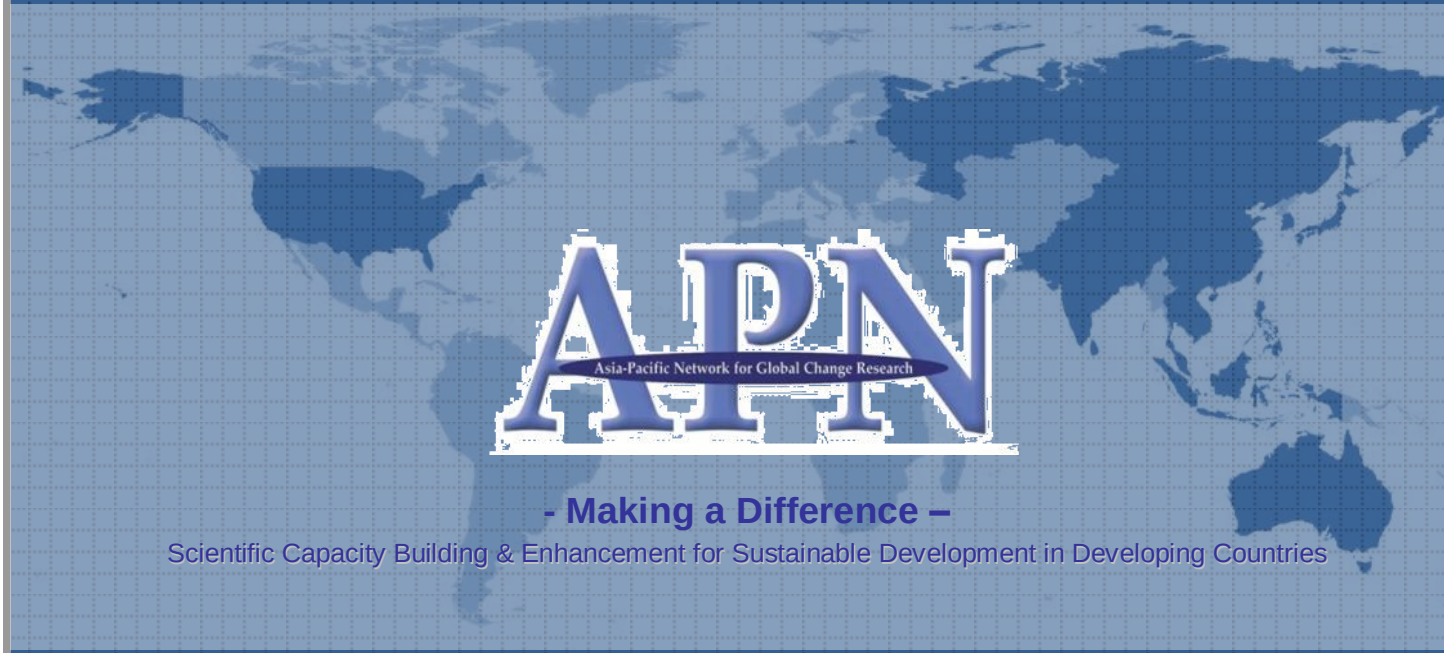
FINAL REPORT for APN PROJECT

Project Reference Number: EBLU2012-02CMY(R)-Scheyvens

# *Participatory Approaches to Forest Carbon Accounting to Mitigate Climate Change, Conserve Biodiversity, and Promote Sustainable Development*




**- Making a Difference –**

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

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# Participatory Approaches to Forest Carbon Accounting to Mitigate Climate Change, Conserve Biodiversity, and Promote Sustainable Development

**Project Reference Number: EBLU2012-04CMY(R)-Scheyvens**
**Final Report submitted to APN**

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# OVERVIEW OF PROJECT WORK AND OUTCOMES

## Non-technical summary

The destruction of forests contributes to global climate change by releasing carbon dioxide (CO2) and other greenhouse gases into the atmosphere and by reducing the potential of forests to absorb CO2. Forest management is expected to make an important contribution to climate change mitigation, as well as global targets associated with biodiversity conservation, combatting desertification, conservation of wetlands, food and energy security, disaster risk reduction and climate change adaptation. A global mechanism popularly referred to as REDD+ is being developed that will provide incentives to developing countries to implement activities to protect and enhance their forest carbon stocks. REDD+ is a performance-based financial scheme, meaning that developing countries must demonstrate results before they will receive payments. This requires that forest carbon stocks and safeguards that have been agreed for REDD+ are monitored.

The basic hypotheses of the APN project *Participatory Approaches to Forest Carbon Accounting to Mitigate Climate Change, Conserve Biodiversity, and Promote Sustainable Development* were (i) that with well-designed training and ongoing support, local communities can take reliable forest measurements for the tracking of forest carbon stocks and, (2) that community involvement in measurement and monitoring could make an important contribution to the sustainability of REDD+ actions, local development and the REDD+ safeguard on participation.

The project developed the concept of community-based forest biomass monitoring (CBFBM) through an intense process of action research conducted with local partners in Indonesia, Laos, Cambodia and Vietnam. Approaches for engaging communities in forest carbon stock monitoring were developed, tested and refined at each research site, and the findings were reflected in a comprehensive manual on community-based forest biomass monitoring, as well as disseminated at national, regional and international workshops, seminars and side-events.

## Keywords

REDD+, community participation, forest carbon stock assessment and monitoring, action research

## Objectives

The main objectives of the project were:

1. Develop and test participatory approaches to involve forest-dependent communities in forest carbon accounting using sample plots;
2. Estimate carbon stocks at the research sites and compare the results with other studies;
3. Explore ways of integrating the participatory approaches to ground-based measurement with remote sensing methods in order to establish reference emission levels;
4. Estimate the costs of implementing participatory ground-based approaches and compare with alternatives;
5. Explore how payment distribution systems can provide incentives for communities to participate in forest carbon accounting;
6. Encourage replication of the approaches through the research outputs.

## Amount received and number years supported

The Grant awarded to this project was:
US$39 ,000 for Year 1
US$ 42,000 for Year 2
US$ 39,000 for Year 3

## Activity undertaken

The activities of the project can be divided into (i) action research with collaborators at field sites to develop, test and refine approaches to CBFBM, (ii) workshops and other events on CBFBM to engage stakeholders, share experiences and findings, and generate outputs, and (iii) promotion of the project and the guidance it developed for CBFBM through a website, presentations at workshops, seminars and side-events, research publications and manuals. The activities were supported both under the APN project and using funds that were secured on a yearly basis from the Ministry of Environment of Japan.

### (i) CBFBM action research with collaborators at field sites

The bulk of the work conducted under the project took the form of intensive action research at selected project sites. The project collaborators took the lead on the action research at each site, with the proponent providing analytical support and extracting generic guidance from the lessons and findings that were generated. Action research is a cumulative learning process in which iterative cycles of planning, action, observation and reflection build on each other in the process of problem solving. Under the APN project, the action research involved researchers and community facilitators working together with local communities in designing, testing, reflecting on and adapting community-based forest monitoring systems. In the first year of the project, action research was launched at sites in Indonesia, Cambodia and Laos. Action research was also launched in Papua New Guinea in the same year using funds from the Ministry of Environment of Japan. The research in Cambodia was concluded at the end of the first year and action research was launched in Vietnam at the start of the second year.

#### Cambodia

In Cambodia, the action research was introduced into the Community-based Production Forestry Project (CBPF) as a collaborative effort of RECOFTC – The Centre for People and Forests and the Wildlife Conservation Society (WCS), with participation of the Forestry Administration (FA). The CBPF lies in the buffer zone of Seima Protection Forest and holds about 10,000 ha of forest. The action research focused on two trial areas for inventory; one for deciduous forest and one for evergreen forest. The action research included awareness raising and agreement with the main stakeholders; mapping of land cover; a training-of-trainers and a training of community-based forest monitoring teams from three ethnic Bunong communities in the project area; full implementation of the trial inventory by the monitoring teams; and analysis of the data and discussion on the results.

#### Indonesia

The action research in Indonesia was implemented by DKN (the National Forestry Council of Indonesia), ARuPA (a national NGO supporting community forestry), and two villages in Yogyakarta province – Semoyo and Terong. Households in Semoyo and Terong have private ownership of trees in their home gardens and in dryland areas where they have established woodlots and planted trees on the land boundaries. The action research evolved to support the communities in the development of a project design document (PDD) for community-based REDD+ using the Climate, Community and Biodiversity (CCB) Standards.

#### Laos

The Faculty of Forestry, National University of Laos (NUOL) launched action research on CBFBM in a hilly part of Sangthong District where four villages hold a total of 9,788.40 ha of forest. The main research activities included a training-of-trainers to build the capacity of the researchers in the Faculty of Forestry to work on CBFBM; wide consultations to agree on the research villages; a socio-economic baseline survey; a training workshop for the district staff and the community members; setting up of community forest biomass inventory teams; forest sampling and initial data processing;

mapping of land cover; and demarcation of forest strata.

**Vietnam**

The CBFBM action research was launched in Vietnam by IGES and the Faculty of Forestry, Vietnam Forestry University (VFU) in 2012. The research was implemented with several ethnic minority communities in Cao Phong district, Hoa Binh province, where Acacia mangium plantations had been established under a small-scale Afforestation/Reforestation Clean Development Mechanism (A/R CDM) project. A key challenge for the action research was to build a research/facilitation team that had the competency to facilitate rather than direct communities on forest monitoring. The VFU team developed a field manual for guiding facilitators and the communities in their future monitoring, tested the manual with one community, and produced a second draft. The action research has evolved to look into the possibility of introducing community-based forest monitoring into Vietnam's Payment for Forest Ecosystem Services system and the planting of indigenous tree species by the participating communities.

**(ii) Sub-national/national and regional workshops**

Sub-national/national and regional reflection workshops were held each year of the project. The objectives of the sub-national and national workshops included capacity building of the groups and individuals involved in the action research, building stakeholder support for the research, and disseminating the results of the research outcomes. Regional project workshops were held each year and provided an opportunity for the proponent and collaborators to share research approaches, lessons and findings with other groups.

**(iii) Promotion of the project and the guidance it developed**

The project was widely promoted through a webpage (http://www.iges.or.jp/en/natural-resource/forest/activity_CBFBM.html) linked to the IGES website. The webpage provides an overview of the project and provides links to all major project outputs, including videos that were produced on the CBFBM concept and action research. Project participants were invited to present on CBFBM at a number events. Most recently, these included presentations by the proponent and the Indonesian collaborator at the regional event "Participatory Forest Monitoring" in Lam Dong, Vietnam on 18-20 November 2014, as well as co-hosting and presenting at the UNFCCC COP20 side-event "Community-Based Forest Monitoring" on 24 November 2014 in Peru.

## Results

In terms of generating new knowledge, by developing and testing approaches to engage communities in monitoring for forest carbon stock assessment, the project was able to identify good practice and demonstrate that CBFBM can produce reliable data and be a cost-effective alternative to conventional surveys. The training outputs include the building of capacities of support organisations, local governments, line agencies, researchers and communities at the research sites on the CBFBM concept and approach, as well as training materials. The project also raised the awareness of local governments and policymakers on how local communities can contribute to the success of national and subnational REDD+ strategies through the monitoring of forest biomass, biodiversity and other forest values.

## Relevance to the APN Goals, Science Agenda and to Policy Processes

***APN goals and science agenda***

The project contributed to APN's Vision "to enable the Asia-Pacific region to successfully address global change challenges" and to APN's Science Agenda by providing science-based approaches that increase understanding and ownership of REDD+ activities at the local level and increase the accuracy of carbon stock, emissions and removals estimations, thereby enhancing the credibility,

effectiveness and sustainability of REDD+ as a mitigation strategy.

***Policy Processes***
REDD+ national strategy and monitoring, reporting and verification (MRV) architecture is under development in all the action research countries. The CBFBM approaches developed by the project were brought to the attention of senior officials involved in REDD+ development in each country by involving them in workshops and site visits. The research and its findings were also presented at side-events associated with the negotiations on a future global REDD+ agreement.

## Self evaluation

The project can claim the following achievements:

1. Provided strong evidence that with appropriate training and ongoing support, communities can provide accurate forest measurements for the assessment and monitoring of forest carbon stocks;
2. Provided strong evidence that communities can make an important contribution to land cover and land use mapping through sharing their local knowledge, boundary demarcation and participation in map accuracy assessments;
3. Provided comprehensive and easy-to-use guidance on implementing CBFBM systems. Users can have confidence in this guidance as it is based on extensive action research in a variety of local contexts found across the region;
4. Raised awareness of local and national governments on the concept of CBFBM and how it can be implemented;
5. Identified the potential for including CBFBM in national forest monitoring systems as well as the challenges for scaling up CBFBM beyond the action research sites;
6. Identified potential benefits of CBFBM for communities (not just payments for REDD+, but also knowledge on how to maximize other benefits from their forests using the data generated);
7. Strengthened the relationships between the communities, researchers, NGOs and local governments active in the action research areas;
8. After the initial cycle of action research, identified new problems associated with community-based forest management and use at the research sites and set out strategies to address these;
9. Confirmed the validity and advantages of action research as an approach for researchers and local communities to collaboratively identify problems associated with natural resources and ecosystem services and to propose and test solutions to these problems.

A major output of the project was a comprehensive community-based forest biomass monitoring training-of-trainers manual. The manual was widely promoted and has proved popular in the short period since its release in April 2014. The manual was used by international organizations to design a regional training in Thailand and translated into Vietnamese to support a training workshop in Vietnam, and has been downloaded about 20,000 times from the IGES website.

## Potential for further work

Global interest in community-based monitoring and knowledge co-production processes involving scientists and communities is growing. In addition to various global initiatives to engage communities in the monitoring of forest carbon, the Intergovernmental Platform on Biodiversity and Ecosystems Services (IPBES) is considering including indigenous and local knowledge (ILK) in its regional biodiversity and ecosystem services assessments. There is thus considerable potential to build on the experience and outputs from the project to explore further policy relevant research on community engagement in generating and sharing data on forest ecosystem services, including biodiversity protection.

## Publications (please write the complete citation)

Edwards, K., Scheyvens, H., Stephenson, J., & Fujisaki, T. (2014). Community based forest biomass monitoring: A manual for training local level facilitators (Research Report 2014/3.). Hayama: IGES.

Ibarra, E. G., Scheyvens, H., & Lopez-Casero, F. (2012). Community Forest Management and REDD+: Opportunities and Challenges. In Greening Governance in Asia-Pacific: IGES White Paper IV 2012 (pp. 85–114). Hayama: Institute Global Environmental Strategies.

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Scheyvens, H., Ibarra-Gene, E., Yamanoshita, M., & Hyakumura, K. (2012). Participatory approaches to forest carbon accounting to mitigate climate change, conserve biodiversity and promote sustainable development. APN Science Bulletin, 2012(2).

Scheyvens, H., Fujisaki, T., & Yamanoshita, M. (2012). Forestry: Importance of local participation in REDD+. In K. Koakutsu, K. Usui, A. Watarai, & Y. Takagi (Eds.), Measurement, Reporting and Verification (MRV) for low carbon development: Learning from experience in Asia (pp. 122–127). Hayama: Japan.

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# TECHNICAL REPORT

## Preface

The basic hypotheses of the APN project *Participatory Approaches to Forest Carbon Accounting to Mitigate Climate Change, Conserve Biodiversity, and Promote Sustainable Development* were (i) that with well-designed training and ongoing support, local communities can take reliable forest measurements for the tracking of forest carbon stocks and, (2) that community involvement in measurement and monitoring could make an important contribution to the sustainability of REDD+ actions, local development and the REDD+ safeguard on participation.

The project developed the concept of community-based forest biomass monitoring (CBFBM) through an intense process of action research conducted with local partners in Indonesia, Laos, Cambodia and Vietnam. Approaches for engaging communities in forest carbon stock monitoring were developed, tested and refined at each research site, and the findings were reflected in a comprehensive manual on community-based forest biomass monitoring (CBFBM), and disseminated at national, regional and international workshops, seminars and side-events.

## Table of Contents

## 1.0 Introduction

Natural forests in the tropics are being converted to other land uses and degraded at high rates. The Food and Agriculture Organisation of the United Nations reported that the area of primary forest in Asia decreased at an average rate of 1.5 million hectares per annum from 1990-2005 (FAO, 2006). The impacts of deforestation and degradation are wide-ranging and include loss of sink capacity and release of greenhouse gases (GHGs) into the atmosphere, as well as loss of biodiversity, soil and water protection and other ecosystem services. Emissions from deforestation during the 1990s are estimated at 5.8 $GtCO_2eq/yr$, making deforestation responsible for as much as 20% of total anthropogenic emissions (IPCC, 2007).

There is high expectation that REDD+ (reducing emissions from deforestation and forest degradation, plus increasing forest carbon stocks) could succeed where other approaches aiming to improve forest management have failed, not only because of the new resources that are being mobilised, but also because REDD+ will be performance-based, i.e. payments will only be made once emissions reductions or increased removals are verified. However, there are also risks that REDD+ could make the mistakes of past technocratic approaches in the tropics that have excluded indigenous people and local communities from forest management and utilising forest resources (White & Martin, 2002). The outcome of these "fortress-like" (Sunderlin & Atmadja, 2009) conservation policies include conflict between local communities and the forestry authorities, a lack of respect for forest laws, and a general failure to reduce national deforestation rates (Scheyvens, Hyakumura, & Seki, Y, 2007).

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) recognise that the participation of indigenous people and local communities is critical to the success of REDD+. The UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) has recognized "the need for full and effective engagement of indigenous peoples and local communities in, and the potential contribution of their knowledge to, monitor and reporting of the activities related to [REDD+]". Furthermore, in Decision 4/CP.15, the Conference of the Parties (COP) "encourages, as appropriate, the development of guidance for effective engagement of indigenous peoples and local communities in monitoring and reporting".

Reflecting the UNFCCC decisions, this project aimed to develop approaches to engage local communities in forest carbon accounting. The assumptions of the research were that the involvement of communities in forest carbon accounting will increase their understanding and support for REDD+ activities, reduce the costs of ground-based measurement, provide more accurate estimates than approaches relying solely on remote sensing, and can contribute to sustainable livelihoods through improved forest management. The research was considered a high priority because of an observable lack of consultation with indigenous and local communities on REDD+ activities (Cotula & Mayers, 2009). The objectives set for the project were to:

- **Develop and test participatory approaches to involve forest-dependent communities in forest carbon accounting using sample plots;**
- **Estimate carbon stocks at the research sites and compare the results with other studies;**
- **Explore ways of integrating the participatory approaches to ground-based measurement with remote sensing methods in order to establish reference emission levels;**

- **Estimate the costs of implementing participatory ground-based approaches and compare with alternatives;**
- **Explore how payment distribution systems can provide incentives for communities to participate in forest carbon accounting;**
- **Encourage replication of the approaches through the research outputs.**

## 2.0 Methodology

It is normally assumed that forest measurement can only be done by people who specialise in forestry. This is because knowledge of sampling is necessary as it is impractical to measure all trees in a forest, and because expertise is needed to determine statistically efficient sample plot 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, usually little thought is given to involving local people in forest assessments beyond the menial tasks of carrying equipment, cutting tracks, etc. However, 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. The concept of forest monitoring is thus not something new to these communities. It is part of their traditional systems of knowledge generation and natural resource management.

The project proponent and collaborators agreed that the most appropriate methodology for developing approaches to engage communities in forest carbon accounting was action research. Action research is a participatory process of research in which the people and organisations affected by a particular problem work together with outside facilitators and researchers to define the problem; set out an analytical framework to investigate the problem; propose and implement solutions; monitor the impacts of the solutions; and based on findings, launch another round of action research. Action research can be distinguished from conventional research approaches in that it emphasises collaboration (researchers and other groups work together in examining a problem and how to solve it) and as a cyclical process involving an interactive cycle of problem identification, action and reflection. Definitions of action research include:

> . . . jointly producing knowledge with others to produce critical interpretations and readings of the world, which are accessible, understandable to all those involved and actionable (Chatterton, Fuller, & Routledge, 2007).
>
> It is an ongoing organizational learning process, a research approach that emphasizes co-learning, participation and organizational transformation (Greenwood, Whyte, & Harkavy, 1993).

The action research was intended to generate and test approaches to forest monitoring in which monitoring teams are established within local communities, in contrast to conventional monitoring, which relies on teams of outside professionals to travel to the forests to conduct the measurement.

Table 1 describes how the project concept of community-based forest biomass monitoring (CBFBM) differs from conventional forest monitoring.

Table 1: Differences between conventional forest monitoring and CBFBM

| | Conventional forest monitoring by professionals | CBFBM |
|---|---|---|
| **Aim** | *Generates data for research, government departments, companies, etc. | *Generates data for communities to strengthen their forest management and consider alternative forest management options<br>*Can also contribute to district/provincial/ national forest monitoring |
| **Capacity** | *Already exists | *Must be built, but utilises local knowledge and skills |
| **Methods/ Equipment** | *Some are "high-tech (e.g. laser distance measuring tools) | *Simplified methods and equipment that provide reliable measurements preferred<br>*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 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<br>*Facilitators train communities and assist in building and coaching community institutions for forest monitoring<br>*Professionals provide technical inputs, such as setting up spreadsheets for data processing, development of allometric equations, etc. |

The research project set out the generic steps to action research that should be followed by the project collaborators for deciding the research sites and conducting the research at each site. However, the collaborators were instructed to ensure that they elaborated the action research to reflect locational, cultural, institutional and other context-specific factors. The generic methodological steps that were initially envisioned for the project appear in the project proposal as follows:

- **Consultations and feasibility analysis to agree on research approach and identify research sites;**
- **Baseline surveys;**
- **Technical training of local community participants;**
- **Forest boundary mapping and stratification;**
- **Siting and establishment of sample plots;**
- **Measurement, data entry, and estimation of carbon stocks;**
- **Preliminary study on reference emission levels (RELs);**
- **Dissemination.**

***Consultations and feasibility analysis***

The research sites are shown in Fig. 1 (Note: The action research in PNG falls outside the APN project). Consultations with national and local governments and other stakeholders were found to be essential (Photo 1), but feasibility analysis was not needed at most of the action research sites as the project collaborators were already working with the local communities at these sites. Feasibility analysis was conducted at sites where the collaborators had not established a prior research relationship with the communities and, in the case of Indonesia, this led to the rejection of

candidate sites in Sumatra. Baseline surveys were generally found not to be entirely necessary because of the prior work by the collaborators at the research sites, but were conducted for participating villages in Laos and Indonesia.

Figure 1: CBFBM project sites and implementing partners

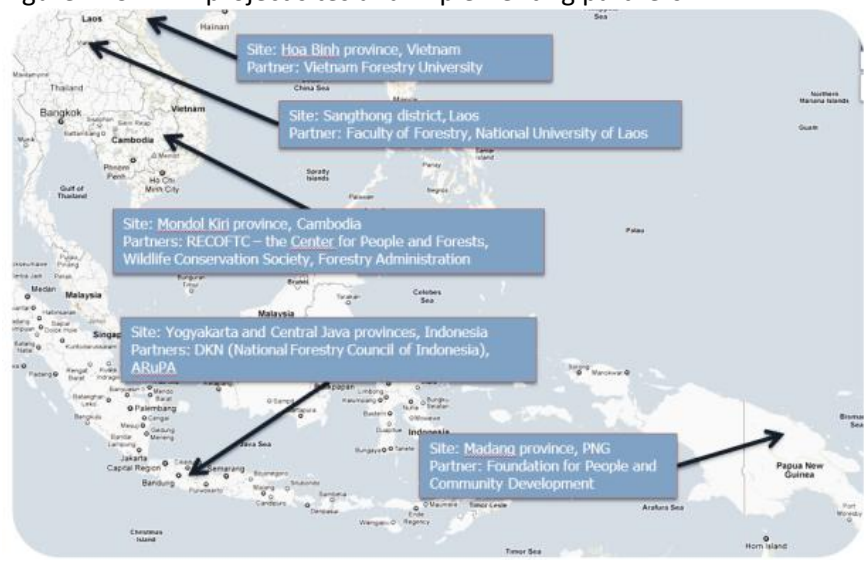



Photo 1: Consultations with village leaders, Semoyo, Indonesia

***Training***

Technical training of local communities was conducted at all the sites, as envisioned (Photo 2), but, during the process of the action research it was found that training of the communities could only proceed after a training of trainers (ToT). ToTs were thus conducted in all the participating countries to ensure that the local level facilitators had the necessary knowledge and skills to train the communities (Photo 3).

***Mapping and stratification***

Forest boundary mapping and stratification are an important part of forest carbon stock assessment and were conducted at all research sites. Through the action research, efforts were made to maximise the involvement of the local communities in the mapping and stratification. This included their involvement in the demarcation of boundaries using handheld GPS and the use of local

knowledge to assist with the interpretation of satellite images and classification of land cover and land use (Photos 4 and 5).

Photo 2: Training of community, Cao Phong, Vietnam

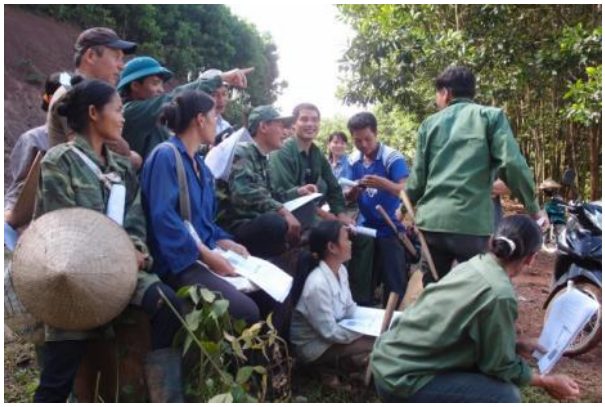


Photo 3: Training of trainers, National University of Laos

Photo 4: Introducing basic GPS use and forest boundary sketch mapping, Laos

Photo 5: Receiving feedback from communities on preliminary land use maps, Laos

***Ground-based measurement***

The collaborators worked with the participating communities in selecting the carbon pools for sampling, the measurement parameters and the measurement equipment and protocols (Photos 6-12). Communities were trained on siting and establishing sample plots, measuring vegetation in the sample plots, and on recording the data in field sheets. Data entry, analysis and management were conducted by the researchers, though efforts were made to train the participating communities in Indonesia on data entry using MS Excel.

Photo 6: Community using GPS and filling field sheets, Terong, Indonesia

Photo 7: Using SUUNTO to estimate tree height, Seima, Cambodia


Photo 8: Measuring diameter using callipers, Seima, Cambodia

Photo 9: Data recording, Seima, Cambodia

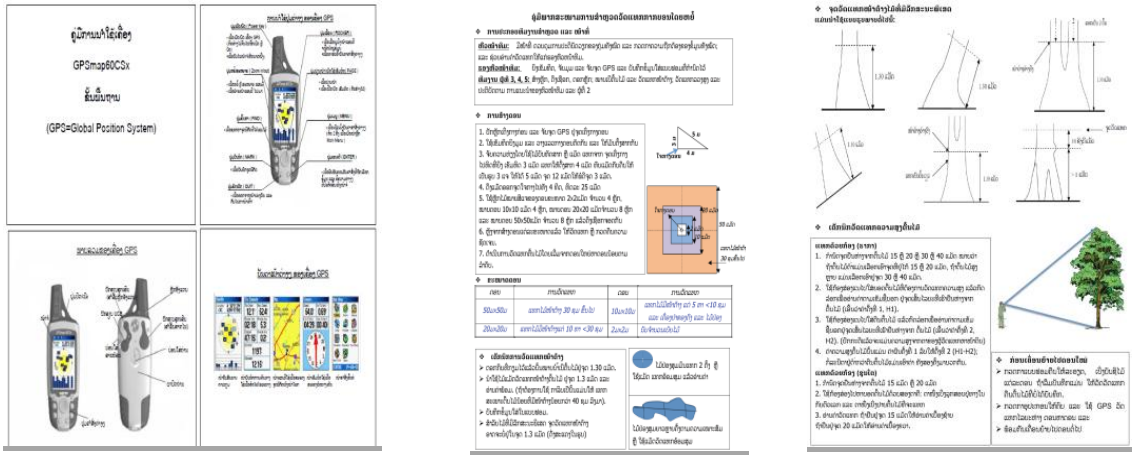
Photo 10: Community members demonstrate how they set out rectangular plots, Seima, Cambodia

Photo 11: Checking plot corners have right angles, Terong, Indonesia

Photo 12: Forest sampling, Laos

The proponent and collaborators created field manuals to guide the forest sampling by communities in each country (Fig. 2). Separate manuals were needed for each country as each collaborator was instructed to agree with the communities on sampling designs and measurement tools and techniques that were best suited for local purposes and to community capacities.

Figure 2: Field and GPS guidance booklet for the field sampling at action research sites in Laos



***Reference levels***

A preliminary study on reference levels was included as part of the proposed methodology, as reference levels are necessary to estimate the impacts of REDD+ activities on forest carbon stocks. The study on reference levels progressed most at the action research site in Cambodia, where emission scenarios under different forest management options were projected.

***Dissemination***

The purpose, content and results of the research were disseminated through published outputs, district level, national and regional workshops, UNFCCC side-events, and public media (Photo 13).

Photo 13: Village radio raising awareness on climate change and community-based forest monitoring, Semoyo, Indonesia

## 3.0 Results & Discussion

The following discussion is divided into sections on (i) achievements at the action research sites and at country level, (ii) development and promotion of general guidance on CBFBM, and (iii) achievement of project aims, gaps and potential for taking the research forward.

### 3.1 Achievements at the action research sites and at country level

#### 3.1.1 Cambodia

***Background and approach***

CBFBM was introduced in 2010 into the Community-based Production Forestry Project (CBPF), which lies in the buffer zone of Seima Protection Forest (SPF) in Cambodia, as a collaborative effort of RECOFTC and the Wildlife Conservation Society (WCS), with participation of the Forestry Administration (FA). The CBPF is a new model of forestry for Cambodia that establishes community institutions to manage forest on a sustainable production basis. The CBFBM action research looked into the potential of training community-based teams to undertake the inventory work for commercial timber harvesting as well as to gather additional data that would allow calculation of carbon stocks and through this consideration of the feasibility of REDD+ for the project area.

The entire CBPF area holds about 10,000 ha of forest and the action research focused on two trial areas for inventory within this; one for deciduous forest and one for evergreen forest. A training of trainers was followed by full implementation of the trial inventory, with the three ethnic Bunong communities in the project area participating. Other features of the action research project included: experimentation with low cost, simple devices using locally available materials to measure trees; experimentation with different sample plot designs to understand their “statistical efficiency”; destructive sampling to develop species-specific allometric equations; use of three dimensional photogrammetric techniques to estimate tree volume; study of tree rings to model tree growth; land cover / land use mapping using remotely sensed data; and study of emissions scenarios under different forest management options.

The project stakeholders are listed in Table 2. After institutional arrangements between FA, WCS and RECOFTC were clarified, including the roles and responsibilities of the different parties involved, a work plan was developed that included the following training and awareness raising activities as integrated activities in the project:

- **REDD+ awareness raising meetings at village level;**
- **Cantonment launch meeting;**
- **Community launch meeting;**
- **Training of trainers on principles of survey methodologies from FA and k-tree method, technical training, and try out;**
- **Follow up training and coaching on inventory methodologies;**
- **Supervised community level implementation.**

Table 2: Project stakeholders

| Stake-holder Level | Stakeholders | Roles |
|---|---|---|
| 4 | Partners / Regional Level officers (IGES, WCS, FA, RECOFTC) | *project design and management<br>*training and capacity building (focused on technical inputs) and supervision of implementation<br>*data-analysis, presentation and communication<br>*coordinating efforts, advising, communicating and coaching of CBPF development |
| 4 | National Level officers (CFO, FA, WCS, RECOFTC) | *supervision and institutional support<br>*training and capacity building for provincial level officers<br>*communication and advising CBPF development |
| 3 | Sub-national officers (CBPF team, Cantonment) | *supervision of ground work, data-input<br>*training and capacity building of community members<br>*presentation and communication of results<br>*recommendations on inventory methods for SPF<br>*coaching and advising on CBPF development |
| 1 | Community members | *data collection<br>*sharing of information within and between villages on project and CBFBM<br>*different roles and involvement in CBPF development<br>*development, implementation and administration |

***Training***

With the objective to increase awareness on REDD+, a cascading process was initiated. For this, national level trainers, who also participated in the initial awareness raising workshop in February 2010, trained provincial level trainers, whom in turn reached out to the communities. Capacity building focused on skills training to address technical aspects of forest inventory, in view of having a full inventory of the forest and of the CO2 sequestered in the forest. Also, it aimed to test the FA requirements for the inventory and compare alternative forest inventory techniques. Further, it aimed to identify the best technology for this type of set up. A ToT on inventory techniques was conducted during 17-21 January 2011 at the SPF headquarters. The ToT was followed by coached field work in early February 2011. During the fieldwork, participants of the January training were guided in their role of managing the community-based inventory work. They were guided on what data should be collected, how they should be collected and recorded, and how to organise the sampling.

During the community launch meeting, half a day was spent identifying two potential trial blocks (one deciduous, one evergreen/semi-evergreen) to be used as training areas for all forest management techniques including inventory, harvesting and silviculture. The boundaries of the proposed areas were inspected by motorbike and on foot by the WCS team. A demarcation team (three people from each village) then walked the entire boundaries, recording waypoints on handheld GPS devices and placing wooden signboards at key points.

***Sampling***

The basic approach for determining carbon stocks in the project area is to derive carbon estimates from regular forest inventory data as prescribed under the FA Community Forestry (CF) Guidelines. Two kinds of modifications were considered by the project - protocols for measuring additional carbon pools/sub-pools and efficiency improvements.

The FA regulations foresee 50 x 100 m sample plots in evergreen forest and 50 x 50m plots in deciduous forest. While such plots may be appropriate in situations where the primary aim is to visually demonstrate the impact of CF operations over periods of five to 10 years, such large plots are not the ideal choice for covering larger areas as in the case of the Seima project area. It was thus decided to test another approach to sampling – the 6-tree method. Also called k-tree sampling, this approach was suggested due to its two major advantages of (1) allowing an automatic adjustment to tree spacing and (2) being far less time consuming since the outer perimeter of the plots do not have to be marked. Figures 3 and 4 show the plot layouts prescribed in the FA community forestry guidelines and the in the k-tree approach. Maps 1 and 2 were prepared for the inventory in the deciduous forest and provide a comparison between the rectangular FA plots and the 6-tree sample plots - both having the same total percentage area coverage. Similar maps were produced for the evergreen forest.

Aboveground woody biomass for trees >10 cm, saplings (regeneration), bamboo and standing plus lying dead wood were the carbon pools/sub-pools measured. In addition to diameter at breast height (DBH), height was measured on all plots that followed the CF guidelines. For the 6-tree plots, the project attempted to establish diameter-height relationships (DHRs) to allow a more precise estimation of aboveground biomass, and also to enable the estimation of timber volumes, without having to laboriously measure every individual tree. For non-timber forest products (NTFPs), estimates were made of quantities using locally chosen units - kg, m, stems etc. - as appropriate to the growth form of the plant. Standard equipment including compasses, 1 m calipers and SUUNTO clinometers were applied in the inventory work.

Figure 3: Plot layout in community foresty guideline

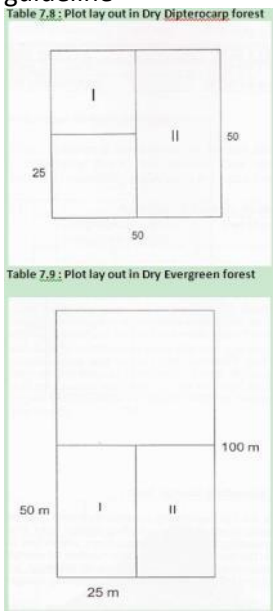
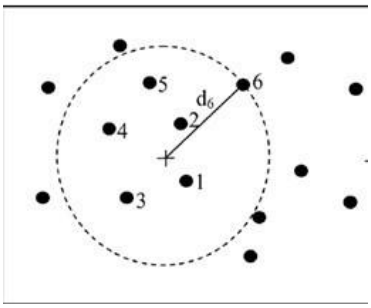
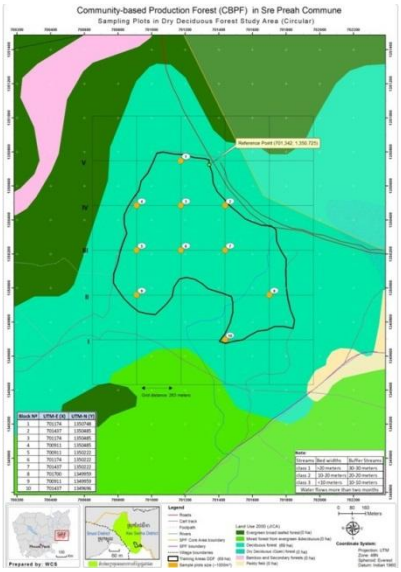



Figure 4: K-tree plot layout




Map 1: Distribution of plots in deciduous forest following CF Guidelines

Map 2: Distribution of plots in deciduous forest following k-tree method


Plot layout work encountered problems in the rectangular plots in establishing right angles at outer and inner plot corner points particularly if visibility was poor. A simple method of laying out plot corners by measuring triangles with 3, 4 and 5 m side lengths, based on the principle $a^2 + b^2 = c^2$ was introduced to help overcome this issue. In order to measure buttressed trees, estimations from variable wedges (either small calipers or transparent rulers with fixed distance to the observer's eye (50 cm) at tape-measured distances to the sample trees was introduced. This was found useful for estimating diameters at up to 6 m high measurement points above the buttress. The method reduced estimation errors considerably (Photo 14).

Photo 14: Estimating tree diameter above buttresses using "locally appropriate" technology

In order to assess biomass of dense bamboo culms the idea of measuring either diameter or circumference of culms was introduced. These parameters can be used to estimate stem numbers via regressions between these parameters and stem numbers measured in sample plots. However, in the end no considerable numbers of clumps of bamboo were found in the compartments studied and thus just stems were counted.

Six data sheets were used for each plot - large and small living trees, saplings, NTFPs, standing dead wood and lying dead wood. Data entry was conducted off-site by WCS staff and thoroughly checked by advisory staff to minimize entry errors and identify likely data recording errors for review. Data were handled using an Excel spreadsheet. Default values and equations used, and the justification for their use can be found in Scheyvens et al. (2014, pp. 50–52).

Data from the plots in the 69 ha deciduous forest study block are summarized in Table 3. Carbon values are based on DBH-only biomass equations, but the timber stocks are based on height measurements too. For the CF Guideline plots these were measured for every stem and for the 6-tree method these are derived from the local DHRs.

Given a similar sample fraction, the precision of the results from the two sampling methods was essentially the same. The key finding was that the level of effort (and hence cost) required to reach this comparable sample fraction/level of precision was markedly different. Total survey time for the 6-tree plots in this example was 57% of the time for plots following the Guidelines, which implies that the field activity costs would be around 40% lower as well. Table 4 shows that the results are comparable with those of similar studies reported in published literature.

Table 3: Summary of the results from the two sampling methods

| **Parameter** | **CF Guidelines** | **6-tree method** |
|---|---|---|
| Number of plots | 4 | 10 |
| Average plot size (ha) | 0.25 | 0.15 |
| Sample fraction for trees >30 cm | 1.4% | 2.2% |
| Team size | 17 people | 8 people |
| Enumeration time per plot (mins) | 53.8 | 14.0 |
| Enumeration time per plot (person-mins) | 914 (+/- 32%) | 112 (+/- 21%) |
| ***Total enumeration time (person-mins)*** | ***3655*** | ***1120*** |
| Approx plot-plot travel times (minutes) | 20 | 10 |
| ***Total travel time (person-mins)*** | ***1360*** | ***800*** |
| ***Time to collect DHR data (person-mins)*** | ***0*** | ***960*** |
| **Grand total survey time** | **5015** | **2880** |
| ***General information*** | | |
| Trees/ha | 304 | 387 |
| Basal area ($m^2$/ha) | 14.1 | 15.2 |
| ***Carbon stock (tC/ha)*** | | |
| Trees >10 cm | 69.7 | 68.7 |
| Saplings | 0.2 | 0.1 |
| Bamboo | 0.0 | 0.0 |
| Standing Dead Wood | 0.2 | 0.7 |
| Lying Dead Wood | 2.1 | 5.6 |
| **Total above ground carbon** | **75.5** | **72.2** |
| Precision for total carbon (95% conf. int.) | +/-26% | +/-23% |
| ***Timber stock (>30 cm DBH)*** | | |
| **$m^3$/ha** | **54.6** | **39.4** |
| Precision for total stock (95% conf. int.) | +/- 31% | +/-46% |
| ***Timber stock (10-29 cm DBH)*** | | |
| **$m^3$/ha** | **36.7** | **54.7** |
| Precision for total stock (95% conf. int.) | +/- 31% | +/- 26% |
| ***Timber stock (all trees)*** | | |
| **$m^3$/ha** | **91.3** | **94.1** |
| Precision for total stock (95% conf. int.) | +/- 28% | +/- 23% |

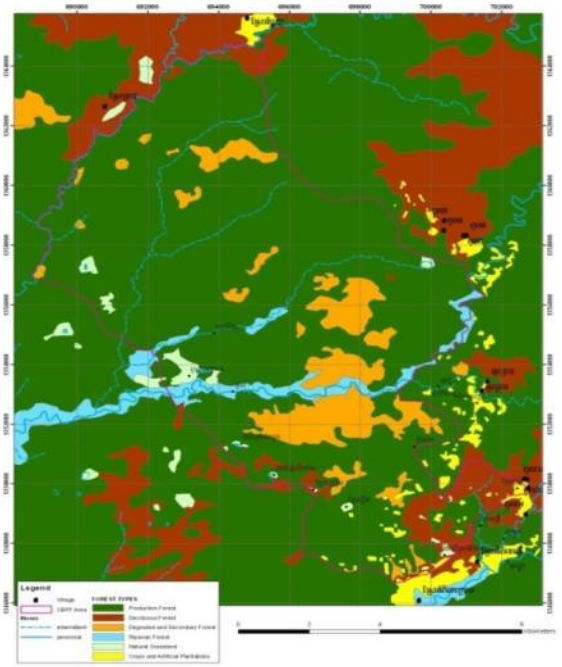
Table 4. Comparison with carbon stocks in other deciduous forests

| Source | Location | Above ground C stocks (tC/ha) | Notes |
|---|---|---|---|
| Current study | SPF Buffer Zone | 72-75 | khlong, chhlik & pchek dominant |
| Khun Vathana (2010) | SPF Buffer Zone | 73.8+/- 8.6 (SE) | Same forest patch |
| IPCC (2003) | Tier 1 Default values, tropical dry DF | 65 (range 50-80) | |
| WCS/FA unpublished data | SPF Core Area (all DF) | 115.3 +/- 10.0 (SE) | DF types include many taller stands with species on richer soils other than current study |

### *Mapping*

A land use / land cover (LU/LC) study of the CBPF area was carried out during June-August 2011. A LU/LC map was obtained by means of visual interpretation of satellite images and aerial photos, using as reference data existing forest maps and ground truthing information obtained in the field (Map 3). The objective of the study was to determine the relevance of the existing national forest cover maps to this site and to provide updated LU/LC data, as a necessary preliminary step for the management of the CBPF. Starting from September 2011, meetings were held in the villages of the CBPF to conduct participatory mapping activities with the communities. The main objectives were to discuss the local classification for the different vegetation types and to let the communities understand and comment on the draft map being produced for the CBPF Management Plan.

Map 3: Final Land Use/Land Cover map of CBPF



### *Reflection*

From an action learning perspective, the project has achieved its objective: the project demonstrated approaches to engage communities in forest carbon stock estimations and monitoring. Capacity building in this context is a process, and community understanding will increase as the project develops and as people gain more experience in participating in different aspects of the work. Where individuals find it difficult to grasp the complexity and meaning of biomass assessment at the beginning of the project because carbon is a new commodity, their

understanding grows as they become more familiar with the project and with the potential value-added of biomass assessment and monitoring for the development of their livelihoods.

### 3.1.2 Indonesia

***Overview***

The action research in Indonesia ran from 2010 through to 2014 and was co-financed by the Ministry of Environment of Japan. The National Forestry Council of Indonesia provided the overall direction and guidance for the research, while field level activities were conducted by ARuPA, an Indonesian NGO with expertise in community forestry. Key activities in the first year of the research were (i) identifying suitable sites for the action research, (ii) conducting consultations with key stakeholders, (iii) designing the initial CBFBM process, (iv) conducting training of trainers and training of communities, and (v) processing the data. In the second year, the action research focused on (i) further capacity building and re-measurement at one of the villages, (ii) introducing the project to another village, and (iii) a workshop in Gunung Kidul district. In Year 3, the major activities were (i) integrating CBFBM into the villages' institutional setting, (ii) adaptation of inventory tools to be more practical for community members, (iii) a socio-economic household survey to establish a baseline for REDD+, and (iv) a regional workshop. In the final year, the key objectives of the action research were to maximise the value of the CBFBM activities undertaken. The main activities were (i) re-measurement of forest carbon stock in Semoyo Village and Terong Village, (ii) publication of lessons learned and a module for organising CBFBM programmes, (iii) bringing CBFBM into national policy dialogues, and (iv) completion of the REDD+ socio-economic baseline survey.

***Selection of research sites***

The determination of research sites was not straightforward. Two forest types were initially considered for the research: (1) private forest consisting of plantations with some agricultural crops, (2) state-owned forestland consisting of natural forest. These considerations directed the research team to initially select the districts of Gunung Kidul in the province of Yogyakarta, Wonosobo in the province of Central Java, and Musi Banyuasin in the province of South Sumatra. Consultations with local authorities were conducted through a series of meetings with the Heads of the respective Forestry Offices. Consultations with the District Forestry Office, DKN's local partner ARuPA and the community, led to the selection of Semoyo Village in Java as one of the action research sites. The research was expanded to Terong Village, which is next to Semoyo, in Year 2 of the project, after consultations with the Village Head and several other village leaders. The forest types covered by the action research were thus those present in these two villages, namely home gardens and dryland woodlots.

***Capacity building***

Training modules were developed to guide the trainings. These covered awareness-raising on sustainable forest management; legal frameworks for forest management and timber trading, climate change and forests, and monitoring principles; training in technical components of tree measurement (setting up a sampling plot, measuring DBH and tree height, and recording data); and data management using MS Excel. The training began with a ToT, in which both local male and female leaders participated. The local people who had participated in the ToT then went on to conduct the training for all the farmers involved in the monitoring.

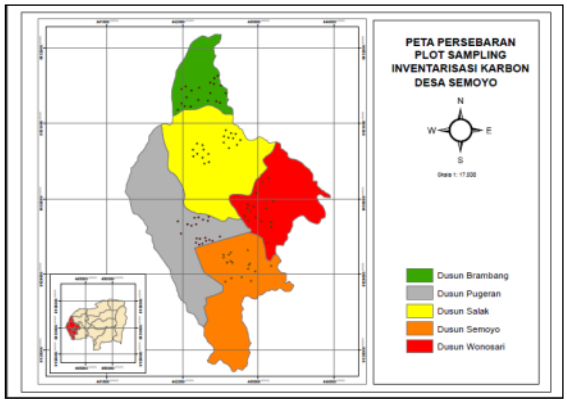
***Forest sampling***

The sampling design was formulated by researchers and field facilitators through the following steps:

- **Determination of sampling frame;**
- **Stratification of sampling units;**
- **Determination of variables to be measured;**
- **Determination of sample plot shape;**
- **Determination of number of sample plots;**
- **Packaging the protocols and methods into a field manual (in Bahasa Indonesia).**

100 permanent sample plots (PSPs) were established in Semoyo and 180 in Terong in both dryland woodlots and home gardens. The sampling unit was determined as a unit of land owned by community members. The units for sampling were determined by random numbers. In Semoyo, there are five sub-villages. Map 4 identifies the allocation of the 20 sampling units allocated to each sub-village.

Map 4: Location of permanent sample plots in Semoyo Village




There were several sub-types of tree spatial patterns according to land use and the dispersion of trees: dryland with trees in clusters, dryland with trees at boundaries, home gardens with trees in clusters, and home gardens with trees at borders. For the clustered tree distribution type, the plot used is square with dimensions of 20 x 20 m for both dryland forests and home gardens, while for trees that are spatially distributed along the border of land units, trees are selected and measured across alternate 10 metre intervals.

The carbon pools sampled were: trees (above ground woody biomass), litter, and above ground non-woody biomass (banana, grass, other herbal plants, food crops). During the training it was found that the complexity of measuring the non-woody carbon pool would not be understood by the community within the first year of the action research. It was thus decided that the measurement of the non-tree carbon pools would be left until a later date.

The parameters measured were DBH, total tree height and thickness of the litter. The measurement, demarcation and measurement equipment used were: tape measure, Haga Meter, Christen hypsometer, plastic line, wooden stick for plot border marking, GPS, tally sheet and notepad. Field measurements were recorded in pre-designed tally sheets. Christen hypsometers were introduced to estimate tree height as they are better matched with community capacities than more

sophisticated and expensive instruments. The Christen hypsometers were produced locally at an affordable price of USD 2.50 per unit. By the end of 2012, Semoyo Village had produced 200 Christen hypsometers (Photos 15 and 16).

Photo 15: ARuPA forester instructing female village leader on the use of a Christen hypsometer

Photo 16: Local manufacture of Christen hypsometer

Research assistants were assigned to supervise the filling of the tally sheets by the community members. Field data were then entered into an MS Excel spreadsheet. Species specific allometric equations were used to estimate biomass from the field measurements. These can be found in Scheyvens et al. (2014, p. 75).

The estimated biomass stocks in Semoyo and Terong community forests are presented in tables 4 and 5. Figures 5 and 6 shows that the carbon stocks in the home gardens and dryland woodlots increased year-by-year since the monitoring began in 2010.

Table 4: Biomass and carbon stocks of Semoyo Community Forest, 2013

| Species | Home garden (kg) | Dryland (kg) |
|---|---|---|
| teak | 49,687.8 | 42,554.5 |
| mahogany | 52,275.9 | 46,493.8 |
| acacia | 3,386.8 | 6,553.2 |
| sonokeling | 22,459.5 | 34,250.3 |
| sengon | 1,400.1 | 3,516.0 |
| **Total biomass** | **129,210.1** | **133,367.9** |
| **tC/ha** | **32.302** | **33.342 tC/ha** |

Table 5: Carbon stocks of the Terong Community Forest, 2013

| Forest type | Total Biomass (ton) | Biomass per ha (ton) | Carbon/ha (ton) |
|---|---|---|---|
| Home garden | 361.47 | 132.41 | **66.20** |
| Dryland woodlot | 266.76 | 89.52 | **44.76** |

Figure 5: Carbon stocks of the Community Forest in Semoyo Village, 2010-2013

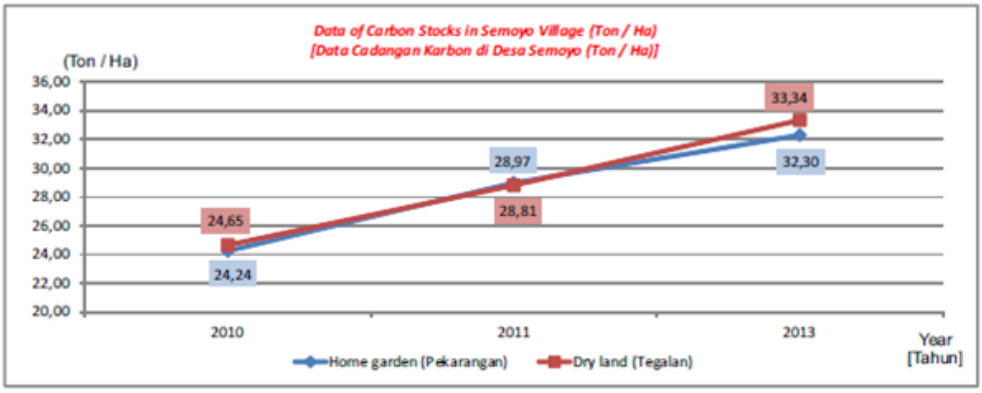
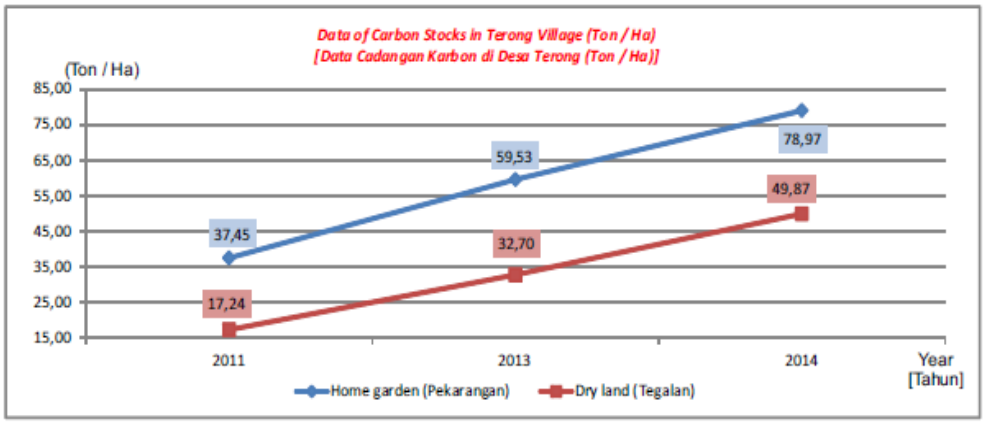



Figure 6: Carbon stocks of the Community Forestry in Terong Village, 2011-2014




***Community REDD+ PDD***

A ToT for the development of a community-based REDD+ project design document (PDD) was conducted in October 2012. This ToT aimed to (i) enable participants to understand in detail what a REDD+ project is and become owners and managers of future REDD+ activities, (ii) build knowledge on PDD elements, and (iii) build competencies in understanding application of a carbon standard (the Climate, Community and Biodiversity (CCB) Standards were selected). The ToT was followed up with support to each village to prepare the PDD. Household surveys were conducted in Semoyo Village on the relative importance of different productive activities for the villagers in order to establish a socio-economic baseline for the PDD. The support for community-based REDD+ PDD development and progress is summarised in Table 6. PDD preparation turned out to be the most challenging activity under the action research for community members.

Table 6: Activities and progress on community-based REDD+ PDD

| Activity | Location | Progress |
|---|---|---|
| Dissemination & internalisation | Semoyo | *Members of Semoyo & Terong acquired basic knowledge on PDDs & are actively contributing to work on the PDD. |
| Training on preparation | Semoyo | *Completed. Key persons in the community forest organisations contributed to preparation of the PDD. |
| Collection of data & information required | Relevant locations | *Required data for Semoyo collected & analysed. |
| | | *Supporting data from neighbouring villages collected. |
| | | *Some secondary data from district & province offices still to be collected. |
| Focus group discussions | Gunung Kidul | *Focus group discussions carried out. |

| | | |
|---|---|---|
| | District & Semoyo Village | *Another focus group discussion needed for completion of PDD. |
| Farmer group meetings | Semoyo | *Organised monthly. |
| Drafting | Semoyo | *Part I & Part II completed.<br>*Two parts left to be written. |
| Monitoring on preparation | Semoyo | *5 meetings with ARuPA at Yogyakarta & Semarang.<br>*6 meetings organised at Semoyo on progress of PDD preparation. |

***Dissemination and outreach, including introducing CBFBM into regional and national policy dialogues on sustainable forest management and REDD+***

As evidence of the strengths of an action research approach, both Semoyo and Terong leaders developed a strong sense of ownership for the CBFBM in their villages. The leaders used village radio to share lessons from their biomass monitoring activities, and monthly women's group meetings to raise awareness on climate change and encourage more women to be involved in the CBFBM.

A leaflet on CBFBM in English and Bahasa Indonesia was created and distributed at forestry events at local and national levels to promote the concept (Fig. 7). A training module on CBFBM in Bahasa Indonesia was also created to facilitate adoption of the concept in other localities (Fig. 8.). A video was produced to promote CBFBM in Indonesia and has been linked to action research project webpage (http://www.iges.or.jp/en/natural-resource/forest/activity_CBFBM.html).

Figure 7: Illustration of CBFBM leaflet


Local workshops with the project communities were held as part of the action research. Workshops were also organised at district level to ensure government departments were engaged and that the CBFBM concept was widely discussed and supported (Photo 17).

Figure 8: Module for organizing CBFBM programmes (top page and 1 technical page shown)

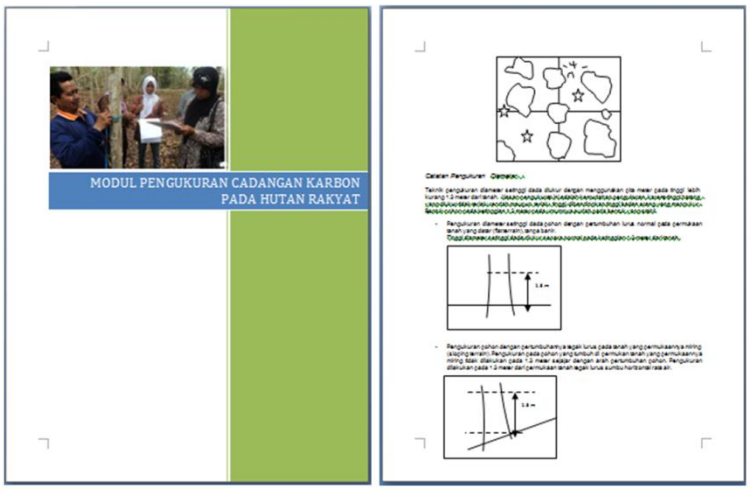



Photo 17: Presentation on community-based forest monitoring to Gunung Kidul forestry office, Java, Indonesia

In 2013 and 2014, the following activities were undertaken to promote the CBFBM concept through subnational and national policy dialogue events:

- **One 3-hour session was allocated to discussion on CBFBM at National Meeting for National Forestry Council of Indonesia (DKN) Academician Chamber and Forest Management Unit Coaches in 2013. The Chairperson of Semoyo Farmer Groups was the sole speaker for this session.**
- **CBFBM was discussed at the 2013 DKN Annual Meeting.**
- **CBFBM was discussed at a session of Regional III Training workshop at Banjarmasin, South Kalimantan.**
- **CBFBM action research lessons were discussed at the National Meeting of Academicians and Civil Society Organizations Supporting the Development of Forest Management Units, October 2014. Three local action research participants took part in the event.**
- **The issue of forest carbon management was introduced to the Indonesia Ecolabeling Institute (LEI) Congress in October 2014. LEI subsequently included the development of forest carbon certification in its 5-year programme.**
- **Semoyo Village hosted a field trip of the first REDD+ Academy Training course conducted by UNORCI (United Nations Office for REDD+ Coordination in Indonesia) on 1-2 November 2014. The action research village members in Semoyo explained the objective of monitoring and demonstrated how they measure forest carbon.**

***Reflection***

Key achievements of the CBFBM action research were the development of approaches for community participation in monitoring planted forests in the region and the training modules to provide a systematic training course for community members. By providing a more accurate understanding of timber stocks and tree growth, CBFBM has the potential to encourage communities to strengthen their forest management. Local forestry officers have found CBFBM beneficial for strengthening community forest management and for supporting local forest information systems.

However, forest management by local people is often exposed to financial stress. Monitoring activities and the information generated need to be beneficial to the communities, such as by adding value to their products, generating payments for REDD+ or other environmental services, etc. For scaling up, it is critical to identify how CBFBM can be linked with the national forest monitoring system in a way that generates clear benefits for the participating communities.

### 3.1.3 Laos

***Overview***

The Faculty of Forestry, National University of Laos (NUOL) and IGES jointly implemented the CBFBM action research project in Sangthong District, Vientiane Municipality, Laos. The action research was launched in 2011 in four villages – Ban. Napor, Ban. Kouay, Ban. Xor and Ban. Nongbua. The research site is near the Training Model Forest (TMF) of the National University of Laos Faculty of Forestry, which is located along the Mekong plain about 80 km northwest of Vientiane (Map 5). The major land use systems in the area are unstocked forestland, forests and various agricultural land uses such as rice paddy, pasture, upland cultivation and agroforestry. Mixed deciduous forest is the dominant forest type, and is now characterised by the rampant occurrence of bamboo in the understory and a low abundance of the high-value commercial tree species. The total land area of the four participating communities is about 19,76.52 ha and the total area of forest is about 9,788.40 ha (Table 7).

***Year 1 activities***

In the first year of the action research, project activities focused on capacity building of the research team, the local authority and community. A training workshop was conducted on forest carbon for NUOL researchers at the Faculty of Forestry. A socio-economic baseline survey was designed and information was collected on features of the research site, perceptions of the communities towards climate change and its impacts on their livelihoods, and forest resource management in the target communities. Some of the outputs of the survey are presented in Fig. 9. The NUOL research team conducted consultation meetings with the district and village authorities, and through the action research villages were selected through this process. The NUOL research team carried out a training workshop for the district staff and the community members, which covered a range of topics including the cause of deforestation and forest degradation in Laos; the concept of REDD+; the current status of the REDD+ programme in Laos; forest inventory techniques; understanding forest

and land use cover types from satellite images and maps; designing of sample plot layout; and tree measurement techniques.

Map 5: Location of the 4 action research villages

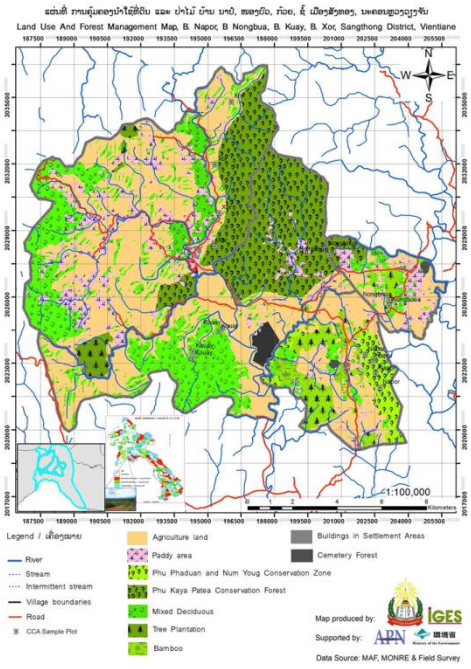


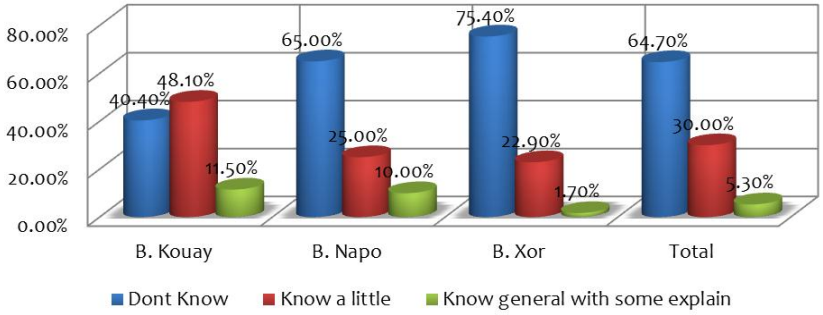

Table 7: Forestland in the participating communities

| No | Village | Total land (ha) | Forest land (ha) | Percentage |
|---|---|---|---|---|
| 1 | Napor | 2,830.00 | 1,521.55 | 53.77% |
| 2 | Kouay | 6,537.56 | 3,945.30 | 60.35% |
| 3 | Nongbua | 1,343.29 | 487.72 | 36.31% |
| 4 | Xor | 9,051.67 | 3,833.83 | 42.35% |
| **Total** | | **19,762.52** | **9,788.40** | **49.53%** |

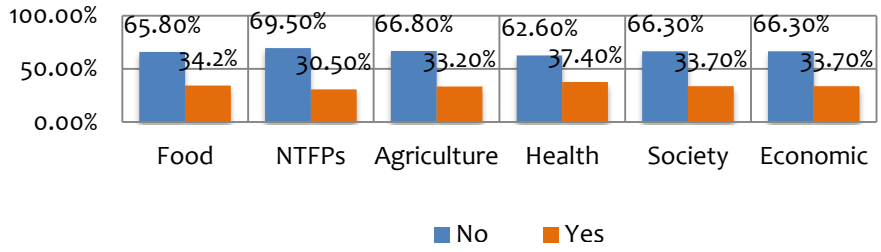
Note: Source data is from GIS database (2014).

Figure 9: Selected outputs of the socio-economic baseline survey

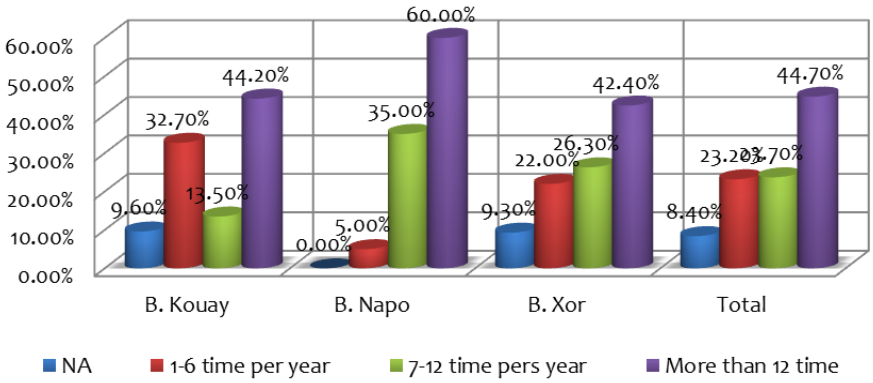
*Level of understanding on climate change*




*Perception on climate change impact*




*Frequency villagers visit the forest*




***Year 2 activities***

In the second year, the social-economic baseline dataset was finalized; training materials and a field guide for the communities were developed; awareness and training for the community on forest biomass inventory were conducted; community forest biomass inventory teams were established; with the support of the university staff, the community teams carried out a ground survey, established sample plots and conducted tree measurements; and the field survey data were analysed.

In total, 16 PSPs were established by the community teams. Each team established four PSPs in their community forest area. In the project area mixed deciduous forest is dominant. Of the 16 PSPs established, 13 are located in primary mixed deciduous forest and three in secondary mixed

deciduous forest. As this was the first experience of the community with biomass sampling, the sampling was limited to above ground living woody biomass.

The sample plots were randomly distributed according to different forest types, accessibility, and terrain. Square 50 x 50 m nested plots, with sub-plots of 20 x 20 m, 10 x 10 m, and 2 x 2 m were used. Plastic poles were placed in the centre of the plots and their location marked with GPS. Every external and internal corner of the main and sub-plots were marked by bamboo and wooden pickets. Team members measured distance with metre tapes and marked out all the internal and external boundary of sample plots with string tapes. Within the 50 x 50 m plots, trees with DBH ≥30 cm were measured; in 20 x 20 m plots, trees with DBH 10-29 cm were measured; in 20 x 20 m plots, saplings (DBH 5-9 cm) and bamboo and NTFPs were counted; and in 2 x 2 m plots, seedlings were counted. All measured trees were tagged using metal labels with tree code numbers inscribed on them. On average, it took around three hours to establish and measure each sample plot. The community teams identified all tree species in the inventory plots using their local names and these were later converted to their scientific names by the NUOL team. These could be the first community teams in Laos to have been trained on and have carried out sample plot establishment, surveying, and data recording for forest biomass measurement.

All data recorded by the community from the field measurement was transferred to a structured MS Excel spreadsheet. The data includes date, time, crew members, location of the plots, forest condition, species, tree height, DBH, etc.

A total of 490 trees were measured and among these trees 80 species were identified with their local names. Only two species were not identified. The major tree species found were *Hopea ferrea, Ivingia sp., Sandoricum sp., Parashorea spp., Litchi chinensis, Gratexylon pruniferium, Diospyros sp.,* and *Walsura angulata Craib.* The tree crown cover ranges between 45 to 90%. The average height of trees with DBH ≥30 cm is 28.17 m, for DBH 10-29 cm, 13.49 m, and for DBH 5-9 cm, 6.13 m. The mean DBH in the different plot areas, from largest to smallest, was 51 cm, 16 cm, and 7 cm respectively. Bole volume, total stem volume and form factor volume equations were applied to estimate the volume of the trees. The equations can be found in Scheyvens et al. (2014, p. 92). The results of the sampling and carbon stock estimates are presented in tables 8 and 9.

Table 8: Preliminary descriptive result of sampling

| Description | Plot size | | |
|---|---|---|---|
| | 50x50m | 20x20m | 10x10m |
| Area of one plot ($m^2$) | 2,500 | 400 | 100 |
| Total sampling area (16 plots) ($m^2$) | 40,000 | 6,400 | 1,600 |
| No. trees | 264 | 169 | 57 |
| Average Height (m) | 28.17 | 13.49 | 6.31 |
| StdDev Height (m) | 21.54 | 4.84 | 2.39 |
| Average DBH (cm) | 51.08 | 16.13 | 7.03 |
| StdDev DBH (cm) | 23.57 | 5.26 | 1.40 |
| Bole volume ($m^3$/ha) | 318.44 | 60.80 | - |
| Total stem volume ($m^3$/ha) | 233.64 | 48.38 | 4.40 |
| StdDev total stem volume ($m^3$/ha) | 2.08 | 0.31 | 0.07 |
| Total volume form factor ($m^3$/ha) | 332.71 | 57.42 | 6.25 |

Table 9: Preliminary result of tree carbon stock estimation

| Plot size | Equation 1 | Equation 2 | Equation 3 |
|---|---|---|---|

| AG Tree Biomass (t/ha) | | | |
|---|---|---|---|
| 10x10m | 2.14 | 3.94 | 4.18 |
| 20x20m | 17.15 | 20.32 | 17.41 |
| 50x50m | 121.43 | 75.68 | 47.80 |
| Average | 103.55 | 65.91 | 42.29 |
| StdDev | 0.61 | 0.28 | 0.15 |
| AG Tree Carbon (tC/ha) | | | |
| 10x10m | 1.07 | 1.97 | 2.09 |
| 20x20m | 8.58 | 10.16 | 8.70 |
| 50x50m | 60.72 | 37.84 | 23.90 |
| Average | 51.78 | 32.95 | 21.15 |
| StdDev | 0.31 | 0.14 | 0.08 |
| AG Tree Carbon (tCO2/ha) | | | |
| 10x10m | 3.92 | 7.23 | 7.67 |
| 20x20m | 31.45 | 37.25 | 31.91 |
| 50x50m | 222.63 | 138.75 | 87.63 |
| Average | 189.85 | 120.83 | 77.54 |
| StdDev | 1.12 | 0.52 | 0.28 |

Progress was also made on land use mapping. The boundaries of villages and other spatial data were added from topographical and other maps, as well as information provided by members of village organisations. A ground-survey was conducted by a team of researchers and some of the village members. GPS was used to mark locations, including the boundaries of land use classes. Through this process, preliminary village land use maps of all four villages were produced. These were printed out and then checked together with the heads of the villages and other villagers. The maps were then revised reflecting feedback from the community members. Map 6 provides an example of one of the village land use maps.

***Year 3 activities***

In the third year of the action research, efforts focused on verifying community capacities for forest sampling using various tools and approaches, and analyzing historical forest and land use change in the research area. For the testing, community members (total of 32) were divided into five teams that had not received prior training on CBFBM and one team that had. The average age of the team members was similar. All teams were comprised of men, except for Team 1, which was comprised of women. Most of the team members had completed schooling at primary or secondary school level.

The CBFBM training covered the establishment of two types of sample plots, methods for measuring DBH and height, and the use of measurement instruments including DBH tapes, calipers, SUNNTO clinometers, and Blume Leiss hypsometers. During the training, four trees were selected as a sample for DBH and height measurement. All participants measured all four trees using different instruments and recorded the results, which were then collected by the trainers. The results are presented in Tables 10 and 11.

Map 6: Napor Village land use map

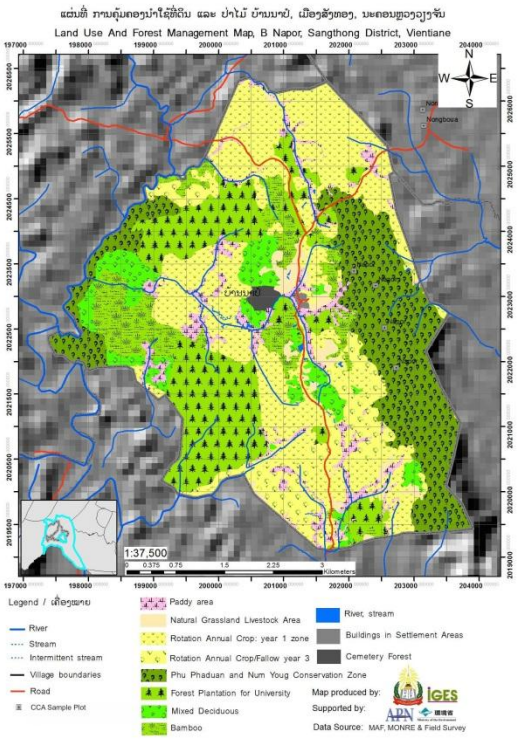



Table 11: Average DBH measured by community members and trainers (cm)

| Tree | Tools use | Team1 | Team2 | Team3 | Team4 | Team5 | Average 5 team | Trainer |
|---|---|---|---|---|---|---|---|---|
| **No.1** | DBH Tape | 24.68 | 24.90 | 25.77 | 23.88 | 24.38 | 24.72 | 24.9 |
| **No.2** | DBH Tape | 50.29 | 51.83 | 49.80 | 49.92 | 50.25 | 50.41 | 49.8 |
| **No.3** | Caliper | 34.93 | 34.08 | 37.13 | 35.90 | 40.33 | 36.38 | 40.2 |
| **No.4** | Caliper | 26.51 | 26.49 | 26.43 | 26.62 | 26.28 | 26.47 | 26.5 |

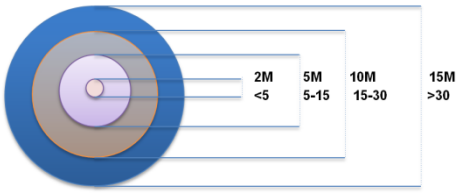
Table 12: Average tree height measured by community members and trainers (m)

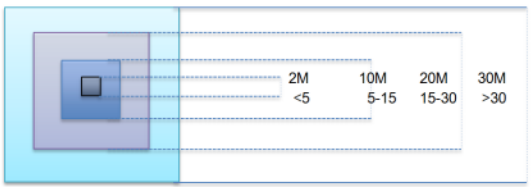
| Tree | Tools use | Team1 | Team2 | Team3 | Team4 | Team5 | Average 5 teams | Trainer |
|---|---|---|---|---|---|---|---|---|
| **No.1** | Blume Leiss | 11.16 | 11.95 | 13.17 | 12.17 | 12.17 | 12.06 | 12 |
| **No.2** | SUNNTO | 18.75 | 20.25 | 20.50 | 21.50 | 16.83 | 19.52 | 17 |
| **No.3** | Blume Leiss | 16.09 | 15.08 | 17.67 | 15.30 | 14.33 | 15.72 | 15 |
| **No.4** | SUNNTO | 16.00 | 16.33 | 14.57 | 13.67 | 16.42 | 15.43 | 13 |

Testing was then conducted in the field. NUOL staff and community members who had previously been trained on CBFBM set up two nested circular and two nested square sample plots, as depicted in Fig. 10.

Figure 10: Plot dimensions used for the testing

Circular plot Square plot




All four sample plots were inventoried by every team. The results are presented in Tables 13 and 14. The differences in the measurements by community members less and more experienced in forest inventory are small.

Table 13: Preliminary result of the sample plots inventory by community team

| Description | Circular Plot (C), Radius (m) | | | Total |
|---|---|---|---|---|
| | 15 m | 10 m | 5 m | |
| Area of one plot ($m^2$) | 706.86 | 314.16 | 78.54 | - |
| Total sampling area (2 plots) ($m^2$) | 1,413.72 | 628.32 | 157.08 | 2,199.12 |
| Number of tree (total) (C1, C2) | 7 (4, 3) | 15 (8, 7) | 19 (14, 5) | 41 (26, 15) |
| Average Height (m) | 20.07 | 15.09 | 7.25 | - |
| StdDev of Height [m] | 1.14 | 1.16 | 1.06 | - |
| Average DBH (Cm) | 44.73 | 19.61 | 8.48 | - |
| StdDev of DBH (Cm) | 0.31 | 0.30 | 0.05 | - |
| **Description** | **Square Plot (S) (m)** | | | **Total** |
| | **30x30 m** | **20x20 m** | **10x10 m** | |
| Area of one plot (m2) | 900 | 400 | 100 | - |
| Total sampling area (2 plots) (m2) | 1,800 | 800 | 200 | 2,800 |
| Number of tree (total) (S1, S2) | 9 (4, 5) | 8 (5, 3) | 20 (10, 10) | 37 (19, 18) |
| Average Height (m) | 20.91 | 11.96 | 8.36 | - |
| StdDev of Height (m) | 1.01 | 1.93 | 0.31 | - |
| Average DBH (Cm) | 47.46 | 19.69 | 9.32 | - |
| StdDev of DBH (Cm) | 0.49 | 0.62 | 0.17 | - |

Table 14: Average tree DBH and height (H) of all 4 sample plots

| Tree Stem DBH | | Team1 | Team2 | Team3 | Team4 | Team5 | Mean (StdDev) |
|---|---|---|---|---|---|---|---|
| >30 Cm | DBH (cm) | 46.10 | 45.99 | 45.88 | 45.79 | 46.71 | 46.09 (0.32) |
| | H (m) | 19.26 | 20.59 | 21.21 | 21.41 | 20.40 | 20.49 (0.81) |
| >15-30 Cm | DBH (cm) | 19.63 | 20.52 | 19.25 | 19.34 | 19.46 | 19.64 (0.45) |
| | H (m) | 13.02 | 11.60 | 14.44 | 14.50 | 14.24 | 13.53 (1.11) |
| >5-15 Cm | DBH (cm) | 9.04 | 8.86 | 8.85 | 8.75 | 8.97 | 8.90 (0.12) |
| | H (m) | 7.28 | 6.96 | 8.78 | 8.01 | 8.20 | 7.81 (0.66) |

Remark: Team 5 carried out the inventory under guidance by trainers.

In addition to the forest inventory research, further progress was made with the thematic mapping. The research team collected further information on the land tenure boundaries of the participating communities, such as land and forest being used and managed by government organizations, the university, village organizations and local households. With this information, new maps of forest and land use tenure and historical change are being developed (Fig. 11).

Figure 11: Mapping activities

***Reflection***

The community teams participated actively in the training and can now conduct sample plot inventory to estimate tree biomass using two types of plots and technical equipment such as Blume Leiss hypsometer, SUNNTO clinometer, caliper and DBH tapes, with the same competency as the trainers. A simple field guideline in local language with easy-to-follow instructions was developed and proved essential to the training.

Benefits of the action research include (i) enhanced networking between university staff, local organizations and the communities, (ii) improved understanding of the communities of their land use through the mapping exercises and products, (iii) increased capacity of the university researchers to promote and facilitate CBFBM across Laos, and (iv) opportunities to share the CBFBM action research experience in Laos with other countries, as well as learn from the CBFBM action research by other project collaborators.

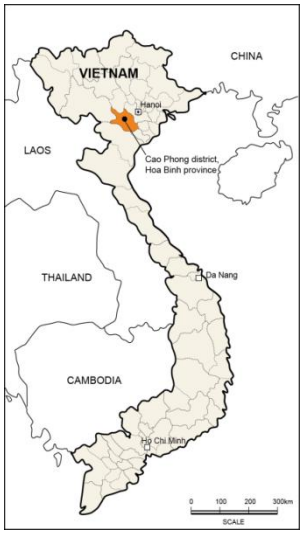
### 3.1.4 Vietnam

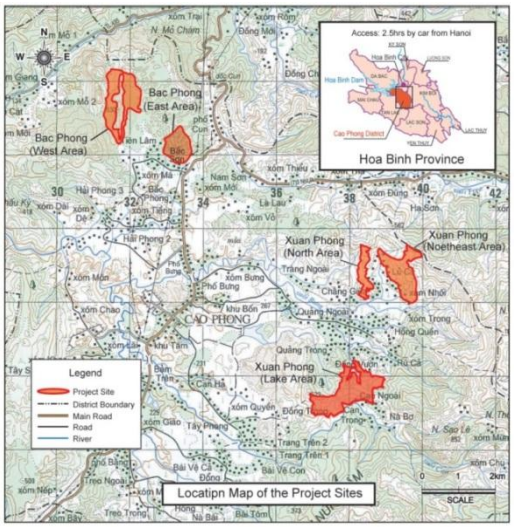
***Overview***

IGES and Vietnam Forestry University (VFU) launched the CBFBM action research project in Vietnam in 2012. The concept of CBFBM was developed and tested with selected villages in Cao Phong district, Hoa Binh province (Map 7). The action research area includes plantations established under a small-scale Afforestation/Reforestation Clean Development Mechanism (A/R CDM) project. The A/R CDM project was registered under the UNFCCC in 2009 and developed by VFU with support from the Japan International Cooperation Agency. The A/R CDM project works with Xuan Phong and Bac Phong communes. Ethnic minority villages participate in the project and more than 200 households are involved. The site is separated into five areas (Map 8).

Map 7: Project location

Map 8: Project site




***Workshops***

In FY2012, CBFBM action research was launched with Ru 3 Village, which is one of the 11 villages participating in the A/R CDM project. Two workshops were held as a series of IGES-VFU-RECOFTC workshops on community participation in forestry in Vietnam. The workshops were highly interactive and not the typical classroom lecture style of workshop. The participants were engaged through numerous experiential exercises. The first workshop focused on the concept and value of participation, while the second workshop focused on practical application of the concept of participation in social research and participatory action research (PAR). The concept of participation was found to be challenging for the participants as they are highly educated and have a strong sense of responsibility to lead and provide direction to the local communities.

A ToT for the CBFBM was held over five days from October 22-26, 2012 at Vietnam Forestry University. Training was provided by IGES researchers. Six VFU researchers/teachers and two officers from local government in Cao Phong District participated. On Day 1, the IGES researchers introduced the concept of community-based forest monitoring and existing standards and guidance for forest biomass assessment. Days 2 and 3 were allocated to group work. Test training with about 15 participants from Ru 3 Village too place on Day 4. The VFU team played the role of trainers and facilitators. The testing began with discussion on the importance of good forest management. The VFU team explained how CBFBM could be applied to the reforestation project and the objectives of the test training. The remainder of the morning was spent testing teaching methods and options for DBH and tree height measurements. 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 facilitators provided guidance and observed both groups as they established the plots and measured trees. The facilitators also recorded the times taken for different plot types (Photos 18 and 19).

Photo 18: VFU facilitators explaining point of

Photo 19: VFU facilitator observing community

measure for DBH

member measuring DBH

The “Participatory Action Research for Community Based Natural Resource Management workshop” was held on 22-26 July, 2013 at VFU. Two trainers were provided by RECOFTC. Sixteen researchers and students of VFU and five local government forestry officers participated in the workshop. On Day 1, the participants learned the fundamentals of action research through group work. On Day 2, the participants were involved in an exercise to show that everyone has different ways of determining his/her values and they learned the importance of considering multiple perspectives. On Day 3, the participants prepared for field work. They were divided into four groups and each group prepared a research plan for the village. They started with identifying a problem to be addressed and key information to be collected to resolve the problem. They then selected suitable PAR tools. The following day, each group carried out their research plan with a community involved in the A/R CDM project and tested the PAR tools. The last day of the workshop was used for field work reflection.

The workshop “Seeking for possibility of applying Community Monitoring in Payment for Forest Ecosystem Services (PFES)” was held on February 28, 2014 at the Department of Forestry (DOF), Hoa Binh province. Participants from IGES and VFU and officers of Hoa Binh province attended the workshop. The purpose of the workshop was to (i) disseminate information on the action research project, (ii) discuss the new policy on PFES in Vietnam and the research and activities that VFU had conducted related to PFES, and (iii) consider the possibility of applying community-based monitoring in PFES. There was general agreement on the benefits of community-based monitoring to PFES, but where and how questions could not be answered. Further surveys and dialogue to gather more detailed information and a clear understanding on the relevant issues were proposed.

***Manual development, testing and results***

The VFU team developed a CBFBM manual in Vietnamese (Fig. 12). The manual includes information for facilitators and instruction materials for the community to help them understand how to use the inventory tools. Step-by-step technical explanations are provided. The instruction materials can be used by the facilitators during community trainings as well as by the communities when they conduct future monitoring. The manual was tested in the field to check applicability of the technical elements of the manual and the ability of communities to understand the manual. VFU facilitators conducted a 2-day training for community members on manual use, observed their responses, reflected on problems identified and lessons learned, and incorporated these into a second draft of

the manual. VFU facilitators also measured the same sample plots established by the communities to check the accuracy of the tree and slope measurements (Table 15).

Figure 12: Example of pages from the manual

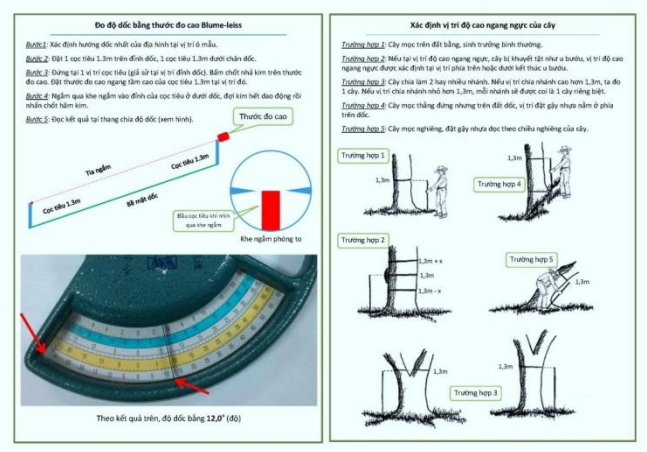



Table 15: Results of measurement by community and experts/facilitators

| | Community | | Expert | | Difference | |
|---|---|---|---|---|---|---|
| | Average DBH | Biomass | Average DBH | Biomass | Average DBH | Biomass |
| | cm | tC/ha | cm | tC/ha | cm | tC/ha |
| Ru3-01 | 8.84 | 7.18 | 8.81 | 7.20 | 0.03 | -0.02 |
| Ru3-02 | 11.09 | 13.11 | 11.17 | 13.55 | -0.08 | -0.43 |
| Ru3-03 | 4.02 | 1.87 | 4.13 | 1.96 | -0.11 | -0.09 |
| Ru4-02 | 8.75 | 15.44 | 8.66 | 15.16 | 0.10 | 0.27 |
| Ru4-03 | 4.92 | 3.92 | 4.80 | 3.73 | 0.13 | 0.18 |
| Ru4-05 | 5.84 | 3.96 | 5.80 | 3.91 | 0.05 | 0.05 |

***Local perceptions on forest management***

A field survey on the environmental benefits of the plantations in the Cao Phong A/R CDM project was conducted with the residents of Nhoi 2 village on February 26 and 27, 2014. The objectives of the field survey were to (i) identify the environmental benefits of the plantations from the perspective of villagers, and (ii) train the VFU researchers to apply the skills they had learned in the "Participatory Action Research for Community Based Natural Resource Management" workshop.

The villagers who took part in this survey were asked to select three sites in the forest with different growing conditions. A field sheet was prepared for the villagers to rate the site condition and take note of their observations during the site visit. The environmental benefits from the plantations identified by the villagers are summarised in Table 16.

***Test planting of indigenous species***

One outcome of the action research activities described above was increased appreciation amongst the local villagers of the values of the planted forests. However, as Acacia is a short-lived species, the villagers expressed interest in planting long-lived indigenous species that would provide long-term benefits. They had in fact planted indigenous species such as *Dracotomelon dupperreanum* and *Chukrasia tabularis* under a government initiative, but survival rates were low and the reasons for

this were never studied. A meeting was held in August 2014 with the heads of the village and this was followed by a field survey of soil conditions. Factors responsible for tree mortality were identified, and included poor, degraded and thin soils, diseases and browsing by cattle. The research team and some of the village heads visited the experimental research stations in Binh Thanh and Thung Nai to study tree selection and planting techniques (Photo 19). Twelve households agreed to participate in the test planting. Six tree species were selected for planting in 21 plots: *Dracontomelon dupperreanum* (one plot), *Canarium album* (three plots), *Canarium nigrum* (nine plots), *Fernandoa brilletii* (four plots), *Madhuca pasquieri* (two plots), and *Pinus massoniana* (two plots). The area of each plot is 1,000 $m^2$ (25x40m). Fifty trees were planted in each plot, with the exception of *Pinus massoniana* (165 trees per plot). Surveys after the planting recorded a high survival rate and generally good health of the trees (Table 17).

Table 16: Villagers perceptions of environmental benefits from their plantations

| Environmental benefit | Observations |
|---|---|
| Drinking water | *Water became clearer<br>*Water level of the stream became higher and stable |
| Irrigation water | *Water level became higher and stable<br>*Irrigation water not much affected as water source is outside of the plantation |
| Soil | *Soil erosion decreased<br>*Soil fertility increased<br>*Soil moisture increased<br>*Even in the bad condition sites, soil quality improved |
| Biodiversity | *More birds and insects in the plantation area than before<br>*Wild fowl appeared |
| Others | *More fuel wood available<br>*Provides shade; good when doing work outside<br>* Air feels fresher<br>* Psychological benefit from more attractive landscape than bare land |

Photo 19: Delegation of research group at the Centre for Experimental Research in Binh Thanh, Cao Phong

Photo 20: Participants receiving guidance on planting techniques

***Monitoring***

To manage forest, local people need to know how many trees are in their forests, the name of trees, the volume of each tree in the forest and other information. Based on this information, local people can know the quality of their forest, forest development as well as the economic and environmental values of their forest. To monitor their forests, all participants were trained on setting up rectangular 1,000 $m^2$ (25x40m) plots. Information on species, DBH, height, quality, etc. will be recorded for trees with DBH>18 cm. For DBH<18 cm and heights < 4 m, species name, height and quality information

will be recorded. In each plot, a 4 $m^2$ (2x2 m) sub-plot is set up to record names and density of shrubs and other vegetation. The number, names and quality of any bamboos present in the plot will also be recorded. This research is ongoing.

Table 17: Results of tree mortality and health survey, November 2014

| No. | Species | Households | Number of planted trees | Number of surviving trees | Remark |
|---|---|---|---|---|---|
| 1 | *Fernandoa brilletii* | Mr. Kin | 50 | 46 | Two trees destroyed by termites |
| 2 | *Fernandoa brilletii* | Mr. Dung | 50 | 48 | |
| 3 | *Fernandoa brilletii* | Ms. Nich | 50 | 48 | |
| 4 | *Fernandoa brilletii* | Ms. Danh | 50 | 46 | One tree destroyed by termites |
| 5 | *Madhuca pasquieri* | Mr. Dung | 50 | 50 | |
| 6 | *Madhuca pasquieri* | Mr. Van | 50 | 50 | |
| 7 | *Canarium album* | Mr. Dieu | 50 | 46 | |
| 8 | *Canarium album* | Mr. Chuc | 50 | 48 | |
| 9 | *Pinus massoniana* | Mr. Kin | 165 | 156 | Two trees destroyed by termites |
| 10 | *Pinus massoniana* | Mr. Danh | 165 | 154 | |

***Reflection***

A feature of the CBFBM action research in Vietnam was that the project started by building the capacity of the VFU researchers to understand the concept of participation and to act as community facilitators. The ToT workshops enabled the VFU researchers to consider the perspectives of the local villagers when developing the CBFBM training programme. In addition to the CBFBM training, participatory social surveys were conducted and problems related to land use and benefits from the plantations were identified.

Given the current situation of the carbon markets and the project institutional arrangement and its capacity, it seems that securing carbon credits for the A/R CDM project will be difficult. IGES and VFU researchers were concerned that this situation would discourage the community from managing the plantations. However, as a result of the action research communities now realise that the plantations do provide important environmental benefits, such as an improvement in the quality of drinking water. The perspective of the villagers has begun to change towards favouring long-term forest management over short-term unsustainable harvesting.

The action research evolved from a focus on carbon revenues to examine other benefits that the communities could secure from various forest management options. The researchers and communities agreed that it made good sense to trial the planting of indigenous species and this became the focus of the final year of the project. The previous trainings on the concept and techniques of participatory research and on biomass monitoring proved useful for introducing a participatory monitoring component into the indigenous species tree planting programme.

### 3.1.5 Regional reflection workshops

A tremendous amount of data, knowledge and experience was generated from the action research conducted in each of the four project countries. Regional project workshops were held each year to provide an opportunity for the proponent and collaborators to share research approaches, lessons and findings with other interested groups. Each of the workshops included a field study. Table 18 provides descriptive details of each workshop.

Table 18: Regional reflection workshop details

| | Indonesia | Cambodia | Japan |
|---|---|---|---|
| Title | Community Carbon Accounting Reflection Workshop | Regional Reflection and Learning Workshop on Community Carbon Accounting | Community Carbon Accounting Regional Reflection and Manual Development Workshop |
| Dates | 02-03 March 2011 | 17-19 January 2012 | 30 Jan – 01 Feb 2013 |
| Location | Yogjakarta | Mondul Kiri | Hayama |
| Objective | Sharing experiences, lessons and findings; Planning and strategizing | Sharing experiences, lessons and findings; Planning and strategizing | Sharing experiences, lessons and findings; Planning and strategizing; Designing contents of CBFBM manual |
| Format | Presentations by proponent, collaborators and others | Presentations by proponent, collaborators and others; Facilitation to reflect on lessons from field study | Presentations by proponent, collaborators and others; Facilitation for participation in manual design |
| Participants | Total: 20<br>Composition: IGES, RECOFTC (Thailand), Forestry Administration (Cambodia), National Forestry Council of Indonesia, Arupa (Indonesia), FPCD (Papua New Guinea), National<br>University of Laos, and Universitas Gadjah Mada | Total: 20<br>Composition: Representatives of action research projects from five countries (Cambodia, Indonesia, Lao PRD, PNG, and Vietnam), members of the Forestry Administration from Cambodia, project partners at regional and national level | Total 19:<br>Composition: Semi-closed workshop; hence mostly action research participants from all countries plus a few observers |
| Field study details | Visit to UGM forest sample plots and community home gardens and woodlots | Visit to action research site in the buffer zone of Seima Protection Forest, where community members demonstrated the skills they had acquired in setting up and measuring both rectangular and circular sample plots. | Visit to protected forest area |
| |  |  |  |

### 3.2 Publications and development and promotion of general guidance on CBFBM

The results of the action research in each country were analysed and this analysis was published in a number of outputs. These include:

Edwards, K., Scheyvens, H., Stephenson, J., & Fujisaki, T. (2014). Community based forest biomass monitoring: A manual for training local level facilitators (Research Report 2014/3.). Hayama: IGES.

Ibarra, E. G., Scheyvens, H., & Lopez-Casero, F. (2012). Community Forest Management and REDD+: Opportunities and Challenges. In Greening Governance in Asia-Pacific: IGES White Paper IV 2012 (pp. 85–114). Hayama: Institute Global Environmental Strategies.

Scheyvens, H. (2012). Community-based forest monitoring for REDD+: lessons and reflections from the field. IGES - Policy Brief, (22), 10 pp. Retrieved from http://enviroscope.iges.or.jp/modules/envirolib/upload/4124/attach/PB_22_E_final.pdf

Scheyvens, H., Ibarra-Gene, E., Yamanoshita, M., & Hyakumura, K. (2012). Participatory approaches to forest carbon accounting to mitigate climate change, conserve biodiversity and promote sustainable development. APN Science Bulletin, 2012(2).

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A manual on CBFBM and a policy report are the two flagship publications of the project. The development of a manual for CBFBM was set as a major objective for the action research, reflecting the call from UNFCCC Parties to develop “guidance for effective engagement of indigenous peoples and local communities in monitoring and reporting” (Decision 4/CP.15). While the proponent oversaw the development of the manual and drafted many of the sections, the manual reflects the efforts of a large number of people and is extensively informed by the action research experiences in each project country. An expert training manual writer, a community facilitation expert and a professional designer were recruited to assist the proponent in designing the manual. The process that the manual presents for designing and implementing a CBFBM system through a ToT is depicted in Fig. 13. The 200-plus page manual provides guidance on each step of the process.

The need for the Community-Based Forest Biomass Monitoring Training-of-Trainers Manual was clear. The manual has already been used twice since its release in April 2014 by international organisations to design regional CBFBM training workshops – one in Thailand and one in Vietnam (IGES gave permission to RECOFTC – The Centre for People and Forests to translate the manual into Vietnamese). The manual has been downloaded about 20,000 times from the IGES website since its release.

A policy report (100-plus pages) that describes the CBFBM concept, the action research in each project country and a set of generic findings and lessons was also published to make the results of the project widely available. Figures 14 and 15 show the covers of the manual and policy report.

Figure 13: Key elements and steps of the CBFBM development process

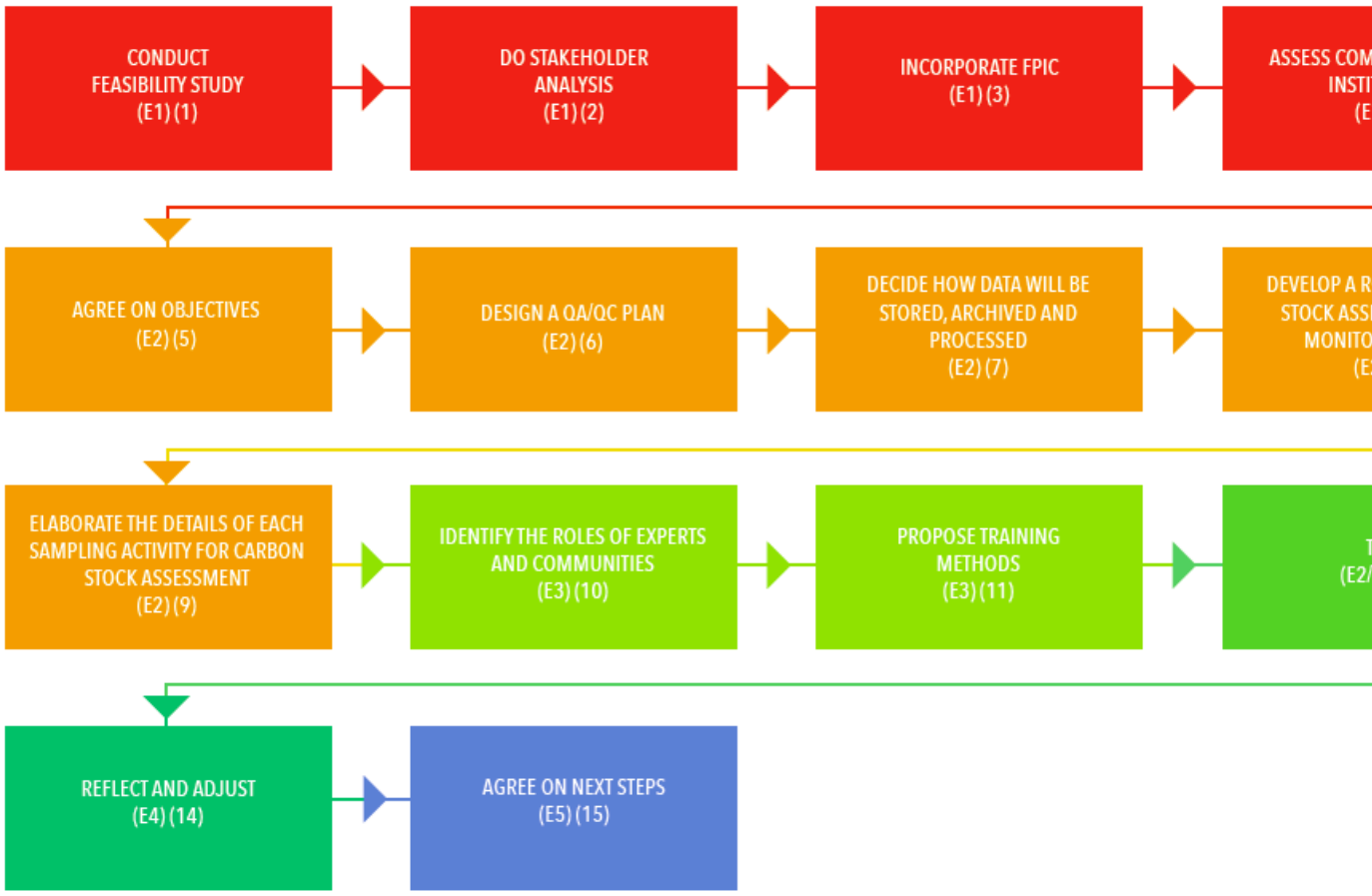



Figure 14: Front cover of CBFBP ToT Manual

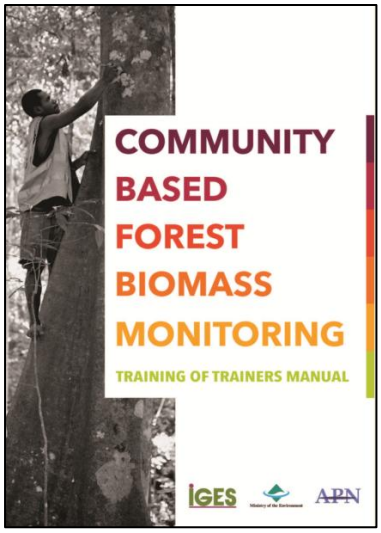
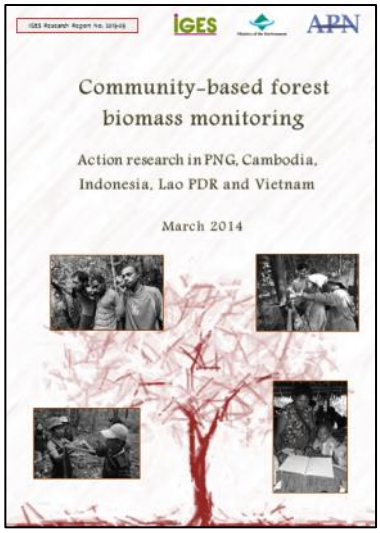



Figure 15: Front cover of CBFBM policy report




***Promotion of outputs***

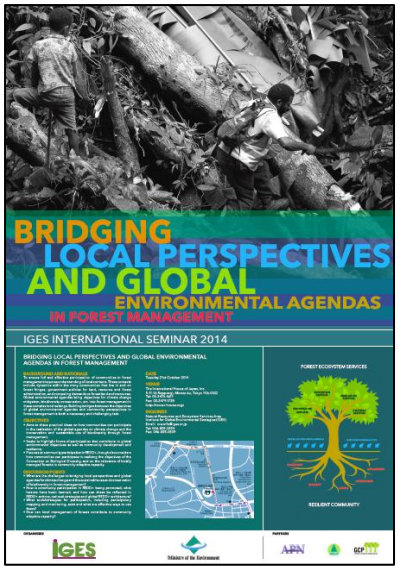
The project was widely promoted through a webpage (http://www.iges.or.jp/en/natural-resource/forest/activity_CBFBM.html) linked to the IGES website. The webpage provides an

overview of the project and provides links to all major project outputs, including videos that were produced on the CBFBM concept and action research.

Project participants were invited to present on the CBFBM concept at a number events. Most recently, these included presentations by the proponent and the Indonesian collaborator at the regional event "Participatory Forest Monitoring" in Lam Dong, Vietnam on 18-20 November 2014, as well as co-hosting and presenting at the UNFCCC COP20 side-event "Community-Based Forest Monitoring" on 24 November 2014 in Peru.

IGES hosted two international seminars on REDD+ in FY2013 and FY2014 that were also used to promote and share the findings of the action research. APN was officially recognised as a co-organiser of the second workshop, which was held in Tokyo on 21 October 2014 and was attended by over 70 people (Fig. 16).

Figure 16: Poster of IGES international REDD+ seminar 2014




### 3.3 Achievement of project aims, gaps and potential for taking the research forward

***Achievements***

The project can claim the following achievements:

1. Provided strong evidence that with appropriate training and ongoing support, communities can provide accurate forest measurements for the assessment and monitoring of forest carbon stocks.
2. Provided strong evidence that communities can make an important contribution to mapping through sharing their local knowledge, boundary demarcation and map accuracy assessments.
3. Provided comprehensive and easy-to-use guidance on implementing CBFBM systems. Users can have confidence in this guidance as it is based on extensive action research in a variety of local contexts found across the region.
4. Raised awareness of local and national governments on the concept of CBFBM and how it can be implemented.
5. Identified the potential for including CBFBM in national forest monitoring systems as well as the challenges for scaling up CBFBM beyond the action research sites.

6. Identified potential benefits of CBFBM for communities (not just payments for REDD+, but also knowledge on how to maximize other benefits from their forests using the data generated).
7. Strengthened the relationships between the communities, researchers, NGOs and local governments active in the action research areas.
8. After the initial cycle of action research, identified new problems associated with community-based forest management and use at the research sites and set out strategies to address these.
9. Confirmed the validity and advantages of action research as an approach for researchers and local communities to collaboratively identify problems associated with natural resources and ecosystem services and to propose and test solutions to these problems.

***Gaps***

The project aimed to develop reference emission levels at the action research sites, but this was not fully completed. Reference emission levels were analysed in Cambodia, but due to the difficulty of securing offset buyers through voluntary markets and concerns that REDD+ payments would be difficult to secure prior to 2020 when a new global climate agreement is expected to come into force, the focus of the action research turned to benefits other than REDD+ payments that the communities could derive from their forest management and monitoring.

***Potential for further work***

In Indonesia, IGES and project collaborators are now exploring the potential to include community-based forest monitoring under forest management units that are currently being established to manage all of the country's forest estate. In Laos, the action research has generated knowledge and capacity that is being used to plan sustainable land use with the local communities. In Vietnam, the action research has evolved to support the planting of indigenous species and the monitoring of their performance by local communities. IGES is also exploring the potential for community-based REDD+ in Papua New Guinea, based on the results of the action research.

The project's experiences and findings will also serve as an important reference for the inclusion of REDD+ under Japan's Joint Crediting Mechanism (JCM). IGES researchers are assisting with the development of guidance on REDD+ for the JCM.

## 4.0 Conclusions

The main objectives of the project were:

1. Develop and test participatory approaches to involve forest-dependent communities in forest carbon accounting using sample plots;
2. Estimate carbon stocks at the research sites and compare the results with other studies;
3. Explore ways of integrating the participatory approaches to ground-based measurement with remote sensing methods in order to establish reference emission levels;
4. Estimate the costs of implementing participatory ground-based approaches and compare with alternatives;
5. Explore how payment distribution systems can provide incentives for communities to participate in forest carbon accounting;
6. Encourage replication of the approaches through the research outputs.

By combining funding from APN and the Ministry of Environment of Japan for action research on CBFBM, and through the eagerness of collaborators, local communities and other stakeholders to participate, the project achieved more than was expected of it. The project provided strong evidence that with appropriate training and ongoing support, communities can provide accurate forest measurements for the assessment and monitoring of forest carbon stocks and that they can make an important contribution to land cover and land use mapping. The research thus presents a strong argument that local communities can make an important contribution to the success of REDD+ as a global climate change mitigation mechanism. Participation should thus not be viewed merely as a REDD+ safeguard, but rather as a means to better forest management. The project also confirmed the validity and advantages of action research as an approach for researchers and local communities to collaboratively identify problems associated with natural resources and ecosystem services and to propose and test solutions to these problems. At the action research sites, the project evolved beyond the development and testing of approaches to engage communities in forest carbon accounting, to strategies to make best use of the data gathered for the communities to strengthen and realize greater benefits from their forest management. The proponent and collaborators used various venues and medium from local to international levels to promote the concept of CBFBM and the research outputs and findings. The project produced the comprehensive training manual on CBFBM, which has already been used to design two regional trainings. There is considerable potential to build on this action research project to consider how communities can be involved in the monitoring and management of a wide range of forest values (not just carbon stocks) in ways that both contribute to community development and to the global objectives on climate change and biodiversity conservation.

## 5.0 Future Directions

Global interest in community-based monitoring and knowledge co-production processes involving scientists and communities is growing. In addition to various global initiatives to engage communities in the monitoring of forest carbon, the Intergovernmental Platform on Biodiversity and Ecosystems Services (IPBES) is considering including indigenous and local knowledge (ILK) in its regional biodiversity and ecosystem services assessments. There is thus considerable potential to build on the experience and outputs from the project to explore further policy relevant research on community engagement in generating and sharing data on forest ecosystem services, including biodiversity protection.

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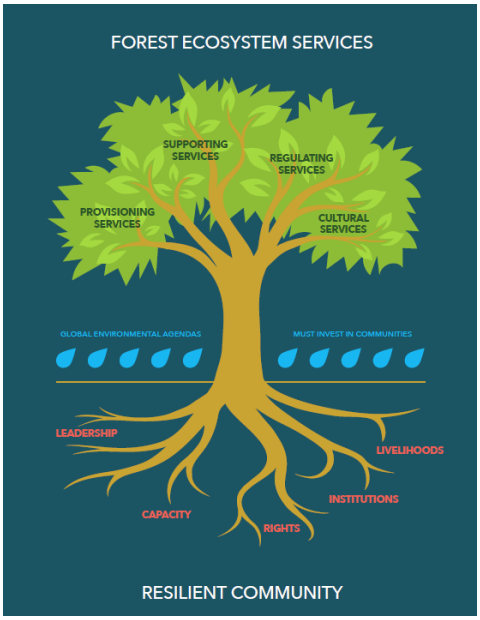
## Appendix

Conferences/Symposia/Workshops

**IGES REDD+ Seminar 2014 "Bridging local perspectives and global environmental agendas in forest management", Tuesday 21st October 2014, Tokyo**

***Seminar rationale***

The theme of the seminar – the need for bridging local perspectives and global environmental agendas in forest management – was identified from the following considerations: (i) Around the World, millions of people live on the fringes of and in forests and depend on them for at least part of their livelihoods and wellbeing; (ii) If the customary claims of forest-dependent people to forest lands and resources are ignored by initiatives to mitigate climate and conserve biodiversity, then these initiatives will not be successful; (iii) To achieve global environmental objectives requires moving away from a narrow focus on single objectives (mitigate climate change, conserve biodiversity, etc.) to a broader approach of building the resilience of forest-dependent communities through investing in leadership, rights security, capacity, institutions, and livelihoods.




***Seminar objectives***

- **Share practical ideas on how communities can participate in the realisation of the global agendas on climate change and the conservation and sustainable use of biodiversity through forest management;**
- **Highlight forms of participation that contribute to global environmental objectives as well as community development and resilience;**
- **Discuss community participation in REDD+ and the contribution of communities to realising the objectives of the Convention on Biological Diversity, as well as the relevance of locally managed forests to enhancing community adaptive capacity.**

***Seminar presentations and Online report***

http://www.iges.or.jp/en/natural-resource/20141021_2.html

***Programme***

| | |
|---|---|
| Opening (Doors Open at 9:30) | |
| 10:00 | Opening Messages, Dr. Yuji Mizuno, Ministry of Environment |
| Session 1: Framing the topic and updates on UNFCCC REDD+ and CBD (Moderator: Mr. Taiji Fujisaki, IGES) | |
| 10:10 | "Framing the topic" Dr. Henry Scheyvens, IGES |
| 10:20 | "Update on UNFCCC REDD+ negotiations" Dr. Makino Yamanoshita, IGES |
| 10:30 | "Update on CBD and thoughts on how community-based monitoring can contribute to REDD+ and biodiversity reporting requirements of the UNFCCC and CBD" Ms Lucy Goodman, GCP |
| 10:40 | Q & A |

| | |
|---|---|
| Session 2 Indigenous and local knowledge: Participatory monitoring and role of trees and forests in community-based adaptation (Moderator: Dr. Kimihiko Hyakumura, Kyushu University) | |
| 10:50 | "Demonstrating Indigenous Peoples' Self-Determined Development in Community-based Monitoring and Information Systems" Ms. Jo Ann L. Guillao, TEBTEBBA, Philippines |
| 11:15 | "The Role of Homestead Forests to Community Resilience and Adaptive Capacity to Climate Change: Experiences from Bangladesh" Prof. Khondoker M. Hossain, Bangladesh Open University, Bangladesh |
| 11:40 | Discussion |
| Lunch break (12:00-13:30) | |
| Session 3: Linking stakeholders and jurisdictions and scaling up in participatory approaches to forest monitoring (Moderator: Ms. Naoko Tsukada, FFPRI) | |
| 13:30 | "Participatory Forest Monitoring- How our work is informing REDD+ in Vietnam" Mr. Nguyen Trung Thong, SNV, Vietnam |
| 13:55 | "The challenges and opportunities of incorporating community data into a national REDD+ MRV system" Ms Lucy Goodman, GCP |
| 14:20 | "Avoidance of deforestation and forest degradation in the border area of southern Laos and central Vietnam for the long-term preservation of carbon sinks and biodiversity and livelihoods" Mr. Fanie Bekker, WWF Greater Mekong, Laos |
| 14:45 | Discussion |
| Coffee Break (15:05-15:30) | |
| Session 4: Voluntary carbon markets, global environmental agendas and community participation in forest management (Moderator: Dr. Jintana Kawasaki, IGES) | |
| 15:30 | "Community Forestry REDD+ Projects in Indonesia" Dr. Ahmad Kusworo, FFI, Indonesia |
| 15:55 | "Community Participation on REDD+ in Oddar Meanchey Province" Mr. Smeun Boreyroth, CDA, Cambodia |
| 16:20 | Discussion |
| Session 5: Panel discussion (Moderator: Dr. Henry Scheyvens, IGES) | |
| 16:40 | Discussion |
| 17:00 Closing | |

***Participants invited from overseas as presenters***

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*Funding sources outside the APN*

Every year of the project, the project collaborators provided various forms of in-kind assistance, such as administrative support, researchers' time, equipment, office space, vehicle use, etc.

The APN project was a part of a larger project on Community Carbon Accounting implemented by IGES. The Community Carbon Accounting Project included the APN project activities as well as activities on community carbon accounting funded by the Ministry of Environment of Japan on a yearly basis. In this way, much of the work conducted under the Community Carbon Accounting project was co-funded by the APN and the Ministry of Environment of Japan. Each year, the Ministry of Environment of Japan provided roughly between 12,000,000 – 15,000,000 yen for the activities under the Community Carbon Accounting Project.

List of Young Scientists

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**Contribution to project activity:** I was the project collaborator for the action research in Laos. I was responsible for designing and guiding the action research, as well as for analysing and reporting on the results. I presented the results of the action research at the regional reflection workshops.

**Message:**

- Had the great opportunity and experiences in conducting the action research project at the community level, understand and gained more knowledge on CBFBM research concepts and the REDD+ related information.
- Learnt a new technique and gets experiences of action research methodology, especially, the way how to observe local community team members in carrying out the action research activities such as: setting and establishing of the sample plots, measuring trees DBH and height.
- Had a chance to identify the community team member's knowledge and experiences in forest inventory activities. Some technical knowledge was transferred from researchers to the community teams. As well as, sharing experiences, knowledge between researchers and community team members throughout the participatory training program and carried out the forest biomass inventory in the field site.
- Learnt the new knowledge and experiences from others CBFBM project partner countries, and had the opportunity to share CBFBM knowledge between NUOL colleagues.
- Get the opportunity to explore the local community livelihood activities, particularly the local community managing and using their land and forest resources.
- Earned valuable information on action research activities and that information will be very useful for future research and academic report development.
- Had the opportunity and gained experiences in managing and coordinating the project activities.

**Name:** Taiji FUJISAKI

**Position:** Policy Research, Forest Conservation Team, Natural Resources and Ecosystem Services Area, Institute for Global Environmental Strategies

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**Contribution to project activity:** From the project second year, I took over responsibility for supporting the action research in Indonesia. I participated in field surveys, workshops and data analysis, and managed the contract and maintained communications with the collaborator.

**Message:**

Through the project I had the opportunity to work closely with local communities, NGOs, researchers, forestry officers and other groups on developing a community-based forest biomass monitoring system in Indonesia. This built my capacity to understand how communities can be involved in forest monitoring and how community-based monitoring can be linked to improvements in community wellbeing and to national forest monitoring systems. I will continue to study these issues further. I am grateful for this opportunity to work with the communities, foresters who are committed to community development, and leading Indonesian experts in the field of forest management.

Glossary of Terms

| | |
|---|---|
| APN | Asia Pacific Network for Global Change Research |
| A/R CDM | Afforestation/Reforestation Clean Development Mechanism |
| CBFBM | community-based forest biomass monitoring |
| CBPF | Community-based Production Forestry Project (Cambodia) |
| CCB | Climate, Community and Biodiversity (Standards) |
| CF | community forestry |
| cm | centimetre |
| CO2 | carbon dioxide |
| COP | Conference of the Parties |
| DBH | Diameter at Breast Height |
| DHR | diameter-height relationship |
| DKN | Dr. Agus Setyarso, National Forestry Council of Indonesia (DKN), Indonesia, asetyarso@dkn.or.id |
| DOF | Department of Forestry (Vietnam) |
| FA | Forestry Administration (Cambodia) |
| FAO | Food and Agriculture Organisation of the United Nations |
| GHG | greenhouse gas |
| Gt | gigaton |
| GPS | global positioning system |
| ha | hectare |
| IGES | Institute for Global Environmental Strategies |
| ILK | indigenous and local knowledge |

| | |
|---|---|
| IPBES | Intergovernmental Platform on Biodiversity and Ecosystems Services |
| IPCC | Intergovernmental Panel on Climate Change |
| kg | kilogram |
| m | metre |
| LEI | Indonesia Ecolabeling Institute |
| LU/LC | land use / land cover |
| MRV | monitoring, reporting and verification |
| NGO | non-governmental organisation |
| NTFP | non-timber forest product |
| NUOL | National University of Laos |
| PAR | participatory action research |
| PDD | project design document |
| PFES | Payment for Forest Ecosystem Services (Vietnam) |
| PNG | Papua New Guinea |
| PSP | permanent sample plot |
| RECOFTC | RECOFTC – The Center 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 |
| REL | reference emission level |
| SBSTA | Subsidiary Body for Scientific and Technological Advice |
| SPF | Seima Protection Forest |
| tCO2 | tonnes of carbon dioxide |
| TMF | Training Model Forest (Laos) |
| ToT | training of trainers |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNORCI | United Nations Office for REDD+ Coordination in Indonesia |
| VFU | Vietnam Forestry University |
| WCS | Wildlife Conservation Society |
| yr | year |