Lao People's Democratic Republic
Department of Forestry, Ministry of Agriculture and Forestry

THE CAPACITY DEVELOPMENT PROJECT FOR ESTABLISHING NATIONAL FOREST INFORMATION SYSTEM FOR SUSTAINABLE FOREST MANAGEMENT AND REDD+

WORK COMPLETION REPORT (FIRST YEAR)

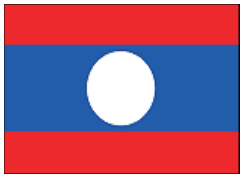
March 2014

Japan International Cooperation Agency

Joint Venture
Kokusai Kogyo Co., Ltd.
Asia Air Survey Co., Ltd.

Location of the Project site

The Capacity Development Project for
Establishing National Forest Information System for
Sustainable Forest Management and REDD+



Lao People's Democratic Republic

Resource : University of Texas

Photos of Activities
September 2013～March 2014

First JCC

Explanation from Chief Advisor

Workshop

Exchanging opinions with another donor

Meeting in local office

Ground Truth Survey

Acronyms

AGB	Above Ground Biomass
AFOLU	Agriculture, Forestry and Other Land Use
ASEAN	Association of Southeast Asian Nations
AWLCA	Ad hoc Working Group on Long-Term Cooperative Action
BGB	Below Ground Biomass
CIFOR	Center for International Forestry Research
CliPAD	Climate Protection through Avoided Deforestation Project
COP	Conference of the Parties
C/P	Counterpart
DAFO	District Agriculture and Forestry Office
DB	Database
DBH	Diameter at breast height
DFRM	Department of Forest Resource Management
DG/DGG	Director General / Deputy Director General
DOF	Department of Forestry
DOFI	Department of Forest Inspection
EDN	ESRI Developer Network
FAO	Food and Agriculture Organization (of the United Nations)
FCPF	Forest Carbon Partnership Facility
FFPRI	Forestry and Forest Products Research Institute
FIM	The Programme for Forest Information Management
FIP	Forest Investment Program
FIPD/DOF	Forest Inventory and Planning Division (Department of Forestry)
FOMIS	Forest Inventory and Management Information System
FPP	Forest Preservation Program
FRA	Global Forest Resources Assessments
FRIMS	Forest Resources Information Management System
FSCAP	Forest Sector Capacity Development Project
GIS	Geographic Information System
GIS/RS	Geographic Information System / Remote Sensing
GIZ	Gesellshaft fuer Internationale Zusammenarbeit
GOL	Government of Lao PDR
IFC	International Financial Cooperation
IT	Information Technology
ITTO	International Tropical Timber Organization
JICA	Japan International Cooperation Agency
JICS	Japan International Cooperation System
JV	Joint Venture
LEAF	Lowering Emission in Asia's Forest
MAF	Ministry of Agriculture and Forestry
MONRE	Ministry of Natural Resources and Environment
MRV	Measuring, Reporting and Verifying
NFCMs	National Forest Carbon Maps
NFI	National Forest Inventory
NFIDB	National Forest Information Database
NFIS	National Forest Information System
NFMS	National Forest Monitoring System
NTFP	Non-Timber Forest Product

NGD	National Geographic Department
PAFO	Provincial Agriculture and Forest Office
PaMs	Policy and Measures
PAREDD	Participatory Land-use and Management for Reducing Deforestation
R/D	Record of Discussion
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation and the role of conservation of forests and enhancement of forest carbon stocks
REL	Reference Emission Level
RL	Reference Level
R-PP	Readiness preparation proposal
RS	Remote Sensing
SG	Safeguards
SIDA	Swedish International Development Cooperation Agency
SBSTA	Subsidiary Body for Scientific and technological advice
SUFORD	Sustainable Forest and Rural Development (Project)
TA	Technical Assistance
TF	Task Force
TWG	Technical Working Group
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VCS	Verified Carbon Standard
WCS	Wildlife Conservation Society
WG	Working Group
WS	Workshop

Outline

Annex

Chapter 1 Overview of the Project

1.1 Background

In the Lao People's Democratic Republic (hereinafter Lao PDR), forest coverage which was 70% or more in the 1940's had declined to 47% in 1989 and 40% in 2010. The government of the Lao PDR (hereinafter GOL) endorsed the "Forestry Strategy 2020" with the objective of restoring a forest coverage of 70%. GOL also views REDD+ as valid means for strengthening of management capacities on all levels, increasing government revenues and improving the livelihood of local residents. . Therefore, GOL has been keen in preparations for implementation of REDD+ including establishment of a REDD+ Task Force(TF) while receiving support from many donors including Japan.

On the other hand, in order to promote forest conservation through REDD+, while the development of forest resource information with high accuracy using satellite information analysis and other means is indispensable, the hardware / software processing capability and capacity that are required for forest resource information management are inadequate, and human resources that perform collection / analysis of related information are in extremely short supply in the Lao PDR, meaning that the infrastructure to further forest conservation through REDD+ is weak.

Consequently, under the "Programme for Forest Information Management" (FIM) grant aid cooperation project, the hardware, software and other resources and equipment required for forest resource surveys and satellite image analysis, etc. have been provided and support has been provided to acquire the basic technology required for the utilization of these, and a "Forest Base Map" has been prepared as part of the outputs.

However, in order to deal with REDD+, which is still in the formulation process, in accordance with international discussions, the development of human resources to perform estimation of carbon stock volume utilizing forest information, conduct prediction of forest carbon dynamics prediction, forest resource monitoring and other related works is a pressing issue in the Lao PDR.

Under these circumstances, GOL made a request to the Government of Japan to implement this technical cooperation project. Upon receiving this request, JICA conducted a detailed planning survey in March 2013, and JICA and MAF concluded an R/D based on the results of this survey on May 20, 2013.

In accordance with this R/D, the counterpart for this work is the Department of Forestry at MAF, and through developing the main elements required for formulation of a national forest information system in the forestry sector in the Lao PDR, the capacities of the counterpart in the Lao PDR will be enhanced, with the objective of contributing to sustainable forest management and REDD+ preparation in the Lao PDR.

1.2 Objectives and output

The Project overall goal, purpose, output and overview of activities are outlined below.

(1) Overall Goal

National Forest Information System (NFIS) of Lao PDR is established.

(2) Project Purpose

Essential components for the establishment of NFIS are in place.

(3) Outputs

1. Information on forest carbon dynamics at national level is compiled.
2. Prototype of National Forest Information Database (NFIDB) is designed.
3. The next round of National Forest Inventory (NFI) is designed.
4. Other relevant information required for REDD+ is compiled.

(4) Activities

1.1 Verify accuracies of national forest type maps as of year 2010, which is a base map, and as of years 2005 and 2000.

1.2 Revise national forest type maps based on the results of verification 1.1 above.

1.3 Identify highly co-related factors with carbon stock, e.g. species, region and elevation, based on the relevant information including past NFI data and inventory data obtained through the Programme for Forest Information Management in Lao PDR (FIM).

1.4 Decide methodology for stratification of forests for producing National Forest Carbon Map (NFCM) based on the result of activity 1.3 above (e.g. species, region and elevation).

1.5 Produce NFCM s (for years 2010, 2005 and 2000) based on the result of activity 1.4 above.

2.1 Analyze and compile existing forest information data, such as FIM, Forest Preservation Programme (FPP) and other projects.

2.2 Examine functions and specifications for statistics and reporting needed for internationally and domestically.

2.3 Identify necessary forest information data and their specifications.

2.4 Design NFIDB based on the results of 2.1, 2.2 and 2.3 above.

3.1 Review the results of past NFIs including FIM.

3.2 Study methodology of the next NFI (e.g. sampling method, plot design, inventory items) based on the result of activity 3.1 above.

3.3 Consider institutional set up of the next NFI.

3.4 Revise the NFI manual.

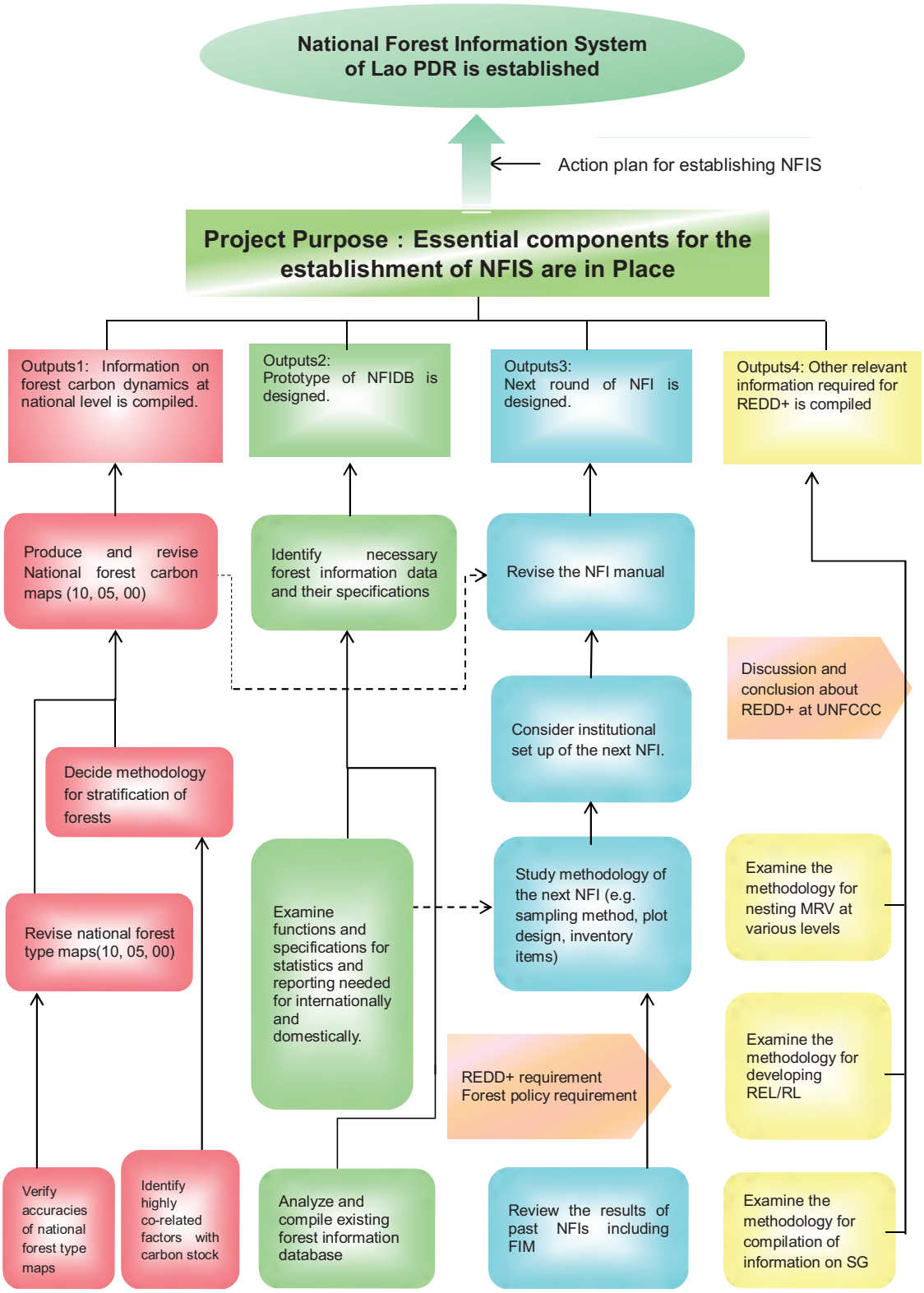
4.1 Examine the methodology for developing REL/RL for REDD+.

4.2 Examine coordination of Measurement, Reporting and Verification (MRV) for the levels of national, sub-national and project.

4.3 Study methodology for compilation of information on safeguards.

1.3 Flow of Main Components

The flow of this project is as follows



Chapter 2 Main Activities Implemented(September2013~March 2014)

2.1 Work

Main Activities implemented during the 1st Phase are as follows.

Table 2-1:Work Process Overview （First Year）

First Year (September 2013～March 2014)
Activities related to Common Items
【1】Organisation and analysis of existing documents/reports
【2】Confirmation and detailed consideration of survey methodology
【3】Preparation of Inception Report
【4】Explanation and discussion of Inception Report
【5】Preparation of Technical Transfer Plan (draft)
【6】Explanation of draft version and consultation to finalise the Technical Transfer Plan
【7】Collection and analysis of existing information
【8】Explanation and exchange of opinions on Inception Report in workshops
【9】Review of other donors' activities and consideration of policy on integration of such activities in this Project
【10】Discussion and consideration regarding collaboration with other donors
【11】Development of training plan for counterparts
【12】Report on results of first field survey in Laos
【13】Preparation and discussion of First Work Completion Report.
【14】Preparation for and start of second year surveys and activities
【15】Report to JICA on progress made on first year activities in Laos
Activities related to Output1: Information on Forest Carbon Dynamics at national level is compiled.
【16】Accuracy assessment of forest distribution map （2000, 2005, 2010）
【17】Revision of forest distribution map (2000, 2005, 2010)
【18】Identification of potential variables of high correlation with carbon volume
Activities related to Output 2 :Prototype of National Forest Information Database (NFIDB) is designed.
【19】Organisation and analysis of existing forest information database
【20】Consideration of functions and specifications for statistical/reporting purposes, etc.
【21】Determination of data types and specifications of forest information
【22】Design of national forest information database
Activities related to Output 3 :Next round of National Forest Inventory (NFI) is designed.
【23】Review of design, methods, implementation and results of national forest inventories
【24】Consideration of objectives, design and survey methods for the next national forest inventory
【25】Consideration of institutional set-up for implementation of the next national forest inventory
Activities related to Output 4 :Other relevant information required for REDD+ is compiled.
【26】Consideration of methods of preparing REL/RL
【27】Consideration of methods for nesting MRV at various scales
【28】Consideration of methods of creating information system regarding safeguards etc.
【29】Participation in UNFCCC negotiations on REDD+

2.2 Common Items for All Outputs

2.2.1 Organization/Analysis of Existing Materials, etc.

Existing and collected materials, etc. were organized/analyzed, and materials that can be used and materials that are to be collected in the first field survey were clarified.

2.2.2 Confirmation of Work Plan and Review of Details

The overall work plan was prepared and the details of the work plan and methods were reviewed.

2.2.3 Preparation of Inception Report

Draft inception report was prepared.

2.2.4 Explanation/Discussion of Draft Inception Report

Before planned activities were started, explanations/discussions concerning the content of the draft inception report were made to/held with the counterpart agency at a first joint coordination committee meeting, and agreement was obtained on the basic project implementation policy, work plan content/methods, technology transfer implementation policy, items for which facilitative assistance is to be provided and other details, and the content of discussions were compiled in the minutes of the meeting.(Annex 1-1)

2.2.5 Preparation of Technology Transfer Plan (Draft)

A technology transfer plan (draft) was prepared. This plan includes the following items.

Technology transfer policy, methods, content and timing

Persons in charge of performing technology transfer, and counterparts that will receive technology

Technology transfer program

Technology dissemination seminars (proposed) to be implemented in the second year

Other issues related to technology transfer

2.2.6 Explanation of Technology Transfer Plan (Draft) / Discussions / Preparation of Technology Transfer Plan

The technology transfer plan (draft) was explained to the C/P organization, discussions were held to gather the views of the C/P, and a final technology transfer plan was prepared together with the C/P organization.

2.2.7 Collection/Analysis of Existing Information

Collection / analysis of existing information (current status of forest management systems, status of forest utilization, related laws and regulations/systems, status and activities of REDD+ TF, activities of other donors, etc.) were implemented.

2.2.8 Explanation of Inception Report at Workshop / Exchange of Views

Workshop was held to explain the inception report to other concerned donors/projects and exchange of views was conducted.(Annex 1-2)

2.2.9 Review of Activity Implementation by Other Donors and Review of Activity Policy for This Survey

Activity implementation by other related donors were reviewed and the output / problems / other issues were organized. This information was used for efficient implementation of the Project activities.

2.2.10 Discussion / Review of Coordination with Other Donors

Coordination with other related donors was discussed/reviewed.

2.2.11 Formulation of Training Plan for Counterparts

Regarding training that is conducted to enhance the capacities as part of the activities related to each output, the learning level of the counterparts in Laos were confirmed, and this information was used to formulate an appropriate training plan.

2.2.12 Review of First Year Results (Output)

Report meetings were held with the counterpart government on March 14 and 19, 2014 based on the results of the first field survey when the first field survey ended. The names of the various participants are shown in Annex 3, and included Mr. Khamphay who is Acting Director General of DOF, Mr. Linthong (Project Director) who is Director of FIPD and Mr. Soukanh (Project Manager) who is Deputy Director of FIPD.

The content of the report consisted of a focus in particular on the accuracy assessment results and the review results of carbon stratification examination for Output 1. At the beginning, though plan of the report meeting was only March 14, the report meeting was continued again on March 19 because there was insufficient time to finish the discussions on March 14. On March 19, it seemed that Mr. Khamphay had high motivation and interest in the report, because he explained the outline of report to C/P again at the end of the meeting. The abstract of comments are below.

For Accuracy Assessment

(Mr. Khamphay)

- There are almost no natural pure Deciduous Forests. Almost all are Mixed Deciduous Forests. Most of the Evergreen Forests are located in the National Biodiversity Conservation Area (NBCA).
- It should be possible to further increase accuracy by also referring to past data.
- The classification classes when FIM was performed were field level, and it should be possible to conduct further grouping for the forest type map at the national level.
    - (Mr. Kajiwara) It will be organized based on the discussion so far.
- It is important to strengthen RS/GIS capabilities, but due to the fact that there are many staff that cannot distinguish forest types in the field, field survey capabilities need to be strengthened.
    - (Mr. Kajiwara) It will be tasked for the future.

(Mr. Soukanh)

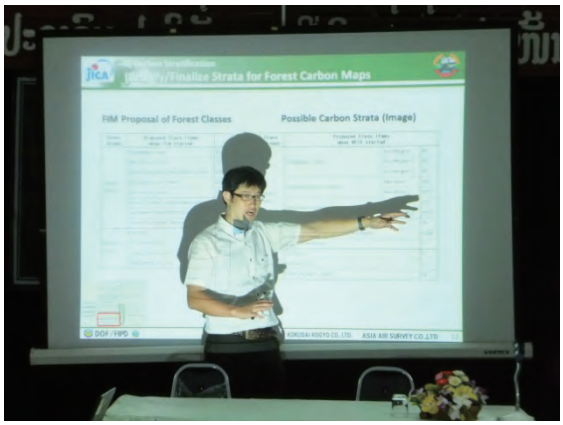
- It is necessary to thoroughly analyze / consider the ground truth survey results that have just been completed, and use them to examine the accuracy assessment results, but the fact that three years have elapsed since the satellite images were taken (2010) needs to be taken into consideration.

For Carbon Stratification

(Mr. Khamphay)

- According to the report, desk-based allometric equations were chosen for carbon stratification due to that existing allomwtric equations were not suitable for some forest types though, it will be good examination to compare the biomass of past NFI calculated by ForestCalc and existing allomwtric equations.
    - (Mr. Kajiwara) It will be conducted soon.
- Difference level of forest degradation between the past and now seems to be one of causes of difference value of biomass between past NFI and FIM.
    - (Mr. Kitamura) There may be effect by degradation though, we are thinking that past NFI and FIM have target (accessible) area for survey, it should be reviewed based on some opinions of persons with experiences of NFI.
- There are big standard deviations of biomass values in each Ecoregion. Considering this, can forest structure information be used for carbon stratification?
    - (Mr. Kitamura) It is useful in the field though, it is difficult for mapping.

Mr. Soukanh Making Opening Speech

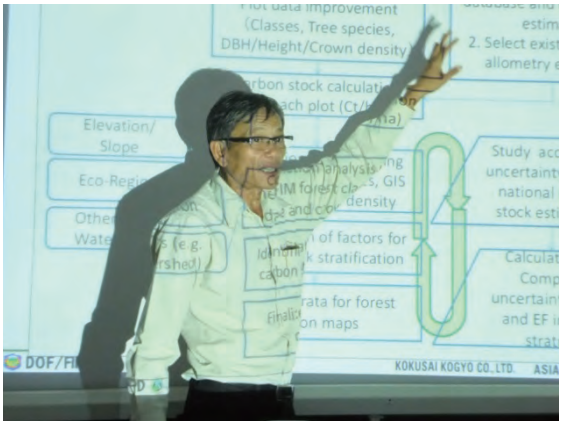


Mr. Kajiwara Reporting the Results

Mr. Linthong listening the reports

Mr. Khamphay making comments

Mr. Kitamura (Chief Advisor) having a discussion



Mr. Khamphay Explaining the reports to C/P again

2.2.13 Preparation/Discussion of Work Completion Report (First Year)

The results of the first year activities and the review meeting on 2.2.12, was taken into consideration when preparing the Work Completion Report (first year), and agreement on the content was obtained through discussion with the counterpart agency.

2.2.14 Starting off or Preparations for Survey Work/Activities in Second Year

For the work that will be conducted in the second year, surveys, starting of activities or preparations were implemented for work that can be started during the first year.

2.2.15 Report to JICA on Progress of First Field Survey

A report was made to the JICA Laos Office on the progress of the first year activities.

2.3 Activities related to Output 1

2.3.1 Accuracy Assessment of National Forest Type Map (2010)

Accuracy assessment was performed for the 2010 national forest type map that serves as the forest base map. In addition, training in Japan was implemented concerning accuracy assessment of national forest type maps.

2.3.2 Correction of National Forest Type Maps (2000, 2005, 2010)

Ground-truth surveys and training that is required for correction work were implemented. Based on the results of 2.3.1 and ground-truth surveys, correction of the 2010 national forest type maps that serve as the forest base maps, 2005 and 2000 national forest type maps were performed mostly in 2nd Phase. In addition, training in Japan was implemented concerning correction of national forest type maps.

2.3.3 Identification of Carbon Stock and Factors of a High Level of Correlation with Carbon Stock

Correlation analysis was performed for the average carbon stock per unit area in each plot, with existing GIS data (regional data, altitude, eco-region, etc.), canopy cover and other such data in order to determine factors that are valid for stratification in accordance with carbon stock. In addition, discussions were held with the C/P and other donors in order to agree on methods and processes for carbon stratification.

2.4 Activities related to Output 2

2.4.1 Analysis/Organization of Existing Forest Information Database

The forest management information system (FOMIS) that is being operated by the DOF with the support of SUFORD, Department of Forestry Reporting System (DOF Reporting System) and previous NFI database (ForestCalc) were analyzed. Since the JV that is implementing FPP technical support has organized the existing databases other than Forest Calc, this work was reviewed, with the focus of analysis placed on Forest Calc.

2.4.2 Review of Functions and Specifications for Statistics/Reporting, etc.

Regarding international reports, review was conducted of country-by-country reports / biennial reports for international organizations such as UNFCC, FRA2015 scheduled to be implemented by FAO, for which support was requested by the DOF in the past. Regarding domestic reports, the past results of existing reports will be used as reference, but the requests of each ministry/department for which reorganization was performed will be organized/reviewed. Furthermore, since organization was performed once for these reports with the technical support of FPP that is being implemented by the JV, this information was reviewed, with a focus on response to REDD+.

2.4.3 Identification of Types/Specifications of Forest Information Data

Based on the output of 2.4.1 and 2.4.2, identification of the following items were performed: Items that can be used for support with existing forest information (and corresponding statistics), items required for organization/review of statistical/calculation methods, items needed for collection of information from other government organizations (MAF, MONRE, National Geographic Department [NGD], etc.) and projects (SUFORD, CliPAD, etc.), items that can be used for generation of data/specifications from satellite images and geographic/other data, and items for which it will be difficult to perform collection/generation immediately. Regarding items for which it will be difficult to perform collection/generation immediately, review was performed for optimum support that may be possible in the future and provisional support at the current point in time.

2.4.4 Design of National Forest Information Database (Outline Proposal)

On top of the results (outputs) of 2.4.1, 2.4.2 and 2.4.3, the database users (engineers that are currently using database and potential users that are expected to use the database in the future) and workflow were analyzed/identified, and database basic design was planned taking into consideration the usage methods for each respective user level. But it took time to do trial and error in analyzing existing NFI database (ForestCalc), then it turned out that there was no enough time to implement and discuss on the design. This basic design will continuously be implement in the second year. In particular, interface design will be conducted so that potential users that are not GIS engineers can use the database. In addition, design was considered in accordance with the structure that will allow browser-based viewing of forest information for which development is planned under FPP technical support that is being implemented by the JV.

Furthermore, regarding work related to development of a forest/GIS database that will be required for the design of the national forest information database, measures were taken to facilitate cooperation with the former DOF/FIPD staff database engineers for which work was subcontracted (Forest inventory database: Development of FoCAS) under the FIM project implemented by the JV.

2.5 Activities Related to Output 3

2.5.1 Review of Past National Forest Inventories

Review was conducted for the past NFI including FIM, from the perspectives of objectives, design, inventory items and implementation system.

2.5.2 Study of Next National Forest Inventory

Requirements and conditions, etc. that need to be considered in the designing of next period NFI from the perspective of REDD+ and sustainable forest management (macro management policy) were to be reviewed, and the options and overview of survey methods were to be studied. Due to the dispatch of Inventory Expert in the 2nd Phase (Apr 2014 to Sep 2015), however, these will be implemented in the 2nd Phase.

2.5.3 Study of Implementation Arrangement for Next National Forest Inventory

The survey system and capacity, etc. related to the FIPD and related local organizations were to be investigated/checked, and the implementation system was to be studied according to the options for the above survey methods. Due to the dispatch of Inventory Expert in the 2nd Phase (Apr 2014 to Sep 2015), however, these will be implemented in the 2nd Phase.

2.6 Activities Related to Output 4

2.6.1 Review of Existing REL/RL Preparation Methods

International trends concerning preparation methods were analyzed/organized based on the case studies such as guidelines concerning preparation of REL/RL at a sub-national/national level (VCS, FCPF, Carbon Fund, etc.) and negotiations/conclusions concerning REL/RL at the UNFCCC.

2.6.2 Review of existing data and initiatives related to MRV at Various Scales

Regarding REDD+ activities that are being formulated/implemented in the Lao PDR on a sub-national/project level, information concerning MRV methodology/content, and in particular, carbon pools, forest classifications, emissions/removals factors and other such data were collected, and harmonization with the national level was examined.

2.6.3 Review of ongoing activities and processes concerning Safeguards (SG) and SG Information System (SIS)

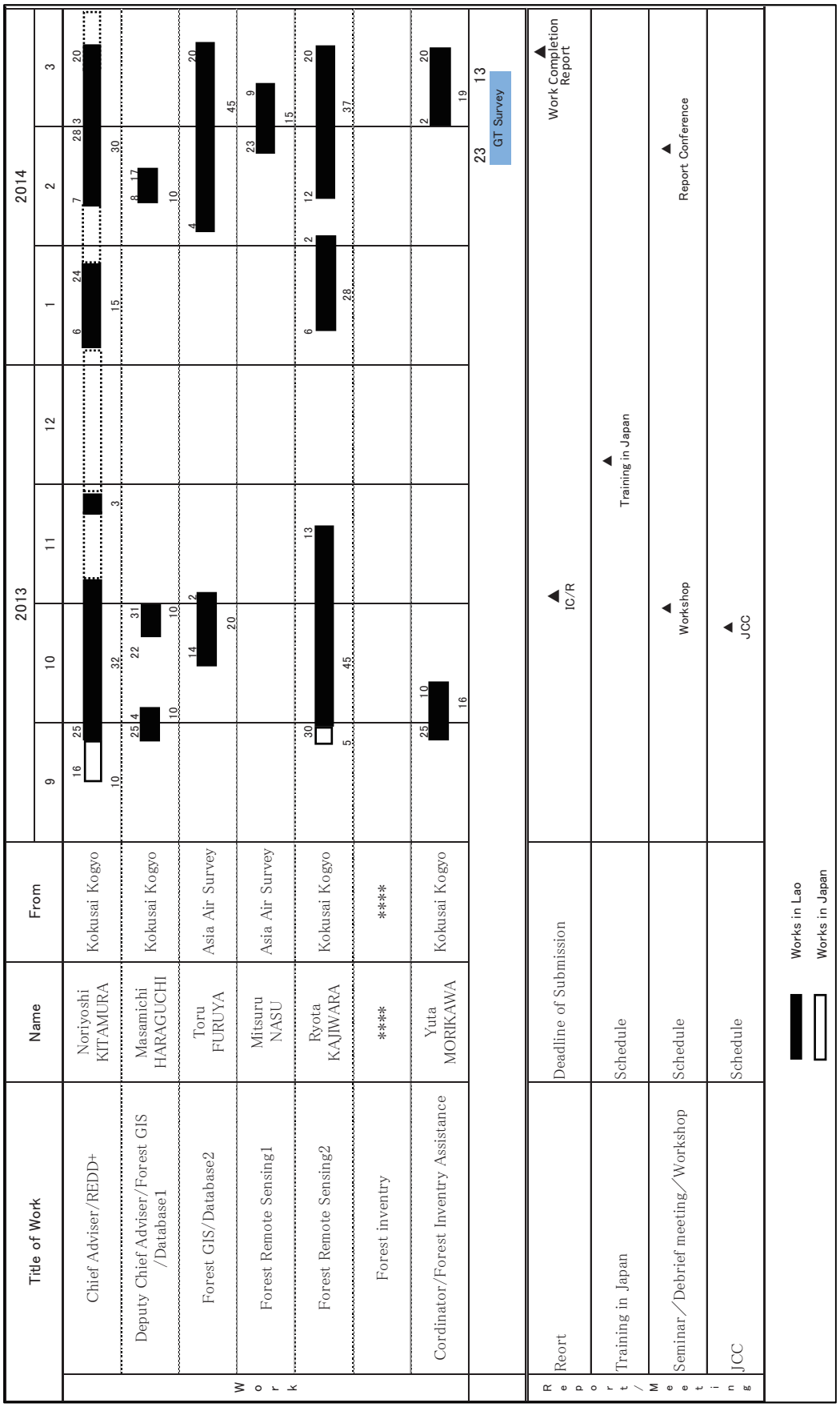
Decisions made at COP19 on Safeguards and SG initiatives of multi-processes such as FCPF and UN-REDD were collected and analyzed. Esp., the status of SG in R-PP of Lao PDR, which is the one of first 14 countries admitted to FCPF, was analyzed. A survey was also conducted as to the safeguards related components in the current legal documents.

2.6.4 Participation in UNFCCC negotiations on REDD+

The Project sent Mr. Linthong Khamdy, Project Director, and Mr. Noriyoshi Kitamura, Chief Adviser, to SBSTA39 and other negotiations under UNFCCC in Warsaw, Poland, from Nov 11 to 20 2013 as official members of the Lao delegation. In addition, there were 2 staff from each of DFRM and DOF and the REDD+ adviser of FSCAP representing the forestry sector in the delegation. The forestry members also attended several side-events related to REDD+ including “REDD+: Study Safeguards from Field Experiences NOW!” jointly organized by JICA and ITTO on Nov 15, “REDD+ Safeguards: Possibility and challenges to develop safeguard information systems based on scientific approaches” jointly organized by Japan’s Forestry Agency and others on Nov 18, and “Facilitating Private Sector Participation in REDD+ Activities” jointly organized by Forest and Forest Products Research Institute of Japan, JICA and ITTO.

2.7 Personnel Deployment

The Experts were deployed as follows.



Chapter 3 Results and Achievements by Output

3.1 Output 1

The work related to output 1 can roughly be divided into accuracy assessment, carbon stratification and correction of the forest type maps and an overview of the respective workflow is shown in Figure 3-1. Accuracy assessment, a portion of carbon stratification and the ground truth survey for correction of the forest type map consist of work content conducted in the first year.

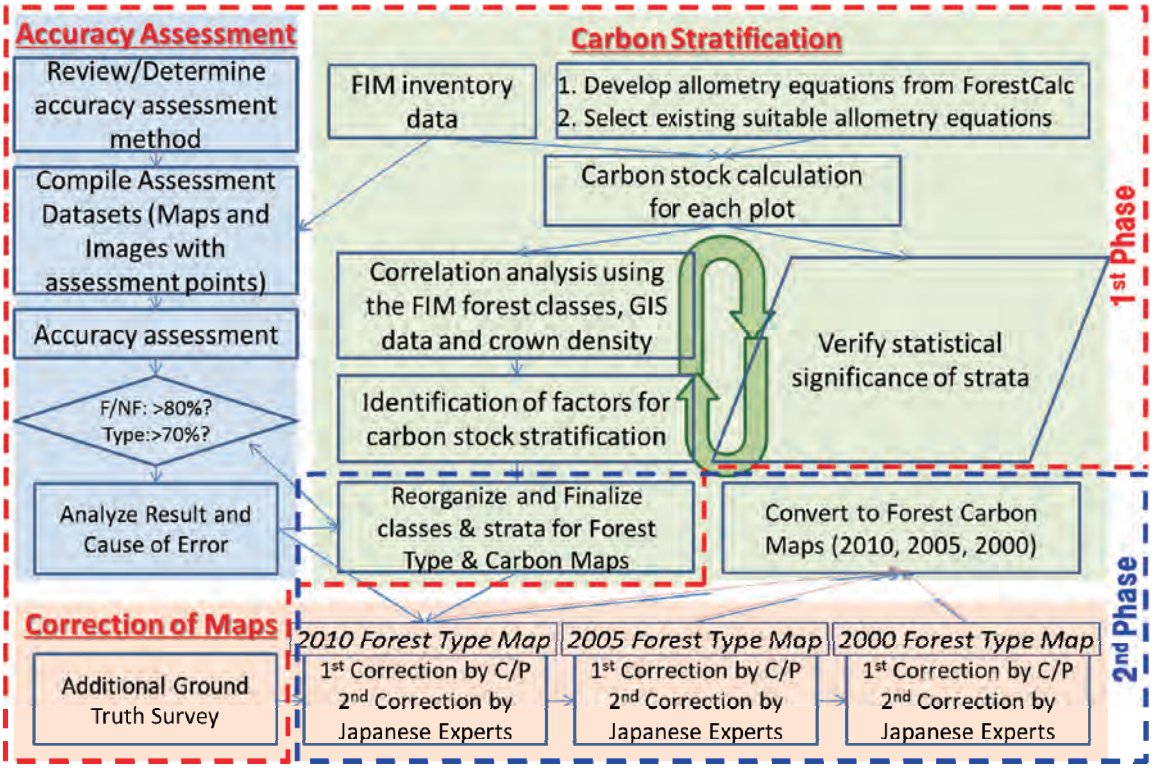


Figure 3-1: Work Flow Related to Output 1

3.1.1 Accuracy assessment of Forest Type Map (2010)

The accuracy assessment methodologies for the 2010 forest type map which will become the forest base map were determined after discussions with the C/P. The work flow related to accuracy assessment is shown in Figure 3-2.

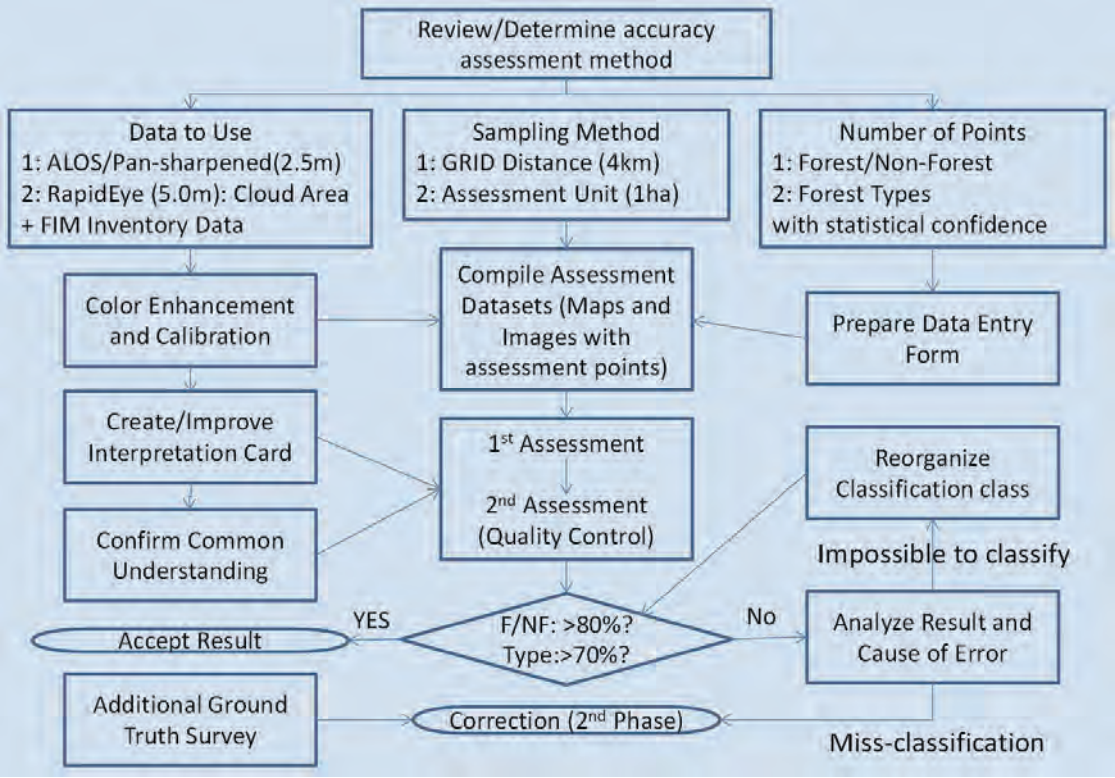


Figure 3-2: Work Flow Related to Accuracy assessment

The decision was made to generate points on a 4 km grid (Figure 3-3) and use this as the accuracy assessment sampling methodology, which is the methodology that is adopted by Japan and many other countries, calculate the number of samples required statistically, and select them randomly.

When the number of samples statistically required was calculated with an existing calculation formula1, it was found that 100 points per classification class would be adequate, including spare points. Since there are 13 classification classes, this results in a total of 1,300 points. The number of samples in each province and each classification class were calculated (Table 3-1) by multiplying the area of each province and each classification class by the ratio that the area accounts for out of the total area of the country. However, due to the fact that experience indicates that 75 sample points are required per classification class when the target area is wide ranging[1], the number of samples for classification classes for which the calculated number of sample was less than 75 was increased to 75 sample points (blue numbers in Table 3-1), and for classification classes for which the total number of points on the 4 km grid was less than 75 points, the decision was made to sample all points on the 4 km grid (red numbers in Table 3-1). After this, as shown in Figure. 3-4, the numbers of samples calculated from the points on the 4 km grid were randomly selected.

[1] Congalton RG, Green K (1999) Assenssing the accuracy of remotely sensed data: principles and practices, CRC Press

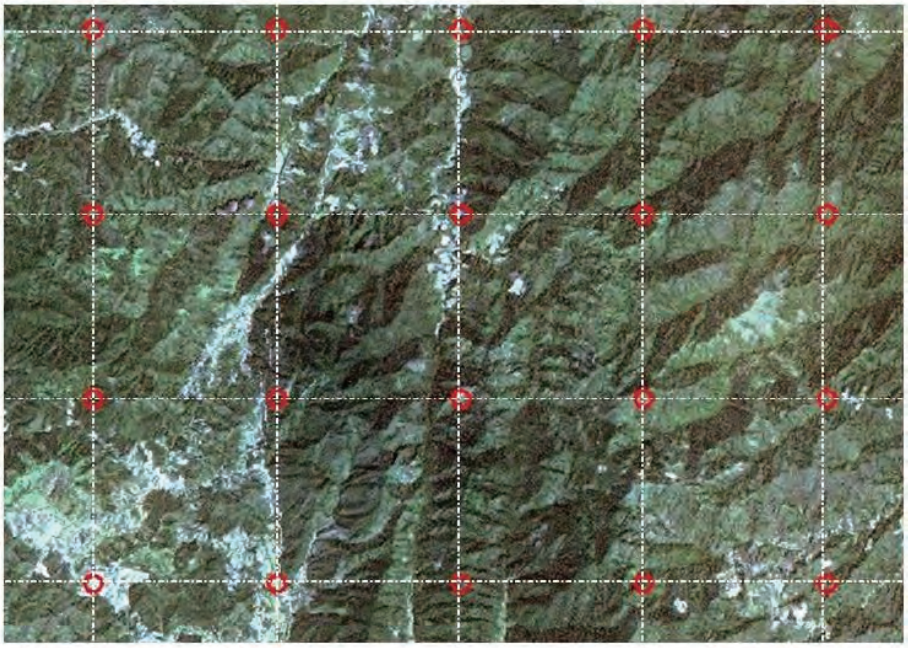


Figure 3-3: 4 km Interval Grid Points Made on Satellite Image

Table 3-1: Calculation of Number of Sample Points

Rate of occupied area by each provinces and classes in whole country

	Current Forest								Potential Forest				NF
	EF	DF	MED	CF	MCB	DD	EP	DP	B	OF	YF	SB	
Phongsaly	0.2%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.1%	0.5%	0.2%	0.4%
Luangnamtha	0.3%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.1%	0.2%	0.1%
Oudomxay	0.4%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%	0.1%	0.3%	0.1%
Luangprabang	0.5%	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	3.1%	0.2%	0.4%	0.5%
Houaphanh	0.0%	3.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	2.7%	0.1%	0.3%	0.4%
Bokeo	0.2%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.1%	0.1%	0.2%
Xiengkuang	0.2%	2.7%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	1.9%	0.2%	0.1%	0.7%
Xayaboury	0.6%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.4%	0.7%	0.2%	0.5%
Vientiane	1.2%	3.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1.3%	1.0%	0.2%	1.3%
Bolikhamxay	0.9%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.5%	0.3%	0.1%	0.6%
Vientiane Capital	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.0%	0.6%
Khammuane	0.9%	1.9%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	0.3%	0.1%	1.6%
Savannakhet	0.0%	3.0%	0.0%	0.0%	0.0%	1.5%	0.0%	0.1%	0.0%	2.8%	0.1%	0.3%	1.4%
Saravane	0.0%	1.8%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	0.0%	0.5%	0.1%	0.0%	1.0%
Sekong	0.1%	2.1%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	0.8%	0.0%	0.1%	0.2%
Champasak	0.1%	3.1%	0.0%	0.0%	0.0%	1.7%	0.1%	0.0%	0.0%	0.2%	0.1%	0.0%	1.2%
Attapeu	0.1%	2.7%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.1%	0.6%	0.0%	0.0%	0.4%

Number of sampling points for accuracy assessment

	Current Forest								Potential Forest				NF
	EF	DF	MED	CF	MCB	DD	EP	DP	B	OF	YF	SB	
Phongsaly	3	17	0	0	0	0	0	1	0	53	10	5	6
Luangnamtha	5	29	0	0	0	0	0	0	2	16	1	5	2
Oudomxay	5	28	0	0	0	0	0	0	0	27	2	7	2
Luangprabang	7	50	0	0	0	0	0	0	4	41	4	11	7
Houaphanh	0	48	0	0	0	0	0	0	21	35	2	9	6
Bokeo	2	21	0	0	0	0	0	0	2	12	1	3	2
Xiengkuang	3	35	0	1	1	0	0	0	10	24	4	3	11
Xayaboury	8	43	0	0	0	0	0	0	6	18	13	6	7
Vientiane	16	40	0	0	0	0	0	0	19	17	18	6	19
Bolikhamxay	12	42	0	0	0	0	0	0	4	20	6	3	9
Vientiane Capital	0	6	0	0	0	0	0	0	1	4	5	1	8
Khammuane	11	24	0	3	0	0	0	0	0	30	5	3	24
Savannakhet	0	39	0	0	0	23	0	1	0	37	2	8	21
Saravane	0	23	0	0	0	14	0	0	0	7	1	1	16
Sekong	1	27	0	1	0	4	0	0	0	11	0	3	3
Champasak	1	40	0	0	0	26	1	0	2	3	1	0	18
Attapeu	1	35	0	0	0	8	1	0	4	7	0	1	5
	75	547	0	49	17	75	19	21	75	362	75	75	166	1556

Calculating

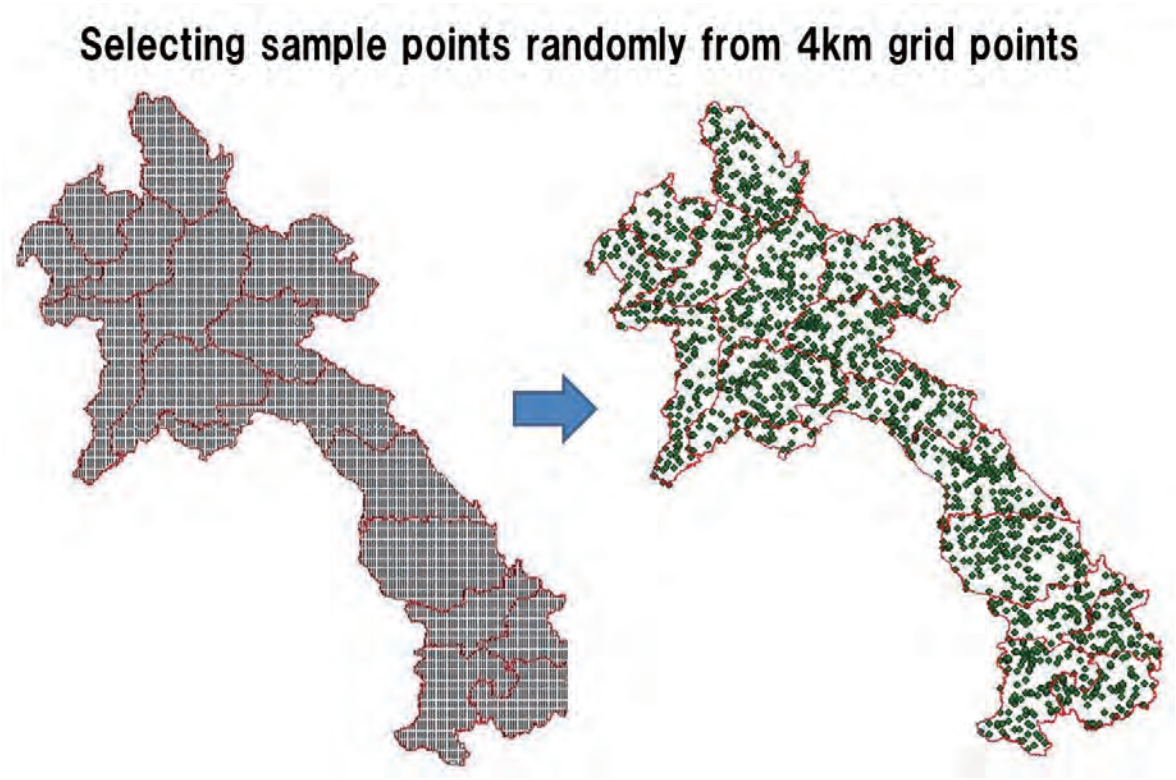


Figure 3-4: Allocation of Samples

The 2010 forest type map which was the subject of accuracy assessment was prepared using RapidEye images captured in 2010. The reference images used for accuracy assessment should be high resolution images. Due to the fact that the only images available which cover the entire country of Laos other than RapidEye images that were captured at the same time are the ALOS Pansharpen images captured in 2010, these images were mainly used as the reference images, and RapidEye images were substituted for images for which the time the images were captured differed (yellow frame in diagram) or locations where there were clouds (Figure 3-5). The difference in resolution of ALOS Pansharpen images and RapidEye images is shown in Figure 3-6. In addition, when an image is used for reference purposes, due to the fact that there are differences due to the impact from clouds and atmosphere when the images were captured, it is difficult to perform accuracy assessment in an appropriate manner without performing tone correction since the images appear different when displayed. In order to unify the tone of all images to the extent possible so the quality of accuracy assessment results is uniform, tone correction of all images was performed as shown in Figure. 3.7.

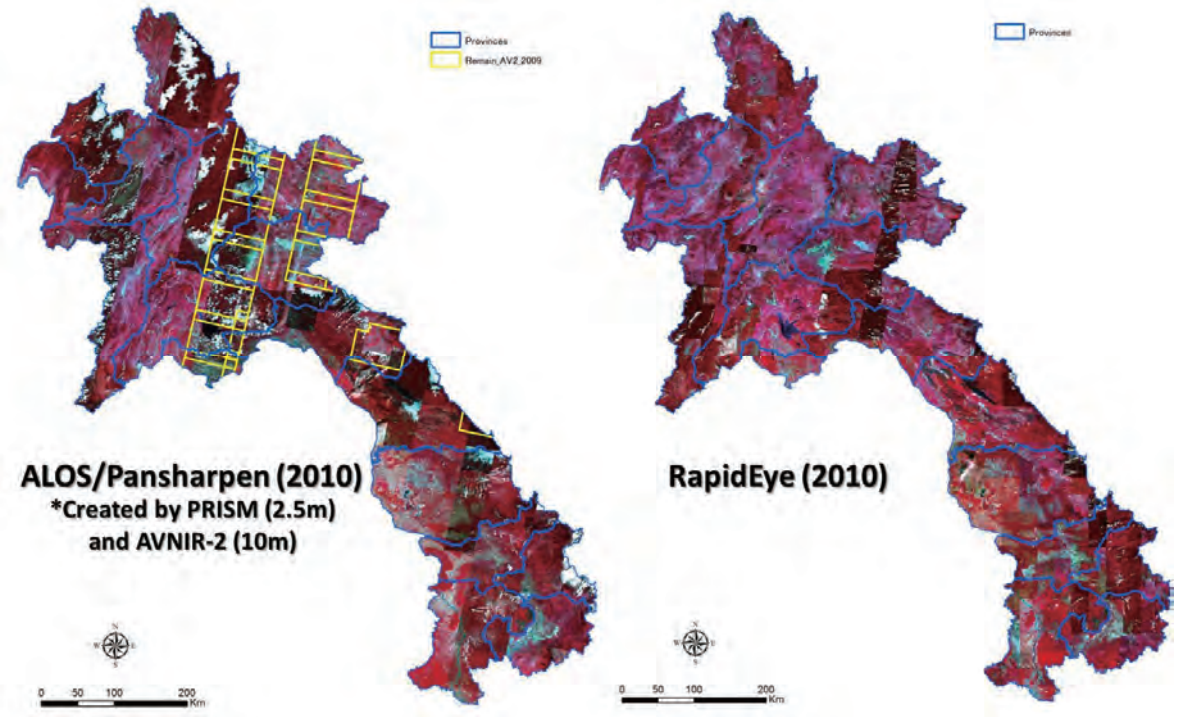


Figure 3-5: Satellite Images Used for Accuracy assessment (Left: ALOS Pansharpen, Right: RapidEye)

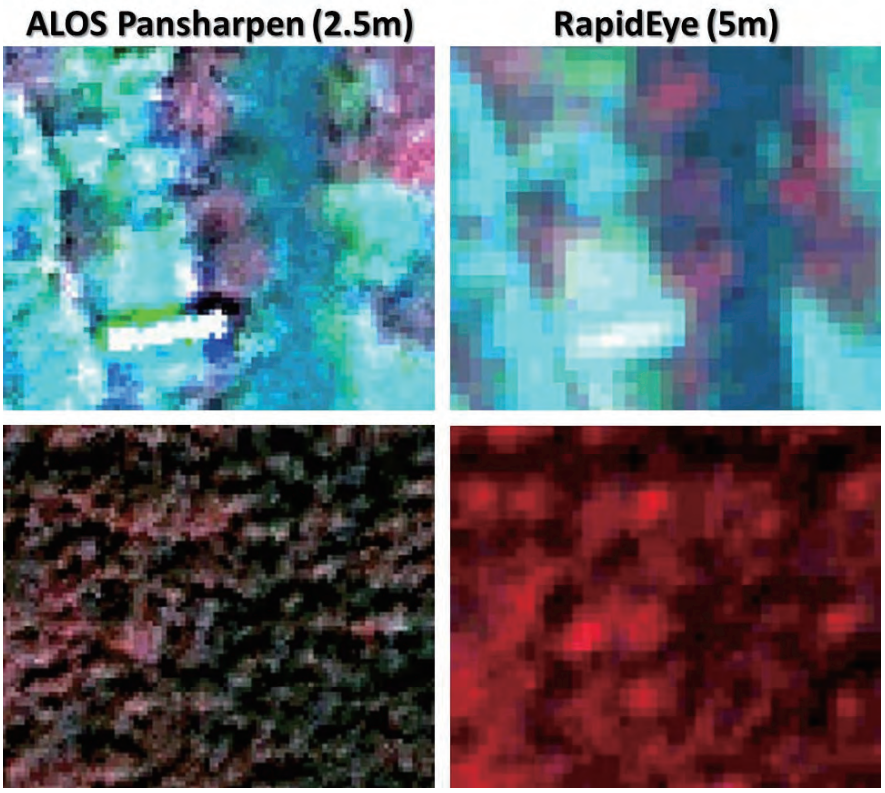


Figure 3-6: Difference in Resolution of Satellite Images Used for Accuracy assessment (Upper: Trees

and village along river, Lower: Forest)

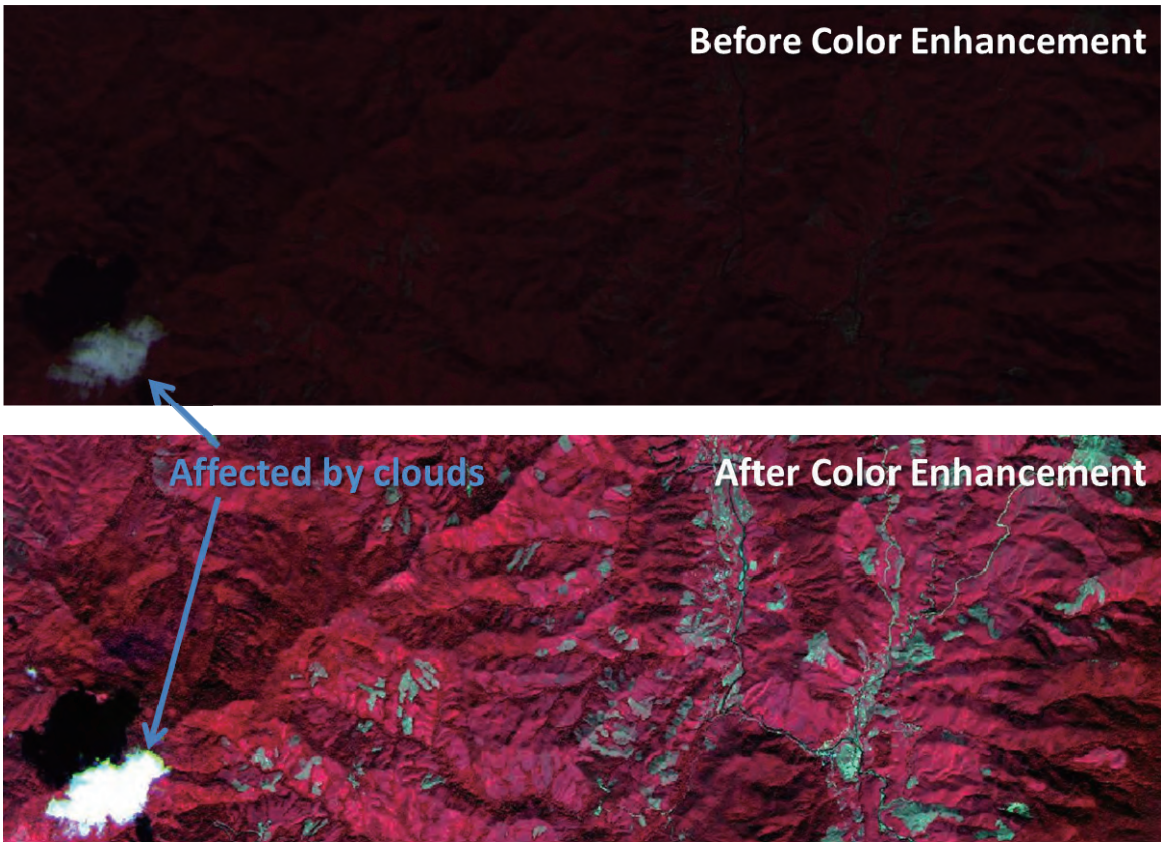


Figure 3-7: Tone Correction Image

The work flow for accuracy assessment is shown in Figure 3-8, and the implementation system is shown in Figure 3-9. The table in the upper part of Figure 3-9 shows the implementation system for the first accuracy assessment, the table in the middle part shows the implementation system for the second accuracy assessment, and the table in the lower part shows the allocation of provinces handled by each team. "FIM Inventory" in the tables in the upper / middle part of the diagram indicates the respective province when the FIM inventory study was performed, and "Assess" indicates the province for which work was performed during this accuracy assessment process. As shown in Figure 3-8 and Figure 3-9, the first accuracy assessment work was conducted by the C/P RS/GIS technical experts, and the second accuracy assessment work was conducted by senior RS/GIS technical experts with an advanced level of technology and wealth of experience in an effort to upgrade the quality. Furthermore, technical experts who worked on the forest study conducted during the FIM project who have a good knowledge of local conditions were designated as the persons in charge, and the technical experts were placed in charge of accuracy assessment of the province that they were actually in charge of at that time. In addition, the Japanese RS/GIS technical experts conducted final third accuracy assessment work, with a focus on sample points for which the reliability was thought to be low during the first / second accuracy assessment in an effort to further boost quality. Furthermore, at the end of each work day, some of the work results of that day were checked by all staff in

an effort to share interpretation standards to facilitate quality management (Figure 3-10).

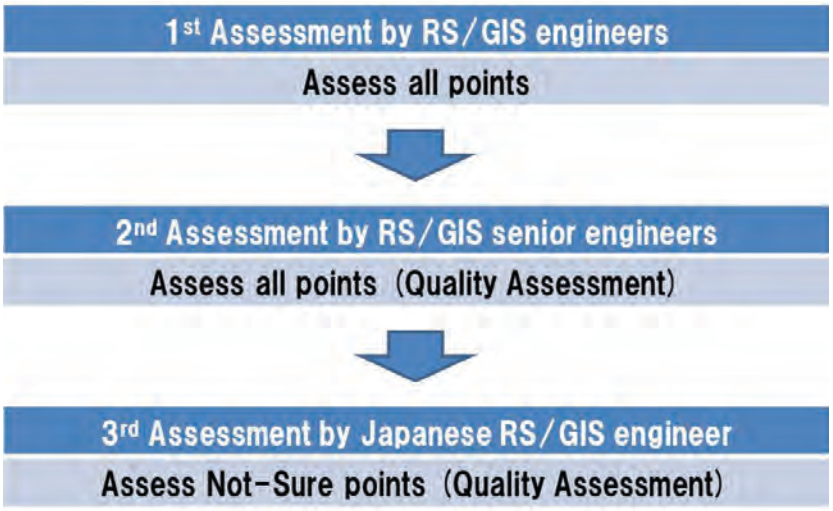


Figure 3-8: Accuracy assessment Work Flow

Team	1st Assessor	FIM Inventory	Assess	Supporter
1	Phouthone	1	1	Chansamouth
2	Keovilay	2	2	Khamsouk
3	Kongsy	0	3	Bounthanome
4	Souvanna	6	4	Khamkhong
5	Piya	5	5	Onkeo
6	Somxay	6	6	Amphaivanh
	Siamphone	0	6	

Team	2nd Assessor	FIM Inventory	Assess
1	Chansamouth	1	1
2	Khamsouk	2	2
3	Bounthanome	3	3
4	Khamkhong	4	4
5	Onkeo	5	5
6	Amphaivanh	6	6

Team	Provinces for each teams			
1	Ponsaly	Oudomxay		
2	Xaybuly	Luannamtha	Bokeo	
3	Luangphabang	Xienkuang	Houaphang	
4	Vientian C	Vientiane	Bolikamxay	Xaisomboune
5	Khamouan	Swamnakeht	Salavang	
6	Champasak	Sekong	Attaphou	

Figure 3-9: Accuracy assessment Implementation System

Figure 3-10: Accuracy assessment of the day's results checked by all staff members

The thinking on the target range of judgments on interpretation when accuracy assessment was performed was determined as shown in Figure 3-11 after discussions with the C/P. First, the uniform land cover / usage range that included the selected sample points was referred to, and when the area of this range was 0.5 ha or more (one forest definition in Laos), this range was judged as a target area. However, when the area of this range was less than 0.5 ha, the decision was made to use the adjoining area in this range with uniform land cover / usage for which the borderline is the longest and the area is 0.5 ha or more. The reason for this is that polygons which were less than the Lao's forest definition and minimum mapping unit definition of 0.5 ha were integrated with adjacent polygons with the ArcGIS elimination process, and an algorithm was used to integrate polygons that were integrated by this process with an adjacent polygon that has the longest shared borderline.

The judgment procedure consisted of first making the judgment as to whether an area is forest or non-forest, and next making the judgment on the respective forest type (Figure 3-12). The reason for this is that the decision was made that the judgment of forest / non-forest is more important since the national level forest type map accuracy that is currently required internationally is forest / non-forest classification accuracy. Regarding the judgment of forest type, while the classification class that belongs to the Current Forest group which currently satisfies the forest definition of Laos does not include shifting cultivation areas,

since there have been discussions on whether or not shifting cultivation land which belongs to the Potential Forest group should be considered forests, when reported internationally, the decision was made to make judgments of these areas as a precautionary measure. The decision was also made to lump together all other classification classes as non-forest areas.

In addition, after discussions with the C/P, the decision was made to make a judgment at two scales as shown in Figure 3-13: 1/25,000 and 1/5,000. Details can be confirmed at a scale of 1/5,000, but by also confirming the land use status in the surrounding area, the accuracy of judgments can be enhanced. When the scale is not predetermined, it would mean that judgments would be made at each scale separately, and this causes fluctuations in the quality of judgment results. Therefore, the scale when judgments are made should be fixed.

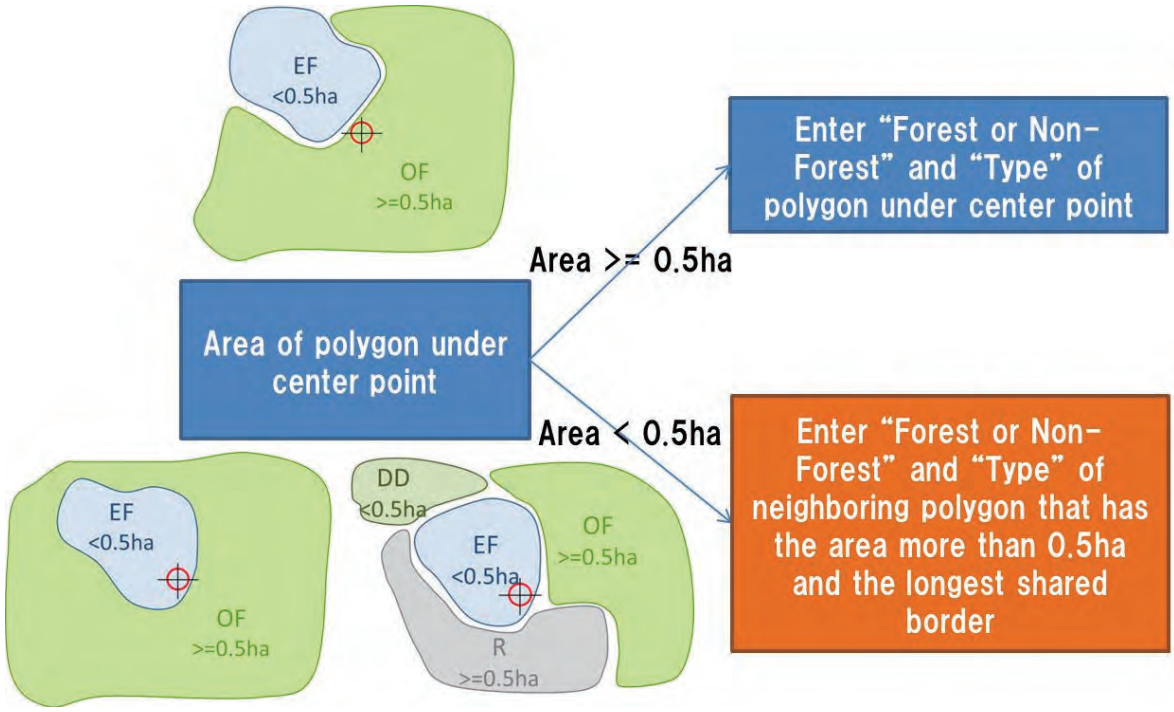


Figure 3-11: Approach to Target Range Judged

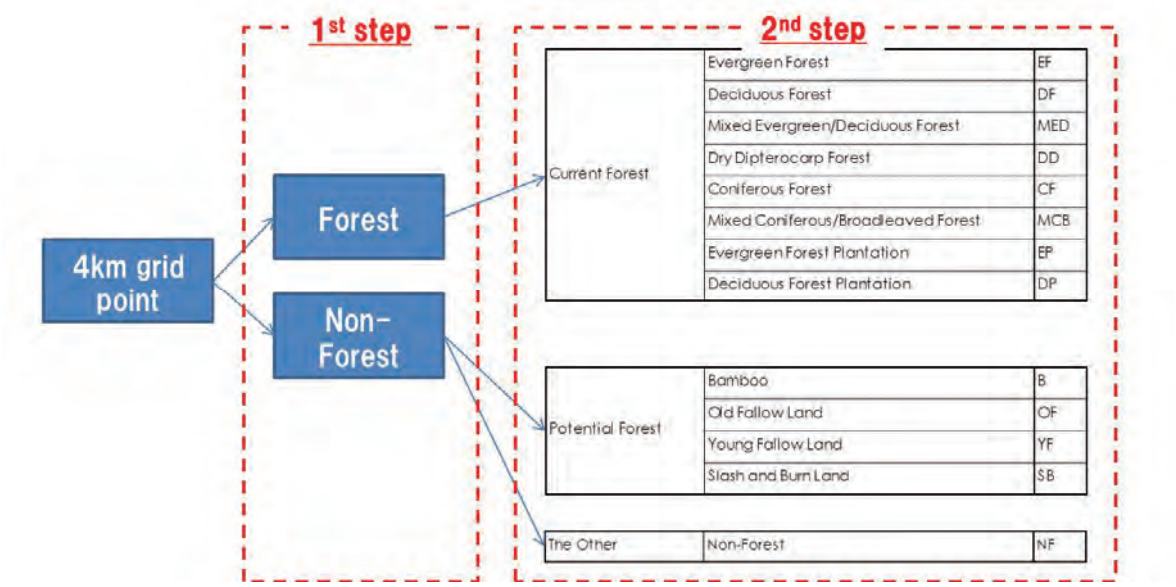


Figure 3-12: Judgment Steps

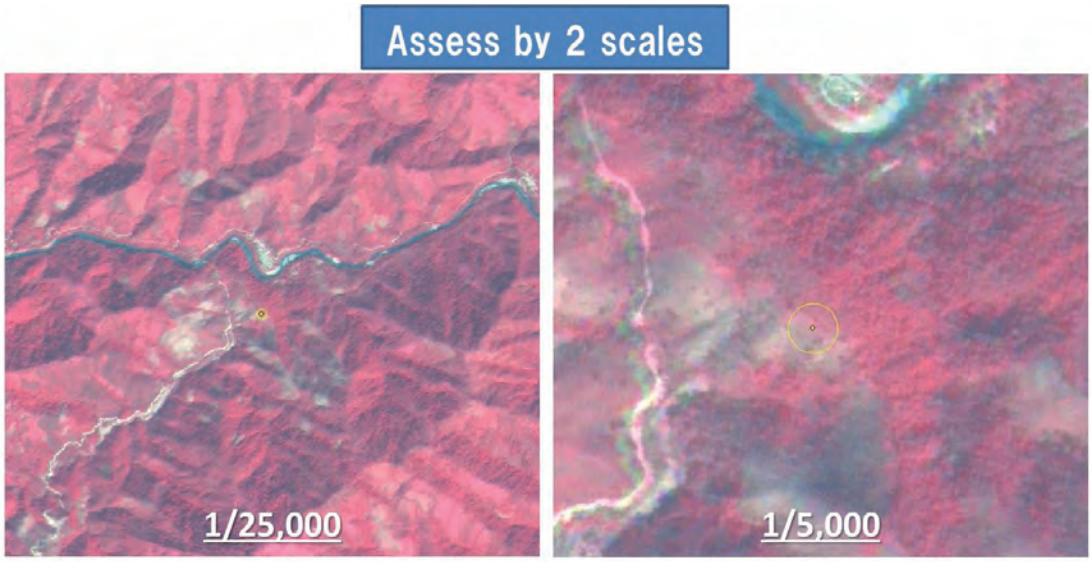


Figure 3-13: Scale Used for Judgment

The work flow after accuracy assessment is performed is shown in Figure 3-14. When the accuracy assessment results do not have an accuracy of 80% or more for forest / non-forest classification, and when the classification accuracy of forest types specifically mentioned in the specifications does not have an accuracy of 70% or more, the cause for the low level of classification accuracy is to be analyzed. When the cause is a judgment mistake, efforts are made to boost the judgment capacity based on the results of the ground truth survey conducted in the first year, and judgment correction of the forest type map is performed in the second year. However, when the judgment is made that classification is difficult with only the information that can be obtained from the images and field knowledge of the C/P, integration with other

classification classes needs to be performed in an effort to boost classification accuracy.

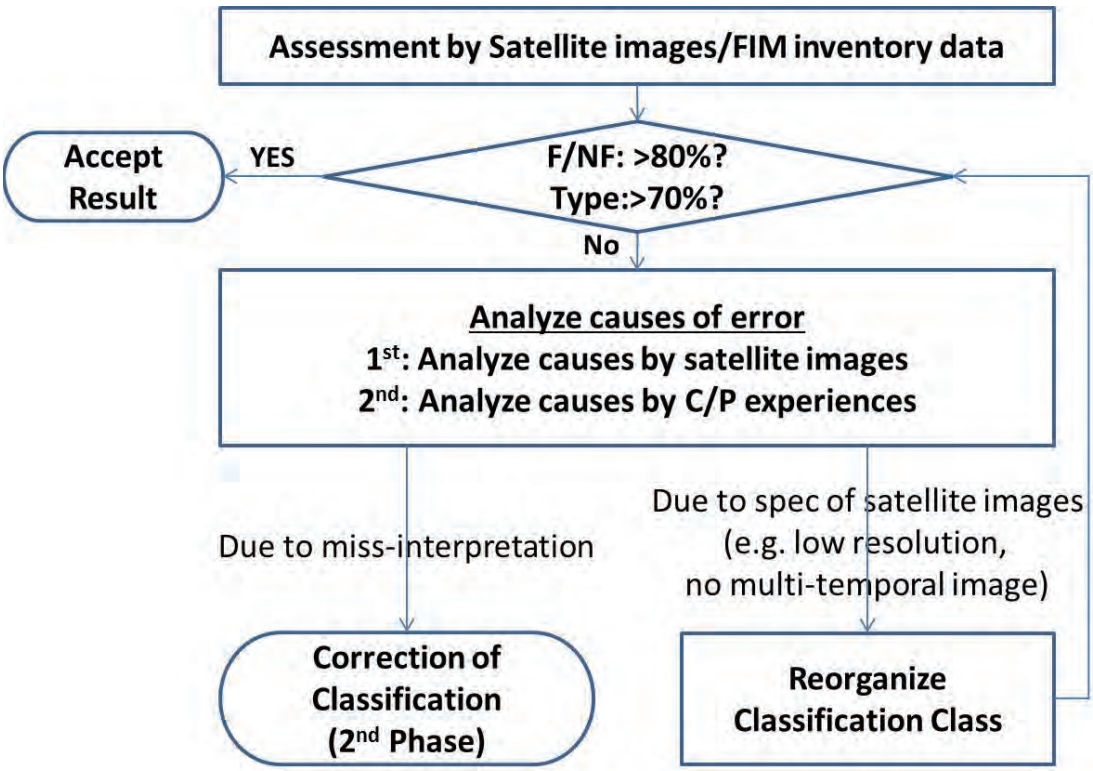


Figure 3-14: Work Flow after Accuracy assessment Performed

Training that included practical training was implemented for the accuracy assessment methodologies that had been determined, and a simple test was given in an attempt to judge the level of understanding by the trainees. Training in Japan was first conducted for four senior technical experts, and after that, training was conducted locally for the other technical experts. The test results improved after training compared to before training, indicating that a certain extent of progress was made with technology transfer as a result of training. In addition, continued OJT practical training was performed after this to further enhance the level of technology.

The verification results of the forest / non-forest classification accuracy on the 2010 forest type map that was inferred in accordance with the above described accuracy assessment methodologies is shown in Table 3-2, Error Matrix for Forest / Non-Forest Classification. Due to the fact that the Shifting cultivation land classification class in the Potential Forest group is defined at this point in time as non-forest in Laos, it was treated as non-forest during this accuracy assessment. This resulted in an overall accuracy of 72.8% in the classification of forest / non-forest areas. While this is lower than the forest / non-forest classification accuracy of 80% that was specially designated for this project, it is a figure that can most likely be achieved by means of the correction work in the second year.

Table 3-2: Error Matrix for Forest / Non-Forest Classification

		Assessment data			
		Forest	Non-Forest	Total	U.A
Map	Current Forest	530	213	743	71.3%
	Potential Forest	147	379	526	74.5%
	NF	28	131	159	
	Total	705	723	1428	
	P.A	75.2%	70.5%		
Overall Accuracy		72.8%			

The verification results for forest type classification accuracy of the 2010 forest type map are shown in Table 3-3, Error Matrix for Forest Type Classification. As mentioned above, due to the fact that the Shifting cultivation land classification class in the Potential Forest group is defined at this point in time as non-forest in Laos, it was treated as non-forest along with other such classification classes. This resulted in an overall accuracy of 61.8% in the classification of forest types. While this is lower than the forest type classification accuracy of 70% that was the goal for this project, it is a figure that can most likely be achieved by means of integration of sorting items and correction work in the second year.

Table 3-3: Error Matrix for Forest Type Classification

			Assessment data										
			Current Forest								NF	Total	U.A
			EF	DF	MED	DD	CF	MCB	EP	DP	NF		
Map	Current Forest	EF	15	48							5	68	22.1%
		DF	35	291		20	3	1			147	497	58.6%
		MED									0	0	
		DD		9		34			1		31	75	45.3%
		CF	1	15		4	15	3			11	49	30.6%
		MCB		2			8	5			2	17	29.4%
		EP							15		4	19	78.9%
		DP		5					2		11	18	0.0%
	NF	NF	15	117	0	34	5	2	2	2	508	685	74.2%
	Total		66	487	0	92	31	11	20	2	719	1428	
	P.A		22.7%	59.8%		37.0%	48.4%	45.5%	75.0%	0.0%	70.7%		
Overall Accuracy			61.8%										

In order to allow analysis of the verification results of the forest type classification accuracy in further detail, the accuracy assessment results including the Shifting Cultivation area classes in the Potential Forest group are shown in Table 3-4, Error Matrix regarding the classification classes for which a User Accuracy (U.A.) of 70% was not achieved that indicates the level of conformity with the classification class judged in classification class accuracy assessment of the forest type map, the causes were analyzed. In addition, Table 3-5 shows the number of samples for which the person making the judgment during accuracy assessment was sure and the number of samples the person was not sure. In addition, Table 3-6 shows the results of the main reasons the staff were not sure verified through interviews of the C/P. The causes for the low accuracy were analyzed as described below along with the information in these tables, and a proposal for dealing with these issues in the future was examined. Furthermore, the ground truth survey results completed in mid-March were also referred to, but detailed study / consideration of the ground truth survey results needs to be performed after a comparison on the image is performed, and the proposal for dealing with problems may be changed depending on these results.

Table 3-4: Error Matrix for Forest Type Classification, Including Potential Forest Classes

			Assessment data														
			Current Forest								Potential Forest				NF	Total	U.A
			EF	DF	MED	DD	CF	MCB	EP	DP	B	OF	YF	SB	NF		
Map	Current Forest	EF	15	48							1	4				68	22.1%
		DF	35	291		20	3	1			22	103	6	5	11	497	58.6%
		MED														0	
		DD		9		34			1			9	1		21	75	45.3%
		CF	1	15		4	15	3			1	10				49	30.6%
		MCB		2			8	5							2	17	29.4%
		EP							15						4	19	78.9%
		DP		5					2			5	3		3	18	0.0%
	Potential Forest	B	2	17				1			19	17	6		8	70	27.1%
		OF	10	77		21	2				27	141	16		27	321	43.9%
		YF	1	5		1	1	1		2	4	19	11	3	23	71	15.5%
		SB		3		3	1				2	5	13	13	24	64	20.3%
	NF	NF	2	15		9	1	0	2	0	2	6	6	1	115	159	72.3%
	Total		66	487	0	92	31	11	20	2	78	319	62	22	238	1428	
	P.A		22.7%	59.8%		37.0%	48.4%	45.5%	75.0%	0.0%	24.4%	44.2%	17.7%	59.1%	48.3%		

Table 3-5: Number of Sample Persons Making Classification Sure / Not-Sure

	Current Forest								Potential Forest				NF	Total
	EF	DF	MED	DD	CF	MCB	EP	DP	B	OF	YF	SB	NF	
Sure	40	246		62	10		19		8	116	28	17	175	721
Not-Sure	26	241		30	21	11	1	2	70	203	34	5	63	707
Total	66	487	0	92	31	11	20	2	78	319	62	22	238	1428
Rate of Sure	60.6%	50.5%		67.4%	32.3%	0.0%	95.0%	0.0%	10.3%	36.4%	45.2%	77.3%	73.5%	50.5%

Table 3-6: Reasons Person Making Classification Not-Sure

	Reason 1	Reason 2
DF	not sure DF or EF	not sure DF or OF
CF	not sure CF or MCB	not sure CF or DF
MCB	not sure MCB or CF	
DP	not sure DP or EP	
B	not sure B or YF or OF or DF	
OF	not sure OF or YF	not sure OF or DF
YF	not sure YF or OF	

Many EF (Evergreen Forest) areas were incorrectly classified as DF (Deciduous Forest). In addition, the reason for the person not being sure also indicates there was difficulty in judging between EF and DF. A report has also been made that classification of EF and DF is difficult in Luang Phabang province, and this was confirmed during the ground truth survey implemented in the first year, but due to the fact that there is a clear difference in biomass volume between EF and DF as described later in "3.1.3 Identifying Factors with a High Correlation with Carbon Stock", methodologies to enhance accuracy by means of zoning with existing GIS data (altitude, amount of rainfall, etc.) will be reviewed.

Many DF (Deciduous Forest) areas were incorrectly classified as OF (Old Fallow Land). The reason for not being sure also indicates there was difficulty making the judgment between DF and OF areas. SB (Slash and Burn Land) immediately after it is burned, YF (Young Fallow Land), OF (Old Fallow Land) and secondary DF are continuous in a time series, and it was known from experience during preparation of the forest type map and discussions with the C/P that classification was difficult except for SB areas where no vegetation can be found immediately after Slash and Burn is performed. Since there are limits to the level of accuracy that can be obtained using images from only one time period, the procurement of PALSAR data from multiple time periods will be proposed in the second year, and SB areas will be tracked over multiple years in an attempt to upgrade accuracy by determining OF areas for locations where slash and burn was performed over the last several years. In addition, the classification of DF and OF is made by judging whether or not the tree canopy texture can be seen, but the judgment capability of the C/P is considered to be inadequate at the current point in time. Therefore, training will be conducted in an effort to upgrade the judgment capability of the C/P, with the goal of boosting the accuracy of DF and OF classification in combination with the above multiple period analysis.

MED (Mixed Evergreen and Deciduous Forest) are not classified on the forest type map, and it became clear by checking with the C/P that these areas were classified as MD (Mixed Deciduous Forest), which is a previous classification class that combines DF and MED. In practice, it is difficult to distinguish between

DF and MED, and since combining these classification classes as MD is more practical, a proposal will be made that they be combined.

Many DD (Dry Dipterocarp Forest) areas were incorrectly classified as NF (Non-Forest) areas, which is most likely the result of incorrect classification as Scrub, Savannah or Rice Paddy which have the same distribution area. These color tones are similar, and an advanced level of interpretation capability is required to perform classification. Since an interpretation key has been verified for these areas by the ground truth survey conducted in the first year, training will be performed to boost interpretation capacity in the second year in order to improve accuracy.

Many CF (Coniferous Forest) areas were incorrectly classified as DF or OF. In addition, the reason for not being sure also indicates there was difficulty making the judgment between CF and DF areas. When checks were made on these points in the field during the ground truth survey implemented in the first year, it was found that the differences in tone / texture between CF and DF / OF could be confirmed on the image. Therefore, training will be performed in the second year to upgrade interpretation capacity in order to boost accuracy.

Many MCB (Mixed Coniferous and Broadleaved Forest) areas were incorrectly classified as CF. In addition, the reason for not being sure also indicates there was difficulty making the judgment between MCB and CF. When checks were made on these points in the field during the ground truth survey implemented in the first year, it was found that it is difficult to make a clear distinction between MCB and CF. However, since there is a clear difference in the biomass volume between CF and MCB as described later in "3.1.3 Identifying Factors with a High Correlation with Carbon Stock", classification needs to be performed. The results of the ground truth survey will be checked in detail, an interpretation key for MCB and CF will be clarified, and this will be used to conduct training to upgrade interpretation capability in the second year in order to boost accuracy.

Many DP (Deciduous Plantation Forest) areas were incorrectly classified as DF or OF. Experience up until now during preparation of the forest type map and discussions with the C/P indicate there is a tendency to incorrectly classify DP areas as Rice Paddy areas, but since there is a clear difference in the color tone of DF and OF, it should be possible to perform classification. However, although it was perceived that DP areas were only teak forests, it was confirmed during the ground truth survey conducted in the first year that rubber forests in the northern part of the country were deciduous. However, clear partitions cannot be seen on images where rubber forests are located in the north due to the fact that they are planted on mountain slopes. Therefore, there is a high possibility that they may be incorrectly classified on the image as OF areas. However, the age of many of these rubber forests is young, with most of the forests thought to have been recently planted as of 2010. Furthermore, since rubber forests are often planted on abandoned Shifting

cultivation land areas, classifying them as OF as of 2010 matches the actual situation to a certain extent, so it is not considered to be a major problem. In addition, teak forests can be classified since there are characteristic tones on the image, and due to the fact there are clear partitions for the large-scale rubber forests in the central south for which it has been confirmed there are no deciduous, classification can be performed. However, the C/P has stated that personnel have trouble making the judgment as to EP or DP due to the reason of not being sure, meaning that these classifications are difficult. Therefore, the decision as to whether or not to combine EP and DP will be made after discussions with the C/P on the issue of whether or not to treat rubber forests as EP, and how much value there is in classifying teak forests.

This completes all of the forest types at this point in time. There are still the shifting cultivation area classification classes (B/OF/YF/SB) for which discussion on IPCC land use classification is being conducted on whether or not to classify them as forests, and an analysis / review of proposal for how to deal with the issue were conducted as described below.

Many B (Bamboo) areas were incorrectly classified as DF or OF. In addition, the reason for not being sure also indicates there was difficulty making the judgment between B and DF / OF / YF areas. It has been ascertained during preparation of the forest type map to date and from the experience of discussions with the C/P that it is difficult to classify B areas, but when confirmation was performed in the field during the ground truth survey implemented in the first year, it was verified that it is extremely difficult to classify these areas on the image. Therefore, since there is mixed distribution of OF and YF in shifting cultivation areas with almost all B areas, these areas should be integrated with OF and YF areas. After this, as proposed in the above DF section, the proposal will be made to analyze PALSAR images from multiple time periods in order to enhance the classification accuracy with respect to DF areas.

Many OF and YF areas are incorrectly classified as DF and OF / NF areas respectively. As stated in the DF section, classification is difficult since the shifting cultivation area classification classes are continuous as a time series. Therefore, OF and YF areas should be integrated along with B areas. In addition, as proposed in the DF section, the proposal will be made to analyze PALSAR images from multiple time periods in order to enhance the classification accuracy with respect to DF areas.

It is not difficult to classify SB areas from other vegetation since the land is bare immediately after it is burned. However, it is easy to incorrectly classify them as Rice Paddy areas for which the tone is similar. Nevertheless, while many SB areas are on mountain slopes, since Rice Paddy areas are generally located in valleys or on level ground, by referring to information on slopes / topography in order to make corrections, it should be possible to upgrade classification accuracy.

The proposal for the policy to deal with the various issues is compiled in Table 3-7, and a comparison of the classification classes for which proposed integration is reflected and the existing classification classes is

shown in Table 3-8.

Table 3-7: Proposal for Policy to Deal with Classification classes with Low Classification Accuracy

EF/DF	Make zoning by DEM or amount of rainfall or shifting cultivation area Train interpretation skill
DF/OF	Refer differences detected by multi-temporal PALSAR data Train interpretation skill
DF/MED	Integrate classes
DD/NF	Train interpretation skill
CF/DF/OF	Train interpretation skill
CF/MCB	Train interpretation skill
EP/DP	Integrate classes
OF/YF	Integrate classes
SB/NF (RP)	Refer slope/topographic information

Table 3-8: Classification classes Before/After Integration (Proposed)

Class Groups	Proposed Class Items when FIM started		Idea of Integrated Class Items for National Level (Draft)	
Current Forest	Evergreen Forest	EF	Evergreen Forest	EF
	Deciduous Forest	DF	Mixed Deciduous Forest	MD
	Mixed Evergreen/Deciduous Forest	MED		
	Dry Dipterocarp Forest	DD	Dry Dipterocarp Forest	DD
	Coniferous Forest	CF	Coniferous Forest	CF
	Mixed Coniferous/Broadleaved Forest	MCB	Mixed Coniferous/Broadleaved Forest	MCB
	Evergreen Forest Plantation	EP	Forest Plantation	P
	Deciduous Forest Plantation	DP		
Potential Forest	Bamboo	B	Fallow Land	FL
	Old Fallow Land	OF		
	Young Fallow Land	YF		
	Slash and Burn Land	SB	Slash and Burn Land	SB
Other Wooded Area	Savannah/Open Woodland	SA	Savannah/Open Woodland	SA
	Scrub, Heath	SR	Scrub, Heath	SR
Permanent Agriculture Area	Rice Paddy	RP	Rice Paddy	RP
	Agriculture Plantation	AP	Agriculture Plantation	AP
	Other Agriculture Area	OA	Other Agriculture Area	OA
Other Non-Forest Area	Grassland	G	Grassland	G
	Swamp	SW	Swamp	SW
	Rock	R	Rock	R
	Barren Land	BL	Barren Land	BL
	Urban Area	U	Urban Area	U
Water	Water	W	Water	W
Other Land	Other Land	O	Other Land	O
Other	Cloud	CL	Cloud	CL
	Shadow	SH	Shadow	SH

3.1.2 Correction of Forest Type Map (2000, 2005, 2010)

Regarding the ground truth survey that is required for correction work, training on an overview and planning was conducted on January 31st and February 19th, and training on implementation was conducted on February 20th (Figure 3-15). There were 12 and 11 participants respectively. Training on implementation was only conducted one day this time, and a comment was obtained during a discussion with Mr. Soukanh when the ground truth survey was performed that some of the technical experts had limited experience in field surveys, making it difficult for them to accurately judge the forest type, and that training was required in accordance with the vegetation in each area. In addition, since a similar comment was made by Mr. Khamphay at the report meeting on the results of the first field survey, it was designated as an issue to be addressed in the future.

Figure 3-15: Training on Overview / Planning (Left)　Training on Implementation (Right)

After training was conducted, a study team was formulated as shown in Figure 3-16, and a ground truth survey was performed. The provinces that each FIPD team was in charge of are shown in the bottom portion of Figure 3-16. The decision was made to have the Japanese team travel throughout the country of Laos. Each FIPD team was allocated provinces for which the FIPD team members would actually be in charge of performing correction work for the forest type map, and since the Japanese technical experts were in charge of correction work for the entire country, the scope of their study was the entire country. Furthermore, Ms. Takanushi on the Japanese team was added to the study in preparation for domestic correction work (in Japan), with the cost being covered by Kokusai Kogyo Co., Ltd. The itinerary for the Japanese team is shown in Table 3-9. In addition, the objectives of the ground truth survey conducted this time are described below.

(1) Confirm land cover / use for uncertain areas on satellite images in order to correct the forest type map.

(2) Confirm typical land cover / use throughout Laos to allow Japanese technical experts to conduct

domestic correction work.

(3) Measure the canopy diameter of trees in areas defined as minimum forest size in Laos (Tree height 5m, etc.).

(4) Confirm locations where there is uncertainty in accuracy assessment work.

The field notebook shown in Figure 3-17 was used to conduct the study. The main objectives of this study are described in item (1) and (2) above, but in order to confirm whether or not the trees defined as the minimum size in Laos can be seen on the satellite images, in addition to the objective described in item (3), the decision was made to include "3. Measure Trees of Minimum Size of Forest" in the field notebook. In addition, a portion of the maps used for this study (total of 77) are shown in Annex 4. An overall map and detailed maps were prepared. In order to provide an understanding of how the overall map changed, 2005 and 2000 version maps were prepared.

FIPD Teams

	FIPD (Leader)	FIPD				
1	Chansamouth (1)	Piya (5)	Driver	PAFO	DAFO	Villager
2	Khamsouk (2)	Keovilay (2)	Driver	PAFO	DAFO	Villager
3	Sombath (*)	Kongsy (*)	Driver	PAFO	DAFO	Villager
4	Khamkhong (4)	Souvanna (6)	Driver	PAFO	DAFO	Villager
5	Onkeo (5)	Phouthone (1)	Driver	PAFO	DAFO	Villager
6	Amphaivanh (6)	Siamphone (*)	Driver	PAFO	DAFO	Villager

Japanese Teams

	FIPD	Japanese 1	Japanese 2		
1	Soukanh	Kajiwara	Takanushi	Driver	PAFO
2	Khamma	Nasu	Furuya	Driver	

Provinces for each FIPD Teams

1	Phonsaly	Oudomxay		
2	Xayabuly	Luangnamtha	Bokeo	
3	Luangprabang	Xiengkuang	Houaphang	
4	Vientian C	Vientiane	Bolikamxay	Xaisomboune
5	Khamouan	Svannahket	Saravane	
6	Champasak	Sekong	Attapeu	

Figure 3-16: Study Implementation System

Table 3-9: Japanese Team Itinerary

GT Survey Schedule for Japanese Teams

Date			Transfer		GT Survey	Accomodation	Nasu	Furuya	Kajiwara	Takanushi
2/24	Mo	AM	Vientiane to Oudomxay	Airplane		Oudomxay Hotel	○	○	○	○
		PM	Airport to Oudomxay Hotel	4WD						
2/25	Tu	AM	Oudomxay Hotel to Luangnamtha Hotel	4WD		Luangnamtha Hotel	○	○	○	○
		PM		4WD	Nam Ha NBCA					
2/26	We	AM	Luangnamtha Hotel to south Luangnamtha	4WD		Luangnamtha Hotel	○	○	○	○
		PM		4WD	South Luangnamtha					
2/27	Th	AM	Luangnamtha Hotel to Oudomxay Hotel	4WD		Oudomxay Hotel	○	○	○	○
		PM		4WD	South Oudomxay					
2/28	Fr	AM	Oudomxay Hotel to Nong Khiaw	4WD	Oudomxay to Houaphang	Viang Thong Hotel	○	○	○	○
		PM	Nong Khiaw to Viang Thong Hotel	4WD	Oudomxay to Houaphang					
3/1	Sa	AM	Viang Thong Hotel to Xam Nua Hotel	4WD		Xam Nua Hotel	○	○	○	○
		PM		4WD	Houaphang					
3/2	Su	AM	Xam Nua Hotel to Phonsavan Hotel	4WD	Houaphang to Xiengkuang	Phonsavan Hotel	○	○	○	○
		PM	Xam Nua Hotel to Phonsavan Hotel	4WD	Houaphang to Xiengkuang					
3/3	Mo	AM	Phonsavan Hotel to south Luangphabang	4WD		Phonsavan Hotel	○	○	○	○
		PM		4WD	South Luangphabang / Xiengkuang					
3/4	Tu	AM	Xiengkuang to Vientiane	Airplane		Vientiane Hotel	○	○	○	○
		PM	Airport to Vientiane Hotel	Hotel pick-up						
3/5	We	AM	Organize the data	4WD		Vientiane Hotel	○	○	○	○
		PM	Organize the data	4WD						
3/6	Th	AM	Vientiane Hotel to Savannakhet Hotel	4WD	VTE to SVK by car	Savannakhet Hotel	○	○	○	○
		PM	Vientiane Hotel to Savannakhet Hotel	4WD						
3/7	Fr	AM	Savannakhet Hotel to Phou Xang He NBCA?	4WD		Savannakhet Hotel	○	○	○	○
		PM		4WD	Phou Xang He NBCA					
3/8	Sa	AM	(SVK to VTE by airplane for Nasu)	Airplane	Savannakhet to Pakse	Pakse Hotel	○	○	○	○
			Savannakhet Hotel to Pakse Hotel	4WD						
		PM	Savannakhet Hotel to Pakse Hotel	4WD	Savannakhet to Pakse					
3/9	Su	AM	Pakse Hotel to Pakxong	4WD	Bolaven Highland	Attapu Hotel		○	○	○
		PM	Pakxong to Attapu Hotel	4WD	Bolaven to Attapu					
3/10	Mo	AM	Attapu Hotel to Pakse Hotel	4WD	Attapu to Pakse	Pakse Hotel		○	○	○
		PM	Attapu Hotel to Pakse Hotel	4WD	Attapu to Pakse					
3/11	Tu	AM	Pakse to Vientiane	Airplane		Vientiane Hotel		○	○	○
		PM	Airport to Vientiane Hotel	Hotel pick-up						
3/12	We	AM	Vientiane Hotel to Thaphabath	4WD		Vientiane Hotel		○	○	○
		PM		4WD	Thaphabath					
3/13	Th	AM	Vientiane Hotel to Vientiane Province	4WD	Vientiane	Vientiane Hotel		○	○	○
		PM		4WD	Vientiane					

FIELD NOTE of Ground Truth Survey (NFIS)

0. General Information

Waypoint No.	:	Date	:
Province	:	Surveyor	:
District	:	Lat / Lon	: ° ' " × ° ' "
Village	:	Elevation	: m

1. Forest land

Main Species & Comment

Type	:	EF	MD	CF	MCB	DD	P
Density	:	Dense		Medium		Sparse	
Another	:						

2. Non-Forest land

Main Crops & Comment

Land use	:	B	SB	YF	OF	SA	SR	RP	AP
		OA	G	SW	R	U	W	O	
Another	:								

3. Measure Trees of Minimum Size of Forest (NOT every plots, only 3plots per provinces)

Comment

			SB in 2010 / Minimum Size of Forest		
Years Old	:	years			
Height	:	m	m	m	m
D. B. H.	:	cm	cm	cm	cm
Crown Diameter	:	m	m	m	m

4. Photo/Sketch/Memo

Photo No.	:	,	,	,	,	,	,
Direction	:	,	,	,	,	,	,
Condition	:	View / Zoom,	View / Zoom,	View / Zoom,	View / Zoom,	View / Zoom,	View / Zoom,

Sketch/Memo

Figure 3-17: Field Notebook Used for Study

Only the results obtained when the team stopped are shown in the attached materials, but many photographs with position information were taken at times while the team was moving, and plans from this point on call for analysis / consideration while comparing these results with the satellite images. In addition,

plans call for organization to be performed along with the data collected by the FIPD team, and preparation of the interpretation cards required for forest type map correction work.

3.1.3 Identifying Factors with a High Correlation with Carbon Stock

In order to review factors that have a high correlation with carbon stock, the carbon stratification analysis methodology was determined after discussions with the C/P. The work flow related to carbon stratification is shown in Figure 3-18. Furthermore, Mixed Evergreen and Deciduous Forest (MED) areas for which there was not a sample at the time of accuracy assessment will be integrated with Deciduous Forest (DF) areas, and a review of carbon stratification as Mixed Deciduous Forest (MD) areas will be conducted.

The carbon stratification methodology is described below. First, the inventory data (including measurement of breast height diameter, tree height and crown ratio in survey of each tree) for each survey plot implemented with FIM was converted into biomass using allometric equation. However, since a unique allometric equation does not exist in Laos, (1) a pseudo allometric equation will need to be prepared by using biomass data calculated using past NFI data in Laos, or (2) work will need to be performed to adapt one of the existing allometric equations developed / formulated by surrounding countries or IPCC among which it can be used in Laos. FIM inventory data which has been converted into biomass will be compared / examined with existing GIS data that potentially has a correlation with carbon stock, and the existence of a correlative relationship will be verified. After this, the significance when carbon stratification is performed will be examined, and whether or not the required accuracy is satisfied will be confirmed. However, as stated in “4.3.1 Accuracy assessment of Forest Carbon Map”, since there is not a unique allometric equation in Laos, the forest type map itself will be the subject of examination. During the first year, a portion of the existing GIS data was used to review the correlative relationship.

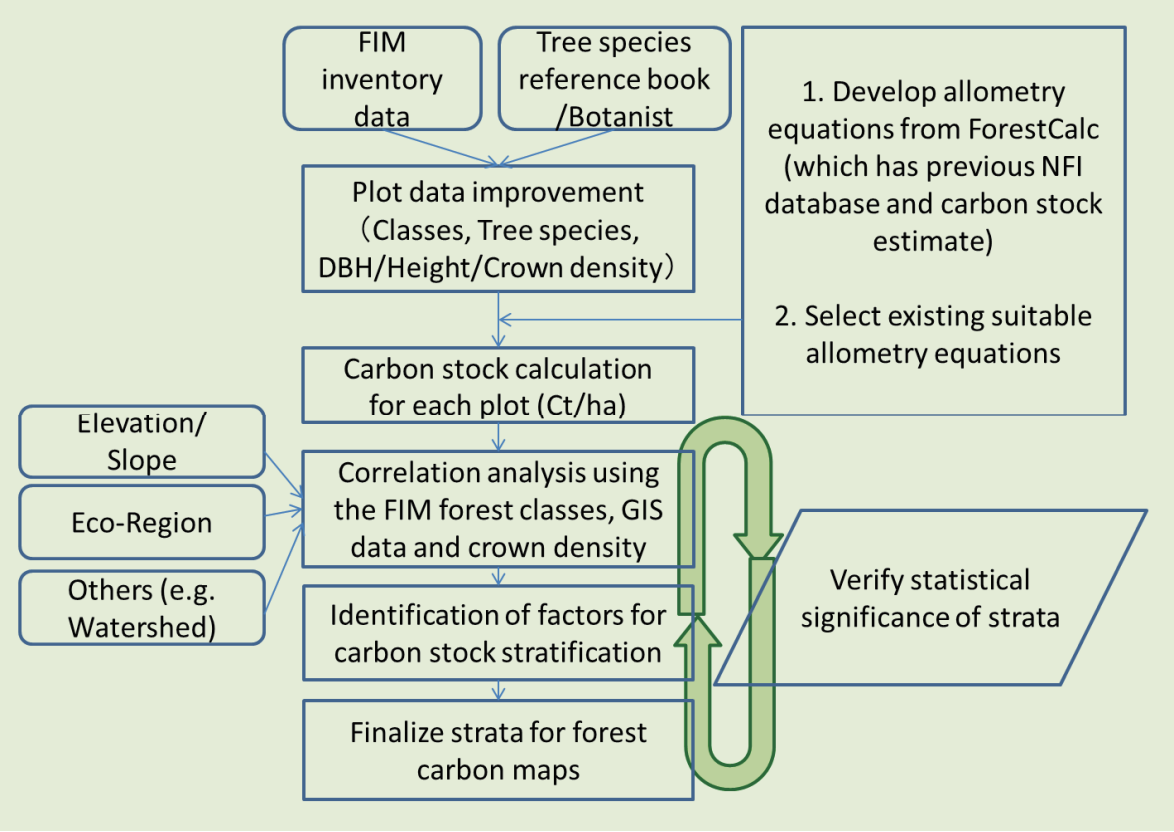


Figure 3-18: Work Flow Related to Carbon Stratification

As stated above, since there is not a unique allometric equation in Laos, review on an applicable allometric equation was conducted with the two methodologies described below.

(1) Preparation of a pseudo allometric equation by using past NFI biomass data in Laos

(2) Adapt an existing allometric equation developed / formulated by surrounding countries or IPCC for use in Laos

For item (1), since the details are described later in "3.2.1 Analysis / Organization of Existing Forest Information Database", the details of item (2) will be described here.

The allometric equations from Vietnam and Cambodia were reviewed as allometric equations from surrounding countries (Figure 3-19). When the allometric equations from surrounding countries share the same characteristics specified by WWF for Ecoregions2 as areas in Laos, the decision was made to adopt the equation. Allometric equations have been developed by UN-REDD for the various areas in Vietnam3,

[2] http://wwf.panda.org/about_our_earth/ecoregions/about/
[3] Tree allometric equation development for estimation of forest above-ground biomass in Viet Nam, UN-REDD PROGRAMME, October 2012

and the Evergreen Forest (EF) allometric equation for the North East, North Central Coast and South Central Coast overlaps with common Ecoregions in Laos, so the decision was made to adopt it. Normally, the equation should only be applicable to Evergreen Forests, but since there is not an allometric equation for the Mixed Deciduous Forest (MD) forest type, the decision was made to tentatively adopt the above Evergreen Forest allometric equation. Next, the decision was made to adopt allometric equation developed as a general purpose equation in Cambodia[4] for Ecoregions that are shared with Cambodia. In addition, since there is not suitable allometric equation for Dry Dipterocarp Forest (DD) areas in Laos, the decision was made to tentatively adopt the allometric equation that can be applied to tropical climate forests in the Indochina region[5].

For the remaining Coniferous Forest (CF), Mixed Coniferous and Broadleaved Forest (MCB) and Plantation Forest (P) areas, the allometric equations developed as general purpose equations by IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry were adopted. The allometric equation from the IPCC guidance for Temperate/tropical pines was adopted for Coniferous Forest areas, and the allometric equations from Vietnam and IPCC guidance for Temperate/tropical pines were adopted for Mixed Coniferous and Broadleaved Forest areas. The Eucalyptus sp. and Tectona grandis b allometric equation was adopted for Plantation Forest areas.

The adopted allometric equations are organized in Table 3-9 and Table 3-10. As stated above, the allometric equations developed / formulated by surrounding countries and the IPCC are not a good match for Mixed Deciduous Forest and Dry Dipterocarp Forest, and this resulted in issues that need to be addressed, such as tentative adoption of the allometric equations for other forest types. However, as described later in “3.2.1 Analysis / Organization of Existing Forest Information Database”, the desk-based allometric equations formulated using past NFI data from Laos were successfully used to perform formulation for each province / forest type. When carbon stratification is reviewed, a different allometric equation should be used for each particular region and forest type. The reason for this is that when an allometric equation for a wider range of regions / forest types is used, it is difficult to extract the differences in carbon stock for particular classes. In addition, it is naturally better to use the allometric equation formulated from unique NFI data in Laos, even though it is a pseudo equation. Consequently, the allometric equation formulated using past NFI data in Laos was utilized to review carbon stratification.

[4] Kiyono Y. (2010) Carbon Stock Estimation by Forest Measurement Contributing to Sustainable Forest Management in Cambodia, JARQ 44 (1), 81 - 92

[5] Monda 式, REDD-Plus Cookbook, REDD Research and Development Center

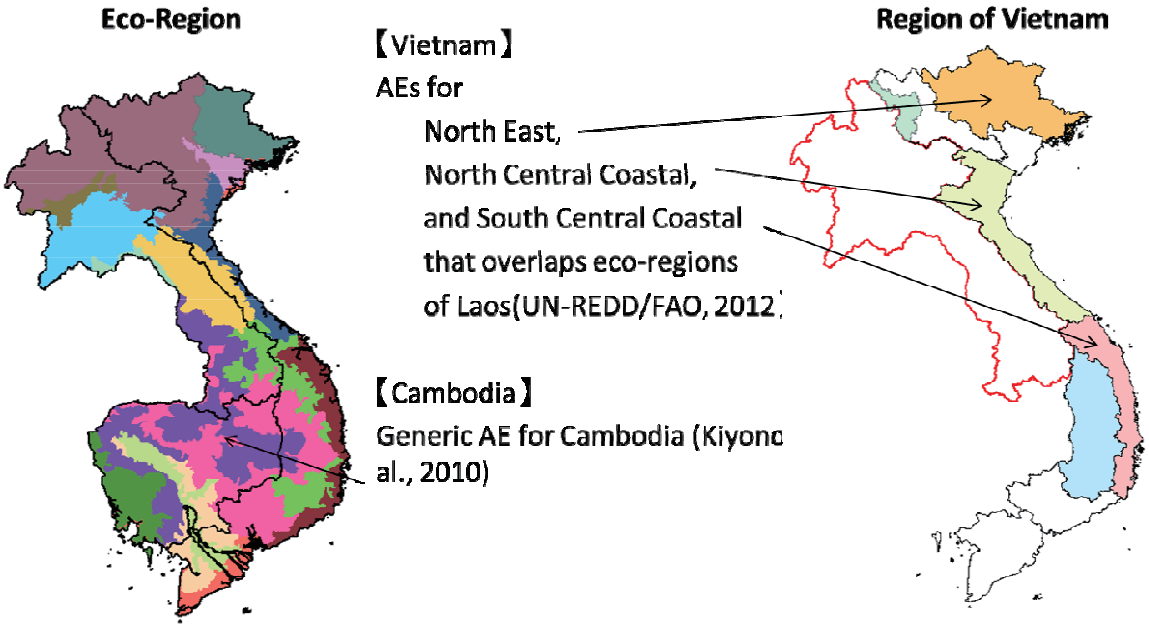


Figure 3-19: Allometric Equations from Surrounding Countries Applicable in Laos

Table 3-10: Allometric Equations Formulated in Surrounding Countries and by IPCC Applicable to Laos Ecoregions and Forest Types: Set 1

Eco-region		Ecoregions in Laos							
		0137	0139	0121	0138	0136	0202	0152	0210
		Northern Indochina Subtropical Forests	Northern Thailand-Laos Moist Deciduous Forests	Luang Prabang Montane Rain Forests	Northern Khorat Plateau Moist Deciduous Forests	Northern Annamites Rain Forests	Central Indochina Dry Forests	Southern Annamites Montane Rain Forests	Southeastern Indochina Dry Evergreen Forests
Forest Tyep in Laos	EF	1) UN-REDD: Vietnam North East	1) UN-REDD: Vietnam North East	2) UN-REDD: Vietnam North Central Coast	–	2) UN-REDD: Vietnam North Central Coast	4) Kiyono equation	3) UN-REDD: Vietnam South Central Coast	4) Kiyono equation
	MD	1) UN-REDD: Vietnam North East	1) UN-REDD: Vietnam North East	2) UN-REDD: Vietnam North Central Coast	2) UN-REDD: Vietnam North Central Coast	2) UN-REDD: Vietnam North Central Coast	4) Kiyono equation	3) UN-REDD: Vietnam South Central Coast	4) Kiyono equation
	DD	5) Monda equation	5) Monda equation	5) Monda equation	5) Monda equation	5) Monda equation	5) Monda equation	5) Monda equation	5) Monda equation
	CF	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	–	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines
	MCB	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	–	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines	6) IPCC: Temperate/tropical pines
		1) UN-REDD: Vietnam North East	1) UN-REDD: Vietnam North East	2) UN-REDD: Vietnam North Central Coast	–	2) UN-REDD: Vietnam North Central Coast	4) Kiyono equation	3) UN-REDD: Vietnam South Central Coast	4) Kiyono equation
	P	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis [b]	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b	7) IPCC: Eucalyptus sp. 8) IPCC: Tectona grandis b

Table 3-11: Allometric Equations Formulated in Surrounding Countries and by IPCC Applicable to Laos Ecoregions and Forest Types: Set 2

	Model	Equation	Variable	Applicable Area	Applicable Forest Type
1)	UN-REDD: Vietnam North East	$AGB = 0.1142*DBH^{2.4451}$	DBH = diameter at breast height (cm)	Northern Indochina Subtropical Forests Northern Thailand-Laos Moist Deciduous Forests	Evergreen Forest
2)	UN-REDD: Vietnam North Central Coast	$AGB = 0.1245*DBH^{2.4163}$	DBH = diameter at breast height (cm)	Luang Prabang Montane Rain Forests Northern Khorat Plateau Moist Deciduous Forests Northern Annamites Rain Forests	Evergreen Forest
3)	UN-REDD: Vietnam South Central Coast	$AGB = \exp(-2.24267+2.47464*\ln(DBH))$	DBH = diameter at breast height (cm)	Southern Annamites Montane Rain Forests	Evergreen Forest
4)	Kiyono equation	$W(stem) = 2.69*ba^{1.29}*WD*^{1.35}$ $W(branch) = 0.217*ba^{1.26}*WD^{1.48}$ $W(leaf) = 173*ba^{0.938}$	ba = basal area of a stem at 1.3m height (m2) WD = basic density of stem wood (kg/m3)	Central Indochina Dry Forests Southeastern Indochina Dry Evergreen Forests in neighboring country of Cambodia	Tropical and subtropical dry land forest
5)	Monda equation	$AGB = 0.3510*DBH^{2.3655}*WD^{1.7827}$	DBH = diameter at breast height (cm) WD = basic density of stem wood ()	Indochina area	Tropical and seasonal deciduous forest
6)	IPCC: Temperate/tropical pines	$AGB\ (kg/tree) = 0.887+[(10486*(DBH)^{2.84})/((DBH)^{2.84}+3$	DBH = diameter at breast height (cm)	Temperate/tropical area	Pine forest
7)	IPCC: Eucalyptus sp.	$AGB\ (kg/tree) = 1.22*DBH^{2}*H*0.01$	DBH = diameter at breast height (cm) H = total height of tree (m)	Tropical area	Eucalyptus forest
8)	IPCC: Tectona grandis [b]	$AGB\ (kg/tree) = 0.153*DBH^{2.382}$	DBH = diameter at breast height (cm)	Tropical area	Teak forest

Next, the set of allometric equations organized in Figure 3-27 for the FIM inventory data were used to perform conversion into biomass (Table 3-11). The sections for the FIM inventory study were circular plots with a radius of 25 m as shown in Figure 3-20. Trees within a small circular area with a radius of 5 m that had a breast height diameter of less than 10cm were measured, and trees in other areas with a breast height diameter of 10cm or more were measured. Since the NFI only measured trees with a breast height diameter of 10cm or more in the past, trees with a check height diameter less than 10cm were excluded from the FIM inventory to allow comparison to be performed, and the small circular survey partition area with a radius of 5m was excluded when calculation was performed.

The FIM inventory data converted to biomass was compared with the Ecoregions / province / forest type / canopy cover ratio, and the correlative relationship between the respective items was considered. A comparison of the FIM biomass volumes with provinces / forest types is shown in Table 3-12, a comparison with Ecoregions / Forest Types is shown in Table 3-13, and a comparison with canopy cover ratio / forest types is shown in Figure 3-21 / Table 3-14.

When the average biomass volume for the different forest types is examined, it is found that it is large for Evergreen Forest (EF) areas, amounting to approximately three times the volume of Mixed Deciduous Forest (MD) or Dry Deputerocarp Forest (DD) areas. Due to the fact that a large portion of Evergreen Forest areas are located in high altitude regions with high humidity and a high amount of rainfall, it is thought that the stock volume is comparatively large. However, on the other hand, Mixed Deciduous Forests often grow in low to medium altitude regions that are dry, and Dry Dipterocarp Forests often grow in locations where the soil conditions are not good. Consequently, the trees do not grow that high, and the stock volume is comparatively low. In addition, there was a difference of between approximately three to four times the volume for Coniferous Forest (CF) and Mixed Coniferous and Broadleaved Forest (MCB) areas. This may result from the fact that there are not that many samples for Coniferous Forest areas, but the same tendency was found in past NFI biomass volume that is described later. When checking was performed in the field during the ground truth survey implemented in the first year, it was found that Coniferous Forests produce low volume of biomass as they often grow in locations where the soil conditions are poor in which it is difficult for other types of vegetation to grow, with burning being periodically performed to provide a supply of grass. The biomass volume is low also because of the low tree density. On the other hand, it can be seen that Mixed Coniferous and Broadleaved Forests grow in soil that is good compared to areas where Coniferous Forests grow, which allows the penetration of broadleaf tree species. Therefore, there is dense growth of Coniferous and Broadleaved species, resulting in high tree density, which increases the biomass volume.

When the average biomass volume for each Ecoregion, province and other respective area is examined, it can be seen that the areas in the north excluding a portion of the provinces have a low biomass volume

compared to the regions in the central and southern parts of the country.

While there is a certain amount of correlation with Mixed Coniferous and Broadleaved Forest areas, with a correlative factor of 0.5074 between the forest type and canopy cover ratio, almost no correlative relationship was found for other types.

The data used for comparison / review purposes will be further increased in the future, candidate factors that have a correlation with carbon stock will be closely examined, discussions will be conducted with the C/P and other donors, and a statistical examination will be performed as to whether or not stratification is possible. Plans call for work to proceed with the identification of factors.

Table 3-12: Conversion of FIM Inventory Data into Biomass (Sample)

959 plots

Primary_ID	DBH (cm)	Province	Forest Type	Allometric Equation	AGB/Plot	AGB/Plot/ha
TR_0704003-4	201	Houaphane	EF	$(AGB)=0.0002\times(DBH)^{2.4655}$	95.40	506.13
TR_1209002-3	157	Khammuane	DF	$(AGB)=0.0002\times(DBH)^{2.4673}$	26.18	138.88
TR_1004004-3	146	Vientiane	EF	$(AGB)=0.0002\times(DBH)^{2.4629}$	42.82	227.15
TR_1106002-4	130	Bolikhamxay	EF	$(AGB)=0.0002\times(DBH)^{2.4578}$	15.69	83.24
TR_1106002-4	130	Bolikhamxay	EF	$(AGB)=0.0002\times(DBH)^{2.4578}$	15.69	83.24
TR_1102007-2	130	Bolikhamxay	DF	$(AGB)=0.0002\times(DBH)^{2.4995}$	19.22	101.98
TR_1304007-4	130	Savannakhet	DF	$(AGB)=0.0002\times(DBH)^{2.5018}$	19.44	103.12
TR_0708003-3	129	Houaphane	EF	$(AGB)=0.0002\times(DBH)^{2.4655}$	31.97	169.59
TR_1704002-3	125	Attapeu	DF	$(AGB)=0.0002\times(DBH)^{2.5285}$	20.05	106.35
TR_0102001-3	123	Vientiane Capital	DF	$(AGB)=0.0002\times(DBH)^{2.4498}$	26.36	139.82
TR_1103002-5	120	Bolikhamxay	EF	$(AGB)=0.0002\times(DBH)^{2.4578}$	12.89	68.38
TR_1104006-4	120	Bolikhamxay	EF	$(AGB)=0.0002\times(DBH)^{2.4578}$	12.89	68.38
TR_1102003-5	120	Bolikhamxay	EF	$(AGB)=0.0002\times(DBH)^{2.4578}$	12.89	68.38
TR_1102001-4	120	Bolikhamxay	EF	$(AGB)=0.0002\times(DBH)^{2.4578}$	12.89	68.38

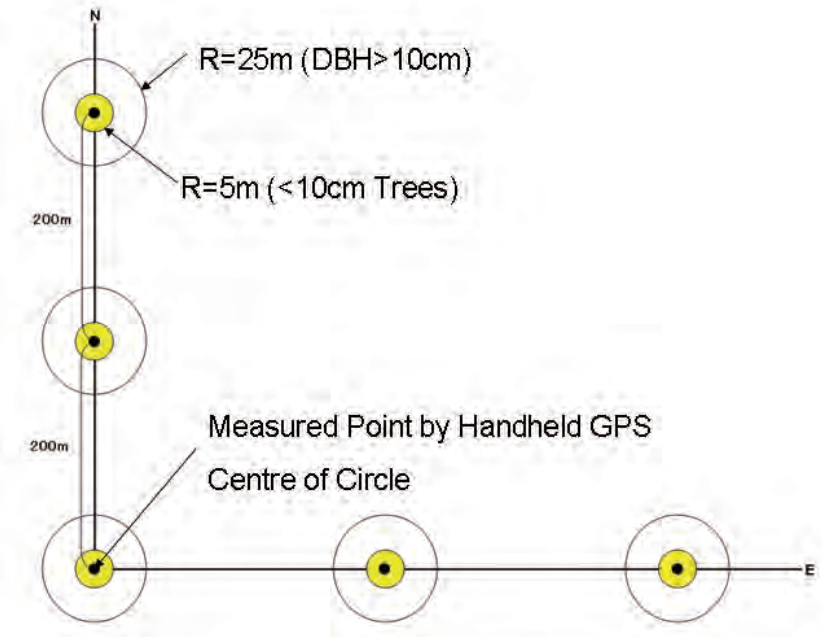


Figure 3-20: Study Plot Design for FIM Inventory Study

Table 3-13: Average Biomass Volume and Standard Deviation for Each Province / Forest Type

Forest Type	EF		MD		DD		CF		MCB		Average	
Province	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha
Phongsaly	144.87	27.51	32.27	34.05							37.64	41.42
Luangnamtha	38.08	0.00	10.88	6.38							11.44	7.39
Oudomxay	88.24	78.80	22.59	23.31							27.28	35.13
Bokeo			9.68	9.52							9.68	9.52
Luangprabang	119.23	93.52	8.61	9.56	88.85	0.00					45.95	71.55
Houaphane	92.34	104.99	38.49	26.32					10.51	5.79	76.26	94.04
Xayaboury			13.42	13.31	11.49	7.86					12.82	11.93
Xiengkouang	55.37	34.17	24.87	38.76			6.80	0.00	26.86	18.90	40.58	34.94
Vientiane	168.23	90.80	32.07	19.78							73.13	81.64
Vientiane Capital			65.32	53.14							65.32	53.14
Bolikhamxay	98.37	48.96	34.95	26.61							58.41	47.65
Khammuane			37.25	44.12	12.70	8.19					35.40	42.97
Savannakhet	79.34	0.00	53.10	47.73	33.77	26.89					45.11	41.19
Saravane			52.80	46.05	50.13	34.22					51.49	40.72
Sekong			26.59	24.03	18.21	7.04					24.12	20.90
Champasak			31.39	20.70	17.18	13.87					24.19	18.96
Attapeu			60.20	52.49	34.03	35.23					51.00	48.78
Average	102.27	85.31	32.31	35.88	27.99	27.46	6.80	0.00	24.14	18.45	39.70	49.20

Table 3-14: Average Biomass Volume and Standard Deviation for Each Ecoregion / Forest Type

Forest Type	EF		MD		DD		CF		MCB		Average	
Eco-Region	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha	Average of AGB/ha	Standard Diviation of AGB/ha
Northern Indochina Subtropical Forests	95.42	97.99	22.65	26.31					10.51	5.79	34.00	52.84
Northern Thailand-Laos Moist Deciduous Forests	96.81	98.24	10.17	10.20	16.73	25.87					16.42	34.29
Luang Prabang Montane Rain Forests	102.84	79.94	30.55	29.78	13.65	8.48	6.80	0.00	26.86	18.90	52.68	62.23
Northern Khorat Plateau Moist Deciduous Forests	120.10	7.65	32.21	25.22							37.09	31.77
Northern Annamites Rain Forests	129.74	47.04	40.96	44.91	29.59	19.90					48.70	51.24
Central Indochina Dry Forests	79.34	0.00	48.28	40.46	31.62	28.21					40.60	36.19
Southern Annamites Montane Rain Forests			20.67	19.88	20.69	4.77					20.67	18.49
Southeastern Indochina Dry Evergreen Forests			54.80	49.97	27.43	29.97					41.68	43.79
Average	102.27	85.31	32.31	35.88	27.99	27.46	6.80	0.00	24.14	18.45	39.70	49.20

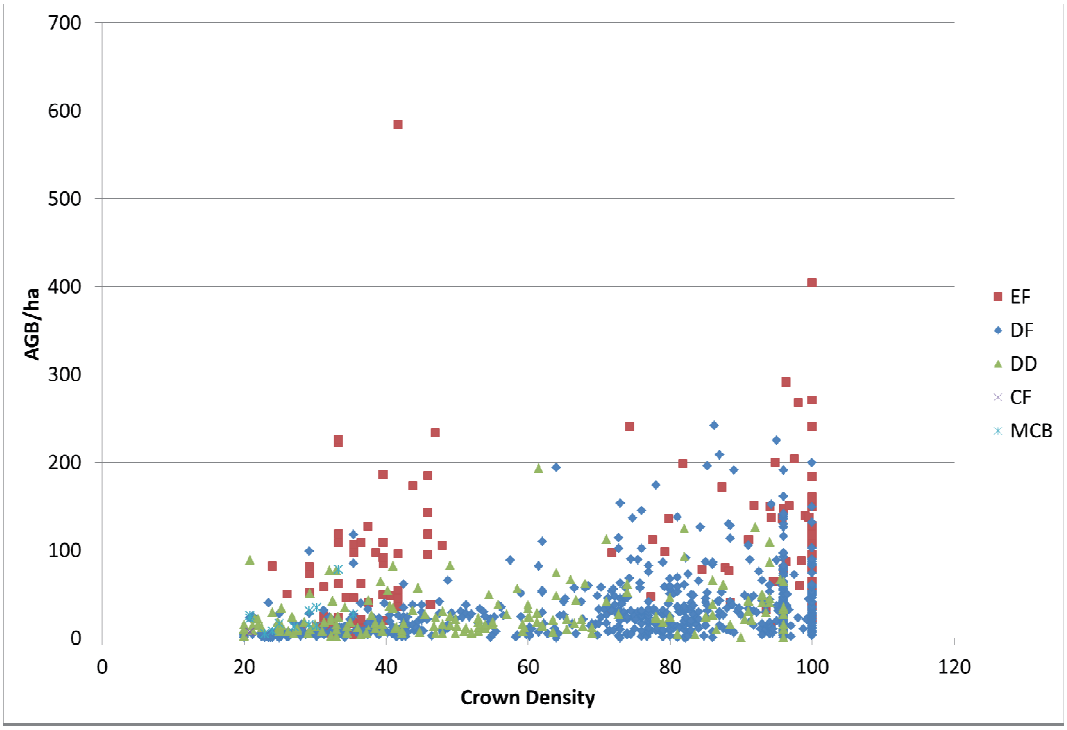


Figure 3-21: Canopy Cover Ratio and Average Biomass Volume Scatter Diagram for Each Forest Type

Table 3-15: Canopy cover Ratio and Average Biomass Volume Correlation Factor for Each Forest Type

EF (Numver of sample: 114)	Crown Density
AGB/ha	0.2942

MD (Numver of sample: 656)	Crown Density
AGB/ha	0.3566

DD (Numver of sample: 176)	Crown Density
AGB/ha	0.3243

MCB (Numver of sample: 12)	Crown Density
AGB/ha	0.5074

Lastly, the FIN inventory data that was converted to biomass volume and past NFI data that was converted to biomass volume were respectively converted to CO2-t/ha, and a comparison of these values is shown in Table 3-15.

In order to convert the past NFI data into biomass volume, the past NFI database (ForestCalc) and NFI materials were analyzed. The past NFI data was obtained in a survey by establishing an L-shaped study tract consisting of A, B and C plots as shown in Figure 3-22. All trees were measured in plot A, trees with a breast height diameter of 30cm or more were measured in plot B, and trees with a breast height diameter of 60cm or more were measured in plot C. Past NFI biomass data made up of a plot group consisting of one plot A area, two plot B areas and one plot C area (red line in diagram) was used to perform calculation. In other words, all trees in the plot group with a breast height diameter of 60cm or more were measured, trees with a breast height diameter of 30 – 60cm were measured in plot A and plot B in the plot group, and trees with a breast height diameter of 10 – 30cm in plot A in the plot group were measured. Therefore, in order to calculate the biomass volume per hectare, since all trees with a breast height diameter of 60cm or more were measured in the 1 ha plot, the total biomass volume for all trees was used. The total biomass volume for trees with a breast height diameter of 30 – 60cm was divided by the 0.2 ha area consisting of plot A and B in the plot, and the total biomass volume for trees with a breast height diameter of 10 – 30cm was divided by the 0.04 ha area consisting of plot A in the plot group. Calculation was then performed by totaling all of these values.

When Table 3-15 is examined, it can be seen that the FIM CO2-t/ha volume is lower compared to the past NFI CO2-t/ha volume. As shown in Table 3-16, the most likely cause for this is that more middle and large diameter trees were measured with past NFI compared to FIM, and there were fewer middle and large trees at the time of FIM compared to the past NFI due to continued forest degradation, but this is something that will continue to be examined in the future. In addition, blanks mean the item which was not acquired at past NFI or FIM.

Table 3-16: CO2-t/ha Volume for Each Province / Forest Type in Past NFI and FIM Data

Province	Forest Type	Past NFI	FIM NFI	Province	Forest Type	Past NFI	FIM NFI
Phonsaly	EF		265.59	Vientiane Capital	EF		
	MD	198.36	59.17		MD	183.65	119.75
	DD				DD	60.35	
	CF				CF		
	MCB				MCB		
Luang Namtha	EF		69.81	Bolikhamxay	EF		180.35
	MD	133.19	19.95		MD	194.09	64.08
	DD				DD	201.45	
	CF				CF		
	MCB				MCB		
Oudomxay	EF	433.99	161.78	Khammuane	EF	292.94	
	MD	114.08	41.41		MD	279.57	68.29
	DD				DD	165.18	23.28
	CF				CF		
	MCB				MCB	457.26	
Bokeo	EF			Savannakhet	EF	501.93	145.45
	MD	118.13	17.74		MD	184.04	97.36
	DD	15.88			DD	155.09	61.91
	CF				CF		
	MCB				MCB		
Luangprabang	EF		218.58	Saravane	EF	465.06	
	MD	36.17	15.79		MD	339.10	96.80
	DD	234.20	162.88		DD	242.87	91.90
	CF				CF		
	MCB				MCB	375.48	
Huaphane	EF		169.30	Sekong	EF	362.25	
	MD	148.81	70.56		MD	199.92	48.74
	DD				DD	178.26	33.38
	CF	133.52			CF	58.10	
	MCB	178.34	19.27		MCB		
Xayabury	EF	424.42		Champasak	EF	304.65	
	MD	232.92	24.60		MD	217.21	57.54
	DD	252.21	21.06		DD	131.05	31.49
	CF				CF		
	MCB				MCB	268.95	
Xiengkouang	EF		101.51	Attapeu	EF	253.22	
	MD	137.00	45.60		MD	297.19	110.36
	DD				DD	199.42	62.39
	CF	120.31	12.47		CF		
	MCB	113.11	49.25		MCB		
Vientiane	EF		308.42	Whole Country	EF	410.28	187.50
	MD	109.73	58.79		MD	220.43	59.23
	DD				DD	168.63	51.32
	CF				CF	118.63	12.47
	MCB				MCB	310.88	44.25

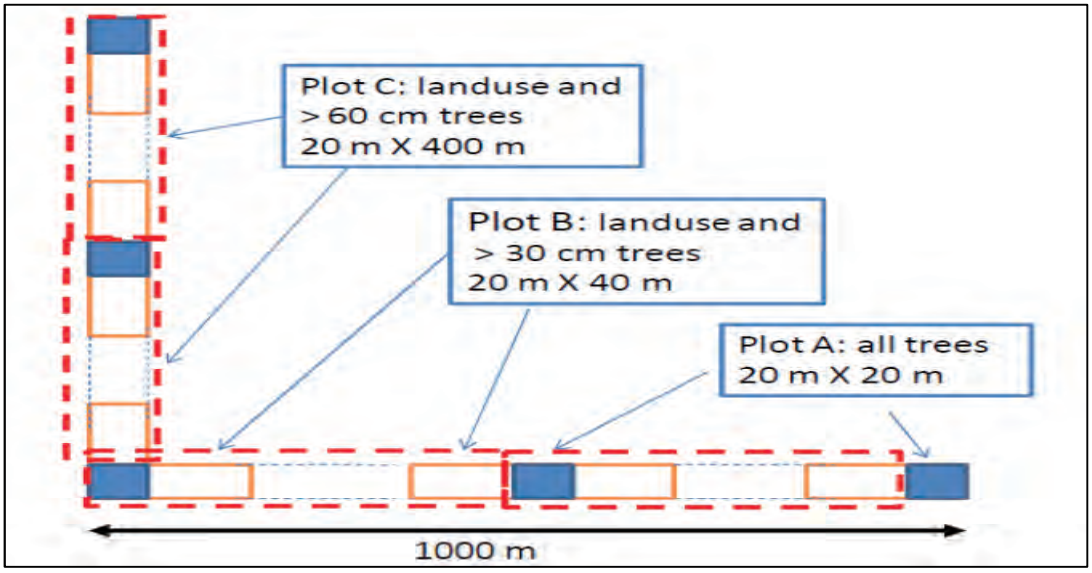


Figure 3-22: Past NFI Study Plot Design

Table 3-17: Number of Trees Measured in Past NFI and FIM for Each Diameter Class

	Past NFI		FIM NFI	
	Number	Rate	Number	Rate
10cm<=DBH<20cm	8178	33.92%	5194	42.41%
20cm<=DBH<30cm	3044	12.63%	3701	30.22%
30cm<=DBH<40cm	4617	19.15%	1856	15.15%
40cm<=DBH<50cm	2310	9.58%	795	6.49%
50cm<=DBH<60cm	1064	4.41%	324	2.65%
60cm<=DBH<70cm	1974	8.19%	190	1.55%
70cm<=DBH<80cm	1182	4.90%	83	0.68%
80cm<=DBH<90cm	725	3.01%	46	0.38%
90cm<=DBH<100cm	416	1.73%	32	0.26%
100cm<=DBH<110cm	209	0.87%	6	0.05%
110cm<=DBH<120cm	146	0.61%	5	0.04%
120cm<=DBH<130cm	88	0.37%	9	0.07%
130cm<=DBH<140cm	61	0.25%	5	0.04%
140cm<=DBH<150cm	32	0.13%		
150cm<=DBH<160cm	31	0.13%		
160cm<=DBH<170cm	19	0.08%		
170cm<=DBH<180cm	4	0.02%		
180cm<=DBH<190cm	6	0.02%		
190cm<=DBH<200cm	3	0.01%	1	0.01%
Total	24109	100.00%	12247	100.00%

3.2 Output 2

3.2.1 Analysis/Organization of Existing Forest Information Database

Existing databases relating to forest information, namely, the Forest Management Information System for production forest (FOMIS), the Department of Forestry Reporting System (DOF Reporting System), Forest Preservation Programme (FPP/TA2) and previous NFI database (ForestCalc) were analyzed and organized.

Forest Inventory and Management Information System (FOMIS)

The current situation and issues were grasped through discussion with DOF and SUFORD on FOMIS in collaboration with the FPP technical assistance activity (TA2), which is being implemented by a joint venture. As a result, the following points were confirmed. 1) It is not easy to modify FOMIS to enable retrieval of necessary information (as the source code and the design details are unknown). 2) DOF wishes to revise FOMIS in connection with the implementation of community-based production forest management program currently promoted by DOF and 3) New SUFORD does not have a plan to revise only FOMIS. Based on the confirmed information, discussions with DOF, SUFORD and FPP were held. Consequently, it was agreed that the system revision of FOMIS will be carried out in the course of the FPP activities to prepare for the expansion of functions in the future. As preparations are being made for the revision, it was decided that the progress of the preparatory work will be checked as appropriate in this project.

Department of Forestry Reporting System (DOF Reporting System)

The current situation and issues were grasped through discussions with DOF, the DFRM and SUFORD in collaboration with the FPP technical assistance activity (TA3), which is being implemented by a joint venture. As a result, the following points were confirmed. 1) The TA3 activity established a structure enabling the DOF Reporting System to function nationwide (structure for equipment procurement and training), 2) As the system covers not only the production forests that DOF is responsible for but also the protection forests and the conservation forests under the management of DFRM, the implementation structure needs to be reexamined and 3) The FPP technical assistance activity (TA2) has already completed verification with respect to the method and the structure for retrieval of information necessary for the implementation of Clearing House. As it was also confirmed that there is a plan to study how to update the table attributes in this system by the DOF and DFRM officers in charge, it was decided that the progress will be checked as appropriate in this project.

Forest Management Information System by FPP/TA2

Progress of the FPP technical assistance activity (TA2) being implemented by a joint venture was checked.

It was reported at the WG meeting that the FPP/TA2 completed the forest management information system (beta version) in December 2013 and that the system has been installed in the FIPD and is now viewable in the DOF intranet environment. Currently, preparations are being made to create a Lao version of the system and to construct the same environment and system in the DFRM.

This system is so designed that when a user of a department or a section of the DFRM and DOF logs in, a GIS portal site prepared for each department and section starts up and displays news/events, documents, project information and GIS map information required by each section. Also, it is ready to organize and output report formats required by each department and section.

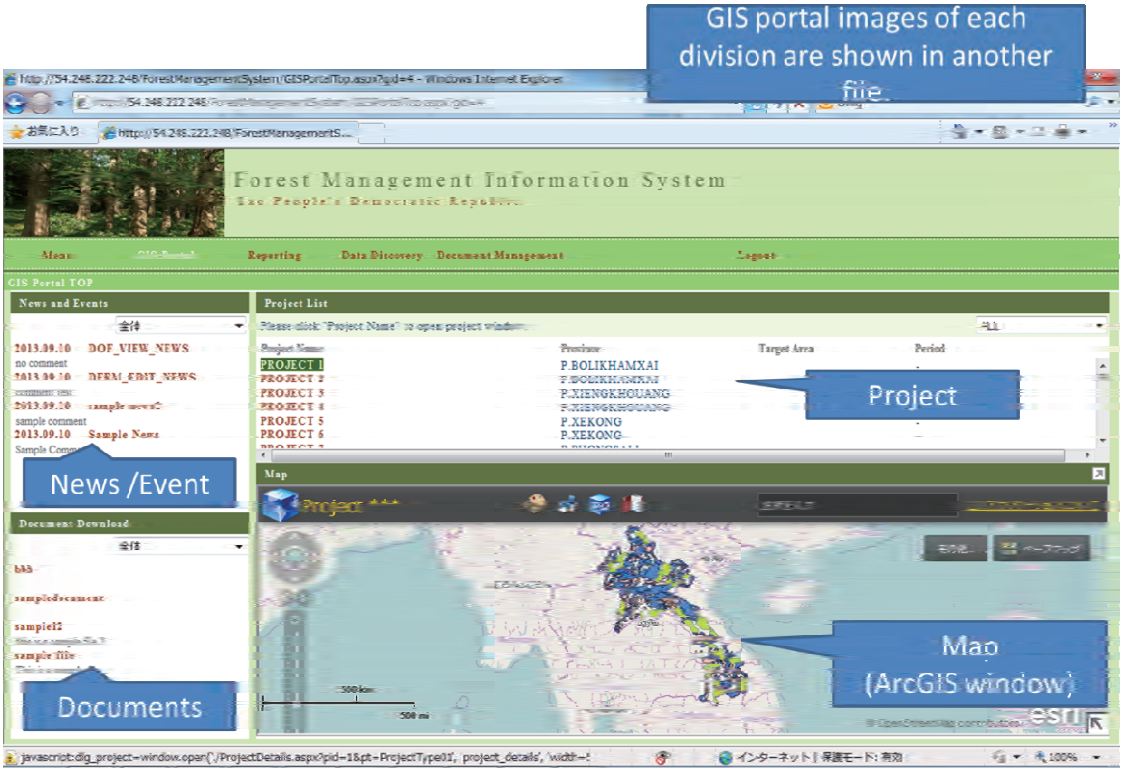


Figure 3-23:Top page of Forest Management Information System (FPP/TA2)

Currently, for the purpose of system demonstration, some of the existing FIPD data and draft data created by FIM have been registered, but it is possible to add the NFIS data and data created in relevant projects as appropriate. As such, it was ascertained that preparations are underway for the establishment of a platform to browse and utilize information necessary for forest management. Therefore, this project may focus on studying the data and the estimation method necessary for incorporating the carbon stock calculation function, which is particularly essential to REDD+, into this system. In addition to carbon amount, the methods to organize/output the non –physical information related to REDD+ PaMs and SG will be considered.

Figure 3-24 shows a list of reports compiled for each department and section through the FPP/TA2 activities.

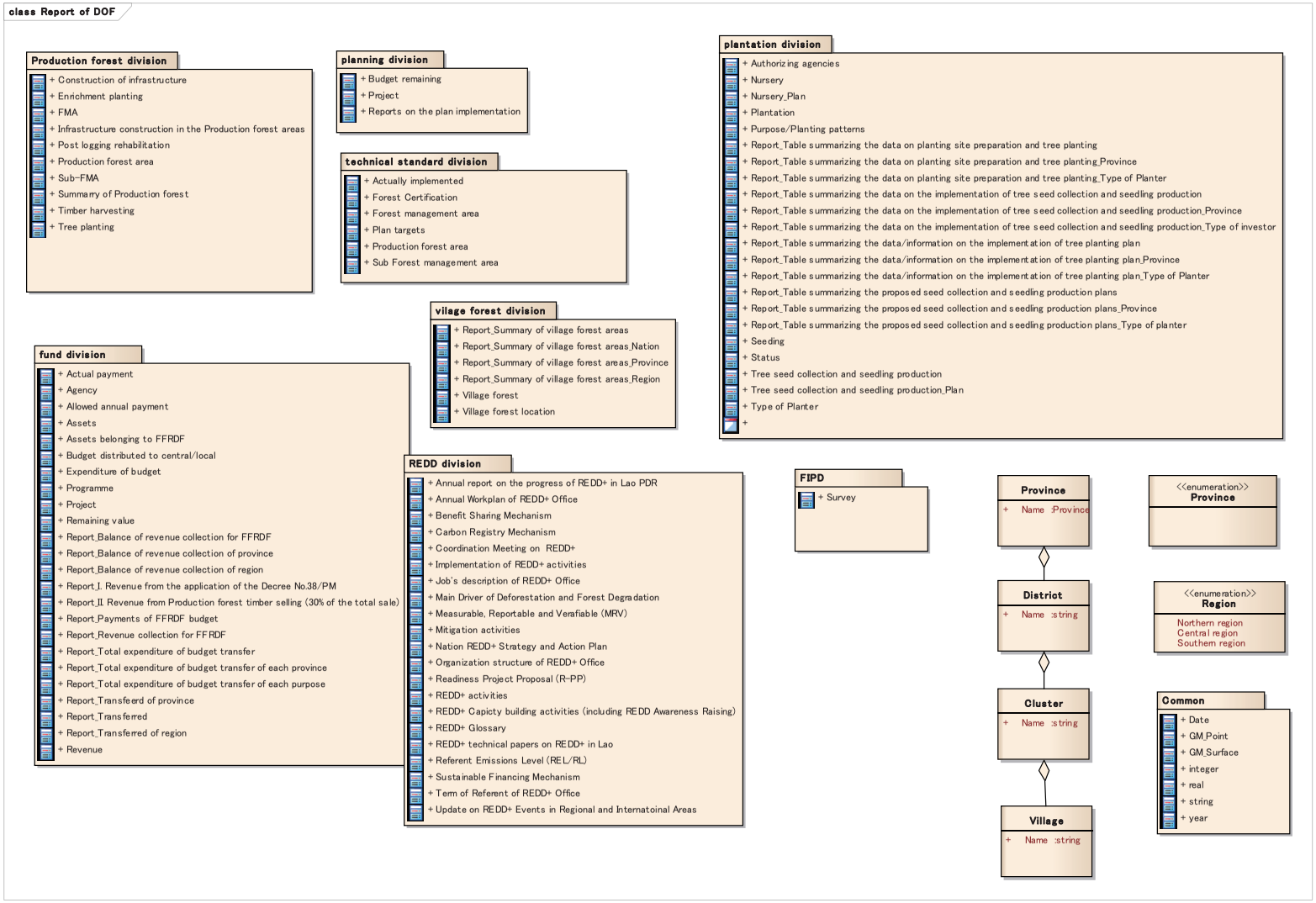


Figure 3-24: List of reports(draft) to be released, compiled in the FPP/TA2

Previous NFI Database (ForestCalc)

In Laos, the NFI was implemented over a long period from 1991 to 2000 in all provinces with the support of Sweden. Also, from 2009 to 2010, SUFORD (World Bank/Finland) developed a database including raw data and biomass/carbon stock calculation functions (ForestCalc). First, in order to obtain the general idea, existing documents were reviewed to study the data and the functions of ForestCalc. Figure 3-25 shows a flowchart of biomass/carbon stock calculation by ForestCalc.

ForestCalc calculates biomass and carbon stock based on the result of a detailed study that had originally been conducted on stem volume, while referring to the review of local survey results on wood density, biomass expansion factor, carbon fraction, etc. as well as the IPCC default values.

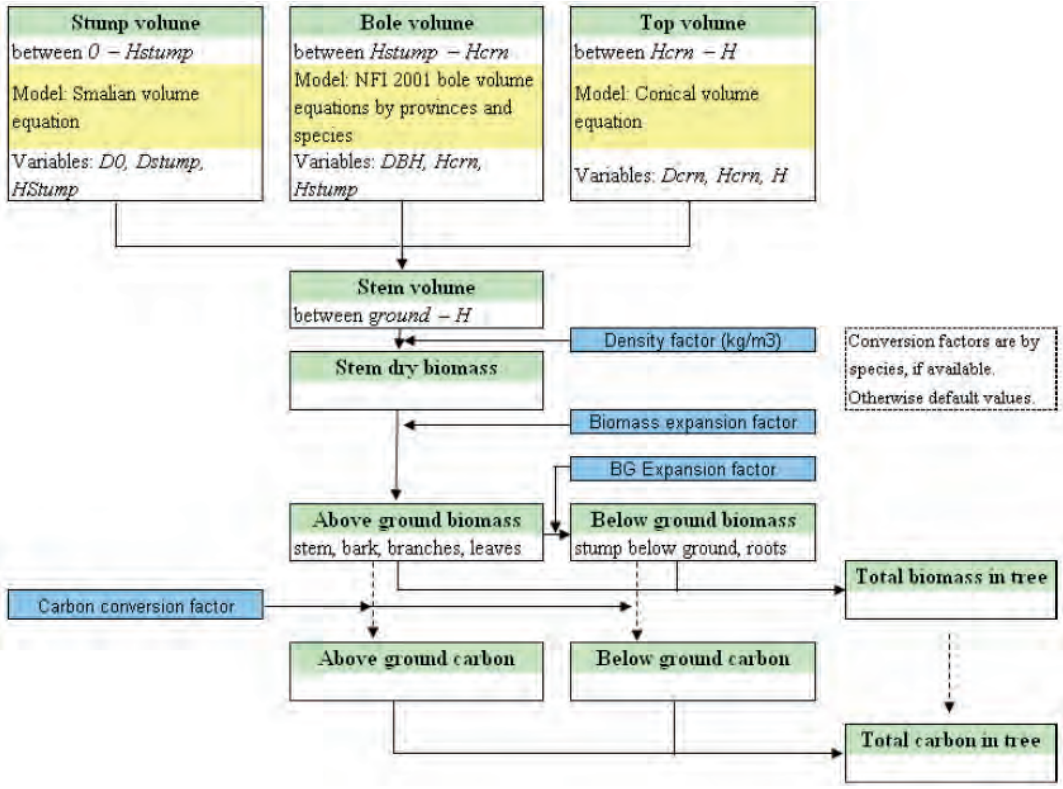


Figure 3-25: Biomass/Carbon Stock Calculation Flow of ForestCalc

This project attempted to develop desk-based allometric equations for carbon stratification by analyzing the ForestCalc data to study the relationship between the amount of ground biomass calculated by ForestCalc and the diameter at breast height as well as the tree height for each province (region) and vegetation type. The analysis was conducted with the approval of the CTA of SUFORD, while communicating with the ForestCalc database developer as necessary.

Since factors highly correlated with the carbon amount are identified in the activities relating to the output 1, activities relating to the output 2 covered the process from the creation of queries (search requirements) to retrieve necessary data from the ForestCalc database to the development

of allometric equations.

Example of Extracted/Summarized Information from ForestCalc

Province	Plot	Species	Landuse	D	H	Biomass AG	Biomass Total	Carbon AG	Carbon Total
1	11001180	142	106	33.8	31.1	6.89	8.61	3.45	4.31
1	11001180	142	106	21.2	26.1	11.85	14.81	5.92	7.40
1	11001180	142	106	14.6	12.7	2.58	3.23	1.29	1.62
1	11001180	142	106	31.8	22.5	3.61	4.52	1.81	2.26
1	11001180	142	106	14.2	12.4	2.42	3.02	1.21	1.51
1	11001180	999	106	11.5	7.5	1.35	1.69	0.67	0.84
1	11001180	999	106	12.0	8.0	1.48	1.86	0.74	0.93
1	11001180	999	106	10.0	6.3	0.86	1.08	0.43	0.54
1	11001180	999	106	11.1	7.4	1.23	1.54	0.62	0.77
1	11001180	999	106	13.7	9.1	2.07	2.59	1.04	1.30
1	11001180	999	106	24.0	15.3	8.71	10.88	4.35	5.44

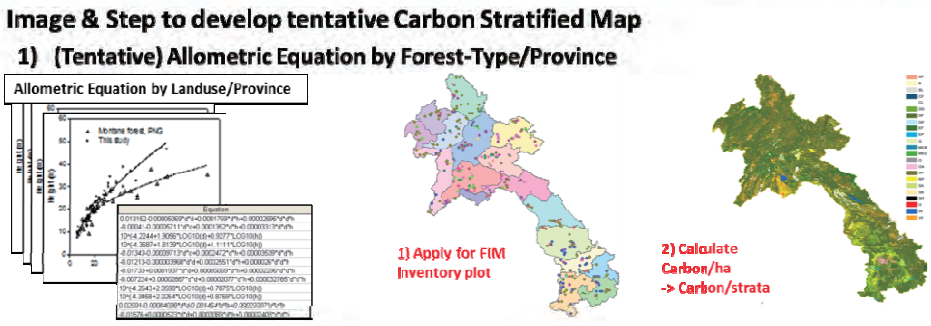


Figure 3-26: Development Image of Desk-Based Allometric Equations for Each Province/Vegetation Type by ForestCalc

Development of Desk-Based Allometric Equations

Since forest classifications of ForectCalc do not completely conform to those of FIM, a correlation table was developed to identify the forest classifications for which allometric equations should be created (items in red).

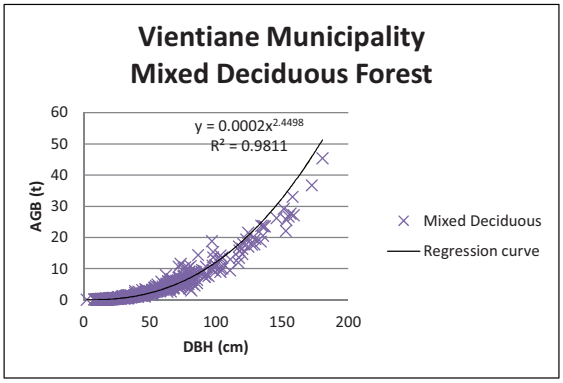
Table 3-18: Comparison of Forest Classifications of ForestCalc and FIM and Identification of Allometric Equation Development Classifications

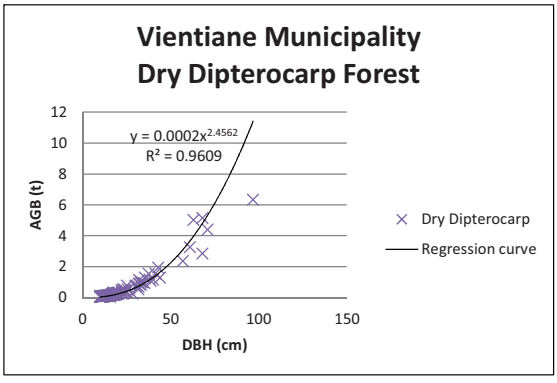
Code	LU_ForestCalc	LU_FIM_2010	For Allometry Equation
101	Lower evergreen	Evergreen Forest	Evergreen Forest
102	Upper evergreen		
103	Lower dry evergreen		
104	Upper dry evergreen	Mixed Evergreen and Deciduous Forest	
105	Lower mixed deciduous		Mixed Deciduous Forest
106	Upper mixed deciduous	Deciduous Forest	
107	Dry dipterocarp	Dry dipterocarp	Dry dipterocarp
108	Gallery forest	included in Evergreen～Deciduous	–
109	Coniferous	Coniferous	Coniferous
110	Mixed broadleaved and coniferous	Mixed broadleaved and coniferous	Mixed broadleaved and coniferous
111	Man-made, plantation	Evergreen Forest Plantation	Forest Plantation
		Deciduous Forest Plantation	
201	Pure bamboo	Bamboo	Bamboo
202	Unstocked	Old Fallow Land	Fallow Land
		Young Fallow Land	
204	Ray	Slash and Burn Land	Slash and Burn (No stock)
203	Natural regeration		
301	Savannah, open woodlands	Savannah/Open Woodland	Savannah/Open Woodland
302	Heath, stunted and scrub forest	Scrub, Heath	Scrub, Heath
401	Rice paddy	Rice Paddy	Rice Paddy
402	Fruit plantation	Agriculture Plantation	Agriculture Plantation
403	Other agriculture	Other Agriculture Area	Other Agriculture Area
501	Barren lands, rock	Barren Land	Barren Land
		Rock	Rock
502	Grassland	Grassland	Grassland
503	Swamps	Swamp	Swamp
504	Urban areas	Urban Area	Urban Area
505	Other land areas	Other Land	Other Land
506	Water	Water	Water

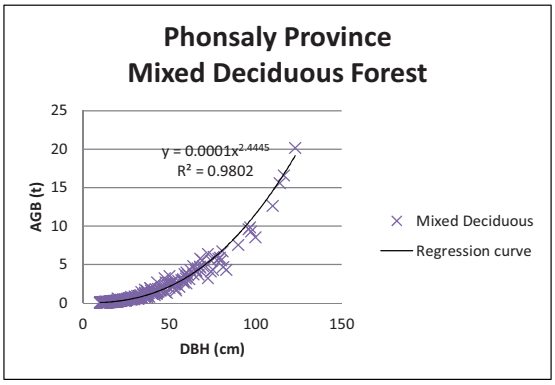
Single regression analysis of the correlation between the diameter at breast height and the ground biomass as well as between the tree height and the ground biomass revealed good correlations between the diameter at breast height and the ground biomass and outstanding variations with respect to the tree height. Therefore, it was decided that single regression analysis should be carried out with respect to the diameter at breast height and the ground biomass for each vegetation type and province in this analysis. The result of the single regression analysis is shown below.

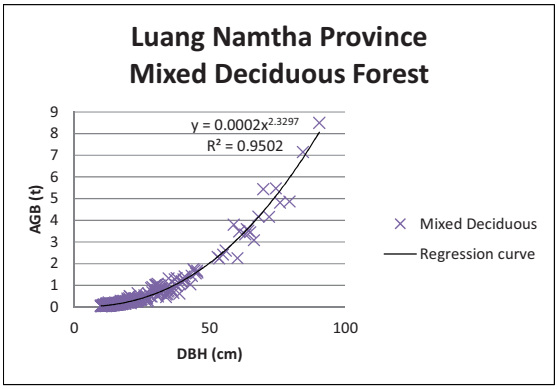
Table 3-19: Single Regression Analysis between Diameter at Breast Height and Ground Biomass for Each Province /Vegetation Type(Sample)

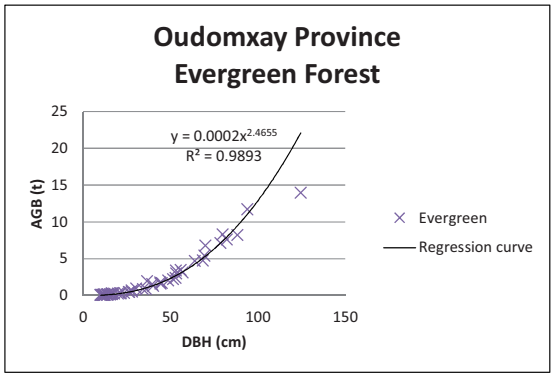
*All figures are shown in Annex5

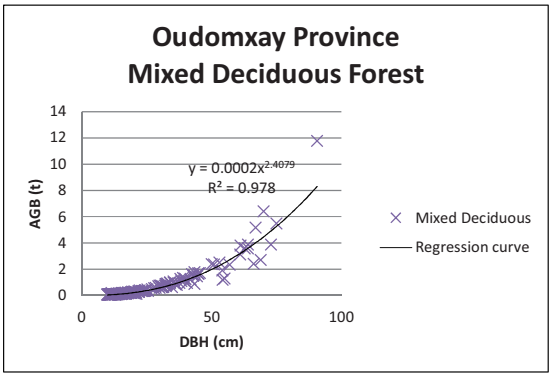












The blank field is the item which the data is not collected by past NFI or FIM inventory.

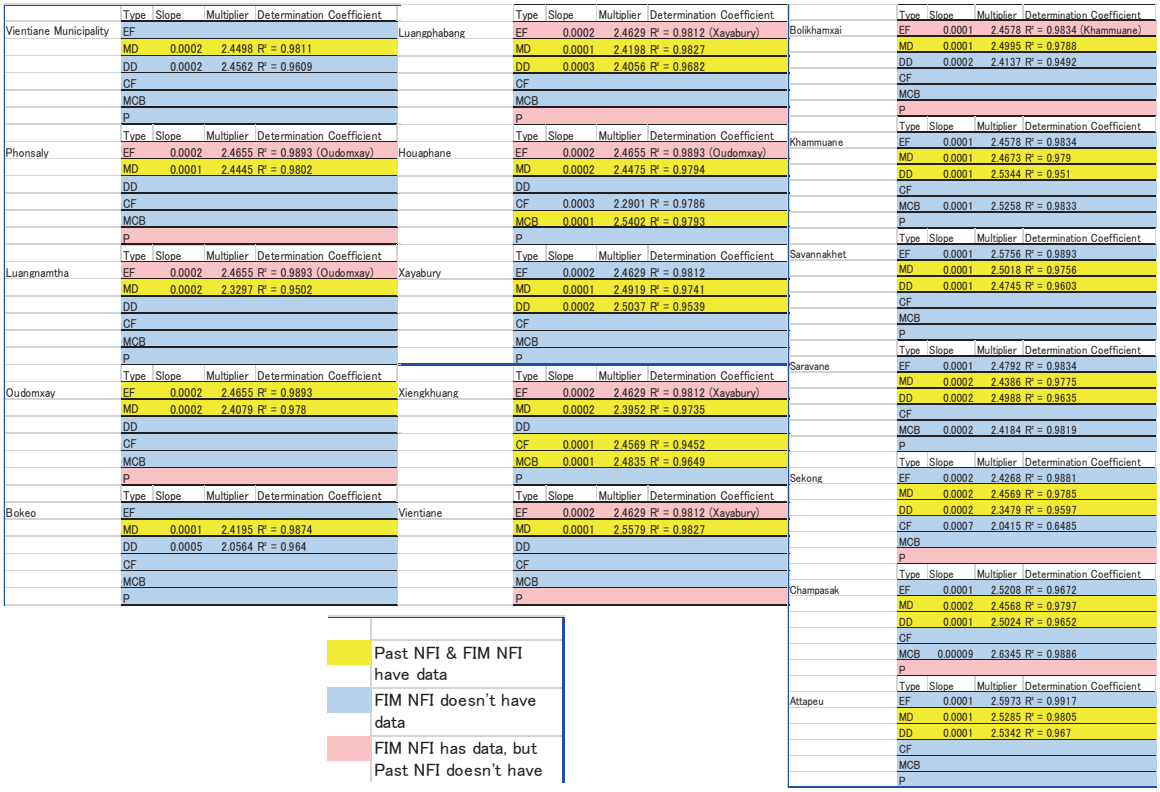


Figure 3-27: Desk-Based Allometric Equations Developed for Each Province /Vegetation Type

3.2.2 Review of Functions and Specifications for Statistics/Reporting, etc

In order to enhance capacity of reporting (R) of MRV system, international reporting support functions will be designed in NFIDB. DOF is currently responsible for compilation of National GHG Inventory in forestry sector as well as Country Report of Global Forest Resources Assessment (FRA). The international reporting support functions will be created in NFIDB to retrieve and summarize necessary information/data for compiling these reports.

Table 3-20: List of international reports responsible by DOF

Type of international report	Implementing organization	Responsibility of DOF
National GHG Inventory reports consisting of: ◆ GHG Inventory Report, ◆ National Communication (NC), and ◆ Biennial Update Report (BUR).	UNFCCC	Compilation of data in forestry sector (MONRE is the focal point to UNFCCC)
Global Forest Resource Assessment (FRA))	FAO	Compilation of Country Report as National Correspondent

UNFCCC

In Laos, first and second national communications (NC) were submitted to UNFCCC in 2000 and 2013 respectively. Now, Climate Protection through Avoided Deforestation (CliPAD) project funded by German Agency for International Development (GIZ) has started capacity building

program on reporting national GHG inventory (compilation of NC and BUR to UNFCCC) in Agriculture, Forestry and Other Land Use (AFOLU) sector. It is considered that this program will enhance the capacity of GHG inventory component in NFMS of Laos (Table 3-20). This program will be mainly offered to the national focal point of UNFCCC in MONRE.

NFIS project reviewed the first and second NCs as well as participated in an inception workshop of the capacity building program held by CliPAD, and the following observations were found:

1) Based on the comparison of the second NC to UNFCCC and FRA 2015, it was observed that different activity data (AD) and emission factors (EFs) were used. As mentioned later, FRA 2015 used past inventory data (1982, 1992 and 2002) and Forest Cover Assessment data (2010) to estimate historical forest cover changes between 1990 and 2010. On the other hand, the second NC to UNFCCC used past inventory data (2002) and Five-Year Sustainable Forest Protection Action Plan (2006-2010) to report forest areas of 2000 and 2010. As a result, while FRA 2015 shows a slightly decreasing trend in the forest area between 2000 and 2010 (app. 0.4% decrease per annum), the second NC shows increasing trend (app. 3.8% increase per annum) in the section "Mitigation Options and Potential, and slightly decreasing as BAU in the same time interval but the consistency of data development/organizing is well implemented.

2) In addition, EFs for estimating the amount of carbon emission or sequestration are different between NC and FRA 2015. While NC uses only default values from IPCC Good Practice Guidance (GPG) for LULUCF (Tier level 1), FRA 2015 uses combined values of default values from IPCC Guidelines and country specific values derived from national forest inventory data (Tier level 1/2).

Table 3-21: List of activity data and emission factors employed in FRA 2015 and Second National Communication to UNFCCC

	Activity Data	Emission Factors
Second National Communication to UNFCCC	NFI database (2002) Five-Year Sustainable Forest Protection Action Plan (2006-2010)	Default values from IPCC Good Practice Guidance for LULUCF
FRA 2015	NFI database (1982, 1992 and 2002) Forest Cover Assessment (2010)	NFI data: Growing stock Default values from 2006 IPCC Guidelines: Chapter 7 Biomass conversion and expansion factors (BCEF); Chapter 8 Ratio of below ground biomass to above ground biomass (R); and Chapter 9 Carbon fraction (CF).

In the second NC to UNFCCC, the following issues are discussed in the implementation of the national GHG inventory in Laos. It is considered that the sharing of NFIDB between different ministries/departments associated with the national GHG inventory could contribute to tackle some

of the issues within the forestry sector, especially on issues 1, 2, 4 and 5.

(1) Inadequate and inaccurate information and activity data;

(2) Lack of local emission factors;

(3) Inadequate capacities of local researchers among relevant agencies;

(4) Poor database to support inventory activities;

(5) Insufficient coherence and coordination; and

(6) Development of regular inventory preparation programme.

Especially, tackling of issue 5 is crucial to make consistent international reports including National GHG Inventory reports and Country Report of FRA. As mentioned before, AD and EFs employed in NC and FRA are different, which resulted in reporting different scenarios from Lao PDR on the future CO2 emission or sequestration. That can be tackled by making closer coordination between different ministries/department associated with the national GHG inventory (e.g. MAF/DOF and MONRE in AFOLU sector). For example it seems necessary that establishing technical working groups constituted by the related ministries/department for every sector to discuss the methodology of GHG inventory and reporting, but it is beyond the scope of C/P and NFIS. It should be noted that this project should address this issues by supporting the role of C/P (FIPD and DOF).

FRA2015

Global Forest Resources Assessment (FRA), coordinated by FAO, was started in 1948, and is currently conducted in five year intervals to provide consistent datasets for describing the world's forest condition. The Assessment is based on two primary sources of data: Country Reports prepared by National Correspondents and remote sensing that is conducted by FAO together with national focal points and regional partners (FAO). In Lao PDR, DOF is the National Correspondent for FRA reporting. Since the Country Report is used internationally as official references for describing the forest condition of the country as well as basic information for international organizations to prepare assistance programs/projects in forest sector, it is very important to compile the report using updated and accurate information/data as far as possible. In Laos, DOF submitted the final draft of Country Report of FRA 2015 to FAO in December 2013. NFIS project supported FIPD on the collection of data sources and compilation of FRA 2015 in order to study the current condition/capacity on FRA reporting as well as to make basic design of NFIDB for the future FRA reporting.

While this project was assisting DOF on the collection of data and compilation of Country Report for FRA 2015, the following observations were found:

A) Information/data required for FRA reporting are dispersed in different ministries/departments;

B) Information are often compiled in analogue (sometimes hand-writing) format;

C) Information/data are often held by individuals and not shared among different ministries/departments;

D) Experiences to prepare the former FRA reports have not been transferred to the current staff member in DOF in charge of FRA reporting; and

E) There is no official framework on the collection and integration of information/data for FRA reporting. These works are currently done by an officer in FIPD in charge of FRA reporting.

3.2.3 Identification of Types/Specifications of Forest Information Data

A technical workshop was held in FIPD in order to discuss the framework of geo-spatial database and identify the necessary data to build the database(table3-22). The identified data were summarized in table * by the criteria as follows:

- Application of data;
- Category and sub-category of data;
- Availability of data in FIPD;
- Location of data (if not available in FIPD);
- Necessity of creating unavailable data for NFIDB; and
- Where, who and how to create unavailable data.

The identified data will be collected and/or created mainly by the staff members of FIPD throughout NFIS project.

Table 3-22: List of data to be collected or developed for building geo-spatial database of NFIDB

Application of data	Category	Sub-category	Description of data (source, year, methodology of production)	Availability of data in FIPD (Yes or No)	Location of data (if not available in FIPD)	Necessity of creating un-available data for NFIDB	Where, who and how to create un-available data
REDD + and SFM	Contour	Contour interval (100m, 50m, 20m)	NGD (National Geographic Department), Updated in 2003 based on aerial photo taken in 1999 (scale: 1:100,000), (http://www.ngdlaos.la/2012/02/01/contour-lines/)	Yes			
	DEM	Elevation, Slope	FIM (Program for Forest Information Management) project, 2010-2012, Automatic generation from ASTER G-DEM	Yes			
	Geology	Unsure	Unsure	No	Geology Department	Geology data is required for forest use planning taking into account potential mining area.	Check Geology Department.
	Soil	Soil type, pH, Depth	NAFRI (National Agriculture and Forest Research Institute)	JPEG file is available but no GIS file.	NAFRI	Necessary to collect or create GIS file.	Check NAFRI for availability of GIS data.
	Watershed	Main watershed, Sub-watershed	1. MRC (Mekong River Commission): Mekong watershed data 2. GTZ project (Watershed management and forest cover monitoring project), Forest cover (1994-1998), Watershed (1999), Digitization of paper map	1. No 2. Yes	1. MRC	Necessary to collect MRC watershed data.	Check MRC for availability of watershed GIS data.

	River network	River, Stream, Small stream	NGD, Updated in 2003 based on aerial photo taken in 1999 (scale: 1:100,000), (http://www.ngdlaos.la/2012/02/01/rivers/)	Yes			
	Road network	Major road, Road, Logging road, Footpath	1. NGD, Updated in 2003 based on aerial photo taken in 1999 (scale: 1:100.000), (http://www.ngdlaos.la/2012/02/01/roads/) 2. Communication and Transport Department (unsure)	1. Yes 2. No		Updating of NGD road network data is necessary.	Updating will be conducted in FIPD using RapidEye images (2010) and aerial photo (2011) orthophoto images.
	Administrative boundary	National boundary, Provincial boundary, District boundary	NGD, Updated in 2003 based on aerial photo taken in 1999 (scale: 1:100,000), (http://www.ngdlaos.la/2012/02/01/administrative-boundary/)	Yes			
	Village	Village point	NGD, Updated in 2008 based on data from Lao Statistics Bureau, (http://www.ngdlaos.la/2012/02/01/villages/)	Yes	Lao Statistics Bureau	Updating of village point data is necessary.	Check Lao Statistics Bureau.
	National Forest Inventory	Sample plot	FIPD, NFI (1991-1999), FIM project (2010-2012)	Yes			
	Land use plan	Unsure	NAFRI	No	NAFRI	Yes	Check NAFRI.
	Concession	Concession type and area	Unsure	No	MONRE	Yes	Check MONRE.

	Statistics / Census	Population	Unsure	No	Lao Statistics Bureau	Yes, but possible to collect only national data in this project.	Check Lao Statistics Bureau.
		Income	Unsure	No	Lao Statistics Bureau	Yes, but possible to collect only national data in this project.	Check Lao Statistics Bureau.
		Employment	Unsure	No	Lao Statistics Bureau	Yes, but possible to collect only national data in this project.	Check Lao Statistics Bureau.
		Forestry (Timber and/or NTFP)	Unsure	No	Ministry of Trade (Timber trade)	Yes, but possible to collect only national data in this project.	Check Ministry of Trade.
		Illegal logging	Unsure	No	DOFI (Department of Forest Inspection)	Yes	Check DOFI.
		Agriculture	Unsure	No	MAF	Yes, but possible to collect only national data in this project.	Check MAF.
		Livestock	Unsure	No	MAF	Yes, but possible to collect only national data in this project.	Check MAF.
	Development plan area	Unsure	Unsure	No	Ministry of Planning and Investment	Yes	Check Ministry of Planning and Investment.
	Irrigation	Unsure	Unsure	No	MAF	Yes	Check MAF.
	Mining	Unsure	Unsure	No	Geology Department	Yes	Check Geology Department.

	Military zone	Unsure	Unsure	No	Military	Yes, but impossible to collect data.	
	Forest along national borders	Unsure	Unsure	No	Military	Yes, but impossible to collect data.	
REDD+	Eco-region	Eco-region	The Nature Conservancy (http://maps.tnc.org/gis_data.html)	No	Website of The Nature Conservancy	Yes	Download from website of The Nature Conservancy.
	Climate	Unsure	Unsure	No	MAF or MONRE (Unsure)	Yes	Check MAF or MONRE.
	REDD+ project boundary	Project boundary	PAREDD, Clipad, WWF	No	PAREDD, Clipad, WWF	Yes	Check each project.
	Biodiversity hotspot	NBCA boundary	NBCA (National Biodiversity Conservation Area)	Yes, but only boundary is available. No attribute data.	MONRE (Ministry of Natural Resource and Environment)	Yes, need to create attribute data for NBCA boundary data (shapefile).	English translation by the project side and data input by FIPD.
	Electric power line network	Electric power line network	Unsure	No	Department of Energy, Trade and Business	Yes	Check Department of Energy, Trade and Business.

SFM	Forest category	Conservation forest	MONRE	Yes			
		Protection forest	MONRE	Yes			
		Production forest	DOF	Yes			
	Village	Village boundary		No	Not available in Laos.	Yes, but impossible to create in this project.	
	Forest management area	FMA (Forest Management Area), Sub-FMA, FC (Forest Compartment)		No	SUFORD	Yes	Check SUFORD as well as Forest Product and Harvest Division (Section name in English is uncertain).
Basemap	Satellite image		RapidEye (2010), ALOS (2010), SPOT-5 (2005)	Yes			
	Aerial photo		Ortho-rectified aerial photo (2011): 6 provinces from Khammouan down to South (http://www.ngdlaos.la/2012/02/01/aerial-photograph/)	Yes			
	Ground truth		FIM (2010-2012), 720 points from non-forest and 1,680 points from forest	Yes			

3.2.4 Design of National Forest Information Database (Outline Proposal)

The framework of REDD+ (or REDD) program has been discussed in Conference of the Parties (COP) in the United Nations Framework Convention on Climate Change (UNFCCC) since COP 11, Montreal (2005). The first methodological guidance on REDD+ activities was provided at COP 15, Copenhagen (2009). That requests developing countries to establish robust and transparent National Forest Monitoring System (NFMS) that:

1) Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes (Monitoring and Measurement);
2) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities (Reporting); and
3) Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties (Verification).

According to UN-REDD NFMS strategy (UN-REDD programme, 2013), NFMS (Figure 3-28) has two main components: Monitoring and MRV (measurement, reporting and verification) functions. MRV function consists of satellite land monitoring system, national forest inventory and GHG inventory. It is considered that NFIDB (Figure 3-28) to be designed in this project shall be a core part of NFMS of Laos. NFIDB has four main functions: (1) geo-spatial database, (2) forest inventory database, (3) forest carbon database and (4) production, protection and conservation forest database. Geo-spatial database function will be a core part of satellite land monitoring system of NFMS that offers basic geo-spatial dataset including satellite image archives and NFCMs for three periods (2000, 2005 and 2010) as well as information necessary for creating historical forest cover changes and Reference Emission Levels (RELs) / Reference Levels (RLs). In addition, forest inventory database and forest carbon database functions of NFIDB database will be a core part of national forest inventory and GHG inventory components of NFMS. However, integration of information/data from other forest inventory and GHG inventory related projects/activities in Laos is required to build up these components.

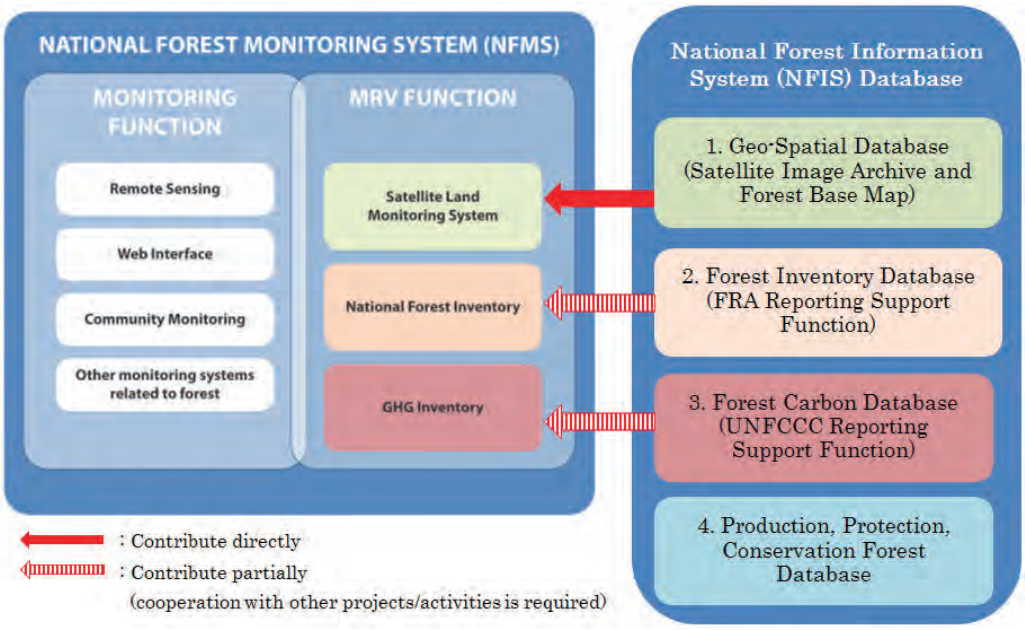


Figure 3-28: NFIDB which will be a core part of NFMS

Role of NFIDB for UNFCCC Report

GHG inventory software will be introduced in the capacity building program of GIZ-CliPAD project. Now, two software (IPCC inventory software (figure 3-29) and ALU software (figure 3-30)) are available for compiling GHG inventory in AFOLU sector.

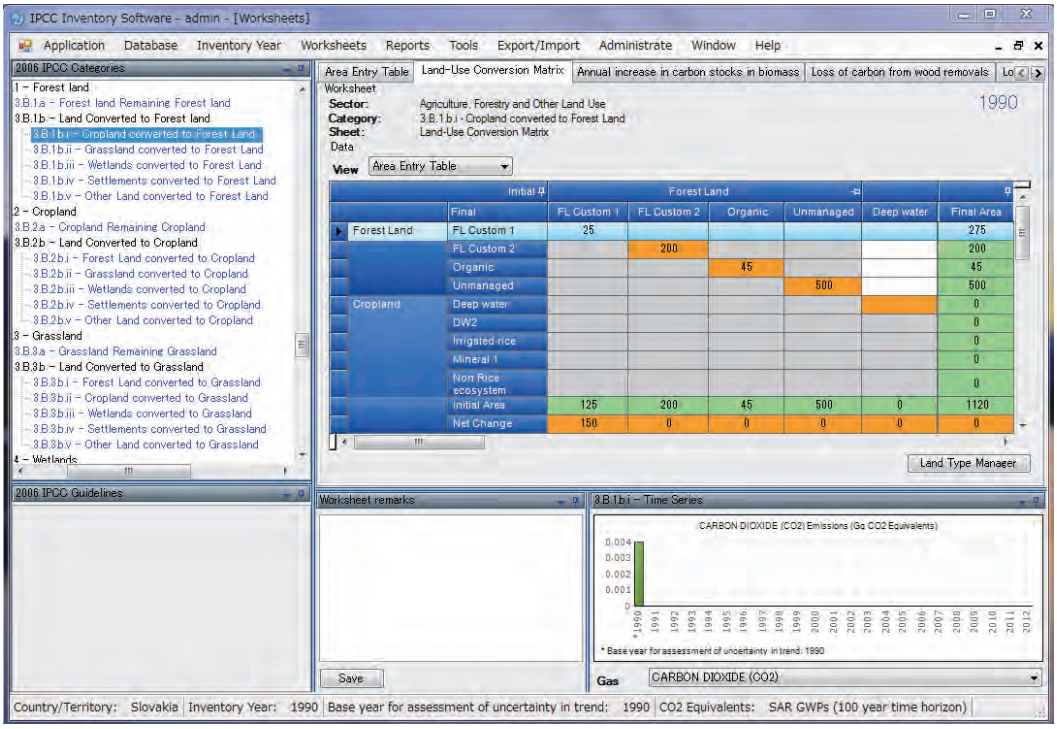


Figure 3-29: IPCC inventory software

Figure 3-30: ALU software

It is considered that GHG inventory software and NFIDB can be operated together (figure 3-31). NFIDB can be used to retrieve and summarize AD and EFs (in form of tables and/or GIS data) that are used to develop national forest type and carbon maps. In addition, NFIDB can be used to make forest cover change matrix, reference level (RL) / reference emission level (REL) and maps for the specified area. The summary (in form of tables and/or GIS data) will be used to input AD and EFs to GHG inventory software. GHG inventory software can be used for quality assurance (QA) / quality control (QC), uncertainty analysis and export data tables. The exported data tables will be transmitted to the national focal point to UNFCCC (MONRE) for integration of GHG inventory data from all sectors and compilation of reports following the standard format of IPCC guidelines.

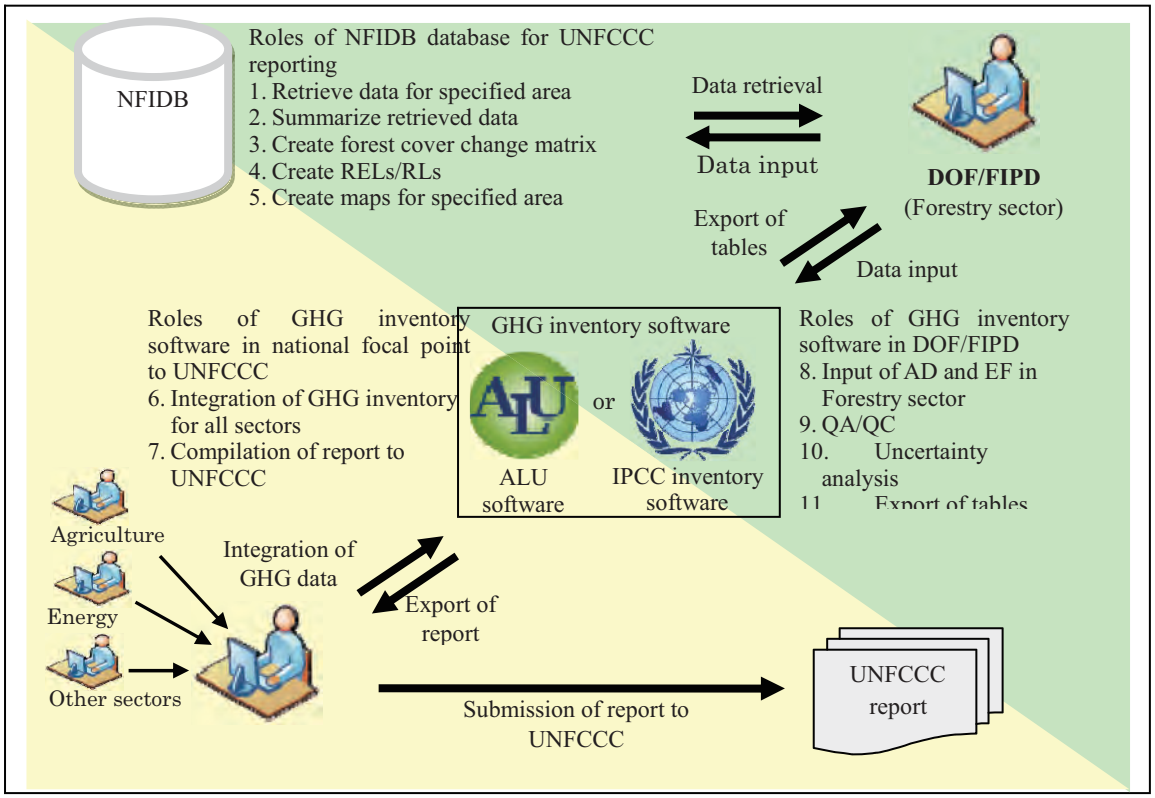


Figure 3-31: Role of NFIDB and GHG inventory software for preparing national GHG inventory report to UNFCCC (This diagram focuses on Forestry sector.)

Role of NFIDB for FRA Country Report

The necessary information/data for FRA reporting are currently dispersed in different ministries/departments and are not well organized. That makes difficult to understand the availability and condition of information/data as well as to create strategy to collect and/or create unavailable information/data. Therefore, it is necessary to create official framework to collect and integrate the information/data periodically from different ministries/departments and store the integrated information/data in a database. As a first step, this project will design data storage and data summary functions in NFIDB to prepare for the next FRA reporting.

In FRA 2015, FAO provides online data entry system (Forest Resources Information Management System, FRIMS) to National Correspondents in order to compile the Country Report in a standard format (figures 3-32 and 33). It is considered that FRIMS and NFIDB can be operated together (figure 3-3). The necessary information/data for FRA reporting will be periodically collected from different departments of DOF and MONRE. The collected information/data will be stored in NFIDB. NFIDB will be used to retrieve necessary data, forecast values for FRA reporting years using the available data, create forest cover change matrix, and make a summary of data for a reference of data entry to FRIMS. The summary of data will be feedback to the related ministries/departments. On the other hand, FRIMS will be used to make Country Report following the standard format of FRA as well as to transmit the finalized report to FAO.

Figure 3-32: Forest Resources Information Management System (FRIMS)

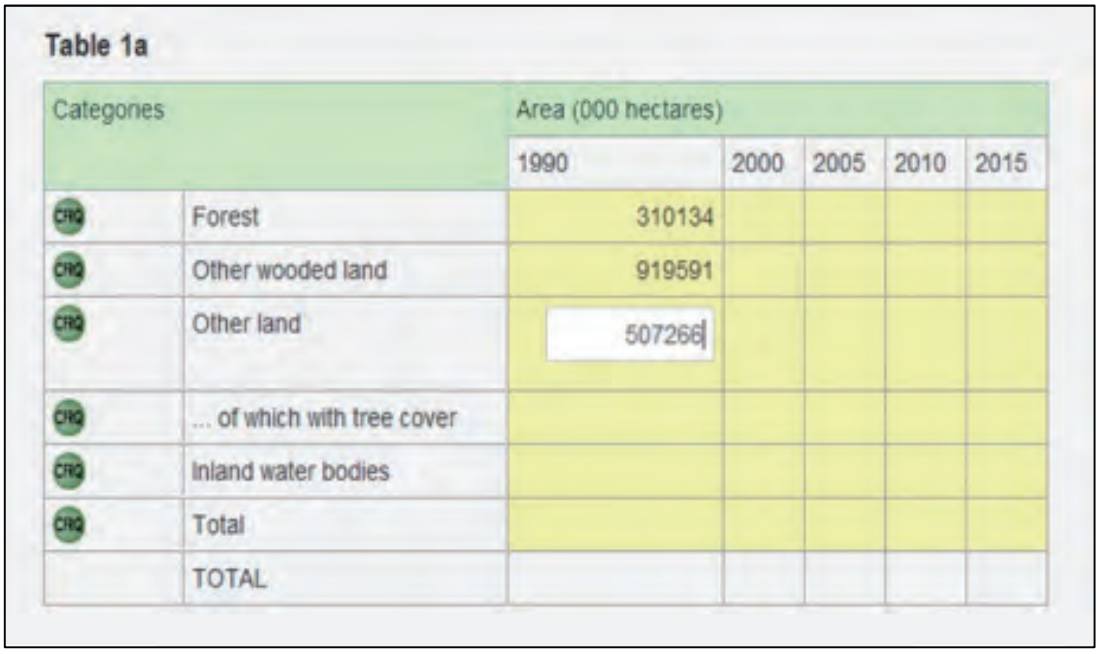


Table 1a

Categories		Area (000 hectares)				
		1990	2000	2005	2010	2015
CFRQ	Forest	310134				
CFRQ	Other wooded land	919591				
CFRQ	Other land	507266				
CFRQ	... of which with tree cover					
CFRQ	Inland water bodies					
CFRQ	Total					
	TOTAL					

Figure 3-33: Data entry form in FRIMS

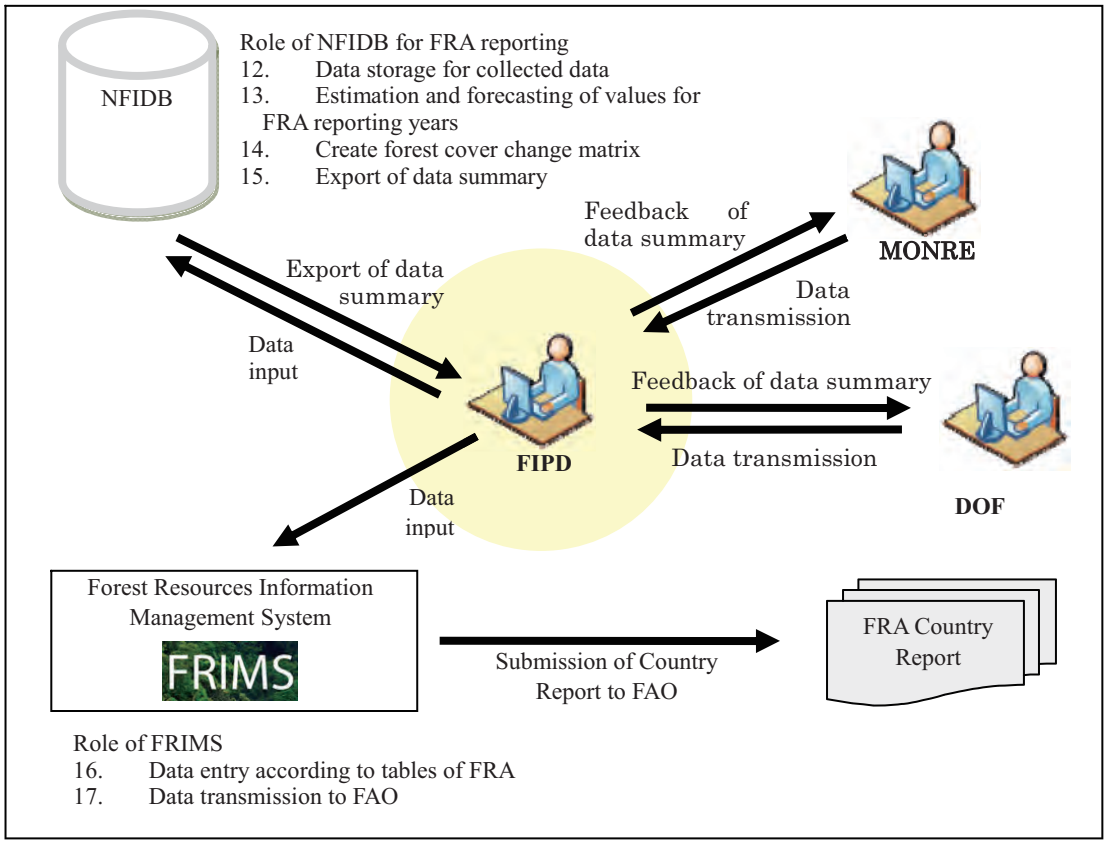


Figure 3-34: Role of NFIDB for FRA Country Report

Table 3-23 shows a list of tables and variables in the Country Report of FRA 2015 as well as the current and expected data sources for FRA 2015 and 2020 respectively taking into consideration the expected outputs of NFIS project. In FRA 2015, past inventory data (1982, 1992 and 2002) and Forest Cover Assessment data (2010) were used as data sources for estimating or forecasting values of FRA reporting years such as forest area (1a), forest expansion and deforestation (1b), forest growing stock (3a), above and below ground biomass (3d), and carbon in above and below ground biomass (3e). However, the methodology to create past inventory data (1982, 1992 and 2002) and Forest Cover Assessment data (2010) is different. That causes lower data consistency. While NFI database (1982, 1992 and 2002) was created by wall to wall mapping using satellite imagery and forest inventory survey data, forest cover assessment data (2010) was created by statistical analysis using the result of forest/non-forest interpretation for 4km grid sampling points.

In NFIS project, NFCMs for three time periods (2000, 2005 and 2010) with adequate thematic accuracy (more than 80% accuracy in forest or non-forest classification) and higher data quality (Tier level 2 depending on the adoption of county or region specific parameters/functions) will be produced. These dataset will be incorporated and/or substituted to the current data sources in the next FRA reporting (FRA 2020) in order to enhance data consistency and data quality. It is estimated that NFI database (1982 and 1992) and NFIS dataset (2000, 2005 and 2010) will be used as data sources for FRA 2020.

Table 3-23:List of data sources for FRA reporting

Tables in FRA2015	Variable	Unit	Reporting year for FRA2015					Reporting responsible department/section	Data source for FRA2015	Data source for FRA2020	Remarks
			1990	2000	2005	2010	2015				
FOREST AREA AND FOREST CHARACTERISTICS											
1a	Forest area	1000 ha	x	x	x	x	x	FIPD	NFI database (1982, 1992, 2002) & Quick assessment map (2010)	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010)	
	Area of other wooded land	1000 ha	x	x	x	x	x				
	Area of other land	1000 ha	x	x	x	x	x				
	… of which with tree cover	1000 ha	x	x	x	x	x		n.a		
	Inland water bodies	1000 ha	x	x	x	x	x		NFI database (1982, 1992, 2002) & Quick assessment map (2010)	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010)	
	Total country area	1000 ha	x	x	x	x	x		FAOSTAT	FAOSTAT	
1b	Forest expansion	1000 ha/yr	x	x	x	x		FIPD	NFI database (1982, 1992, 2002) & Quick assessment map (2010)	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010)	
	… of which afforestation	1000 ha/yr	x	x	x	x			n.a		
	… of which natural expansion of forest	1000 ha/yr	x	x	x	x					
	Deforestation	1000 ha/yr	x	x	x	x			NFI database (1982, 1992, 2002) & Quick assessment map (2010)	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010)	
	… of which human induced	1000 ha/yr	x	x	x	x			n.a		
	Reforestation	1000 ha/yr	x	x	x	x			n.a		
	… of which artificial	1000 ha/yr	x	x	x	x					
2a	Primary forest	1000 ha	x	x	x	x	x		NBCA data	NBCA data	
	Other naturally regenerated forest	1000 ha	x	x	x	x	x		SUFORD database	SUFORD database	
	… of which introduced species	1000 ha	x	x	x	x	x		n.a		
	… of which naturalized	1000 ha	x	x	x	x	x				
	Planted forest	1000 ha	x	x	x	x	x	SUFORD & FIPD	SUFORD/FIPD forest cover data from SPOT-5 and Landsat	SUFORD database	
	… of which introduced species	1000 ha	x	x	x	x	x		n.a		
2b	Primary forest transition matrix	1000 ha	(1990-2000, 2000-2010, 2010-2015)					FIPD	n.a		
2c	Area of mangrove forest	1000 ha	x	x	x	x	x	-	-	-	No mangrove forest in Lao PDR
	… of which planted	1000 ha	x	x	x	x	x				
PRODUCTION											
3a	Total forest growing stock	Million m3	x	x	x	x	x	FIPD & SUFORD	NFI database (1982, 1992, 2002) & Quick assessment map (2010) as well as SUFORD database	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010) as well as SUFORD database	Growing stock factor (Forest: 59.27 m3/ha, OWD: 6.87) derived by NFI (1992-1997) is applied to forest area.
	… of which coniferous	Million m3	x	x	x	x	x				
	… of which broadleaved	Million m3	x	x	x	x	x				
	Total other wooded land growing stock	Million m3	x	x	x	x	x				
	… of which coniferous	Million m3	x	x	x	x	x		n.a		
	… of which broadleaved	Million m3	x	x	x	x	x				
3b	Volume of top ten species	Million m3	x	x	x	x		SUFORD	SUFORD database	SUFORD database	
3c	Net annual increment	m3/ha/yr	x	x	x	x			n.a		
	… of which coniferous	m3/ha/yr	x	x	x	x					
	… of which broadleaved	m3/ha/yr	x	x	x	x					
3d	Above-ground biomass	Million tonnes	x	x	x	x	x	FIPD	NFI database (1982, 1992, 2002) & Quick assessment map (2010) as well as default BCEF values from 2006 IPCC Guidelines	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010) as well as country/region specific allometry functions	
	Below-ground biomass	Million tonnes	x	x	x	x	x				
	Dead wood	Million tonnes	x	x	x	x	x		n.a		
3e	Carbon in above-ground biomass	Million tonnes	x	x	x	x	x		Default carbon fraction value from 2006 IPCC Guidelines	Default carbon fraction value from 2006 IPCC Guidelines	
	Carbon in below-ground biomass	Million tonnes	x	x	x	x	x				
	Carbon in dead wood	Million tonnes	x	x	x	x	x		n.a		
	Carbon in litter	Million tonnes	x	x	x	x	x		Default value from 2006 IPCC Guidelines	Default value from 2006 IPCC Guidelines	
	Soil carbon	Million tonnes	x	x	x	x	x		n.a		
4a	Production forest	1000 ha	x	x	x	x	x	FIPD	SUFORD database	SUFORD database	
	Multiple use forest	1000 ha	x	x	x	x	x		n.a		
4b	Value of most important commercial NWFP	1000 local currency				x		NAFRI	n.a		

: information to be updated by the result of NFIS project

*Abbreviation

n.a: not available
DOF: Department of Forestry
MONRE: Ministry of Natural Resources and Environment
OWL: Other wooded land
DFRM: Department of Forest Resource Management
FRDF: Forestry and Forest Resource Development Fund
NBCA: National Biodiversity Conservation Area
BCEF: Biomass conversion and expansion factors

PROTECTIVE FUNCTIONS ECOSYSTEM SERVICES											
5a	Protection of soil and water	1000 ha	x	x	x	x	x	DFRM・MONRE	Protection area data	Protection area data	
	… of which production of clean water	1000 ha	x	x	x	x	x				
	… of which coastal stabilization	1000 ha	x	x	x	x	x		n.a		
	… of which desertification control	1000 ha	x	x	x	x	x				
	… of which avalanche control	1000 ha	x	x	x	x	x				
	… of which erosion, flood protection or reducing flood risk	1000 ha	x	x	x	x	x				
	… of which other	1000 ha	x	x	x	x	x				
5b	Ecosystem services, cultural or spiritual values	1000 ha	x	x	x	x	x				
	… of which public recreation	1000 ha	x	x	x	x	x		n.a		
	… of which carbon storage or sequestration	1000 ha	x	x	x	x	x				
	… of which spiritual or cultural services	1000 ha	x	x	x	x	x				
	… of which other	1000 ha	x	x	x	x	x				
BIODIVERSITY/CONSERVATION											
6	Conservation of biodiversity	1000 ha	x	x	x	x	x	DFRM・MONRE	NBCA data	NBCA data	
	Forest area within protected areas	1000 ha	x	x	x	x	x	FIPD	n.a	NFI database (1982, 1992) & NFIS database (2000, 2005, 2010)	
7	List of woody invasive species	1000 ha			x	x		DFRM・MONRE	n.a		
	Area of forest affected by woody invasive species	1000 ha			x	x					
DISTURBANCE AND FOREST DEGRADATION											
8a	Total land area burned	1000 ha	Annual data 2003-2012					FIPD	n.a		
	… of which forest area burned	1000 ha	Annual data 2003-2012								
8b	Area of forest damaged by outbreak of: insects, diseases and severe weathe	1000 ha	List of year(s) of latest outbreak								
9	Area of forest with reduced canopy cover	% canopy cover	2000-2010								
MEASURING PROGRESS TOWARD SFM											
i. National-scale enabling environment for SFM											
10	Policies supporting sustainable forest management	Boolean	Latest available year					SUFORD	Yes	Yes	
	… of which in publicly owned forests	Boolean	Latest available year								DOF policy/law includes regulation for village forests.
	… of which in privately owned forests	Boolean	Latest available year								
	Legislation and regulations supporting SFM	Boolean	Latest available year						Yes	Yes	
	… of which in publicly owned forests	Boolean	Latest available year								
	… of which in privately owned forests	Boolean	Latest available year								
11	National stakeholder platform	Boolean	Latest available year					DOF	n.a		
12	Forest area intended to be in permanent forest land use	1000 ha				x		DOF	n.a		
	… of which permanent forest estate	1000 ha				x					
13a	Forest area monitored under a national forest monitoring framework		Latest available year					FIPD	n.a	Filled based on the result of NFIS project	
13b	Criteria and indicators reporting	Boolean	Latest available year						n.a		
	Periodic national state of the forest reporting	Boolean	Latest available year					FIPD	n.a		
	Other	Boolean	Latest available year						n.a		
	None	Boolean	Latest available year						n.a		

	: information to be updated by the result of NFIS project										
*Abbreviation	n.a: not available	DOF: Department of Forestry				MONRE: Ministry of Natural Resources and Environment				OWL: Other wooded land	
	DFRM: Department of Forest Resource Management	FRDF: Forestry and Forest Resource Development Fund				NBCA: National Biodiversity Conservation Area				BCEF: Biomass conversion and expansion factors	

ii. Operational scale progress toward SFM											
14a	Forest area with management plan	1000 ha				x		SUFORD	n.a		
	… of which for production	1000 ha				x					
	… of which for conservation	1000 ha				x		DFRM・MONRE			
14b	Monitoring of forest management plans		Latest available year					SUFORD & FIPD	n.a		
	Soil and water management	Boolean	Latest available year					Not clear			
	High conservation value forest delineation	Boolean	Latest available year					Not clear			
	Social consideration/community involvement	Boolean	Latest available year					DAFO/village			
14c	Percent of area under forest management plan that is monitored annually	%	Latest available year					SUFORD & FIPD	n.a		
15	Type of stakeholder inputs		Latest available year					PAFO & DAFO	n.a		
	Planning phase_Boolean_Not applicable	Boolean	Not applicable								
	Operations phase_Boolean_Not applicable	Boolean	Not applicable								
	Review of operations_Boolean_Not applicable	Boolean	Not applicable								
16a	Area of forest certified under FSC_1000 ha_Annual data 2000-2012	1000 ha	Annual data 2000-2012					DOF & SUFORD	n.a		
	Area of forest certified under PEFC_1000 ha_Annual data 2000	1000 ha	Annual data 2000								
	Area of forest certified by other international certification	1000 ha	Annual data 2000								
16b	Domestic forest management certification	1000 ha	Annual data 2000					n.a	n.a		
ECONOMICS/ LIVELIHOODS											
17	Forest revenue	1000 local currency		x	x	x		FRDF	Record from DOF	Record from DOF	
	Public expenditures on forests	1000 local currency		x	x	x					
18a	Public ownership	1000 ha	x	x	x	x		DOF	Record from DOF	Record from DOF	
	… of which owned by the state at national scale	1000 ha	x	x	x	x			n.a		
	… of which owned by the state at the sub-national government scale	1000 ha	x	x	x	x					
	Private ownership	1000 ha	x	x	x	x			n.a		
	… of which owned by individuals	1000 ha	x	x	x	x					
	… of which owned by private business entities and institutions	1000 ha	x	x	x	x					
	… of which owned by local, tribal and indigenous communities	1000 ha	x	x	x	x					
	Unknown ownership	1000 ha	x	x	x	x					
18b	Holder of management rights of public forests	1000 ha	x	x	x	x		DOF, PAFO, DAFO, village	n.a		
	Public administration	1000 ha	x	x	x	x					
	Individuals	1000 ha	x	x	x	x					
	Private companies	1000 ha	x	x	x	x					
	Communities	1000 ha	x	x	x	x					
	Other	1000 ha	x	x	x	x					
19	Employment in forestry	1000 FTE	x	x	x	x		DOF, PAFO, DAFO, village	Record from DOF and DFRM・MONRE	Record from DOF and DFRM・MONRE	
	… of which female	1000 FTE	x	x	x	x					
20	Gross value added from forestry	Million local currency	Latest available year					FRDF	n.a		
LOOKING FORWARD											
21a	Government targets/aspirations for forest area in 2020 and 2030	1000 ha	2020 and 2030					DOF	2020 strategy is available. But modification is planning to be made for 2030 by DOF and DFRM.		
21b	Forest area earmarked for conversion	1000 ha	2013					Ministry of Industry and Trade, and MAF	n.a		

	: information to be updated by the result of NFIS project			
*Abbreviation	n.a: not available	DOF: Department of Forestry	MONRE: Ministry of Natural Resources and Environment	OWL: Other wooded land
	DFRM: Department of Forest Resource Management	FRDF: Forestry and Forest Resource Development Fund	NBCA: National Biodiversity Conservation Area	BCEF: Biomass conversion and expansion factors

	: information to be updated by the result of NFIS project			
*Abbreviation	n.a: not available	DOF: Department of Forestry	MONRE: Ministry of Natural Resources and Environment	OWL: Other wooded land
	DFRM: Department of Forest Resource Management	FRDF: Forestry and Forest Resource Development Fund	NBCA: National Biodiversity Conservation Area	BCEF: Biomass conversion and expansion factors

Considering User Interface (Draft)

The draft User-Integration of Geo-Spatial Database and Forest Inventory Database, which had been developed in FIM, was considered. The image of the interface was presented d in the Technical Workshop.

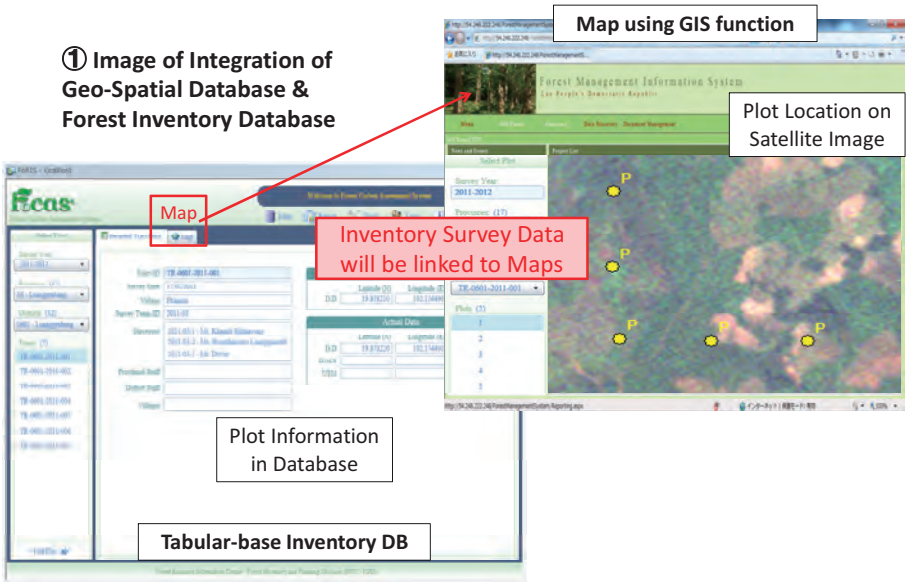


Figure 3-35: Image of Integration of Geo-Spatial Database and Forest Inventory Database

In addition, the plan and image of the reporting user-interface based on browser based interface of (Forest Management Information System., which have been developed in FPP, was presented in the Technical Workshop.

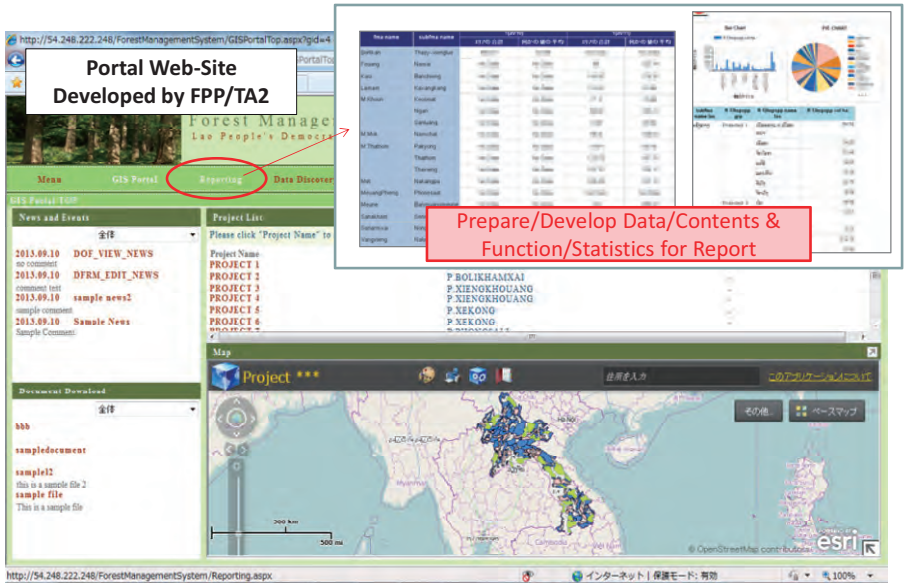


Figure 3-36: Image of Reporting User-Interface based on Web-browser System

In the second year, the concrete page layout design and specifications based on the image described above shall be considered and discussed in cooperation with the local database consultant.

3.3 Output 3

During the 1st Phase, collection and analysis of data/information,action of the 1st NFI (1991-99), Design of Forest Resource Assessment (FRA) by SUFORD (2010), Nation-wide inventory of FIM and Forest Biomass Survey in Houaphane Province by CliPAD was conducted. Among these, SUFORD FRA proposes a tract and plot design, which is slightly modified version of NFI's, but doesn't propose concrete methods including number of tracts/plots and survey items, therefore it is not analyzed further.

The objectives, target area, survey items are compiled in Table 3-24 below.

Table 3-24: Objectives, Target areas and Survey Items of 1st NFI, FIM and CliPAD

	1st NFI	FIM	CliPAD
Objectives	- Estimate of growing stock - Development of volume functions - Revision of forest definitions if found necessary	- Estimate of forest carbon stock - Reference for forest type map	Forest biomass survey for VCS JNR certification
Target area	Nation wide (Only accessible areas)	Nation wide (Only easily accessible areas)	2 Districts in Houaphane Province
Implementation Year	1991-1999	2011-2012	2014
Number of plots	Forest : 2368 Non-forest : 1696	Forest : 1680 Non-forest : 720	
Plot design and shape			
Single plots			
Cluster plots	**X**	**X**	**X**
Nested plots		X	X
Circular plots		X	
Rectangular plots	X		X
Forest classification	X	X	X
Photographs		X	X
Living trees	**X**	**X**	**X**
DBH	X	X	X

Diameters at middle and top of bole	X		
Tree height	X	X	
Tree quality	X	X	
Population of saplings	X	X	
Canopy density	X	X	X
Non-forest class	X	X	X
Forest structure	X	X	
Speices (local name)	X	X	X
Species (Scientific name)			
Slope	X	X	X
Deciduousness			X
Leaf fall index			X
Stumps	**X**		**X**
Diameter	X		X
Height	X		X
Non-tree vegetation			
Fresh mass			
Dry mass			
Standing dead trees			**X**
DBH			X
Height			X
Lying Dead Wood			**X**
Diameter			X
Density			
Decomposition class			X
Litter			
Fresh mass			
Dry mass			
Soil	**X**		
Soil type	X		
Bulk density			
Organic carbon content			

NTFP	**X**	
Rattan	X	
Bamboo	X	
Hauling	**X**	
Hauling distance to road	X	
Slope of hauling route	X	

Source

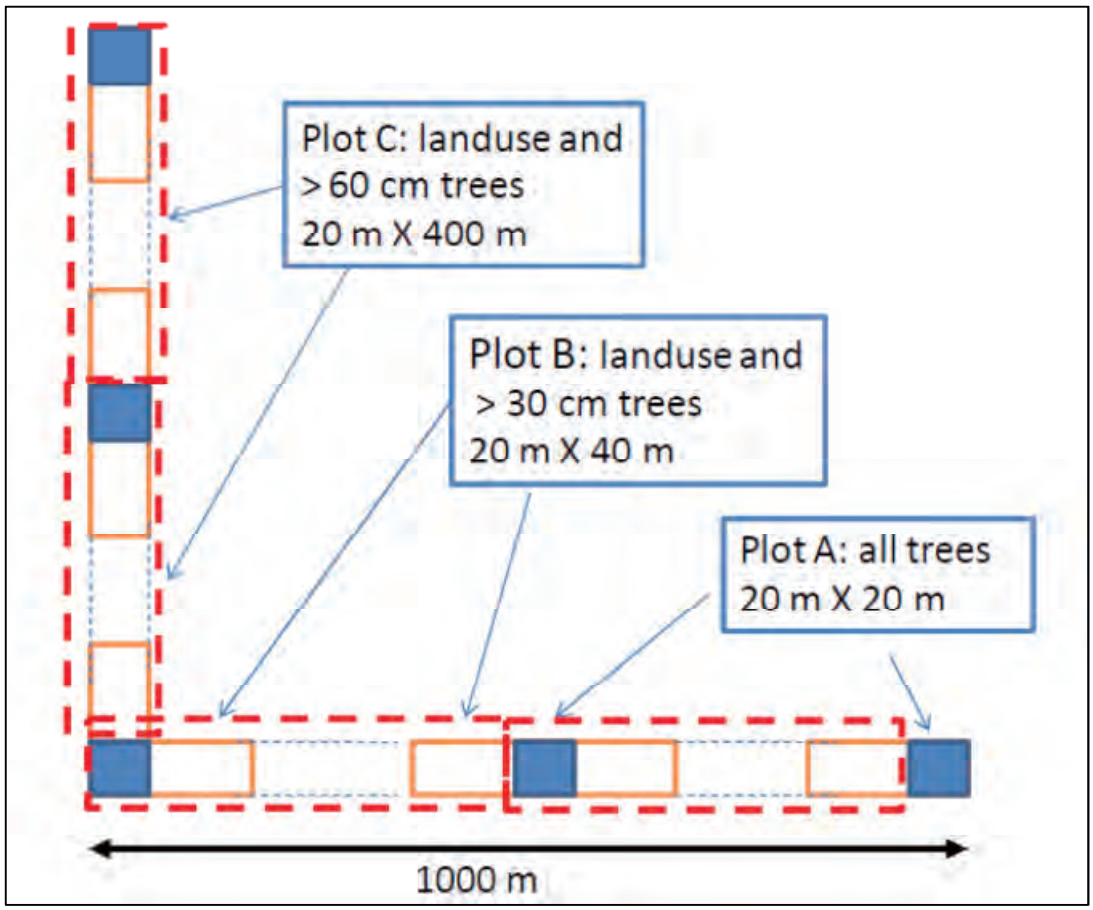
1st NFI: Lao National Forest Inventory Field Manual 1993/94, DOF

FIM: Guideline on National Forest Inventory Survey for Satellite Image Classification Analysis, Jul 2012, JICS/FIPD/Kokusai Kogyo

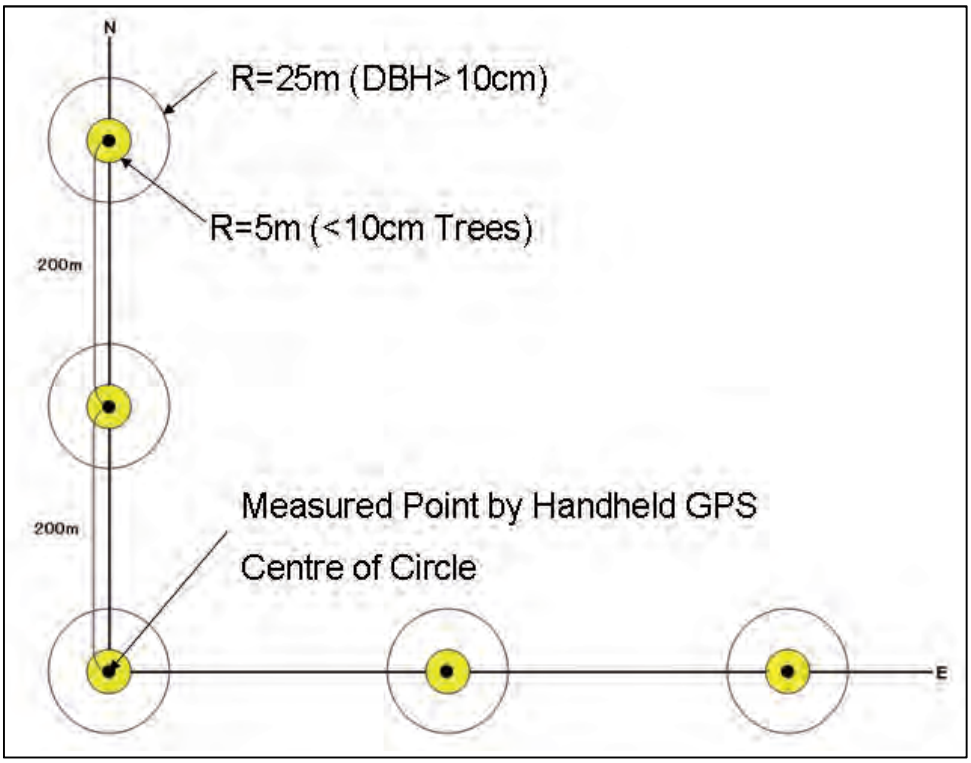
CliPAD; Proposed National Carbon Assessment Standard Operating Procedures submitted by Felipe Casarim, Gabriel Eickhoff, Timothy Pearson and Sandra Brown, Sep 2013

Design of tract (cluster plots) of each survey is as follows.

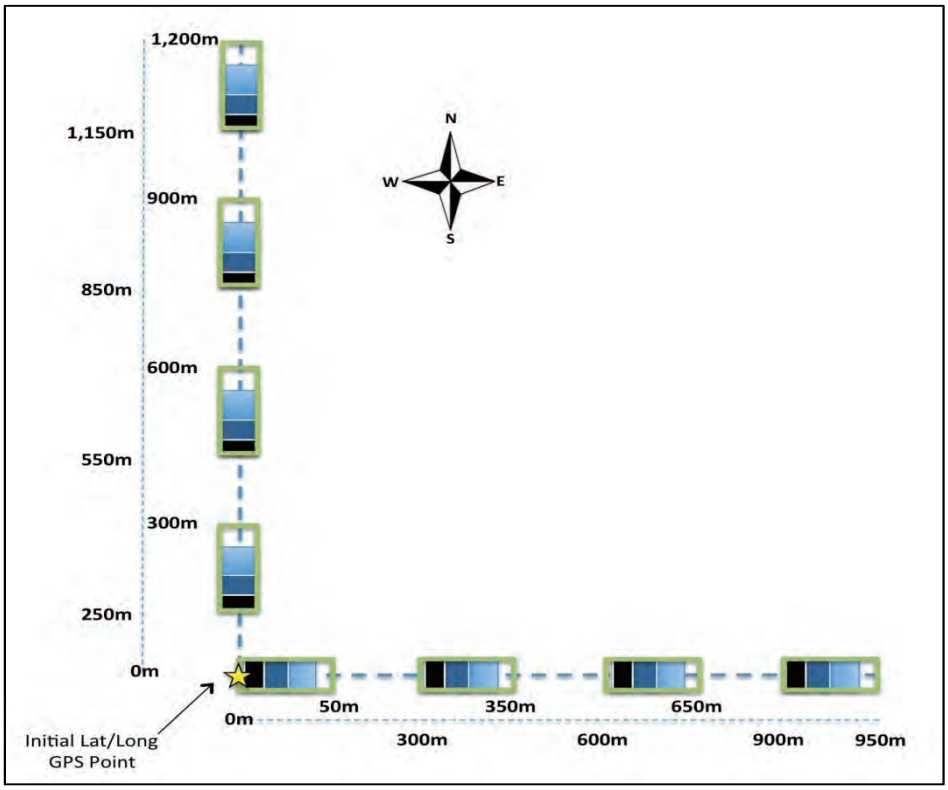
1st NFI



FIM



CliPAD



The 1st NFI's objective was mainly to assess the resource situation of wood and major NTFP for commercial harvest planning, and the survey items clearly reflect this objective. On the other hand, CliPAD survey focuses on estimate of biomass/carbon of 3 pools i.e AGB, dead tree and litter out

of the 5 pools defined in IPCC guidelines. Its plot design is the one proposed by SUFORD FRA design and it is said that by using laser distance measurement equipments plot boundary setting by rope is not necessary and much more efficient than the conventional method. FIM is the only survey among these which uses circulr cluster plots and plot setting is easier than rectangular ones by use of sound distance measurement equipments. These modern distance measurement equipment can easily judge whether trees on plot borders are in for measurement or out for no-measurement.

Concerning the survey crew, 1st NFI had a team of 8 staff excluding driver and so on and they included the team leader, reader of measurement, recording and species specialist. According to SUFORD analysis, on average 40 hours including transportation and walking to plots were necessary for one tract of 1st NFI. FIM measured one tract per day on average.

3.4 Output 4

<Review of Existing REL/RL Preparation Methods>

Decisions made at UNFCCC

At COP17 (Decision 12/CP.17) REL/RL are defined as benchmarks for assessing each country's performance in implementing the 5 REDD+ activities. The Decision further elaborates the modalities and its summary is as follows;

- REL/RL at national level, but sub-national REL/RL acceptable as an interim measure
- Taking into account historical data and be consistent with forest related GHG inventory
- A step-wise approach as new knowledge, data and/or pools gained or added
- Submission of all information including data, methods, procedures and national circumstances used for construction of REL/RL
- Establishment of a process for technical assessment of the proposed REL/RL

Further, COP19 agreed on the Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels (Decision 13/CP.19). However, the Decision has no technical guidance on methodsto construct REL/RL and the developing countries can resubmit REL/RL based on communications with technical experts, therefore it is understood that the submitted or resubmitted REL/RL will be accepted and used as the benchmarks for assessing perfomance. It is expected the submitted REL/RL will vary from country to country in terms of availability/accuracy of historical data, level of Tier, incorporation of national circumstances and so on, therefore it is likely that there need to be more deliberations and agreements between Parties concerning methodology aspects of submitted REL/RL taking into account experiences from other processes like FCPF Carbon Fund.

FCPF Carbon Fund Methodological Framework

FCPF has two Funds i.e. Readiness and Carbon Funds (CF) and CF is to pay for large scale demonstration activities to gain experiences and maintain momentum of REDD+. FCPF Readiness countries can prepare and submit their Emission Reduction Programs (ERP) to CF and through mediation by WB have Emission Reduction Purchase Agreement with investors of CF including governments, NGOs and private sector.

FCPF CF adopted its Methodological Framework (MF) in December 2013 and MF does not provide concrete standards or methods for REL/RL or MRV, instead it consists of Criteria and Indicators (C&I) for use by member countries for development of ERP. MF's C&I covers not only technical areas such as REL/RL or MRV but other REDD+ components like displacement (leakage), non-permanence, safeguards, benefit distribution and so on.

There are 3 criteria and 10 indicators for REL/RL as follows;

Criterion 10: The development of the Reference Level is informed by the development of a Forest Reference Emission Level or Forest Reference Level for the UNFCCC.

Indicator 10.1: The Reference Level is expressed in tonnes of carbon dioxide equivalent per year.

Indicator 10.2: The ER Program explains how the development of the Reference Level can inform or is informed by the development of a national Forest Reference Emission Level or Forest Reference Level, and explains the relationship between the Reference Level and any intended submission of a Forest Reference Emission Level or Forest Reference Level to the UNFCCC.

Indicator 10.3: The ER Program explains what steps are intended in order for the Reference Level to achieve consistency with the country's existing or emerging greenhouse gas inventory.

Criterion 11: A Reference Period is defined.

Indicator 11.1: The end-date for the Reference Period is the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3. An alternative end-date could be allowed only with convincing justification, e.g., to maintain consistency of dates with a Forest Reference Emission Level or Forest Reference Level, other relevant REDD+ programs, national communications, national ER program or climate change strategy.

Indicator 11.2: The start-date for the Reference Period is about 10 years before the end-date. An alternative start-date could be allowed only with convincing justification as in Indicator 11.1, and is not more than 15 years before the end-date.

Criterion 12: The forest definition used for the ER Program follows available guidance from UNFCCC decision 12/CP.17.

Indicator 12.1: The definition of forest used in the construction of the Reference Level is specified. If there is a difference between the definition of forest used in the national greenhouse gas inventory or in reporting to other international organizations (including a Forest Reference Emission Level or Forest Reference Level to the UNFCCC) and the definition used in the construction of the Reference Level, then the ER Program explains how and why the forest definition used in the Reference Level

Criterion 13: The Reference Level does not exceed the average annual historical emissions over the Reference Period. For a limited set of ER Programs, the Reference Level may be adjusted upward by a limited amount above average annual historical emissions. For any ER Program, the Reference Level may be adjusted downward.

Indicator 13.1: The Reference Level does not exceed the average annual historical emissions over the Reference Period, unless the ER Program meets the eligibility requirements in Indicator 13.2. If the available data from the National Forest Monitoring System used in the construction of the Reference Level shows a clear downward trend, this should be taken into account in the construction of the Reference Level.

Indicator 13.2: The Reference Level may be adjusted upward above average annual historical emissions if the ER Program can demonstrate to the satisfaction of the Carbon Fund that the following eligibility requirements are met:

i. Long-term historical deforestation has been minimal across the entirety of the country, and the country has high forest cover;

ii. National circumstances have changed such that rates of deforestation and forest degradation during the historical Reference Period likely underestimate future rates of deforestation and forest degradation during the Term of the ERPA.

Indicator 13.3: For countries meeting the eligibility requirements in Indicator 13.2, a Reference Level could be adjusted above the average historical emission rate over the Reference Period. Such an adjustment is credibly justified on the basis of expected emissions that would result from documented changes in ER Program circumstances, evident before the end-date of the Reference Period, but the effects of which were not fully reflected in the average annual historical emissions during the Reference Period. Proposed adjustments may be rejected for reasons including, but not limited to:

i. The basis for adjustments is not documented; or

ii. Adjustments are not quantifiable.

Indicator 13.4: An adjustment of the Reference Level above the average annual historical emissions during the Reference Period may not exceed 0.1%/year of Carbon Stocks.

In addition, it is decided that a number of Emission Reductions (ER i.e. credits), which is the positive difference between RL and reported and verified emissions/removals, will be set aside for a buffer reserve and the number of ER set aside will be based on the aggregate uncertainty of ER as follows.

Aggregate Uncertainty of Emissions Reductions	Conservativeness Factor (Discount Ratio)
≤ 15%	0%
> 15% and ≤ 30%	4%
> 30 and ≤ 60%	8%
> 60 and ≤100%	12%
> 100%	15%

Furthermore, MRV C&I requires Activity Data(AD) for deforestation should be at IPCC Approach 3 (i.e. wall-to-wall mapping) and Emission Factor(EF) should be equal or above IPCC Tier 2 (i.e. country specific EF).

VCS's rules on baselines (i.e. REL/RL) in the Jurisdictional and Nested REDD+ Requirements (JNRR).

JNRR has detailed rules on construction and harmonization of baselines at various scales including project, sub-national and national and some of them related to national and sub-national levels are as follows.

Baseline period	5-10 years with periodic revision
Activities	Deforestation, degradation and stock enhancement can be included according to VCS activity classification. In principle, no more than 2 activities in the same area.
Uncertainty in	-More than 75% accuracy for forest and non-forest classification on maps

AD and EF	-AGB should be measured within the target areas and its uncertainty should be within standards set by VCS (confidence interval should be within 30% of estimated value at 95% confidence level)
Historical data, methods, etc.	-At least 3 historical data within 10 years before start of REDD+ program and latest data within 2 years before the start -Calculation and submission of both annual average and trend. Model also acceptable -For landscape accounting, the net carbon stock change estimate should have equal or less than 50% confidence interval at 95% confidence level.

Status of REL/RL development at national or sub-national level in Lao PDR

At the national level, Lao PDR is developing forest maps for the three time points i.e. 2000, 205 and 2010 through NFIS assistance. Biomass estimate derived by SUFORD in 2010 from the 1st NFI data is the only EF estimate at Tier 1.5 because some default value and equations are used. In order to meet the requirements of FCPF MF Lao PDR needs to conduct more forest mapping for AD estimate as well as biomass survey for country specific and more recent EF estimate.

REL/RL development by CliPAD for Houapane Province for VCS JNR and possibly by SUFORD SU for the northern 2 Provinces for FCPF CF will greatly inform the development of national REL/RL.

Review of existing data and initiatives related to MRV at Various Scales

As shown in Section 3.3, the 1st NFI in the 1990s focused on resource assessment for harvest planning and little consideration was made for biomass or other carbon pools. FIM also measured only standing trees and no other pools were measured. BGB can be calculated applying an internationally acceptable constant such as IPCC default values to AGB. This fact means at the national level REL/RL will count only 2 pools of the 5 pools and the other 3 pools i.e. dead wood, litter and soil carbon will be left out and subsequent MRV will be made only for the 2 pools if the EF derived from the 1st NFI and FIM are to be used.

On the other hand, CliPAD is going to measure 4 pools except soil carbon and if any of the 2 pools i.e. dead wood and litter are found significant in estimating forest carbon stock, it may be necessary to measure these pools in the next NFI depending on time and finance available.

<Review of ongoing activities and processes concerning Safeguards (SG) and SG Information System (SIS)>

Decisions made at UNFCCC

COP 16 adopted so called "Cancun Agreement", which contains the landmark decisions on REDD+ including Safeguards, which developing countries should promote and support when implementing the 5 REDD+ activities. Safeguards shown in Table 3-25 are annexed to the main text, but the other items i.e. land tenure and genderconsideration are often dealt together with the 7 SG items.

Table 3-25:Safguards items agreed in Cancun

	Safeguards	Category*
(a)	Actions should complement or be consistent with the objectives of national forest programs and relevant international conventions and agreements	Forest Governance
(b)	National forest governance structures should be transparent and effective, taking into account national legislation and sovereignty	
(c)	Actions should respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples	Social
(d)	The relevant stakeholders, in particular indigenous peoples and local communities, should fully and effectively participate in the actions referred to in paragraphs 70 and 72 of this decision	
(e)	Actions should be consistent with the conservation of natural forests and biological diversity, ensuring that the actions referred to in paragraph 70 of this decision are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits	Environmental/ Social
(f)	Actions should be taken to address the risks of reversals	Climate
(g)	Actions should be taken to reduce displacement of emissions	

Note: *) "Category" is the FFPRI's grouping, not UNFCCC's.

At COP17 (Decision 2/CP.17) it was agreed that developing countries should have a system for providing information on how REDD+ SG are being addressed and respected to obtain and receive result-based finance. Furthermore, a summary of SG information should be provided in national communications , or , through communication channels agreed by COP after the start of implementation of the 5 REDD+ activities. At COP19, it is agreed that the summary of SG information could be submitted on a voluntary basis via the web platform on the UNFCCC site (Decision 12/CP.19).

This means that developing countries should have a REDD+ strategy, National Forest Monitoring System and SG information System in place and submit REL/RL and provide a summary of SG information after starting REDD+ activities.

Concerning the modalities of SG Information System COP17 adopted the following decision.

Decision 2/CP. 17 paragraph 2:

"Agrees that systems for providing information on how the safeguards referred to in appendix I to decision 1/CP.16 are addressed and respected should, taking into account national circumstances and respective capabilities, and recognizing national sovereignty and legislation, and relevant international obligations and agreements, and respecting gender considerations:

(a) Be consistent with the guidance identified in decision 1/CP.16, appendix I, paragraph 1;

(b) Provide transparent and consistent information that is accessible by all relevant stakeholders and updated on a regular basis;

(c) Be transparent and flexible to allow for improvements over time;

(d) Provide information on how all of the safeguards referred to in appendix I to decision 1/CP.16 are being addressed and respected;

(e) Be country-driven and implemented at the national level;

(f) Build upon existing systems, as appropriate;

SBSTA41 in December 2014 in Loma, Peru, are going to further discuss development of SG information system and types of information to be provided.

SG related initiatives of muti-lateral processes

Most developing countries taking actions for REDD+ development are supported by either or sometimes both of FCPF and/or UN-REDD, and these processes are addressing SG issues, too. As

for FCPF, when countries prepare a readiness preparation proposal (R-PP), a Strategic Environment and Social Assessment (SESA) is to be conduted to assess the impacts of proposed REDD+ strategy options and actions, and based on the findings of the SESA, an Environmental and Social Management Framework (ESMF) is to be prepared to mitigate or avoid adverse impacts on environment and society. However, SESA and ESFM are not addressing concrete issues like the ones in SG 7 items and rather they put more focus on processes and consultations with a wide range of stakeholders to identify and address potential adverse impacts.

UN-REDD has developed more concrete Social and Environmental Principles and Criteria (SEPC) for application to development of REDD+ strategies in member countries. SEPC consists of 7 principles and 25 criteria having clear linkage with the SG 7 items. UN-REDD is developing some guidelines for actual application of SEPC.

Status in Lao PDR

Lao PRD was one of the first 14 countries admitted to FCPF in 2008 and its draft R-PP was submitted in Aug 2010 and finally approved in December of the same year. However, Lao R-PP was developed in line with the template, which didn't have a clear focus on SESA and ESMF. Therefore, SESA for proposed strategy options was not conducted and ESFM was not established. Instead, TOR for SESA was annexed to R-PP and SESA and ESFM were to be conducted and established by the Readiness Project with the budget of $3.6 M. However, mostly due to a long transition period of separation of forest management organizations i.e. Department of Forestry under Ministry of Agriculture and Forestry and Department of Forest Resource Management under Ministry of Narutal Resources and Environment, the preparation and inception of the Readiness Project has been delayed. The grant agreement for the project was recently signed and the project is envisaged to commence sometime in mid 2014.

As stated above, the activities related to REDD+ SG in Lao PDR are in infantcy stage, however, individual REDD+ projects are starting to address this issue. Mr. Sawan Chanthakumman, Director of REDD+ Office, DOF, cited participation of local people in land use planning for social issues and environmental impact assessment for environmental issues as important measures to address SG issues on the ground and called for use of the participatory land use planning manual developed by MAF with support from JICA and GiZ by all concerned agencies and projects.

REDD+ strategy and actions at national level in LaoPDR are likely to be more efficient policy implementation, strict law enforcement and strengthening of forest management with participation of local people and villages, so mostly at macro and landscape levels. However, existing laws such as the Forestry Law (2007) doesn't have articles or phrases which ensure participation of local

people in formulation of management plans for the gazetted forests i.e. Conservation and Protection Forests except Production Forest and Village Forest allocated to them.

Environment Protection Law of Lao PDR was revised in December 2012, and the new Article 19 on Strategic Environmental Assessment was introduced. SEA is to assess impacts on society and environement including climate change when sectoral policy, strategy and plans are formulated. It also requires participation to the formulation process of not only concerned agencies but also local people and communities under potential direct and indirect impacts. However, Ministerial regulations on implementation of SEA are not promulgated yet. According to the definition of SEA, the National REDD+ Strategy will be subject to SEA. It is necessary to avoid double assessment i.e. SEA under the Environment Protection Law and SESA under FCPF and to make sure they are conducted as a set. Furthermore, SEA and SESA/ESMF should be made in line with the decisions and guidance on SG of UNFCCC so that Lao PDR can submit a summary of SG information without further works.

<Participation in SBSTA39 and other negotiations under UNFCCC>

The forestry members of the Lao delegation attended most of REDD+ related sessions including SBSTA plenary, contact group meetings, informal meetings and informal-informal ones throughout their stay in Warsaw. The Lao delegation made two interventions in informal meetings on the draft guidelines for technical assessment of REL/RL and the draft decision on coordination of support. As a result of active participation in negotiations and thorough reading of decision drafts, the Lao participants esp. the Project Director deepens understanding of objectives and importance of NFIS activities in terms of transparent, consistent and accurate estimate of forest area and carbon stock and their changes for construction of REL/RL and Measuring/Reporting purposes. It is also very useful for the implementation on NFIS as well as for REDD+ establishment in Lao PDR that the Lao participants witnessed the completion of the REDD+ framework under UNFCCC at COP19 and understood what is required to prepare, submit and communicate for obtaining result-based finance.

Chapter 4 Issues for Project Implementation and Management

4.1 Issues for All Outputs

1. Coordination and Cooperation with concerned Projects

There are several projects, that have components and activities especially. REDD+ related ones similar to NFIS Project. They are FSCAP (JICA/DOF), PAREDD (JICA/DOF), LEAF(SNV/Winrock/DFRM) and CliPAD (GiZ/DFRM,) and SUFORD SU (Finland/WB/FIP/DOF), which has just started, and FC/PF Readiness Project in preparation may also have similar or related activities.

FSCAP is assisting DOF/DFRM at policy level and is the key project coordinating all Japan/JICA assistance in the forestry sector and also has a REDD+ expert. As NFIS project produces concrete results/data such as historical data for construction of REL/RL or database for forest management, it is necessary to closely cooperate with FSCAP in analysis of the results and to jointly organize workshops and so on for actual use in establishment of REDD+ architecture and sustainable forest management. PAREDD has been active in developing the PAREDD approach for reducing deforestation in Luangprabang Province and also drafting a Project Descrption covering the Hoaikin Cluster Village for VCS certification as well as establishing Provincial-wide REL/RL. Information exchange on forest classification and methods for REL/RL construction will be conducted and harmonization with the national level ones will be examined and discussed.

LEAF is active in publishing and providing trainings on technical aspects of REDD+ such as construction of REL/RL, forest carbon assessment and so on even though they are not concerned with actual national level data. CliPAD is also conducting similar trainings as well as implementing a sub-national jurisdictional REDD+ in 2 Districts in Houapane Province in collaboration with LEAF. As NFIS and these projects proceed and accumulate knowledge and data, it is more important to closely exchange information and utilize their experiences/achievements in development of national level REDD+ components.

SUFORD SU will assist DOF in establishing and managing Production Forest in 12 Provinces out of the total of 18 and conduct a land scale level approach i.e. covering all forest in Bokeo and Luang Namtha Provinces, which may develop into a sub-national REDD+ project to be applied to FC/PF Carbon Fund because a large part of funding comes from Forest Investment Fund, which aims to bridge the readiness phase and full implementation phase by supporting large scale demonstration REDD+ activities. NFIS will continue cooperation with SUFORD SU in updating the DB for Production Forest as part of DB for all forest management, and when they go to a sub-national REDD+, NFIS, LEAF, CliPAD and SUFORD-SU need to establish strong

coordination relationship for well harmonized and efficient establishment of REDD+ in Lao PDR.

The grant agreement for FC/PF Readiness Project has been recently signed by WB and GOL and its TOR is being prepared. However, it may take sometime to recruit consultants for project implementation. Draft TOR are to be consulted with FSCAP and CliPAD and NFIS will communicate with FSCAP to streamline the TOR so that there will be no duplication with it. One main component of the Readiness Project is to conduct a Strategic Environment and Social Assessment and to establish an Environment and Social Management Framework, which are essentially a SG and SG information system component. NFIS will cooperate with this project in this component, too.

2. Forest Cover Survey for 2015 and its impacts on NFIS

GOL has the 75% forest cover target by 2020 and 65% for 2015. In personal communication with DOF executive officers, the 65% target is included in the 5 year plan of the forestry sector (2011-2015), and GOL needs to report the current forest cover rate to the National Assembly in June 2015 as part of the achievement of National 5 Year Plan. Responding to the request by DOF, FSIP and SUFORD assisted in assessing the forest cover rate for 2010 and it is very likely that a similar request will be made soon. NFIS may be the first project to be requested for assistance and regardless of NFIS assistance or not, many, if not all, of NFIS C/P staff will have to conduct the assessment and cannot implement NFIS activities for several months causing a significant delay in project implementation.

At the time of report writing, the request has not been made not only to NFIS but to other forestry projects. However, it is imperative to collect related information as soon as possible and request DOF to allocate necessary C/P staff for NFIS activities in order to minimize the potential delay and disturbance.

4.2 Issues for Forest Type Map

4.2.1 Setting Forest Type Map Accuracy Goals Reflecting International Requirements

Currently, a forest type classification accuracy of 70% or more has been set in the special specifications, but in consideration of discussions at COP/SBSTA, required specifications for VCS (Verified Carbon Standard) Jurisdictional and Nested REDD+ (JNR) and other international requirements, it is important to establish suitable accuracy goals in order to have the forest type map which is the output of this work be internationally recognized.

4.2.2 Standardization of Interpretation Key and Strengthening of Interpretation Capabilities

The interpretation capabilities of the C/P RS/GIS technical experts are not uniform due to the impact

of personnel relocation and other such factors. Therefore, in consideration of the ground truth survey implemented in the first year, it is necessary to unify the interpretation key used for correction of the forest type map, and to focus on training to t strengthen the interpretation capabilities of the C/P based on this.

4.3 Issues for Carbon Stratification

4.3.1 Accuracy assessment of Forest Carbon Map

Currently, the accuracy goal for the 2010 forest carbon map is 80% or higher. The international standard that indicates concrete values for the accuracy of emissions volume at the national and sub-national level consists of VCS (Verified Carbon Standard) Jurisdictional and Nested REDD+ (JNR). According to "JNR Requirements, v3.1", which is the latest version, a confidence level of 95% is recommended, with the confidence interval width to be within 50% of the estimated value.

Forest Carbon Map will be developed by Forest Type Map (Activity Data), which is reconstructed by carbon classes which are reorganized by dividing or integrating forest classes of Forest Type Map, and carbon value per unit area (Emission Factor). However, allometric equations which is necessary for calculation of carbon value per unit area have not been developed in Lao PDR, it is impossible to assess the accuracy of carbon value per unit area as Emission Factor. Therefore, it can be done to assess only Forest Type Map which is reconstructed by carbon classes as Activity Data. However, if carbon stratification is done by existing GIS data (e.g. Ecoregions, DEM), the accuracy of carbon stratification is 100%, thus the accuracy of forest classes actually equal the accuracy of Activity Data.

Therefore, the accuracy of Forest Carbon Map will be the accuracy of Forest Type Map basically though, the conclusion should be considered more in the next phase.

4.3.2 Additional Analysis Work Related to Carbon Stratification

Existing GIS data is used to study carbon stratification, but there is the risk of additional work needing to be performed due to unexpected requests from the C/P (such as analysis of canopy cover ratio, for example).

4.4 Issues for Forest Information DB Design

1. Workload of designing (analyzing) DB

In the first year, it was found that the workload concerning the design of for NFIDB is greater than the estimation in the initial planning. Therefore, it is proposed that in the second year, part of the assignments of the members responsible for forest remote sensing 2 should be transferred to the members responsible for forest GIS/database and that the period of work relating to the DB at the

project site should be extended.

2. Concentration of work on C/P personnel in charge of DB

From the beginning of the project, shortage of the C/P personnel with a technical background and ability to handle operations relating to the DB has been a matter of concern. However, in the first year, such personnel were often called upon to go on business trips to provinces, because they are skilled in the operation of equipment used in field study and are good at communicating in English. As operations relating to the DB to be carried out at the project site will begin on a full scale in the second year, it is necessary to coordinate well with the C/P project manager concerning the assignment of the C/P personnel.

3. Discussion on DB with decision makers

As a result of the activities in the first year, concrete information necessary for the design of and the discussions on the DB has been collected, although discussions with the engineers and the decision maker of the C/P were not adequate. In the second year, based on the information collected in the first year, efforts should be made, in particular, to hold enough meetings to discuss the DB with the decision makers. Since the decision makers are extremely busy, however, it is necessary to proceed with the work, while keeping in mind that such meetings should be arranged in advance so that the decision makers can adjust their schedules.

4.5 Issues for Next National Forest Inventory Design

1. Capacity of C/P Staff

The number of staff involved in the 1st NFI between 1991 to 1999 is becoming fewer and fewer, and the FIM inventory is the only nationwide inventory after 1st NFI. Even though FIPD has conducted many forest surveys for Production Forest Management Planning, concessions and so on and is familiar with field surveys, C/P's capacity in important design parts of NFI including calculation of necessary plot number, plot design and so on still seems to be insufficient.

Since the next NFI is going to be the last historical data for REL/RL construction, it is very important to maintain consistency with the previous surveys such as the 1st NFI and FIM inventory with necessary modifications. Therefore, the focus should be capacity development for designing so that the subsequent NFI or MRV for REDD+ can be done by C/P themselves.

2. Trade-off between accuracy/data and costs/time

Many survey plots and number of data will produce results with lower uncertainty and contribute more to management planning, but the time and costs will also increase accordingly. It is a hard and very intensive work to survey 1000-2000 plots spread in all parts of the country within a few

dry months taking into account the fact that C/P staff have other unavoidable tasks.

Through the piloting of several methods of plot design, survey/recording procedures, quality assessment and so on and studying experiences of other projects especially. CliPAD in Houapane Province, NFIS needs to identify most efficient, statistically reliable, and robust NFI design and survey procedures with capacity building of C/P at the center.

4.6 Issues for Collecting REDD+ Related Information

1. C/P agency(s) for REDD+ specific information

The NFIS's C/P agency is FIPD, which is specialized in forest survey and management planning for production forest. Therefore, the Outputs 1 through 3 are under FIPD's responsibilities with some linkage with DFRM. However, REDD+ specific information, including REL/RL, SG and harmonization of REL/RL and MRV at different scales are not their mandates and it is not clear or decided yet which agency is responsible for these components. It is envisaged that technical working groups responsible for various components of REDD+ will be established under the National REDD+ Task Force and then the chair or facilitating agency for REL/RL, SG and so on will become clear or be agreed upon. NFIS will consult with DOF/FIPD on how to cooperate with those agencies, if they are not FIPD.

2. Emission/Removal Factors at Tier 2

As stated in the Chapter 4, the biomass estimates for each forest type and all forest area are derived from converting FIM data (DBH, forest type, etc.) by using the desk-based allometric equations developed from tree measurement by 1st NFI and biomass conversion by SUFORD, and they are not at Tier 2 level required by FCPF Carbon Fund or VCS JNR. Moreover, because of this, it is impossible to estimate uncertainty of the estimates.

Under the Forest Preservation Program, a nation-wide destructive biomass survey to develop national and region specific allometric equations is being prepared. Once these equations are developed and used for 1st NFI and FIM inventory data, emission factors at Tier 2 level will be estimated. However, for efficient and accurate allocation of destructive biomass survey plots, a reliable forest type map is required. This means that 2010 forest map development under NFIS and allometric equation development under FPP are closely linked and the map needs to be finalized as planned for smooth design and implementation of the destructive biomass survey.

3. Close link between SG information and REDD+ strategy/Policy and Measures (PaMs)

According to UNFCCC decision (1/CP16), SG should be promoted and respected when the

developing countries implement the 5 REDD+ activities (Policy and Measures; PaMs), which will be defined in their REDD+ strategies. Therefore, in principle, SG information to be collected may vary according to PaMs. For example, at the national level most PaMs are likely to be strengthening policy implementation, strict law enforcement and/or more efficient and effective implementation of national forest programs for management. But, in order to identify concrete SG information concerning participation of local communities and conservation of biodiversity to be collected, it should be made clear which policy is implemented at what level, how and where the enforcement of laws will be strengthened, what kind of forest programs are to be formulated and how and where they are to be implemented.

Since the PaMs at the national level are mostly likely to be stronger and stricter enforcement of existing policy and laws/regulations and the formulation and the endorsement of REDD+ Strategy will be after the termination of NFIS, NFIS will focus on collection and analysis of SG related articles/aspects of existing laws/regulations and main forest related government programs.

Chapter 5 Activities in Second Phase (Apr 2014 – Sep 2015)

5.1 Common Items for All Activities

5.1.1 Explanation of First Year Work Results / Discussions

The first year work results will be explained to the counterpart agency and JICA at the JCC, at which time discussions will be held for revision or improvement in implementation.

5.1.2 Preparation of Second Year Work Plan / Technology Transfer Plan

The second year work plan and technology transfer plan will be prepared together with the C/P organization.

5.1.3 Report on Second Year Work Results / Holding of Technology Dissemination Seminar

A report meeting / technology dissemination seminar to the counterpart agency and other donors, etc. will be held when the second year ends, based on the results (outputs) of the second year activities. The activities for each output are described below. Furthermore, technology transfer will be implemented as necessary by means of the respective activities.

5.1.4 Report to JICA on Second Field Survey Progress

A report will be made to JICA on the status of progress of the second field survey.

5.1.5 Preparation of Action Plan Concerning Formulation of National Forest Monitoring System / Work Completion Report (Final) (Draft)

An action plan related to formulation of a national forest monitoring system implemented by the Lao PDR will be prepared, taking the overall evaluation of activities up to the second phase into consideration, and will be compiled as a Work Completion Report (final) (draft).

5.1.6 Explanation/Discussion Concerning Work Completion Report (Final) (Draft) / Technology Dissemination Seminar

Explanations will be made to / discussions will be held with JICA concerning the content of the Work Completion Report (final) (draft) and technology dissemination seminar, and agreement will be obtained.

5.1.7 Preparation of Technology Dissemination Seminar Materials

Materials will be prepared for the technology dissemination seminar.

5.1.8 Preparation of Technology Transfer Implementation Report

5.1.9 Preparation of Work Completion Report (Final)

Regarding the technology transfer to the C/P implemented through this survey and the technology dissemination seminar, the output and other details will be compiled for each field, and a Technology Transfer Implementation Report will be prepared, and attached to the Work Completion Report (final).

5.2 Activities Related to Output1

During the second year, forest classification, which was determined in the first year activities will be discussed and verified in order to determine final classification and forest stratification method. Based on this classification, correction and creation of the 2010 national forest type maps that will serve as the forest base maps and 2005 / 2000 national forest type maps will be continued and the accuracy verified at the end.Above-mentioned forest stratification will be used to prepare national forest carbon maps(2000,2005,2010)

5.2.1 Continuing Correction of National Forest Type Maps (2000, 2005, 2010)

Correction of the 2010 national forest type maps that will serve as the forest base maps and 2005 / 2000 national forest type maps prepared during the first field survey will be continued.

In addition, lectures (proposed) will be implemented as shown in the table below with the objective of advancing the level of knowledge concerning theoretical concepts related to satellite image analysis.

<table>
<tr><td colspan="2">Theme: Theoretical Lectures Concerning Satellite Image Analysis,
Schedule: Late August – Early September 2014 (15 days)</td></tr>
<tr><td colspan="2">Objectives of Training
The C/P is capable of analysis software operation based on the satellite image analysis techniques, but there are few persons that understand the theoretical background of image processing/analysis, etc. The objective of implementing this training is to provide an understanding of the physical, mathematical and information processing theory of each forest analysis process that is performed with remote sensing (RS) technology, give meaning to the results that are obtained by image processing/analysis software, and in turn improve the quality of quality management and other such work results (output).</td></tr>
<tr><td>Lecture Theme</td><td>Description</td></tr>
<tr><td>Principle of RS Technology</td><td>➢ Physical meaning of information (data converted into images) obtained from RS technology
➢ Principle of multi-band satellite RS system
➢ Spectroscopic characteristics of forests
➢ Basic flow of forest RS analysis for REDD+
➢ Technical issues with RS technology for REDD+ and ways to supplement information</td></tr>
<tr><td>Pre-Processing of RS Images</td><td>➢ Theoretical background of noise processing
➢ How to calculate radiance / reflectance ratio
➢ Image enhancement / space filtering processing methods
➢ Theory for topographical correction
➢ Mathematical model for geometric correction
➢ Error theory and least-square method based recurrence analysis</td></tr>
<tr><td>Feature Extraction from Forest Information</td><td>➢ Image calculation based feature extraction method
➢ NDVI theory</td></tr>
<tr><td>Preparation of Thematic Map Using Image Classification</td><td>➢ Theory of supervised classification method
➢ ISODATA method
➢ Object-based image classification</td></tr>
<tr><td>Analysis of Time-Series Data</td><td>➢ Forest information for time-series analysis based on RS
➢ Change analysis method
➢ Using two time period synthetic images, etc. to visualize and extract change points (sites)</td></tr>
<tr><td colspan="2">Objectives to be Achieved by Training
➢ Attain level where C/P has certain amount of understanding of the content of various types of data</td></tr>
</table>

processing that is being performed behind the scenes from operation of the analysis software by the C/P.
- Upgrade level of basic mathematical / physical knowledge being used with RS technology by the C/P.

5.2.2 Accuracy Verification of National Forest Type Maps (2000, 2005, 2010)

Accuracy verification will be performed for the 2010 national forest type maps and 2005 / 2000 national forest type maps that will serve as the forest base maps that were corrected in d1.1.

5.2.3 Verification of Factors That Have a High Level of Correlation to Carbon stock

Verification of the factors identified to have a high level of correlation to carbon stock will be performed based on the results of the ground-truth survey implemented during the first field survey.

5.2.4 Determination of Forest Stratification Method

Review of an appropriate forest stratification method will be performed using GIS analysis and satellite image analysis in accordance with the identified factors. In addition, discussions will be held on the results with the C/P and other donors to determine the method.

In addition, the lectures in the table below will be implemented with the objective of improving the understanding of the theory concerning stratification analysis.

Theme: Theoretical Lecture Concerning Stratification Analysis Schedule: Early – Mid March 2015 (15 days)	
Objectives of Training Plans call for practical training in stratification analysis to be separately implemented in order to estimate the forest carbon accumulation volume. However, a lecture will be conducted on a background of the discussions that are taking place around the world, necessity/theory of stratification analysis with the objective of making a contribution to upgrading the basic capacity of the C/P in this field.	
Lecture Theme	Description
Introduction to Forest Carbon Accumulation Volume Estimation	➢ Forest carbon accumulation volume estimation methods that are being discussed internationally ➢ Fundamental information and theory required for forest carbon accumulation volume estimation ➢ Methods for/characteristics of forest carbon accumulation volume estimation used during this work
Stratification Analysis Methods	Methods for and necessity of stratification analysis / Theory for stratification extraction methods / Stratification extraction elements
Correlation Analysis	Correlation analysis elements / Theory for correlation analysis / Correlation analysis methods / Correlation analysis practical training
Preparation of Stratification Matrix	Stratification matrix table preparation methods / Preparation standard for stratification matrix table
Estimation of Forest Carbon Accumulation Volume	➢ Obtaining grasp of change in forest carbon accumulation volume from past to present (preparation of maps) ➢ Prediction of future forest carbon accumulation volume (preparation of maps) ➢ NFI stratification extraction

Objectives to be Achieved by Training

- Attain level where C/P understands the necessity of stratification analysis as part of estimation of forest carbon accumulation volume, estimation of change in forest carbon accumulation volume from past to present (setting of RL), necessity of future predictions and techniques for stratification estimation.
- Advance level of basic knowledge on techniques used during forest sampling and other surveys conducted by the C/P.

5.2.5 Preparation of National Forest Carbon Maps

The 2010 national forest type maps that will serve as the forest base maps and 2005 / 2000 national forest type maps for which correction / accuracy verification was performed in d1.1 and d1.2 will be used to prepare national forest carbon maps for the respective years, and accuracy assessment will be performed.

5.3 Activities Related to Output 2

5.3.1 Design of National Forest Information Database

The national forest information database will be redesigned, taking into consideration the review results of subcontracted field work described in b2.4 conducted during the first year, content of carbon stratification and NFI design for which review is proceeding in parallel, and trends in international discussions at COP and SBSTA. In the second year, work will be performed on the detailed design (physical design), such as the definition of tables and fields, rather than on the specific conceptual design (that will serve as the basis for adjustments at the stage of implementation). In addition, training in Japan related to the national forest information database will be implemented.

5.3.2 Preparation of "Report Concerning National Forest Information Database Prototype"

Regarding the national forest information database prototype for which final design was performed in d2.1, a "Report Concerning National Forest Information Database Prototype" will be prepared that contains design content, review process/reference information based on the results of analysis/organization of existing forest information data collected during first field survey, review of functions/specifications required domestically/internationally for statistics and report, etc., identification of forest information data types/specifications as well as results of second field survey.

5.4 Activities Related Output 3

In the second year, based on the review results of past NFI result, SOP creation status and other project's forest survey design/implementation during the first year, the next period NFI survey method(sampling, plot design, survey items, etc.) and institutional arrangements will be studied. Inventory piloting of several types of plot design and data input methods and so on will be subcontracted locally in order to study the feasibility of the survey methods and data processing

arrangements in terms of appropriateness to the Lao forest situation, efficiency, accuracy and other characteristics for the next period NFI. The next period NFI manual will be completed by revising the first one based on the result of inventory piloting and discussions with C/P and other projects.

5.4.1 Review of Next Period National Forest Inventory Survey Methods

Regarding the next period NFI options , the feasibility of stratified sampling surveys based on the 2010 forest base/carbon maps,cost-benefit performance and other issues will be reviewed, and compiled in the next period NFI proposal (objectives, sampling methods, plot design, survey items, etc.).

5.4.2 Review of Next Period National Forest Inventory Implementation System

The institutional arrangements for implementation of the next period NFI proposal that is determined above will be compiled as the final proposal.

Inventory piloting in a certain number of plots will be subcontracted locally in order to study the feasibility of the next period NFI designs and institutional arrangements, efficiency and other characteristics.

5.4.3 Revision/Completion of National Forest Inventory Manual

The necessary corrections and other changes will be made based on the results of the inventory piloting, results of inventory conducted by other projects and discussions with C/P and other projects, a manual (including objectives, design and implementation system) for the next period NFI will be completed by revising the first NFI manual.

5.5 Activities Related to Output 4

5.5.1 Review of REL/RL Preparation Methods

Based on the national forest type maps / carbon maps at three points of time that will be completed in output 1, the gross emissions (basis for REL) and net emissions/removals (basis for RL) caused by the change in the carbon stock in two periods due to deforestation / forest degradation/carbon stock enhancement will be calculated, and the preparation methods which are internationally accepted will be used to review options and other issues for REL and RL.

5.5.2 Review of Adjustments Related to MRV

The MRV status of the current REDD+ activities at project and sub-national levels collected during the first phase, forest base/carbon maps and the next period NFI design will be reviewed, and the MRV adjustment rules at project, sub-national and national level will be considered with VCS/JNR as reference.

5.5.3 Review of Information Development Methods Related to Safeguards, etc.

Following the first year results, trends in discussions at the UNFCCC, SESA/ESFM to be conducted by the FCPF Readiness Fund will be collected and analyzed. Based the analysis and review results of existing legal framework and GOL forest related programs, necessary

recommendations to meet the SG will be proposed for discussions. Concerning the SG information system, it will be studied whether the National Forest Information System is the appropriate system to collect and provide SG related information since NFIS is to collect and store REDD+ strategy and PaMs for the 5 REDD+ activities and related laws and regulations.

5.5.4 Preparation/Completion of Report Compiling Above Review Results

Following the first year result, study review will be conducted for the REDD+ reference level (REL/RL) preparation methods, the adjustment methods concerning MRV at the national/sub-national/project levels, and the information development methods concerning safeguards and other issues. A “Report on Organization/Analysis of REDD+ Reference Level (REL/RL) Development Methodology” and a “Report on Organization/Analysis of Information concerning REDD+ Safeguards” that compile the above study results will be prepared and completed.

Chapter 6 Suggestions For Achievement of the Overall Goal

6.1 Suggestions in General

Acceleration of REDD+ strategy formulation

According to UNFCCC decisions related to REDD+, developing countries seeking result-based payment should submit REL/RL for technical assessment and have their national or sub-national REDD+ strategy and national forest monitoring system in place. They should also submit a summary of SG information. As stated in the section of SG in Chapter 4, SG information to be collected can be identified only when the strategy and PaMs are agreed upon in the countries. The REDD+ strategy to be agreed in the near future are likely to be the ones identified in the Lao R-PP, but there is a possibility of some changes once the status of carbon stock changes become available through NFIS or the results of next NFI including forest area/carbon change estimate are known. REDD+ strategy itself is out of the NFIS scope, but it is necessary to accelerate its formulation with assistance/support from FSCAP and concerned projects so that GOL can submit all of the required items to UNFCCC without any delay.

Cooperation with concerned projects

As stated in Chapter 4, there are several REDD related projects and they possess considerable knowledge and experiences of REDD+ based on their field activities and so on. When NFIS proposes an action plan for establishment of the National Forest Information System, which includes NFMS defined by UNFCCC, their knowledge and experiences should be utilized through consultations and information exchange.

More specifically, activities of remote sensing analysis and inventory survey by other donors are begining in earnest, national level discussions to ensure data conformity have come to be intensified. Discussions on the standardization of inventory survey methods and the development of common specifications for relevant inventory databases have already been held, but such discussions should be continued among the parties concerned to organize the future directions and to study the technological aspects to yield specific results.

Coordination of next NFI and Forest Area Change Analysis and Necessary Support

NFIS will assist DOF to design the next NFI, which only covers field survey. Designing for estimate of forest area and carbon stock change in 2015 or 2016 through RS is out of the NFIS scope. It is expected that the C/P capacity in RS and mapping will be strengthened both technically and institutionally through preparation of the 2010 forest type map, which is going to be the

benchmark map. However, NFIS should be ready to identify areas for further improvement so that their capacity can be strengthened without any delay in the next NFI including mapping in 2015or 2016.

Ensuring consistency with GHG Inventory

According to UNFCCC decision on REDD+ MRV made at COP19, developing countries should submit MRV report as a technical annex to their biennial update report (BUR) every two years and it is required that REDD+ MRV be consistent with the GHG-I in AFOLU or LULUCF sector. On one hand REDD+ measures carbon stock changes in forest, but on the other hand in AFOLU GHG-I carbon stock changes in forestland remaining forest land and between forest land and other land uses should be estimated. Forest land includes degraded land or barren land, which may reach forest thresholds if no disturbances are made. This means carbon stocks and areas of non-forest in forest land and those of other land use categories need to be measured and reported. Good coordination and cooperation with other land use sectors such as land management and agriculture should be strengthened and those sectors should be approached by the national REDD+ office.