVITIES TO BE TESTED	MEASUREMENT EQUIPMENT	TEACHING MATERIALS	ROLE ASSIGNED TO EACH TRAINER	OBSERVATIONS / LESSONS LEARNED

BACKGROUND

The Faculty of Forestry at Vietnam Forestry University is supporting a small scale Afforestation/Reforestation Clean Development Mechanism (A/R CDM) project in Cao Phong district, Hoa Binh province. Under this project several Acacia mangium plantations have been established by the participating villages.

As the project aims to generate carbon credits through carbon sequestered and stored by tree plantations, assessment and monitoring of forest carbon stocks are required. The idea of CBFBM was introduced into this project several years after it had been launched, with the trees having reached a height of about 5 metres. Prior to the beginning of the CBFBM, the participating villages had already received training on issues such as climate change, the role of forests in climate change mitigation, and forests and carbon standards/markets.

PREPARATION

Ru 3 Village, one of the 11 reforestation project villages, was selected for testing some of the proposed elements of the CBFBM system and the proposed training activities. Prior to the training, the facilitation team at Vietnam Forestry University contacted the village leaders and agreed on an appropriate place, time and programme for the test training, and on who should participate.

It was agreed that the test training would be held over one day with about 15 participants from the village. A day was selected when the community would not be too busy with their usual work. The community participants were selected after discussion with the village leaders; the local level facilitators encouraged the village leaders to consider the participation of women.

The local level facilitators prepared the field equipment (chalk, flagging tapes, calipers, distance measurement tape, DBH tape, Blume Leiss, compass, etc.) and training materials (e.g. sketches on A0 paper of how to identify the point of measure for DBH) the day before the testing. The local level facilitators also agreed on the roles that each of them would play throughout the day. While some were providing the training, others were assigned to making observations of the testing in notebooks. Photos and video were also captured for later reflection.

The logistics were also organised the day prior to the testing. Transportation was booked and packed lunches were ordered for all the local level facilitators and community participants.

AGENDA AND LOCATIONS

The training agenda is given in Table 4G-2. The testing began with discussion on the importance of good forest management. The local level facilitators explained how CBFBM could be applied to the reforestation project. They then explained the objectives of the test training. The remainder of the morning was spent testing training ideas and options for DBH and tree height measurements.

A location on the edge of one of the plantations was selected for the morning's training. The location provided shade, was sheltered from the wind, and had trees that could be used for the testing.

After lunch, the testing moved into the plantation, where the community was divided into two groups, with one instructed on how to establish a circular plot and the other on how to establish a square plot. The local level facilitators then provide guidance and observed both groups as they established the plots and measured trees. The local level facilitators also recorded the times taken.

At the end of the day's testing, the local level facilitators called the community participants together to reflect on the proposed monitoring methods. Each participant was asked in turn what they found

easy and what they found difficult about the training, and whether they had any suggestions for the monitoring or the training activities.

Table 4G-2: Cao Phong CBFBM test agenda

TIME	CONTENT	DETAILS
8:30-9:30	Introduction	
	Explain purpose of training	▪ Explain forest management Link to biomass assessment ▪ Link to improving forest management
	Explain need for forest management	▪ Discuss value of forests for community ▪ Encourage participants to propose ideas for better forest management
	Explain roles of facilitating organisations and roles of community	▪ Facilitating organisations – support role ▪ Community – manage the forest (planning, implementation, monitoring and evaluation, etc.)
	Introduce content and approach of today's testing	▪ Outline today's programme ▪ Explain reason for establishing plots, monitoring tree growth, etc. ▪ Explain role of local level facilitators and role of community participants
	Organise participants into manageable groups	▪ Divide into 2 testing groups
9:30-10:30	Testing on diameter measurements.	
	Guidance on measuring instruments	Instrument: Aluminum caliper ▪ Explain POM: Using drawing on A0 paper ▪ Mark the location measured on trees by chalk ▪ Measure the diameter with any two perpendicular directions ▪ Read the results on the aluminum caliper
	Test using pre-selected trees	▪ Select trees to test POM that represent situations in actual plantation (forked trees, leaning trees, trees on slopes, etc.) ▪ Local people identify and mark the location of measurement (use 1.3m length pole) Divide into pairs: one person measures and calls out result; one other person records the results ▪ Check all results and provide guidance on difficult trees
	Discussion and lessons learnt	▪ Bring all participants together to discuss level of difficulty and lessons
10:30-12:00	Testing on height measurements	
	Guidance on measuring instruments	▪ Instrument: Blume Leiss ▪ Using drawing on A0 to explain how instrument works ▪ Define measurement distance (15m) ▪ Select a suitable position in order to measure trees ▪ Define measuring point (top of trees, foot of trees ▪ Measure and read the results for top of trees (h1 ▪ Measure and read the results for foot of trees (h2) Calculate height of trees h = h1+/-h2 ▪ Note: Read results to 1 decimal place
	Test using pre-selected trees	▪ Use same trees for diameter to test height measurement ▪ Divide into pairs: one person measures and calls out result; one other person records the results ▪ Calculate height of trees ▪ Check all results and provide guidance on difficult trees
12:00-13:00	Lunch	
13:00-15:30	Testing on plot establishment and measurement	

TIME	CONTENT	DETAILS
	Locate training sample plots	▪ Choose areas representative of the plantation
	Testing on sample plots	▪ Divide local level facilitators amongst the 2 groups. 1 group is trained and tested on circular plots, the other on square plots. ▪ Explain plots using diagrams on A0 paper, then provide practical training ▪ For circular plot, participants to mark centre and divide into 8 sections using flagging tape ▪ For square plot, participants to use 3-4-5 method to establish right angles
	Test marking of trees, DBH and height measurement, and data recording	▪ Instruct each group to assign a leader, and have the leader appoint tasks (e.g. 1 participant to number trees, 2 participants to measure DBH, 2 participants to estimate height, 1 participant to record the data) ▪ Swap the roles ▪ Provide guidance only when necessary
15:30-16:30	Discussion and lessons learnt	▪ Bring all local level facilitators and participants together ▪ Ask the two groups to share their experiences: What they found difficult; What they found easy; Any suggestions ▪ local level facilitators to provide comments ▪ Lead community facilitator to summarise the results of the testing

TESTING OPTIONS AND ENCOURAGING COMMUNITY INPUT INTO CBFBM DESIGN

The proposed agenda in Table 4G-2 was modified during the actual testing day to allow for testing different options for DBH and height measurement. The local level facilitators proposed using calipers for measuring DBH, but some community participants found this difficult as some parts of the measurement scale are obscured when taking readings. The participants proposed using tailor's tape, which is widely available and which they are familiar with. The local level facilitators were concerned that the tailor's tape could easily stretch and the scale become distorted. They checked the scales of some of the tailor's tapes that the villages had with them against regular distance measurement tape. The tailor's tape was found to be accurate, and it was agreed that using the tailor's tape was the most suitable way to measure DBH for the CBFBM (but that the local level facilitators would have to continue to monitor the quality of the tailor's tape used).

The experience with the testing of instruments for height estimation was similar. The local level facilitators initially proposed estimating heights using hypsometers (Blume Leiss), but in the dense plantation it was found that the tops of tree crowns were too difficult to sight. The community participants proposed measuring height by fixing measurement tape to a bamboo pole, then placing the pole alongside the tree. This method was checked against height estimates using the hypsometers and was found to be accurate.

The importance of the testing was further highlighted for plot design. The local level facilitators found that with good instruction the participants were able to accurately set up the 20 m X 20 m square plots. The community participants understood and could use the 3-4-5 method they were taught to establish plot right angles. In contrast, with the circular plots the participants had more difficulty as they found it hard to distinguish whether borderline trees were inside or outside the plot. The local level facilitators thus initially concluded that square plots would be more appropriate for the CBFBM. However, after further discussion they decided that circular plots should be used. The testing showed that the circular plots were much quicker to set up and measure, and the local level facilitators concluded that if they improved their training method, the community members would have no problems with the borderline trees.

(left). Local level facilitators preparing the test. (right). Local level facilitators explaining POM for DBH measurement

(left). Local level facilitator observing community member's use of tailor's tape for DBH measurement. (right). Local level facilitators and community participants reflect on the testing

OBSERVING, RECORDING AND DISCUSSING LESSONS LEARNED

The local level facilitators assigned some of their members to observe and record lessons that were learnt at each stage of the training. The following day, all the local level facilitators gathered at Vietnam Forestry University to discuss the lessons learned, to agree on how they could improve their training on CBFBM, and on how they could design an effective, community-friendly forest monitoring system.

This section provides supporting materials and guidelines including examples of training design scenarios that can be adapted by trainers using this manual.

ANNEXES

1 | ANNEX: TRAINING SCENARIOS

TRAINING SCENARIO ONE: ONE-OFF FIVE-DAY CBFBM TOT WITHOUT DESIGN TESTING

LEARNING OBJECTIVES

By the end of the five-day course, the participants
- can explain the rationale, value and key steps of the CBFBM ToT process
- have designed their own CBFBM carbon assessment and monitoring plan and associated community training activities
- have applied and practiced key facilitation and community training design principles and skills
- have prepared a team plan for follow up in their own sites for testing and adapting

TIME	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
AM	▪ What is CBFBM? ▪ What is REDD+	▪ Feasibility Assessment for CBFBM ▪ Free Prior Informed Consent for CBFBM	▪ Developing a robust carbon assessment and monitoring plan ▪ Best practice in skills transfer with communities	▪ Technical Tool Box (Specific sessions on parameters and design tables)	▪ Unpacking facilitation skills for CBFBM ▪ Practicing listening and paraphrasing
PM	▪ Why CBFBM? ▪ Unpacking the CBFBM process	▪ Adult learning principles ▪ Introducing communities to climate change, carbon, REDD+ and CBFBM principles	▪ Technical Tool Box (Specific sessions on parameters and design tables)	▪ Technical Tool Box (Specific sessions on parameters and design tables) ▪ Role of experts and communities in the CBFBM process	▪ Designing an effective community training process ▪ Why and how to test the CBFBM design

TRAINING SCENARIO TWO: ONE-OFF FIVE-DAY CBFBM TOT WITH DESIGN TESTING

Note: Suitable when participants are experienced local level facilitators from specific projects that have established good trust relationships with the communities and worked with them on community-based forest management approaches

LEARNING OBJECTIVES

By the end of the five-day course, the participants
- can explain the rationale, value and key steps of the CBFBM ToT process
- have designed their own CBFBM carbon assessment and monitoring plan, and associated community training activities
- have applied and practiced key facilitation and community training design principles and skills
- have tested key elements of their proposed CBFBM design with one community
- have adapted their design based on lessons learned from the testing

TIME	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
AM	• What is CBFBM? • Why CBFBM? • Unpacking the CBFBM process • Role of experts and communities in the CBFBM process	• Developing a robust carbon assessment and monitoring plan • Technical Tool Box (Specific sessions on parameters and design tables)	• Technical Tool Box (Specific sessions on parameters and design tables)	• Testing of design with community	• Reflection on testing and adaptation of design
PM	• Designing an effective community training process • Introducing communities to climate change, carbon, REDD+ and CBFBM principles	• Technical Tool Box (Specific sessions on parameters and design tables)	• Why and how to test your initial CBFBM design	• Testing of design with community	• Planning

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TRAINING SCENARIO THREE: ONE-OFF ONE-DAY OVERVIEW DECISION MAKER/PLANNER TRAINING WORKSHOP

LEARNING OBJECTIVES

By the end of the day, participants
- can explain the rationale, value and key steps of the CBFBM process and its feasibility for a specific context
- have identified the key stakeholders and developed a draft stakeholder engagement strategy for a CBFBM site

TIME	SESSION (ONE DAY)
AM	▪ What is CBFBM? ▪ Conducting feasibility assessment for CBFBM
PM	▪ Unpacking the CBFBM ToT process ▪ Facilitating stakeholder mapping for CBFBM

TRAINING SCENARIO FOUR: FOUR-DAY SANDWICH FIELD BASED LEARNING WORKSHOP

Note: This design assumes that the site and communities have already been prepared and that the project team has the capacity to use the technical tool box themselves to fill in their CBFBM design tables in between the two-day sandwich. Participants are given a clear framework to process and present their findings before the start of the second segment of the course. Trainers may want to be available for coaching analysis of findings on the evening before the second segment.

LEARNING OBJECTIVES FOR PROJECT FIELD TEAM SANDWICH COURSE

By the end of the four days, participants
- can explain the rationale, value and key steps of the CBFBM process
- have developed a framework for a carbon assessment and monitoring plan for further development with team members at project site
- have designed and received feedback on a community training process for CBFBM including a plan for testing

TIME	DAY ONE	DAY TWO	(2 WEEKS BACK TO WORK)	DAY THREE	DAY FOUR
AM	■ What is CBFBM? ■ Why CBFBM?	■ Introducing the CBFBM Process Design Elements and Steps ■ The role of experts and communities in the CBFBM process		■ Sharing CBFBM design tables for each technical parameter	■ Designing an effective community training process
PM	■ Linking CBFBM with voluntary carbon and other standards	■ Developing a robust carbon assessment and monitoring plan ■ Introduction to Technical Tool Box and CBFBM Design Tables		■ Adult Learning Principles ■ Introducing communities to climate change, carbon, REDD+ and principles of CBFBM	■ Why and how to test your initial CBFBM design

2 | ANNEX: SAMPLE LOCAL FACILITATORS' SESSION PLAN

ANNEX 2: SAMPLE LOCAL FACILITATORS' SESSION PLAN

Explanation: The CBFBM training programme below is a four-day training programme designed by the Foundation for People and Community Development, with support from the Institute for Global Environmental Strategies, for communities in Madang Province, Papua New Guinea. The forests are natural tropical forests with high species diversity. Forest conditions vary widely, partly due to high relief. The participating communities own the forests under customary systems. The communities have intimate knowledge about the forests, because for generations they have depended on them for wood and non-wood forest products. Under the CBFBM, the communities are trained to set up and measure permanent sample plots in their forests. The first two days of the training take place in and around the villages. Training inside the classroom is mixed with practical exercises outside but near the classroom. On Days 3 and 4, the local level facilitators guide the community team in setting up and measuring several sample plots in their forest.

SECTION	TOPIC	DESCRIPTION	DURATION	EQUIPMENT/ MATERIALS TO BE PREPARED	TEACHING AID	NOTES FOR THE FACILITATOR
DAY 1						
Opening	Important formalities	▪ Registration ▪ Prayer ▪ Welcome speech ▪ Expectations from participants	30 min	registration forms; field manuals; pens/ pencils		Participants receive the monitoring manual and pencils after registration
Introduction	Why should we conserve our forests?	Discuss importance of forest to the community	15 min			Ask participants to describe the value their forest has for them
	Why should we monitor our forests?	▪ Discuss importance of monitoring to forest management ▪ Discuss opportunities that scientific data can create for new management options	10 min			Ask participants to explain how their forest grows and changes
	How can we monitor our forests?	Introduce the forest monitoring steps	10 min		sketch of monitoring steps on A0 paper	
COFFEE BREAK			15 MIN			

SECTION	TOPIC	DESCRIPTION	DURATION	EQUIPMENT/ MATERIALS TO BE PREPARED	TEACHING AID	NOTES FOR THE FACILITATOR
Check on understanding		Do check on who can remember the monitoring steps	10 min			
Introduction to manual and equipment	Field manual	Explain how to use the manual	10 min		manual	
	Equipment	Lay out all field equipment and explain one by one	15 min	all field equipment		
Tree measurement (1)	Tree Numbering, Tagging, Marking	■ Classroom: Explain numbering, tagging and marking system ■ Field exercise: Have all participants practice these tasks	40 min	aluminium cans, nylon string, paint and paint brushes, knives or scissors	manual	■ Identify several "practice trees" near the classroom. ■ Have participants practice cutting tags from aluminium cans and inscribing numbers using a sharp point, then practice tying the tags to the trees with the nylon string. Make sure they understand to tie the string loosely to allow for tree growth. ■ Have participants cut a 1.3 metre stick to identify where trees should be painted (i.e. the POM). Explain that sometimes the paint mark might be higher or lower, depending on where DBH is measured. Have participants practice marking the trees
LUNCH BREAK			1 HOUR			
Tree measurement (2)	Recording tree species	■ Classroom: Explain importance of recording tree species ■ Field exercise: Practice identifying and recording species names	30 min			■ Ask what the common tree species are and who the best people are to identify the species. Usually these will be older people. Tell the participants that it is a good idea to have some older people in the monitoring teams. ■ Identify a few trees near the classroom for participants to practice identifying tree species. For each tree, have the community provide the local name, and then you can tell them the botanical name. ■ Tell them that we can record species in local names, as long as we can later translate these to their botanical names.

SECTION	TOPIC	DESCRIPTION	DURATION	EQUIPMENT/ MATERIALS TO BE PREPARED	TEACHING AID	NOTES FOR THE FACILITATOR
	Measuring tree diameter	■ Classroom: Explain how to measure tree diameter ■ Field exercise: Practice on several trees	1 hour	DBH tape	manual, sketches on A0 paper	■ Explain all common terms for tree diameter measurement including DBH, unit (cm) and POM in classroom ■ Using sketches on A0 paper, explain how to identify the POM and measure DBH for "normal trees" and "unusual trees" (leaning trees, trees on slopes, etc.) ■ Have all participants practice measuring DBH on a variety of trees
	Estimating tree height	■ Classroom: Explain how we estimate tree height ■ Field exercise: Practice on several trees	2 hours	2-3 clinometers, measurement tape, paper and pencils for recording data	manual, sketches on A0 paper	■ Explain how clinometers are used to estimate tree height using A0 sketches ■ Explain how to identify total height and merchantable height ■ Have each participant practice using a clinometer on several trees ■ Give some practical examples of actual tree height estimates using the data the participants have recorded
DAY 2						
Check on understanding	Tree measurement		20 minutes			
Deadwood measurement		■ Explain why and how deadwood is measured	20 minutes		manual, sketches on A0 paper	■ Explain how the deadwood transect is set using a sketch on A0 paper ■ Explain the "machete test"
Setting up plots	Plot size and shape	■ Explain plot dimensions ■ Explain what diameter classes are measured in each sub-plot	30 minutes		manual, sketches on A0 paper	■ Using sketches, explain that it is important for plots to have right angles, and explain how a compass can be used to set a right angle ■ Write up 10 different tree diameters on the A0 paper, break the participants into groups and ask them what sub-plots each tree should be measured in
	Plot set up	Field exercise: Practice setting up one plot	1 hour	compasses, metal stakes, sledge hammer, measurement tape	manual, sketches on A0 paper (for compass use)	Guide the participants in setting out the borders of one plot using the equipment.

SECTION	TOPIC	DESCRIPTION	DURATION	EQUIPMENT/ MATERIALS TO BE PREPARED	TEACHING AID	NOTES FOR THE FACILITATOR
Positioning plots		▪ Classroom: Explain systematic locating of plots ▪ Field exercise: Practice using GPS to locate plots	1.5 hours	2 -3 GPS handheld devices	manual	▪ Explain how the plots are located along the baseline ▪ Explain how to read GPS accuracy, to mark a waypoint and to find a waypoint ▪ Run the "treasure hunt" exercise
LUNCH BREAK			1 HOUR			
Site conditions		▪ Discuss how forest varies with conditions ▪ Explain what variables we record	20 minutes		manual	Point out that the participants may have good knowledge of disturbance (e.g. old garden areas) at the plots sites which is important to record
Field Sheet		▪ Explain how to fill in field sheets	20 minutes		manual, copies of field sheets	▪ Stress importance of assigning Data Recorders who are careful and write neatly, and need for Team Leader to check and sign off field sheets before leaving the plots ▪ Explain points not covered so far: recording time to reach plot, time of arrival and time of departure; names of team members
Organising monitoring team		▪ Explain different roles ▪ Explain importance of assigning good people for each role	20 minutes			▪ Discuss what skills are needed for the monitoring Team Leaders and the Data Recorders ▪ Tell the participants that before going to the forest to set up and measure plots, a team leader must be selected and he/she must assign roles to all team members
Check on understanding			30 minutes			▪ Ask participants which topics and skills are most difficult, and provide further guidance/practice as necessary
DAYS 3 & 4	Trainers to guide community forest monitoring teams in setting up sample plots in their forest.					

3 | ANNEX: FIELD SAFETY

Field safety takes priority over other considerations in forest monitoring. Precautions appropriate to the conditions that will be faced in the forest must be taken. For CBFBM, thought must be given to safety during travel and the community trainings, and when the community teams are undertaking the forest monitoring.

Some safety precautions will be different for local people that frequently spend time in the forest for hunting, gathering, etc. and are well-adapted to the forest environment, and for others who seldom spend time in forests. The following generic guidance should be considered for all CBFBM systems: A basic first-aid kit prepared for likely injuries in the forest should be carried during the training and subsequent sampling. A medical practitioner should be consulted on how to prepare the kit. First aid kits should contain Epinephrin/Adrenalin or an antihistamine for allergic reactions (e.g. bee/wasp stings).

- Enough water and food should be carried for the monitoring, with thought also given to how to cope if the stay in the forest is longer than expected. Iodine or other forms of water purification could be carried if there is a risk that water will be consumed from unclean sources. Matches/lighters and flashlights (with fully charged batteries) should always be carried.
- Clothing should be worn that protects from the sun and cold. Though sturdy footwear is normally recommended, local people are often more comfortable, and highly capable, of walking in the forest in bare feet or in sandals.
- Sun block and insect repellent should be carried.
- Basic first-aid training could be provided and this could incorporate sharing information on traditional treatments used by the local communities for injuries.
- Details of the nearest medical facility should be known, including the telephone number and how to arrange transportation.
- Monitoring team members should never work and travel alone.
- For both the training and the sampling, contact persons who are not participating in the CBFBM field activities must be appointed. The contact persons must be given the schedules of the field activities and instructions on what to do if there is considerable delay in monitoring teams returning from the field.
- Ideally, the monitoring teams should carry a cell/mobile phone or other device that allows them to call for outside help if there is an emergency. The battery charge should be checked each time before entering the field. If communications are not possible, arrangements could be made for other community members to periodically check on the field teams.
- High risk areas, e.g. areas where there is potential conflict with other groups, illegal activities taking place, volcanic activity, etc., should be identified and avoided. If plots are in places that are dangerous to work, e.g. on very steep slopes or where bees are present, they should be relocated. The reason for relocation and how the new location was decided should be recorded in the field sheets.
- In the event of snake bite, the victim should be taken immediately to a medical facility. Conventional "snake bite kits" (e.g. suction cups, razors) have been proven ineffective or even harmful and should not be used.
- For basic skin hygiene and to avoid extended contact with plant oils, ticks, and/or chiggers, the same clothes should not be worn over two days in the field without washing.
- When travelling off-road, vehicles should only be driven by people highly experienced with the conditions. Basic tools, a fully-inflated spare tyre, a spade, etc. should be carried.

USEFUL GUIDANCE FROM PROJECTS THAT HAVE EMPLOYED CBFBM
A field guide for assessing and monitoring reduced forest degradation and carbon sequestration by local communities
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http://www.recoftc.org/site/resources/REDD-ToT-Manual-for-Community-level-Facilitators.php

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