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

Lao People's Democratic Republic

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

(Phase Ⅱ)

Completion Report

(Summary)

2016 March

Japan International Cooperation Agency

Joint Venture
KOKUSAI KOGYO CO., LTD.
ASIA AIR SURVEY CO., LTD.

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Outline

Chapter1 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 Objective 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.

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 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.

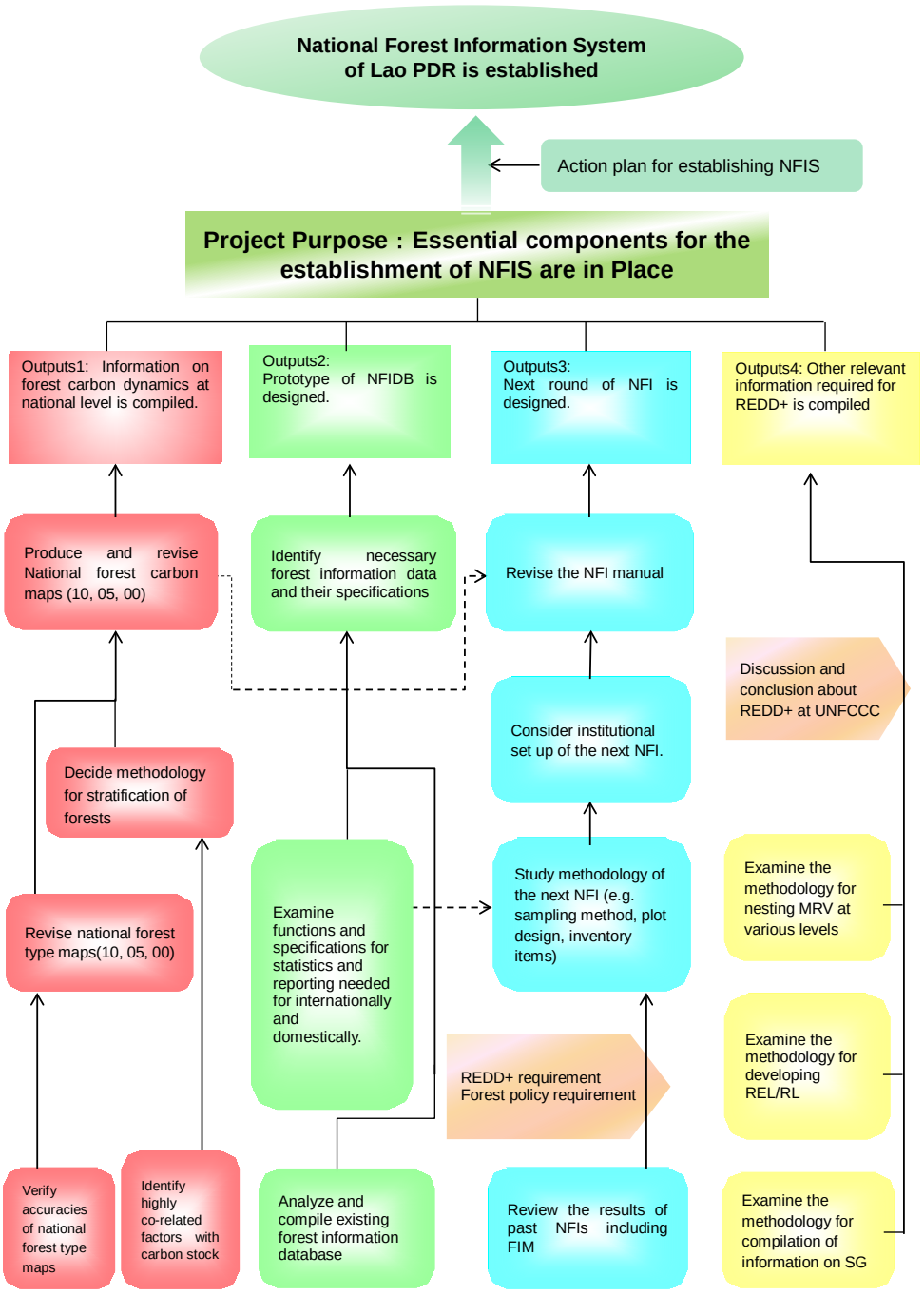
4.1 Examine the methodology for developing REL/RL for REDD+.

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



The "National Forest Information System" established as the overall goal of this project is defined as an "Information system for comprehensive management (including periodical update) of relevant information and data required for sustainable forest management and REDD+" and includes information and data related to forest management such as satellite images, inventory and other data, and logging information as well as information required for REDD+ such as carbon stock changes, REL/RL, and safeguards.

Chapter2 Main Activities Implemented (Sep2013~Sep 2015)

2.1 Activities related to Output 1

2.1.1 Accuracy Assessment of Forest Type Maps (2000, 2005 and 2010)

With respect to the forest type maps of 2010 that serve as the forest base map, accuracy assessment was carried out before the revision. Also, training in Japan was implemented concerning accuracy assessment of the forest type maps. (Training outline: Annex 3) Based on the assessment results, the method to revise the forest type maps, which serve as the forest base maps, was developed and discussions were held with the C/P to obtain their agreement on it. In addition, the definition of forests and the national level classification system in the Lao PDR were reviewed and reorganized from the viewpoint of national forest policy and international reporting, and discussions were held with the involvement of the whole forest sector, including the C/P and other donors, and agreement was obtained within the forest sector.

After preparing the forest type maps of 2000, 2005 and 2010 as described in 2.1.2, accuracy assessment was performed for the forest type map of each year.

2.1.2 Revision of Forest Type Maps (2000, 2005 and 2010)

Ground truth surveys and training necessary for the revision work were implemented. In order to reduce the variation in the classification results caused by the difference of interpretation ability between the technical experts, based on the results of the ground truth survey, interpretation cards and interpretation keys were prepared and developed for each classification item and each satellite image (RapidEye, SPOT multi-spectral, LANDSAT).

Also, lectures with the objective of improving the knowledge of the theory concerning satellite image analysis were implemented as follows. According to the original schedule, the first series of lectures were on the basic theory of remote sensing and the second series consisted of theoretical lectures on stratification analysis. However, as it turned out that the content of the lectures on stratification analysis had been mostly covered by OJT and that although the first series of lectures helped in promoting the understanding of the basic theory of remote sensing, the time for practical training to practice the theory in connection with the actual operation was not enough, it was decided that the second series of lectures should also address the basic theory of remote sensing (Theory of Remote Sensing – Part 2), allocating more time on practical training to make the training more practical.

In accordance with the revision method agreed on as described in Section 2.1.1, the forest type maps of 2010 were revised. Also, a new method for the preparation of forest type maps of 2000 and 2005 based on change extraction was developed and agreed with the C/P after discussions. The forest type maps of 2000

and 2005 were prepared in accordance with the new method.

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

Factors effective for carbon stratification were studied by performing correlation analysis of average carbon volume per unit area of each plot, existing GIS data (regional data, elevation, Ecoregion, etc.) and data such as canopy cover ratio. Also, the uncertainty of average carbon volume per unit area of each forest type was calculated and the result showed that the uncertainty was not high for any of the forest types.

2.1.4 Determination of Forest Stratification Method

Based on the results of 2.1.3, it was determined that it was not necessary to divide the items any further as far as the carbon volume is concerned. On the contrary, integration of the items was studied instead. Based on the existing data, uncertainty of average carbon volume per unit area and uncertainty of classified area were calculated and overall uncertainty of each forest type and that in the case of integrating the items were tentatively assessed, respectively. Although the assessment was performed only tentatively due to unavailability of the information internationally required for the assessment of comprehensive uncertainty, discussions were held with the C/P with this as a tentative forest stratification proposal to obtain their understanding. It was decided that the final forest stratification should be studied again and determined after preparing the forest type map of 2015 and implementing the NFI in the next phase to obtain the necessary data.

2.1.5 Preparation of National Forest Carbon Maps

Based on the forest stratification proposal studied as described in Section 2.1.4 and the conventional forest classification, forest carbon maps of 2000, 2005 and 2010 were prepared. Also, based on these maps, uncertainty of the changes in total carbon stock was calculated for each, and the uncertainty thus calculated was taken as an alternative to the accuracy assessment results of the forest carbon map.

2.2 Activities related to Output 2

2.2.1 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. Furthermore, the statuses of database assistance by the donor projects were organized based on discussion with the persons in charge.

2.2.2 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 the data and functions to be stored in NFIDB, the future directions were organized in terms of collection and storage of survey data, available allometric equations, and definitions of average biomass and carbon stocks. Regarding domestic reports, review was conducted on the types of reports made by concerned offices, which were organized through FPP/TA2 activities.

2.2.3 Identification of Types/Specifications of Forest Information Data

Based on the output of 2.2.1 and 2.2.2, 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. In addition, the data sources were reviewed in preparation for future international reports to organize the current response statuses and the future response possibilities.

2.2.4 Design of National Forest Information Database (Outline Proposal)

Based on the results of 2.2.1, 2.2.2, and 2.2.3, the relationship with the National Forest Monitoring System (NFMS) was organized, the roles of NFIDB in UNFCCC report and the Global Forest Resources Assessments (FRA) were defined, and the user interfaces (proposal) of NFIDB were reviewed. Regarding the report related to the prototype of the National Forest Information Database, a data product specification (proposal) and a functional requirement definition (proposal) were reviewed and put together.

2.3 Activities Related to Output 3

2.3.1 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.

2.3.2 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.

2.3.3 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.

2.3.4 Revise and finialize the Next Natinal Forest Inventoy manual

Draft NFI manual which was created based on the above-mentioned activities wss revised and finalized based on the Pilot survey.

2.4 Activities Related to Output 4

2.4.1 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.

2.4.2 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.

2.4.3 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.

Chapter3 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 (Figure 3-1).

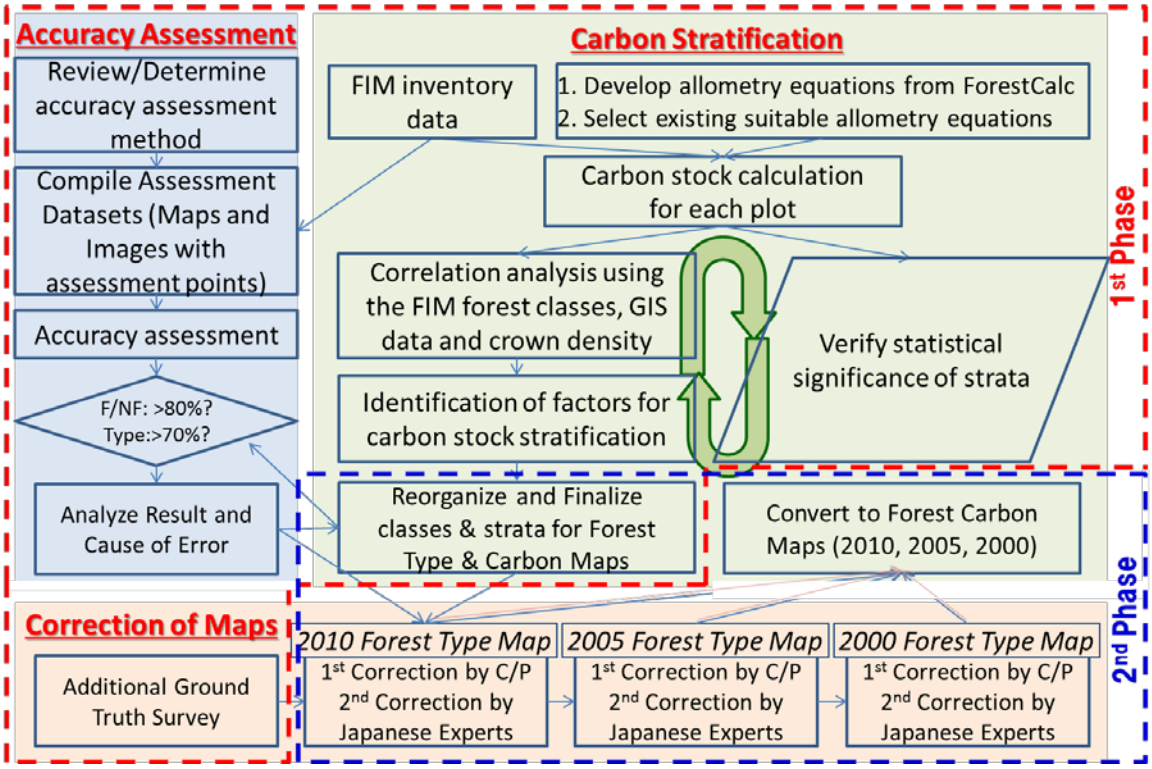


Figure 3-1 Work Flow Related to Output 1

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 decision was made to generate points on a 4 km grid and use this as the accuracy assessment sampling methodology, which calculate the number of samples required statistically, and select them randomly.

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 or locations where there were clouds.

The work flow for accuracy assessment is as follows. 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. 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.

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 3-1. 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 3-1 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 3-2, 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 3-2 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%										

3.1.2 Method of Integration and Revision for Improvement of Classification Accuracy

As a result of the analysis in Section 3.1.1, the accuracy improvement method was studied as described in Table 3-5 and discussions were held with the C/P to obtain their agreement. Detailed description of the method is as follows.

Table 3-3 Method of Integration and Revision for Improvement of Classification Accuracy

Methods to Improve Accuracy of Classification

	Difficult Classification	Priority	Which Team?	Specific Method	Order of Correction
Aggregation	DF/MED			Aggregate to MD	
	EP/DP			Aggregate to P	
	OF/YF/B			Aggregate to FL -> C/P required that B should be distinguished.	
Correction	EF/MD	4	Every Teams	1) Create EF zone data. (NBCA: existing, Near border/Far from Shifting Cultivation: need to be created.) 2) To correct EF in zone area, if there is MD. 3) To correct MD in the other area, if there is EF.	2nd
	MD/FL	1	Every Teams	1) PALSAR data is pre-processed. (Japanese Expert) 2) To correct by interpretation refered PALSAR data.	
	CF/MCB	5	Team A (Sekong, Khamuane) Team B (Bolikhamsay) Team C (Houaphang, Xiengkuang, (Phonsaly))	1) Create CF zone data. 2) To correct CF/MCB in zone area. 3) To correct CF/MCB in the other area.	
	DD/NF (SA, SR, RP)	2	Team A (Every Provinces) Team B	1) To correct by interpretation refered interpretation cards.	3rd 4th 1st
	CF/MD, FL	3	Team A (Sekong, Khamuane) Team B (Bolikhamsay) Team C (Houaphang, Xiengkuang, (Phonsaly))	1) Create CF zone data. 2) To correct CF/MCB in zone are. 3) To correct CF/MCB in the other area.	
	FL, SB/NF (RP, etc)	6	Every Teams	1) PALSAR data is pre-processed. (Japanese Expert) 2) To correct by interpretation refered PALSAR data, slope information and shape of object.	

3.1.3 Ground Truth Survey

Regarding the ground truth survey that is required for correction work was implemented.

3.1.4 Development of Interpretation Keys and Interpretation Cards

The forest type maps of 2010, 2005 and 2000, which are the outputs of this project, were prepared based on various satellite images. It is necessary to interpret the satellite images and correctly judge the land cover and usage of a given area of land in preparing the maps, but ample experience in the interpretation of satellite images and field survey is needed for this purpose. In addition, the criteria for judgment of land cover and usage greatly vary in accordance with the experience of each individual. As such, it is not easy to prepare forest type maps of uniform quality.

3.1.5 Lectures on Theory of Remote Sensing

In this project, the GIS/RS section staff attended a lecture series entitled "Theory of Remote Sensing" and received OJT training on creating image interpretation keys(21st June 2015~ 1st August 2015).

3.1.6 Lectures on Theory of Remote Sensing – Part 2

This lecture course was held in July 2014(3rd ~ 13th March) for staff members of the GIS/RS section and the field survey training being held at the Phou Khao Khouay National Park on the outskirts of Vientiane.

3.1.7 Investigation of Forest Definitions and National Level Classification System, and Consistency with Sub-national Level Classification System

① Discussion regarding National Level Forest Definitions and Classification System

Separate discussions were held regarding national level classification system and the forest definition far slash and burn land under UNFCCC with Mr. Khamphay, Mr. Somchay, Deputy Directors General of the Department of Forestry, and Mr. Linthong, Director of the Forest Inventory and Planning Division, and agreement was obtained in the form of minutes of the meetings. The agreed national level classification system is shown in Table 3-4.

Regarding the national level classification items, the Level 1 and 2 classification items are to be applied to all levels, and the Level 3 classification items can be flexibly used at sub-national and project level. Also, regarding the forest definition for slash and burn land under UNFCCC, cultivated land after burning, which to date has been treated as slash and burn land, was renamed as Upland Crop, and is treated as agricultural land under the IPCC land-use classification. In addition land abandoned after cultivation, which to date has been treated as Fallow Land, has been renamed to Regenerating Vegetation, and is treated as fallow land under the IPCC land-use classification. In addition, regarding bamboo, although it had been agreed in the technical workshop on classification held on October 21st, 2014 to include this in Fallow Land, there was a request that it be classified again as this was an important research matter, so it was decided to continue to classify it.

Table 3-4 Classification system for National level

Land/Forest Classification at National Level for Lao PDR

Land/Forest Classification at National Level for Lao PDR is shown below in comparison with IPCC land use categories.
'Level 1' have to be used for any level of map.
'Level 2' should be used for any level of map.
'Level 3' can be used for Sub-National/Project Level.

IPCC Definition	*National Level Classification System for Lao PDR*				
	Level 1	*Level 2*		*Level 3*	
Forest Land	**Current Forest**	Evergreen Forest	EF	High Density Evergreen Forest	HEF
				Low Density Evergreen Forest	LEF
		Mixed Deciduous Forest	MD	High Density Mixed Deciduous Forest	HMD
				Low Density Mixed Deciduous Forest	LMD
		Dry Dipterocarp Forest	DD	High Density Dry Dipterocarp	HDD
				Low Density Dry Dipterocarp	LDD
		Coniferous Forest	CF		
		Mixed Coniferous and Broadleaved Forest	MCB		
		Forest Plantation	P	Evergreen Forest Plantation	EP
				Deciduous Forest Plantation	DP
	Regenerating Vegetation	Bamboo	B	Bamboo	B
		Regenerating Vegetation	RV	Fallow Land	FL
				Degraded Forest	DF
Grassland	**Other Vegetated Areas**	Savannah	SA		
		Scrub	SC		
		Grassland	G		
Wetlands		Swamp	SW		
Cropland	**Cropland**	Upland Crop	UC		
		Rice Paddy	RP		
		Other Agriculture	OA		
		Agriculture Plantation	AP		
Settlements	**Non Vegetated Areas**	Urban	U		
Other Land		Barren Land and Rock	BR		
	Other Land	Other Land	O		
Wetlands	**Water**	Water	W		

3.1.8 Revision of Forest Type Maps (2000, 2005, 2010)

The 2000, 2005, and 2010 forest type maps were prepared in accordance with the method of revision of the 2010 forest type maps agreed in Section 3.1.2, and the method of preparing the forest type maps of 2000 and 2005. Also, each of the forest type maps prepared are shown in Figure 3-2 to Figure 3-4, and the area of coverage of each type of forest in the forest type maps are shown in Table 3-5. The area of Current Forest that satisfied the forest definition of Laos decreased slightly between 2000 and 2010, from 13,915,062 ha (60.4%) in 2000, to 13,797,575 ha (59.8%) in 2005, and 13,430,740 ha (58.3%) in 2010. The area of Regenerating Vegetation, which mainly consists of abandoned slash and burn farmland excluding Upland Crop, also decreased slightly in the same period, from 6,231,011 ha (27.0%) in 2000, to 6,079,325 ha

(26.4%) in 2005, and 5,523,443 ha (24.0%) in 2010. Meanwhile, the area of Cropland including Upland Crop increased between 2000 and 2010, from 1,811,945 ha (7.9%) in 2000, to 2,076,163 ha (9.0%) in 2005, and 2,538,589 ha (11.0%) in 2010. These changes suggest the potential progress of the conversion of forestland into cropland during this period. However, the increase in Upland Crop between 2005 and 2010 can be partly attributed to the following fact: it is difficult to distinguish UC and newly developed Cropland of the other types or Plantation from interpreting an image taken at a certain point of time. It was possible to distinguish these two on the images taken in 2000 and 2005 because the images taken later were available for comparison to identify the changes that occurred since 2000 and 2005, respectively. However, it was not possible to do so with the images taken in 2010 because images taken later were not available and, therefore, it was not possible to verify the changes that occurred after 2010. Thus, when it was not possible to confidently interpret whether a certain area was newly developed Cropland/Plantation or Upland Crop on an image taken in 2010, the area concerned was classified as Upland Crop. While it is considered possible to correct the classification by verifying images taken after 2010, a study will have to be conducted on the way to handle such cases when new data (of 2015) are to be created. As the area of Cloud and Shadow accounted for 2.4% of the area covered by the images taken in 2010, the accuracy of the forest type data will have to be improved by referring to images taken after 2010. This improvement may change the figures of the areas mentioned above.

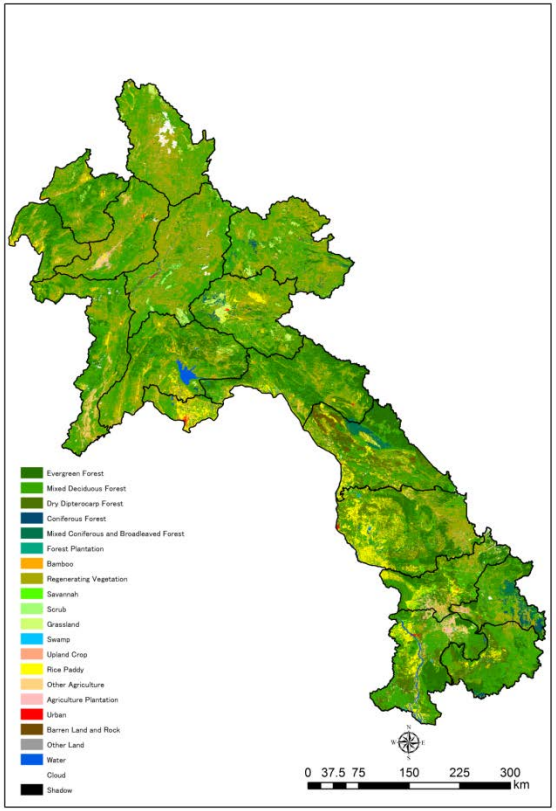


Figure 3-2 Forest type map in 2000

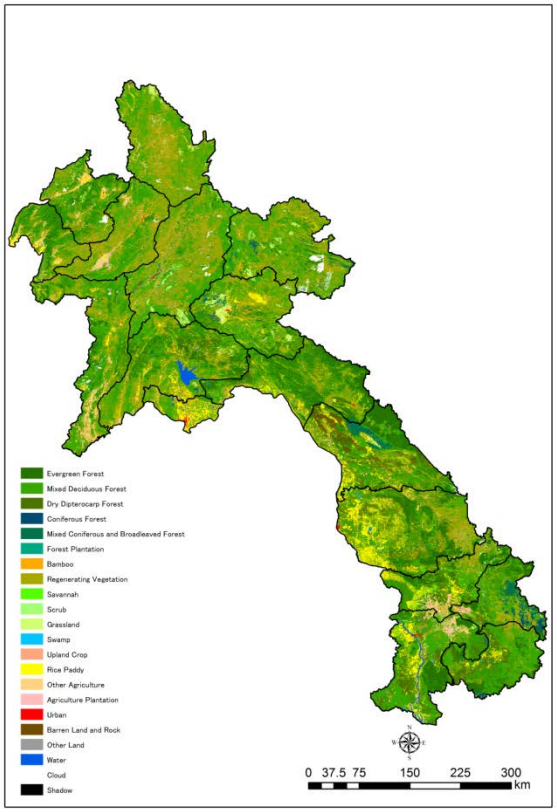


Figure 3-3 Forest type map in 2005

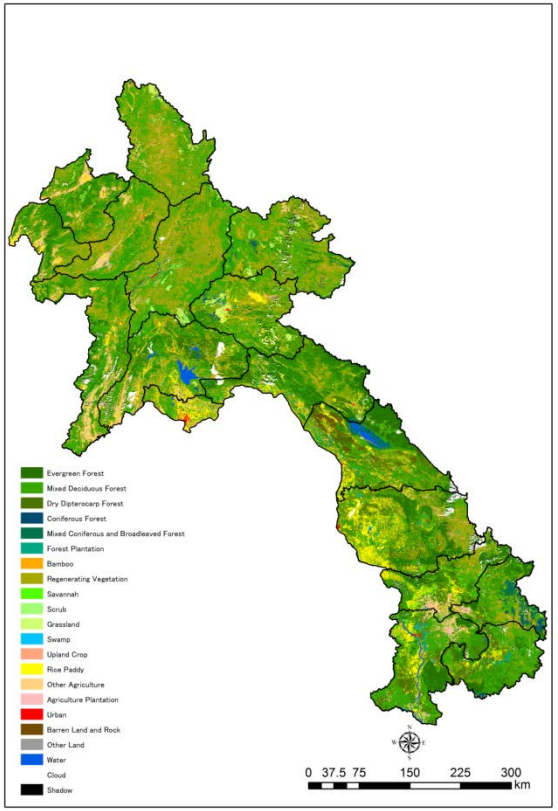


Figure 3-4 Forest type map in 2010

Table 3-5 Area for each Classification in 2000, 2005 and 2010

National Level Classification System for Lao PDR			2010		2005		2000	
Level 1	Level 2		ha	%	ha	%	ha	%
Current Forest	Evergreen Forest	EF	2,984,601		3,055,050		3,047,762	
	Mixed Deciduous Forest	MD	8,827,908		9,097,006		9,215,611	
	Dry Dipterocarp Forest	DD	1,205,454		1,293,013		1,301,558	
	Coniferous Forest	CF	86,270		86,646		87,997	
	Mixed Coniferous and Broadleaved Forest	MCB	218,932		244,121		244,439	
	Forest Plantation	P	107,575	58.3%	21,738	59.8%	17,695	60.4%
Regenerating Vegetation	Bamboo	B	87,517		68,491		63,343	
	Regenerating Vegetation	RV	5,435,926	24.0%	6,010,834	26.4%	6,167,668	27.0%
Other Vegetated Areas	Savannah	SA	103,998		106,643		107,786	
	Scrub	SR	24,626		27,623		27,489	
	Grassland	G	245,150		272,691		283,065	
	Swamp	SW	10,187	1.7%	9,685	1.8%	11,156	1.9%
Cropland	Upland Crop	UC	441,336		238,892		196,960	
	Rice Paddy	RP	1,187,568		1,178,021		1,152,985	
	Other Agriculture	OA	844,124		609,283		414,027	
	Agriculture Plantation	AP	65,561	11.0%	49,967	9.0%	47,973	7.9%
Non Vegetated	Urban	U	72,224		64,280		63,776	
	Barren Land and Rock	BR	182,691	1.1%	184,365	1.1%	183,322	1.1%
Other Land	Other Land	O	20,310	0.1%	19,181	0.1%	18,994	0.1%
Water	Water	W	342,776	1.5%	277,043	1.2%	276,151	1.2%
Other	Cloud	CL	400,276		129,225		113,249	
	Cloud Shadow	SH	159,216	2.4%	10,427	0.6%	11,220	0.5%
SUM			23,054,225	100%	23,054,225	100%	23,054,225	100%

3.1.9 Final Accuracy Assessment of Forest Type Maps (2000, 2005, 2010)

The results of the final accuracy assessment of the 2000, 2005, and 2010 forest type maps are shown in Table3-6 to Table 3-13.

Table 3-6 to Table 3-9 show the results of the final accuracy assessment in accordance with the classification system adopted during the initial phase of this project, and Table 3-10 to Table 3-13 show the results of the final accuracy assessment in accordance with the classification system that was finally agreed to within the forest sector through this Project, which is reported in 3.2.7.

Although the target accuracy shown in the special specification was set at the beginning of this Project for the initial classification system, it was decided to perform assessment for both classification systems. The difference between these classification systems is that while the initial system did not include land abandoned after slash and burn (RV) and bamboo forest (B) in forests, the final classification system includes RV and B in forests. The issue of classification of RV and MD, which are often formed in transition after deforestation to UC and are considered to be a type of forest degradation as they are changes to another item of forests, was analyzed by performing accuracy assessment in accordance with the final classification system.

The target accuracy shown in the special specification was 70% or more for the forest type classification accuracy in the 2010 forest type map. As the overall accuracy for forest type in the 2010 forest type map was 72.7% (

Table 3-6), the target was achieved. With respect to the target classification accuracy of 80% or more for forest and non-forest in the 2010, 2005, and 2000 forest type maps, which was independently set in this Project, the overall accuracy for forest and non-forest in the 2010 forest type map was 81.2% (

Table 3-7) and so the target was achieved. However, the overall accuracy for forest and non-forest in the 2005 and 2000 forest type maps was 78.6% (Table 3-8) and 78.6% (Table 3-9), respectively, which were slightly lower than the target.

With respect to the classification accuracy in accordance with the classification system agreed in

this Project, while the overall accuracy of forest and non-forest in the 2010, 2005, and 2000 forest type maps was 91.2% (Table 3-11), 88.4% (Table 3-12) and 90.3% (Table 3-13) respectively, which was higher than the VCS and other international standards, the overall accuracy of forest type in the 2010 forest type map was 66.9% (Table 3-10), which was lower than 70%. It is considered that the classification accuracy of forest type was low because the newly agreed classification system includes MD and RV, covering the majority of the land of Lao PDR and changing drastically and being difficult to classify, in the forests (treating them as forest degradation). In fact, Table 3-10 shows that the user accuracy of MD and RV, which account for about 60% of all the assessment points, are 60.8% and 62.7%, which are not high, even though these have been improved from the user accuracy before the modification. As described in 3.2.2, it is not easy to classify MD and RV on satellite images captured in a period of time. As such, in order to improve the accuracy further, it is necessary to further clarify the definitions and the operation and assessment methods based on the premise that chronological data are used. Since various chronological global data sets have been developed, they should be utilized, and at the same time, continuous efforts should be made to address improvements with accuracy to reduce uncertainty and combat forest degradation as part of the activities to formulate the reference emission level. Also, the user accuracy of CF (52.2%) and B (21.7%) are much lower than 70%, although the number of their assessment points is small. It was revealed from this study that it is difficult to clearly classify CF and MCB on images, since they are formed as a result of continuous transformation of the same vegetation combination. While each classification is to be kept for forest management, it should also be considered to treat them as the same item in the evaluation of overall uncertainty in the carbon stock calculation. With respect to B, after verification based on the results of this study, it was presumed that the main cause is the lack of uniform perception among the operators concerning the appearance on images and the distribution range. Examinations should be carried out to determine whether or not to leave it as an item after identifying the distribution range by utilizing aerial photographs that have become available in Lao PDR and verifying how it looks on satellite images.

Table 3-6 Error Matrix for Forest Type Classification of 2010 Forest Type Map (Past Classification System)[2,3]

2010				Reference data								
				Forest						NF		
				Current Forest							Total	U.A
				EF	MD	DD	CF	MCB	P			
Map	Forest	Current Forest	EF	**121**	28	2				11	162	74.7%
			MD	40	**293**	18	3	3	1	124	482	60.8%
			DD		7	**48**			1	13	69	69.6%
			CF		3		**12**	3		5	23	52.2%
			MCB	2	6	2	1	**29**		1	41	70.7%
			P		1				**22**	6	29	75.9%
	NF			9	82	9	1	1	7	**513**	622	82.5%
		Total		172	420	79	17	36	31	673	1428	
		P.A		70.3%	69.8%	60.8%	70.6%	80.6%	71.0%	76.2%		
Overall Accuracy				**72.7%**								

[2] U.A: User's accuracy、P.A: Producer's accuracy

[3] Overall accuracy is the ratio of total points (in blue) that matched between the map and the reference data to the total assessment points.

Table 3-7 Error Matrix for Forest / Non-Forest Classification of 2010 Forest Type Map (Past Classification System)[2,3]

2010		Reference data			
		Forest	Non-Forest	Total	U.A
Map	Forest	646	160	806	80.1%
	Non-Forest	109	513	622	82.5%
	Total	755	673	1428	
	P.A	85.6%	76.2%		
Overall Accuracy		81.2%			

Table 3-8 Error Matrix for Forest / Non-Forest Classification of 2005 Forest Type Map (Past Classification System)[2,3]

2005		Reference data			
		Forest	Non-Forest	Total	U.A
Map	Forest	636	177	813	78.2%
	Non-Forest	128	487	615	79.2%
	Total	764	664	1428	
	P.A	83.2%	73.3%		
Overall Accuracy		78.6%			

Table 3-9 Error Matrix for Forest / Non-Forest Classification of 2000 Forest Type Map (Past Classification System)[2,3]

2000		Reference data			
		Forest	Non-Forest	Total	U.A
Map	Forest	639	179	818	78.1%
	Non-Forest	126	484	610	79.3%
	Total	765	663	1428	
	P.A	83.5%	73.0%		
Overall Accuracy		78.6%			

Table 3-10 Error Matrix for Forest Type Classification of 2010 Forest Type Map (New Classification System)[2,3]

2010				Reference data										
				Forest Land								NF	Total	U.A
				Current Forest						Potential Forest				
				EF	MD	DD	CF	MCB	P	B	RV			
Map	Forest Land	Current Forest	EF	**121**	28	2					11		162	74.7%
			MD	40	**293**	18	3	3	1	4	101	19	482	60.8%
			DD		7	**48**			1		2	11	69	69.6%
			CF		3		**12**	3			4	1	23	52.2%
			MCB	2	6	2	1	**29**				1	41	70.7%
			P		1				**22**		3	3	29	75.9%
		Potential Forest	B	2	8					**5**	7	1	23	21.7%
			RV	6	66	2	1	1	2	7	**224**	48	357	62.7%
	NF			1	8	7	0	0	5	1	19	**201**	242	83.1%
		Total		172	420	79	17	36	31	17	371	285	1428	
		P.A		70.3%	69.8%	60.8%	70.6%	80.6%	71.0%	29.4%	60.4%	70.5%		
Overall Accuracy				**66.9%**										

Table 3-11 Error Matrix for Forest / Non-Forest Classification of 2010 Forest Type Map (New Classification System)[2,3]

2010		Reference data			
		Forest	Non-Forest	Total	U.A
Map	Forest	**1102**	84	1186	92.9%
	Non-Forest	41	**201**	242	83.1%
	Total	1143	285	1428	
	P.A	96.4%	70.5%		
Overall Accuracy		**91.2%**			

Table 3-12 Error Matrix for Forest / Non-Forest Classification of 2005 Forest Type Map (New Classification System)[2,3]

2005		Reference data			
		Forest	Non-Forest	Total	U.A
Map	Forest	**1112**	124	1236	90.0%
	Non-Forest	42	**150**	192	78.1%
	Total	1154	274	1428	
	P.A	96.4%	54.7%		
Overall Accuracy		**88.4%**			

Table 3-13 Error Matrix for Forest / Non-Forest Classification of 2000 Forest Type Map (New Classification System)[2,3]

2000		Reference data			
		Forest	Non-Forest	Total	U.A
Map	Forest	1156	101	1257	92.0%
	Non-Forest	38	133	171	77.8%
	Total	1194	234	1428	
	P.A	96.8%	56.8%		
Overall Accuracy		90.3%			

3.1.10 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.

3.1.11 Determination of Forest Stratification Method

As stated above, further detailed stratification is not necessary. Integration was considered.

It is considered that evaluation of the overall uncertainty in investigation of integration of strata contributes to decision-making. Stratification is carried out in order to improve the accuracy (reduce the uncertainty) in the estimation of the quantity of reduction in GHG emissions, so if there was a high level of uncertainty, it would be necessary to conservatively evaluate the estimated reduction in quantity of GHG emissions. Also, the Lao PDR is currently planning to participate in the World Bank Forest Carbon Partnership Facility (FCPF) / Carbon Fund (CF), and in the FCPF/CF conservative factors are clearly defined in accordance with the value of the overall uncertainty as shown in Table 3-14. Conservative factors can be limited by minimizing the overall uncertainty, and a greater reduction in emissions can be reported. Therefore, it was considered that investigating whether the overall uncertainty can be reduced by integration can contribute to the decision-making of the C/P.

First the overall uncertainty was calculated before integration in accordance with Table 3-15. However, normally when calculating the overall uncertainty, it is necessary to perform the calculation using the actual activity data (AD) and emission factor (EF), but at this time the calculation was provisionally carried out using the accuracy assessment results of the 2010 forest type maps and the first NFI data, for which the data was available.

From this it was found that the overall uncertainty was about 16% when integration is not carried out. At this point in time the uncertainty in the CF and the MCB is high, but these are difficult to classify on a map, and the tree type composition also includes coniferous tree types so they have a point in common, so integration was attempted (Table 3-16). The uncertainty of the integrated CF/MCB was still high, so integration was attempted again for MD for which errors of interpretation were found on the maps and which has a point in common on the tree type composition (Table 3-17). Although the uncertainty of the integrated MD/CF/MCB was kept low, in this case the overall uncertainty was about 16%, so there was virtually no change in the overall uncertainty compared with when integration was not carried out. Therefore, next further integration was attempted with EF, for which the uncertainty was high (Table 3-18). This was because it is difficult to distinguish between EF and MD on maps, because they have many of the compositional tree types in common. As a result the overall uncertainty was reduced slightly to about 14%. This is because provisional data was used in the calculation, but according to Table 3-14 which shows the relationship to the FCPF/CF conservative factors, if the overall uncertainty is equal to or less than

15%, the estimated GHG emission reduction can be reported without conservative evaluation, so this integration scheme is beneficial for the Lao PDR.

The above result is a provisional evaluation because the information necessary for evaluation of the overall uncertainty as required internationally is not available at the present time. Integration was investigated as one approach, that was discussed with the C/P and their understanding was obtained as a provisional carbon stratification scheme. The next period NFI data will be used for the final carbon stratification

Table 3-14 Relationship between overall uncertainty value and conservative factors in FCPF/CF

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

Table 3-15 Evaluation of overall uncertainty using the accuracy assessment results of the 2010 forest type maps and the first NFI data (before integration)

All		EF	MD	DD	CF	MCB	RV	Total
Uncertainty of area of map	90% CI	20%	5%	16%	47%	78%	6%	
− Number of classification data		68	497	75	49	17	462	1,168
− Number of reference data		66	487	92	31	11	459	1,146
− Map area (ha)		1,300,729	9,684,810	1,146,274	82,283	27,577	7,570,539	19,812,212
Uncertainty of carbon stock	90% CI	16%	4%	4%	25%	12%	21%	
− Mean (AGB/ha)		251	127	98	72	165	37	
− Standard Deviation		185	90	68	61	111	29	
− Number of plot		58	836	655	32	81	39	1,701
− Amount of Carbon (t)		163,370,728	616,799,529	56,137,576	2,975,023	2,273,617	134,453,192	976,009,665
Total Uncertainty	90% CI	25%	7%	17%	53%	79%	22%	
Overall Uncertainty	90% CI	**16%**						

Table 3-16 Evaluation of overall uncertainty using the accuracy assessment results of the 2010 forest type maps and the first NFI data (CF/MCB integrated)

Aggregation CF/MCB		EF	MD	DD	CF/MCB	RV	Total
Uncertainty of area of map	90% CI	20%	5%	16%	40%	6%	
− Number of classification data		68	497	75	66	462	1,168
− Number of reference data		66	487	92	42	459	1,146
− Map area (ha)		1,300,729	9,684,810	1,146,274	109,860	7,570,539	19,812,212
Uncertainty of carbon stock	90% CI	16%	4%	4%	12%	21%	
− Mean (AGB/ha)		251	127	98	139	37	
− Standard Deviation		185	90	68	108	29	
− Number of plot		58	836	655	113	39	1,701
− Amount of Carbon (t)		163,370,728	616,799,529	56,137,576	5,248,640	134,453,192	976,009,665
Total Uncertainty	90% CI	25%	7%	17%	42%	22%	
Overall Uncertainty	90% CI	**16%**					

Table 3-17 Evaluation of overall uncertainty using the accuracy assessment results of the 2010 forest type maps and the first NFI data (MD/CF/MCB integrated)

Aggregation MD/CF/MCB		EF	MD/CF/MCB	DD	RV	Total
Uncertainty of area of map	90% CI	20%	5%	16%	6%	
− Number of classification data		68	563	75	462	1,168
− Number of reference data		66	529	92	459	1,146
− Map area (ha)		1,300,729	9,794,670	1,146,274	7,570,539	19,812,212
Uncertainty of carbon stock	90% CI	16%	4%	4%	21%	
− Mean (AGB/ha)		251	129	98	37	
− Standard Deviation		185	93	68	29	
− Number of plot		58	949	655	39	1,701
− Amount of Carbon (t)		163,370,728	622,048,169	56,137,576	134,453,192	976,009,665
Total Uncertainty	90% CI	25%	6%	16%	22%	
Overall Uncertainty	90% CI	**16%**				

Table 3-18 Evaluation of overall uncertainty using the accuracy assessment results of the 2010 forest type maps and the first NFI data (EF/MD/CF/MCB integrated)

Aggregation EF/MD/CF/MCB		EF/MD/CF/MCB	DD	RV	Total
Uncertainty of area of map	90% CI	4%	16%	6%	
− Number of classification data		631	75	462	1,168
− Number of reference data		595	92	459	1,146
− Map area (ha)		11,095,399	1,146,274	7,570,539	19,812,212
Uncertainty of carbon stock	90% CI	4%	4%	21%	
− Mean (AGB/ha)		136	98	37	
− Standard Deviation		104	68	29	
− Number of plot		1,007	655	39	1,701
− Amount of Carbon (t)		785,418,897	56,137,576	134,453,192	976,009,665
Total Uncertainty	90% CI	6%	16%	22%	
Overall Uncertainty	90% CI	**14%**			

3.1.12 Preparation of National Forest Carbon Map

Forest carbon maps were prepared for 2000, 2005, and 2010 with the investigated carbon stratification scheme and the conventional forest categories. Also, the uncertainty in the change of each of the overall carbon cumulative stock was calculated based on this data, and this was used as an alternative to the forest carbon map accuracy assessment result. Table 3-19 shows carbon stock by forest type. It shows a decrease in carbon stock from 4,915,958,121 t CO_2 in 2000, to 4,885,205,583 t CO_2 in 2005, and 4,836,938,716 t CO_2 in 2010. As mentioned in 3.2.8, the area of Current Forest, which accounts for more than 90% of the carbon stock, is decreasing and the carbon stock is decreasing in proportion. The changes between MD and RV are expected to affect the change in the carbon stock the most for the following reasons: 1) The area of these two categories accounts for more than 60% of the territory of Laos; 2) The changes between MD and RV occur frequently because a large part of them are found where slash and burn farming is practiced; and 3) The difference in the carbon stock per unit area between the two is large. However, since it was difficult to distinguish the two as mentioned in 3.2.2 (note: with regard to MD and FL (Fallow land) in the original definition), the area of RV was underestimated intentionally in this study (by selecting only the areas interpreted and verified as such without doubt) in order to estimate greenhouse gas emissions and carbon stock conservatively. As mentioned in 3.2.9, it may become possible to identify more changes between MD and RV than those identified in this study by improving the accuracy of the classification of MD and RV using time series data in the process of analyzing forest degradation for the establishment of reference emission level. If more changes have been identified, the change in the carbon stock may become larger.

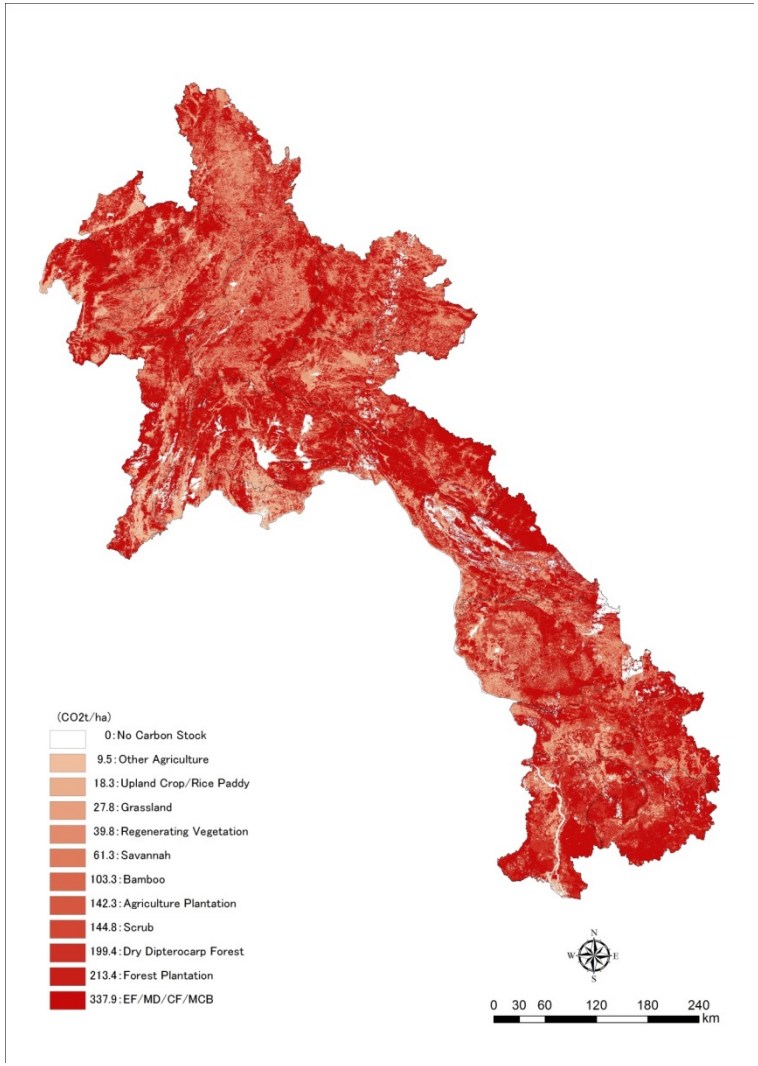


Figure 3-5 2010 Forest Carbon Map (Existing Classification)

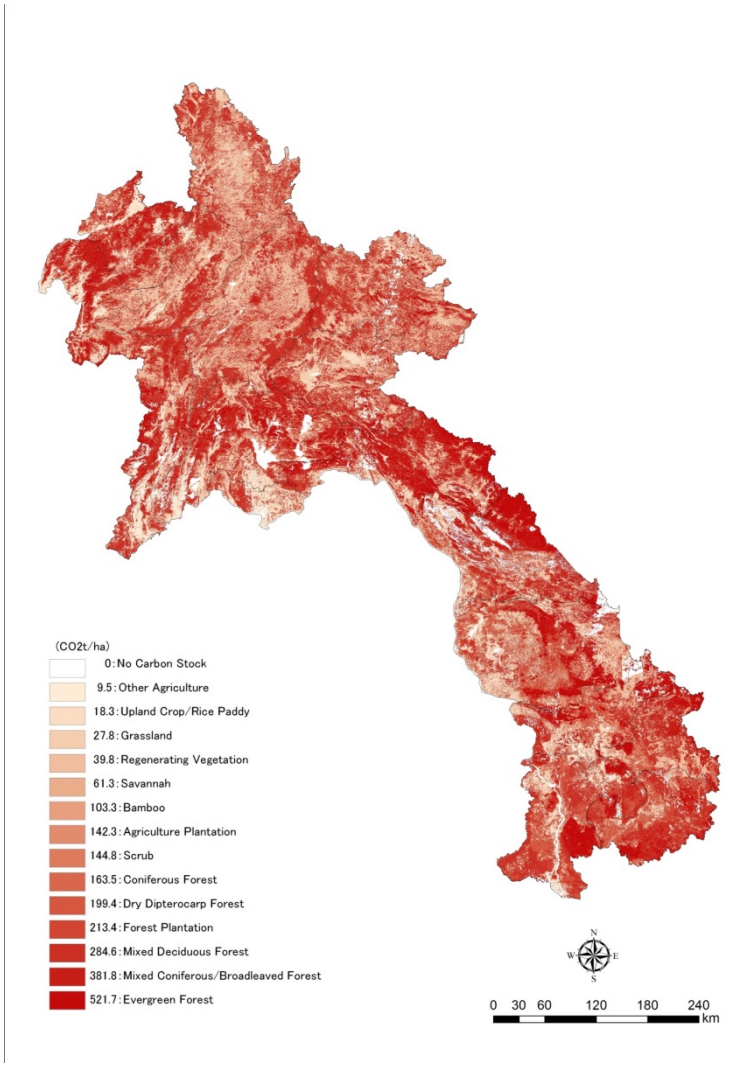


Figure 3-6 2010 Forest Carbon Map (Provisional Carbon Stratification)

Table 3-19 Estimated Amount of Carbon Stock for each Existing Classification and Provisional Carbon Stratification in 2000, 2005 and 2010

Existing Classification									
IPCC Definition	*National Level Classification System for Lao PDR*			2010		2005		2000	
	Level 1	*Level 2*		CO2t	%	CO2t	%	CO2t	%
Forest Land	Current Forest	Evergreen Forest	EF	1,595,792,303		1,603,531,861		1,598,647,348	
		Mixed Deciduous Forest	MD	2,574,800,540		2,604,673,871		2,636,885,869	
		Dry Dipterocarp Forest	DD	246,356,486		259,409,049		260,950,419	
		Coniferous Forest	CF	14,457,889		14,254,888		14,467,541	
		Mixed Coniferous and Broadleaved Forest	MCB	85,659,728		93,765,404		93,825,382	
		Forest Plantation	P	23,532,247	93.9%	4,668,211	93.8%	3,797,439	93.7%
	Regenerating Vegetation	Bamboo	B	9,268,068		7,120,305		6,580,742	
		Regenerating Vegetation	RV	221,493,781	4.8%	240,431,749	5.1%	246,541,711	5.1%
Grassland	Other Vegetated Areas	Savannah	SA	6,529,871		6,573,257		6,639,319	
		Scrub	SR	3,653,493		4,023,077		4,000,872	
		Grassland	G	6,979,692	0.4%	7,621,549	0.4%	7,906,256	0.4%
Cropland	Cropland	Upland Crop	UC	8,292,401		4,406,372		3,630,537	
		Rice Paddy	RP	22,313,602		21,728,679		21,252,795	
		Other Agriculture	OA	8,247,470		5,843,899		3,968,483	
		Agriculture Plantation	AP	9,561,147	1.0%	7,153,412	0.8%	6,863,409	0.7%
	SUM			4,836,938,716	100%	4,885,205,583	100%	4,915,958,121	100%

Provisional Carbon Stratification									
IPCC Definition	*National Level Classification System for Lao PDR*			2010		2005		2000	
	Level 1	*Level 2*		CO2t	%	CO2t	%	CO2t	%
Forest Land	Current Forest		EF/MD/CF/MCB	4,270,710,459		4,316,226,024		4,343,826,139	
		Dry Dipterocarp Forest	DD	246,356,486		259,409,049		260,950,419	
		Forest Plantation	P	23,532,247	93.9%	4,668,211	93.8%	3,797,439	93.7%
	Regenerating Vegetation	Bamboo	B	9,268,068		7,120,305		6,580,742	
		Regenerating Vegetation	RV	221,493,781	4.8%	240,431,749	5.1%	246,541,711	5.1%
Grassland	Other Vegetated Areas	Savannah	SA	6,529,871		6,573,257		6,639,319	
		Scrub	SR	3,653,493		4,023,077		4,000,872	
		Grassland	G	6,979,692	0.4%	7,621,549	0.4%	7,906,256	0.4%
Cropland	Cropland	Upland Crop	UC	8,292,401		4,406,372		3,630,537	
		Rice Paddy	RP	22,313,602		21,728,679		21,252,795	
		Other Agriculture	OA	8,247,470		5,843,899		3,968,483	
		Agriculture Plantation	AP	9,561,147	1.0%	7,153,412	0.8%	6,863,409	0.7%
	SUM			4,836,938,716	100%	4,885,205,583	100%	4,915,958,121	100%

Based on the argument mentioned above, the uncertainty of each forest carbon map was calculated and the obtained uncertainty figures were used as the results of the accuracy assessment. The Table 3-20 – Table 3-22 show the uncertainties of the forest carbon maps of 2010, 2005, and 2000, respectively. The accuracy assessment of the forest type maps of 2010, 2005 and 2000 was conducted using the land use classification of IPCC, a minimum requirement for an international report. Among the categories in the classification of land use of IPCC, only Forest Land, Grassland, and Cropland can stock carbon, thus the accuracy of the maps was assessed for them. The data of the first NFI were used in the calculation of the uncertainty of the emission factors. However, a biomass survey was not conducted in areas where the ground cover and use corresponding to Grassland and Cropland was found in the first NFI. Therefore, only the uncertainty of emission factor of Forestland, for which biomass data were available, was calculated.

As shown in Table 3-20 – Table 3-22, the overall uncertainties of the forest carbon maps of the three years were larger than 20%. A conservativeness factor of 4% applies to the overall uncertainties of the three maps in accordance with the uncertainty assessment provided in the Carbon Fund of FCPF. However, it is considered necessary to re-assess the uncertainty of emission factors after the implementation of the next NFI because the NFI data used in this study were insufficient for the assessment of the uncertainty of emission factors, as mentioned above.

Table 3-20 Evaluation for Uncertainty of Estimated Amount of Carbon Stock in 2010

2010		Forest Land	Grassland	Cropland	Total
AD Uncertainty	95% CI	1.7%	27.7%	10.4%	
	90% CI	1.4%	23.1%	8.7%	
– Number of classification data		1,171	17	170	1,358
– Number of reference data		1,136	45	177	1,358
– Map area (ha)		18,954,183	373,774	2,538,589	21,866,547
EF Uncertainty	95% CI	7.9%	–	–	
	90% CI	6.6%	–	–	
– Mean (AGB/ha)		40	–	–	
– Standard Deviation		49	–	–	
– Number of plot		958	–	–	958
Total Uncertainty	95% CI	8.0%	27.7%	10.4%	
	90% CI	6.7%	23.1%	8.7%	
Overall Uncertainty	95% CI	**27.3%**			
	90% CI	**22.8%**			

Table 3-21 Evaluation for Uncertainty of Estimated Amount of Carbon Stock in 2005

2005		Forest Land	Grassland	Cropland	Total
AD Uncertainty	95% CI	2.0%	26.9%	11.8%	
	90% CI	1.6%	22.4%	9.8%	
– Number of classification data		1,220	19	129	1,368
– Number of reference data		1,145	49	174	1,368
– Map area (ha)		19,876,900	406,957	2,076,163	22,360,019
EF Uncertainty	95% CI	7.9%	–	–	
	90% CI	6.6%	–	–	
– Mean (AGB/ha)		40	–	–	
– Standard Deviation		49	–	–	
– Number of plot		958	–	–	958
Total Uncertainty	95% CI	8.1%	26.9%	11.8%	
	90% CI	6.8%	22.4%	9.8%	
Overall Uncertainty	95% CI	**26.5%**			
	90% CI	**22.2%**			

Table 3-22 Evaluation for Uncertainty of Estimated Amount of Carbon Stock in 2000

2000		Forest Land	Grassland	Cropland	Total
AD Uncertainty	95% CI	1.8%	27.3%	14.1%	
	90% CI	1.5%	22.8%	11.8%	
- Number of classification data		1,238	21	113	1,372
- Number of reference data		1,191	49	132	1,372
- Map area (ha)		20,146,073	418,340	1,811,945	22,376,357
EF Uncertainty	95% CI	7.9%	-	-	
	90% CI	6.6%	-	-	
- Mean (AGB/ha)		40	-	-	
- Standard Deviation		49	-	-	
- Number of plot		958	-	-	958
Total Uncertainty	95% CI	8.1%	27.3%	14.1%	
	90% CI	6.8%	22.8%	11.8%	
Overall Uncertainty	95% CI	27.0%			
	90% CI	22.5%			

3.2 Output 2

3.2.1 Analysis/Organization of Existing Forest Information Database

Proposal and Discussion of Future Directions of NFIS and NFIDB

At such opportunities as explanation of work plans in the first year and the technical workshops in the second year (the second session co-hosted with CliPAD), the concepts and future directions of NFIS and NFIDB and the association with existing forest information databases (DBs) were explained to have discussions and consultations with stakeholders. Furthermore, consultation was given in advance to the decision-makers who are the Project Director and Manager, and Director General of DOF to obtain approval on the future directions of NFIDB.

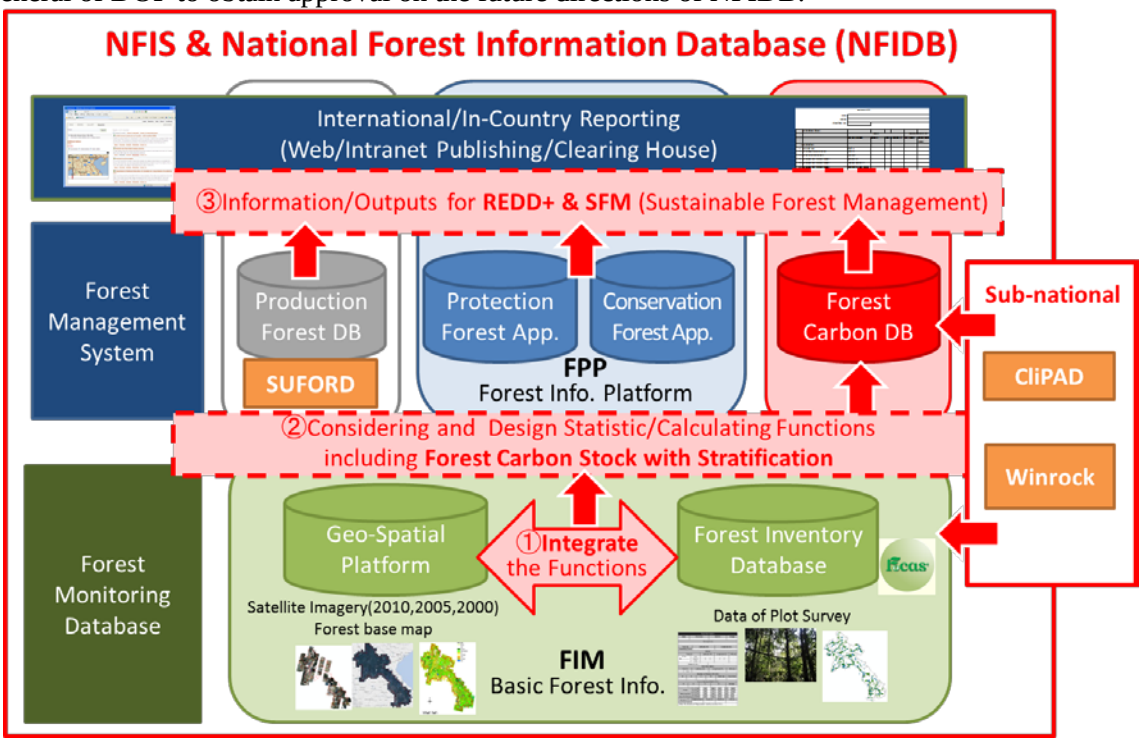


Figure 3-7 Outline and Future Directions of NFIS and NFIDB and Relationship with Existing Database

As the current-state analysis of Output 2 activities, the existing forest information databases were analyzed and organized, which include the geo-spatial information platform and forest inventory database (FoCAS) that have been developed by the FIM project in which a joint venture was

engaged, forest management information system (FPP/TA2: renamed to the forest information platform), Department of Forestry Reporting System (DOF Reporting System), Forest Inventory and Management Information System (FOMIS), and first NFI database (ForestCalc).

Organization of Statuses of Database Assistance by Donor Projects

Discussion was held with the person in charge of database (DB) of each project providing assistance to DOF. Based on the result of discussion, the current statuses of DB assistance by donor projects were organized.

Table 3-23 Organization of Statuses of Database Assistance by Donor Projects

	CliPAD	JICA(NFIS)	SUFORD SU	FAO
Analysis Application	QGIS & IDRISI (FC) eCognition (Aruna)	ArcGIS eCognition	ArcGIS ERDAS	TerraAmazon
Mobile Application	ODK & FormHub(->Ona)		ODK & FormHub (customize)	OpenForis Collect
Survey Database	NoSQL (MangoDB)		PostgreSQL (new table for display)	SQLite/PostgreSQL
Back-end Database	MS SQL Server		PostgreSQL	PostgreSQL

As described so far, there appears to be too many DBs in use. However, the biomass DB and the production forest management DB under study by JICA and CliPAD need not necessarily be the same DB because they need information of vastly different types. Any DB that serves each of their purposes may be used for development. What is more important, as proposed by CliPAD in SOP, is the standardization of survey data and analysis methods. The data exchange between DBs does not pose any major problem because it can be technically solved only if the specifications and regulations for input-output are determined.

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

In order to enhance capacity of reporting (R) of MRV system, NFIDB needs to study the functions and specifications for supporting international reporting. 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 3-24 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

Current State Analysis for UNFCCC Report

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.

Table 3-25 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)	NFI data: Growing stock
	Forest Cover Assessment (2010)	Default values from 2006 IPCC Guidelines: ・Biomass conversion and expansion factors (BCEF); ・Ratio of below ground biomass to above ground biomass (R); and ・ Carbon fraction (CF).

Current State Analysis for FRA2015

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. 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.

Data and Functions to Be Stored in NFIDB

Both the UNFCCC report and the FRA report have an issue of insufficient consistency of information because uniform management of data is not conducted at present. NFIDB is expected to alleviate and solve this issue. For this purpose, it is important to realize the three data types and functions listed below.

(a) Collecting and storing “survey data (raw data)” efficiently without errors
(b) Organizing and storing “calculation formulas” used to derive the biomass and carbon stocks from survey data
(c) Deriving the average biomass and carbon stocks from survey data and calculation formulas and storing them as “constants”

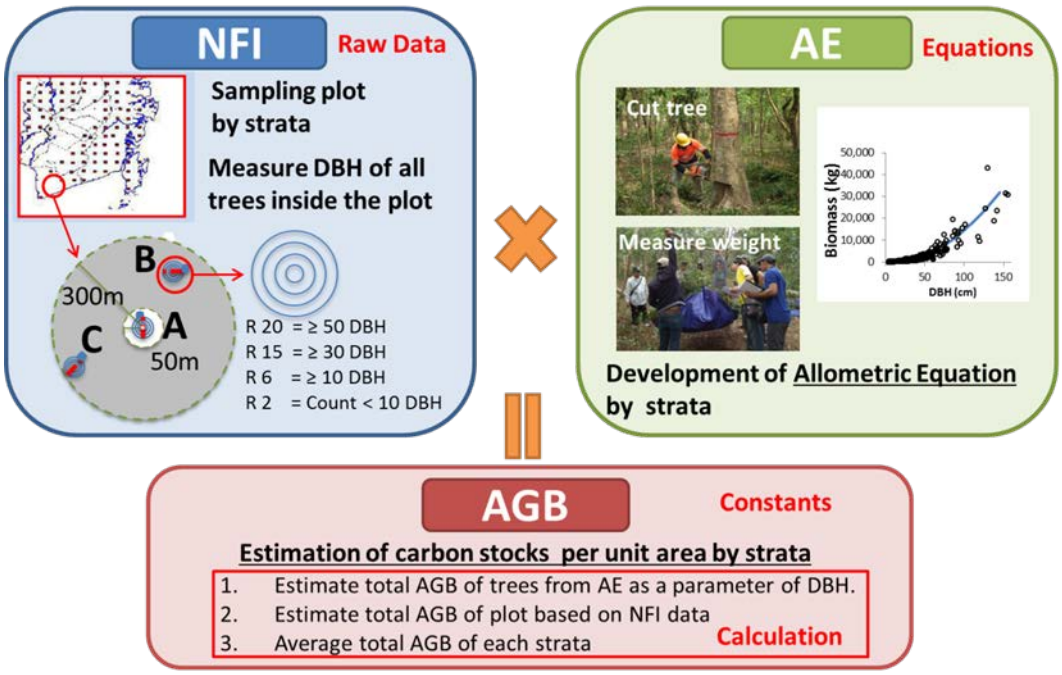
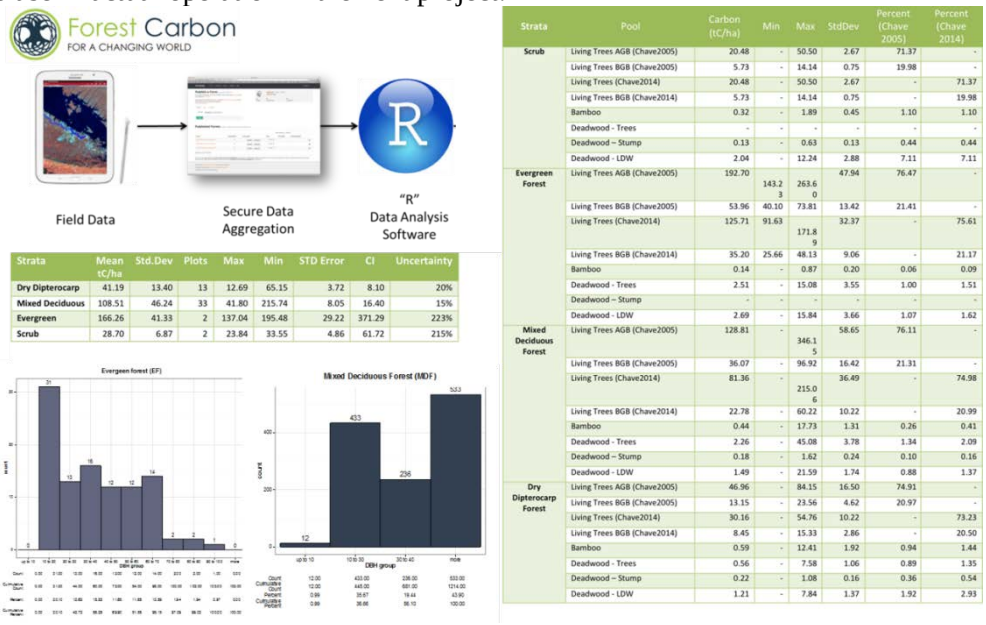


Figure 3-8 Outline of Data and Functions to Be Stored in NFIDB (*e.g.* Above-Ground Biomass (AGB))

Development of Demo Version of Inventory Survey Data Prompt Analysis System

The scope of this project is up to the design of NFIDB. However, a function of promptly analyzing inventory survey data was developed as a demo version, which is a script that runs on free statistical analysis software called "R" (see Output 3). It is expected to improve this system to enable its use in actual operation in the next project.



Strata	Mean tC/ha	Std.Dev	Plots	Max	Min	STD Error	CI	Uncertainty
Dry Dipterocarp	41.19	13.40	13	12.69	65.15	3.72	8.10	20%
Mixed Deciduous	108.51	46.24	33	41.80	215.74	8.05	16.40	15%
Evergreen	166.26	41.33	2	137.04	195.48	29.22	371.29	223%
Scrub	28.70	6.87	2	23.84	33.55	4.86	61.72	215%

Strata	Pool	Carbon (tC/ha)	Min	Max	StdDev	Percent (Chave 2005)	Percent (Chave 2014)
Scrub	Living Trees AGB (Chave2005)	20.48	-	50.50	2.67	71.37	-
	Living Trees BGB (Chave2005)	5.73	-	14.14	0.75	19.98	-
	Living Trees (Chave2014)	20.48	-	50.50	2.67	-	71.37
	Living Trees BGB (Chave2014)	5.73	-	14.14	0.75	-	19.98
	Bamboo	0.32	-	1.89	0.45	1.10	1.10
	Deadwood - Trees	-	-	-	-	-	-
	Deadwood – Stump	0.13	-	0.63	0.13	0.44	0.44
	Deadwood - LDW	2.04	-	12.24	2.88	7.11	7.11
Evergreen Forest	Living Trees AGB (Chave2005)	192.70	143.23	263.60	47.94	76.47	-
	Living Trees BGB (Chave2005)	53.96	40.10	73.81	13.42	21.41	-
	Living Trees (Chave2014)	125.71	91.63	171.89	32.37	-	75.61
	Living Trees BGB (Chave2014)	35.20	25.66	48.13	9.06	-	21.17
	Bamboo	0.14	-	0.87	0.20	0.06	0.09
	Deadwood - Trees	2.51	-	15.08	3.55	1.00	1.51
	Deadwood – Stump	-	-	-	-	-	-
	Deadwood - LDW	2.69	-	15.84	3.66	1.07	1.62
Mixed Deciduous Forest	Living Trees AGB (Chave2005)	128.81	-	346.15	58.65	76.11	-
	Living Trees BGB (Chave2005)	36.07	-	96.92	16.42	21.31	-
	Living Trees (Chave2014)	81.36	-	215.06	36.49	-	74.98
	Living Trees BGB (Chave2014)	22.78	-	60.22	10.22	-	20.99
	Bamboo	0.44	-	17.73	1.31	0.26	0.41
	Deadwood - Trees	2.26	-	45.08	3.78	1.34	2.09
	Deadwood – Stump	0.18	-	1.62	0.24	0.10	0.16
	Deadwood - LDW	1.49	-	21.59	1.74	0.88	1.37
Dry Dipterocarp Forest	Living Trees AGB (Chave2005)	46.96	-	84.15	16.50	74.91	-
	Living Trees BGB (Chave2005)	13.15	-	23.56	4.62	20.97	-
	Living Trees (Chave2014)	30.16	-	54.76	10.22	-	73.23
	Living Trees BGB (Chave2014)	8.45	-	15.33	2.86	-	20.50
	Bamboo	0.59	-	12.41	1.92	0.94	1.44
	Deadwood - Trees	0.56	-	7.58	1.06	0.89	1.35
	Deadwood – Stump	0.22	-	1.08	0.16	0.36	0.54
	Deadwood - LDW	1.21	-	7.84	1.37	1.92	2.93

Figure 3-9 Development of Demo Version of Inventory Survey Data Prompt Analysis System Using "R"

Review of Integration with GHG Inventory Software

In comparison of GHG inventory software (IPCC Inventory Software and ALU Software), ALU Software with a relatively higher function of integration with GIS data was studied to identify steps for integration.

Future integration patterns

NFIS is designing the next NFI and studying implementation of the designed NFI in the technical cooperation in preparation. At the same time, the biomass survey is currently being reviewed and prepared for. Therefore, the NFIDB design must be conducted while assuming an integration method after the development of estimated values for carbon stocks, etc. using allometric equations. Until these values are developed and publicized, however, it is necessary to keep the climate and soil layers integrated with the land use categories and use a function to output them in CSV format to facilitate the importing of them using GHG inventory software.

3.2.3 Identification of Types/Specifications of Forest Information Data

As a result of discussion and review with the FIPD staff, the types and specifications of forest information data to be surveyed and identified will be organized by the following application fields and data types.

Table 3-26 Organization of Types/Specifications of Forest Information Data

Application field	Data type
REDD+ & SFM	Contour, DEM, Geology, Soil, Watershed, River network, Road network, Administrative boundary, Village point, National Forest Inventory, Land use plan, Concession, Statistics/Census, Development plan area, Irrigation, Mining, Military zone, Forest along national borders.
REDD+	Eco-region, Climate, REDD+ project boundary, Biodiversity hotspot, Electric power line network.
SFM	Forest category, Village boundary, Forest management area.
Basemap	Satellite image, Aerial photo, Ground truth.

Addition of Forest Information Data to Forest Information Platform

Forest information collected through activities so far was added to the forest information platform developed in FPP/TA2 as a demo capacity building activity of C/P.

At present, the forest information platform has not been disclosed to the public on the Internet but is in service on the LAN/intranet of DOF. The GIS information and documents of 51 production forest projects were added to this platform. Users can browse the names, periods, outlines, and circumstances of projects.

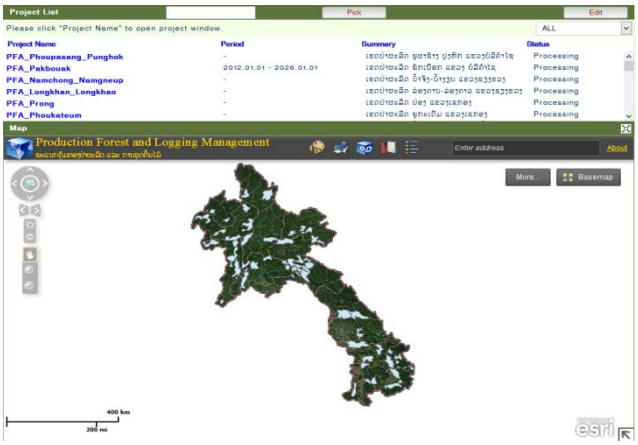


Figure 3-10 Production Forest Project Information Added to Forest Information Platform

Review of Data Sources in Preparation for Future International Reports

UNFCCC Report

Table 3-27shows a list of data sources of UNFCCC reports (AFOLU sector) used in the second National Communication and the next National GHG Inventory report (National Communication or Biannual Update Report). The construction of NFIDB will improve the Tier levels of activity data and emission factors and consequently the accuracy of the next National GHG Inventory report.

Table 3-27 List of Data Sources of UNFCCC Reports Updated by Construction of NFIDB

<table>
<tr><th></th><th>Second National Communication (2013)</th><th colspan="2">Next National GHG Inventory report</th></tr>
<tr><td>Activity data [Tier level]</td><td>NFI database (2002) [Tier 2]
Five-Year Sustainable Forest Protection Action Plan (2006 – 2010) [Tier 1]</td><td colspan="2">NFIS DB (2000, 2005, 2010) [Tier 2]</td></tr>
<tr><td rowspan="3">Emission factor [Tier level]</td><td rowspan="3">Default values in the 1996 IPCC Guidelines [Tier 1]</td><td rowspan="2">Forest land</td><td>Country-specific allometric equation: Average biomass for forest types [Tier 2]</td></tr>
<tr><td>Default values in the IPCC Guidelines: Ratio of below-ground to above-ground biomass (R) and carbon fraction (CF) [Tier 1]</td></tr>
<tr><td>Other land use</td><td>Default values in the IPCC Guidelines [Tier 1]</td></tr>
</table>

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.

3.2.4 Design of National Forest Information Database (Outline Proposal)

Organization of National Forest Monitoring System (NFMS) and Relations

According to UN-REDD NFMS strategy (UN-REDD programme, 2013), NFMS (Figure 3-11) 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 3-11) 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 management 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 NFMS 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.

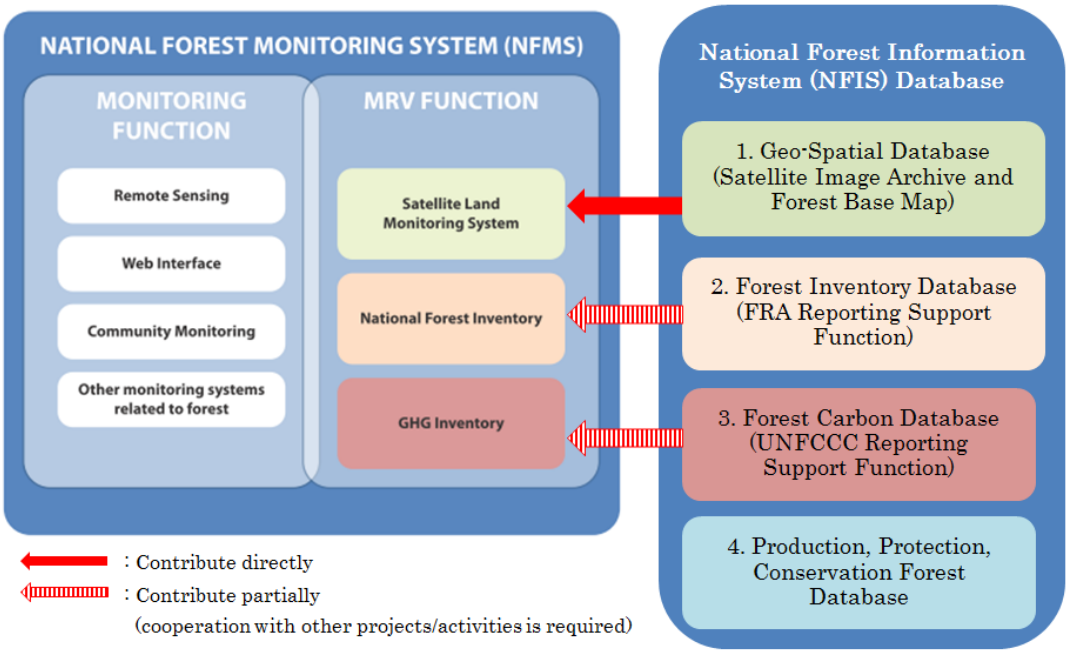


Figure 3-11 NFIDB which will be a core part of NFMS

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 its foundation, this project reviewed and designed 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 (and). It is considered that FRIMS and NFIDB can be operated together (Figure 3-12). 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.

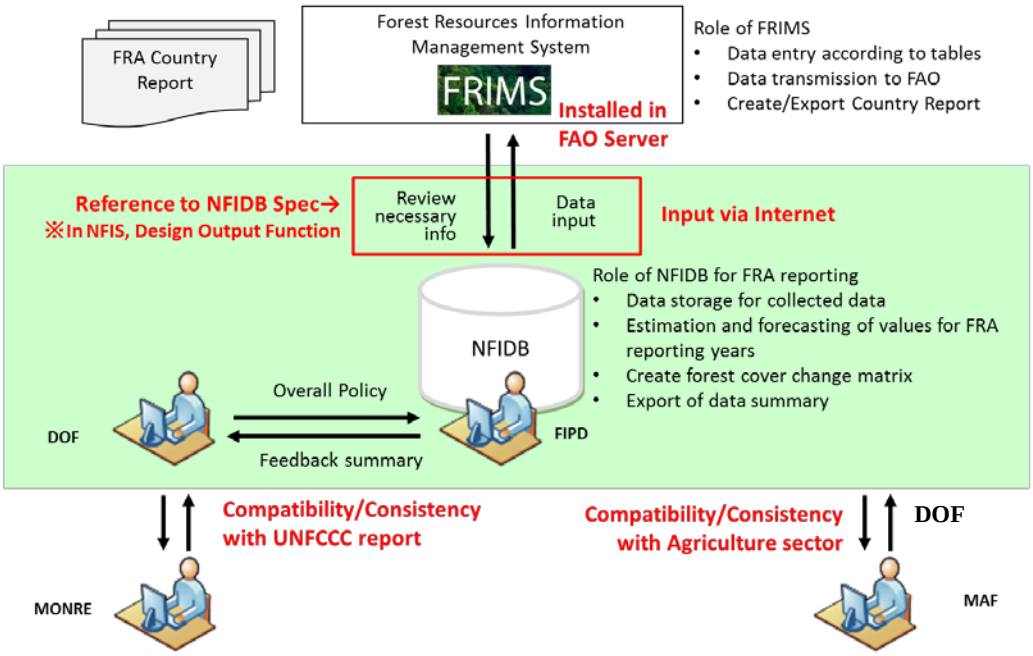


Figure 3-12 Role of NFIDB for FRA Country Report

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.

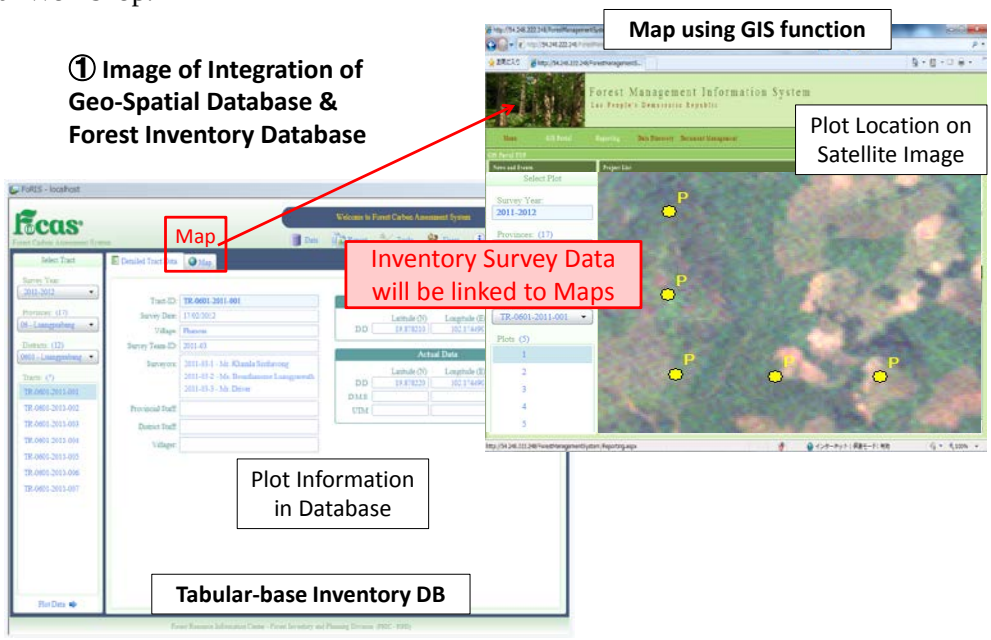


Figure 3-13 Image of Integration of Geo-Spatial Database and Forest Inventory Database

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.

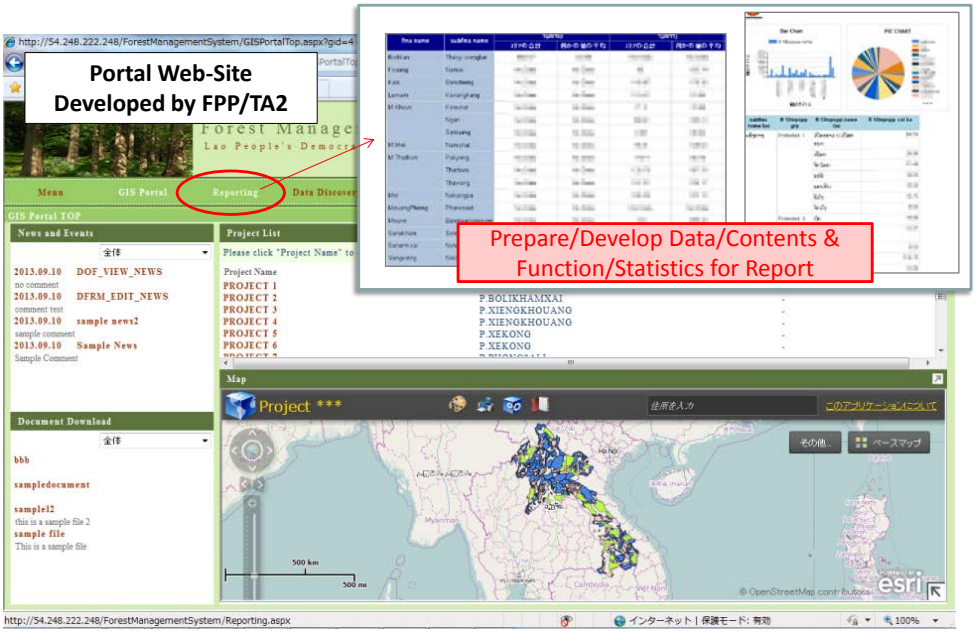


Figure 3-14 Image of Reporting User-Interface based on Web-browser System

3.3 Output 3

3.3.1 Result of 1st NFI reviewing

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.

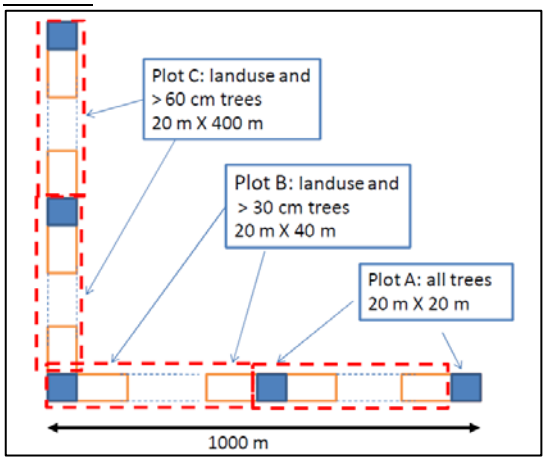
The objectives, target area, survey items are compiled in Table 3-28 below.

Table 3-28 Objectives, Target areas and Survey Items of 1st NFI, FIM and CliPAD

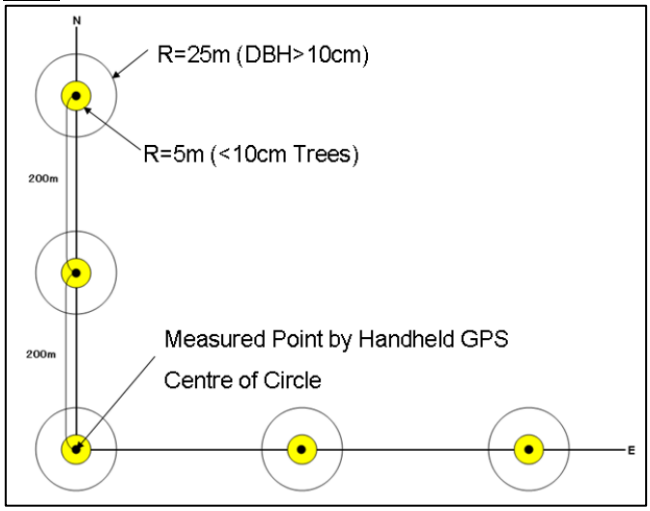
	1st NFI	FIM	CliPAD
Objectives	- Estimate of growing stock - Development of volume functions - Revision of forest definitions if found necessary	- Estimate of forest carbon stock - Reference for forest type map	Forest biomass survey for VCS JNR certification
Target area	Nation wide (Only accessible areas)	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	

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

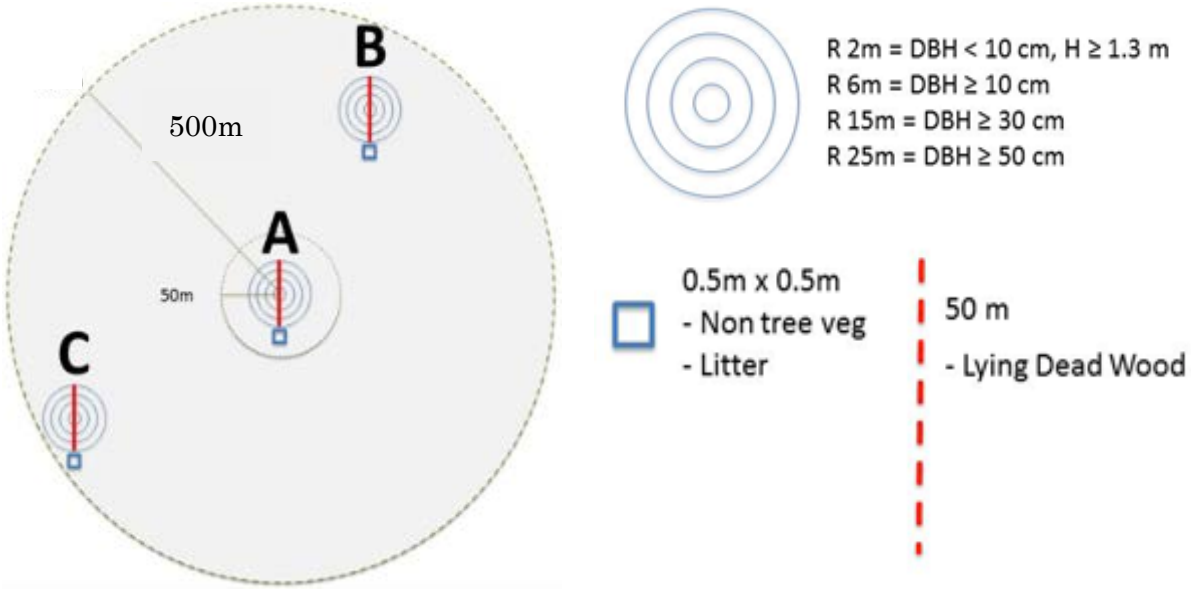
1st NFI



FIM



CliPAD



The list of data and reports

At the same time as the review above, the data and report of the past and current projects were listed up (Annex 11). The information of the list was shared with C/P and additional materials were collected and updated.

Provision of Data from Inventory Survey Projects

A request was made for the provision of similar survey data from the SN-REDD and PAREDD+ projects. SN-REDD outputs including reports and raw survey data were to be shared initially at the end of January and then after the modified agreement at the end of April, but as of July 2015 no outputs have been provided. If the outputs are shared before implementation of the next NFI, they will be used in the design of the manuals and other survey tools. The final outputs of PAREDD+ were shared through JICA.

3.3.2 Study of Next National Forest Inventory Survey Methods (Sampling method, plot design, survey items, etc.)

The next NFI survey methods were compiled based on a review of past and ongoing projects and a certain level of agreement was obtained following discussions with the C/P. The outputs were compiled for each of the following items.

Agreement of National Forest Inventory Purposes and Survey Items

Two technical workshops were held with the C/P based on the above-mentioned created materials as well as the results of past and present inventory surveys analyzed so far. As the C/P participated from the process of designing the NFI survey method, they were encouraged to consider anew the purposes and meaning of the survey items, and at the same time strong emphasis was placed on getting them to understand the process of deciding the detailed content. A summary of the technical workshops is given below.

	Date	Place	Participants	Content
First Workshop	9/25/2014	FIPD Training Room	Mr. Linthong KHAMDY, Director, FIPD Mr. Soukanh Sanontry, DDG,FIPD Mr. Bounpheng VICHITH, DDG, FIPD Approx. 8 members of FIPD Forest Inventory and Planning Division Group members and subcontractors' engineers	Mainly lectures on NFI purposes, cases in other countries, cases in Lao PDR, candidate survey items, demands of international society, stratification and sampling design.
Second Workshop	10/10/2014	FIPD Training Room	Mr. Khamphay MANIVONG, Deputy DG, DOF Mr. Somchay SANONTRY, Deputy DG, DOF Mr. Linthong KHAMDY, Director, FIPD Mr. Soukanh Sanontry, DDG,FIPD Mr. Bounpheng VICHITH, DDG, FIPD Group members and subcontractors' engineers	Lectures on survey purposes, survey items, survey frequency, implementation system and plot design based on the first technical workshop.

The decisions reached during the second workshop were recorded in the minutes signed by Mr. Khamphay, Deputy Director General of DOF. The next NFI survey items (draft) and implementation system (draft) will be designed based on the decisions contained therein. A summary of the decisions is given below. For details, refer to Annex 2-3.

Table 3-29 Decisions on Next NFI

Item	Main Decisions
Purposes of NFI	• The focus of the next NFI will be on grasping carbon and biomass volume • The number of plots should differ for the three forest types (protected forest, conservation forest and forest reserve) • It is enough just to investigate whether NTFP exists or not • As no expansion factors were developed for calculating the trunk volume of some of the main tree species in the first NFI, they will be developed in the biomass survey (allometric equation development survey) planned in the current fiscal year
Land coverage targeted in NFI	• Forest types and forest definitions should be formally established at the earliest possible stage
Plot design	• Basically, systematic random, pre-stratification plot design is adopted
Plot type	• Mainly temporary plots are established • A few permanent plots are also established to grasp the amount of growth
Survey frequency (period)	• Leaving aside financial feasibility, the NFI survey should be implemented for one year (as the land cover changes quickly in Lao PDR). However, depending on the survey items, the permissible range of implementation is 2-3 years. The shorter the period, the better.

3.3.3 Study of Next National Forest Inventory Implementation System

The implementation system for the next national inventory was discussed in the second technical workshop (held on 10 October 2014) described in Section 3.4.2.

In subsequent discussions it was decided that PAFO, DAFO, PONRE and DONRE staff will also be included in the survey structure, centered on FIPD. It was also confirmed in the final briefing session that the Forest Inventory Division of DFRM will also be involved in the survey for the next NFI.

The NFI Steering Committee will be established before the next NFI is conducted, and the purposes, methods and structure of the survey will be approved. Furthermore, the permits required for implementing the survey will be made widely known to the related ministries and agencies to ensure smooth implementation of the survey.

3.3.4 Summary of Inventory Pilot Survey

An overview of the pilot survey and the results are shown in the table below. For details, see Annex 12.

Overview

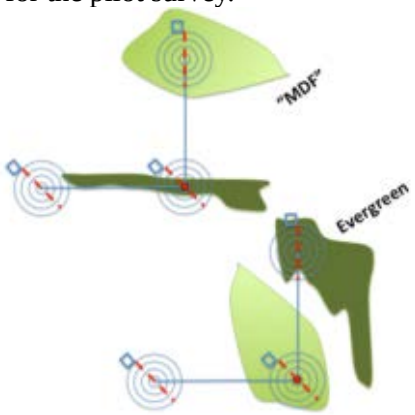
Items	Detail
Purpose	- To examine efficiency and accuracy of the survey method specified in the next NFI manualdraft - To grasp average carbon biomass and Standard deviation for the each targeted three forest type - To grasp the average time required for a plot - To verify the plot designing (L type or Floating tye) - To suggest the improvement for the next NFI
Survey area	Khammuane Province, whole area
Forest type of	- Dry Dipterocarp

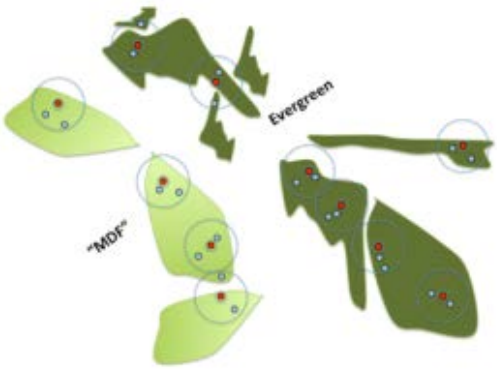
survey area	- Mixed Deciduous Forest - Evergreen Forest
Time schedule	- 2015. Jan – Mar: discussion and dicision of the survey method and plot design - Mar 9 – 13: training of FIPD staff - Mar 19 – Apr 7: Field survey - May 1 – 10: analysis of the survey results
Implementation system	- Training and field survey supervision : Forest Carbon (subcontractor) Mr. Morikawa expert - Field survey teams: 3 tems - Member of the tems: FIPD inventory 2 or 3, PAFO 1 or 2, DAFO 1 or 2
Number of targeted survey plots	- 85 Clusters

Results

(1) Results of Cluster Plot Design Validation (L-shape or Floating)

Before starting the pilot survey, a review was carried out to establish which type of cluster plot design (L-shape (left) or floating (right)) was appropriate for the forest distribution in the target area. The results showed that in Khammuane Province where forest types are found in small patches, with the L-shaped plot design, there were few plots on the same forest type, while many clusters fell outside the survey when arranged at random. Hence, the floating type plot design was adopted for the pilot survey.





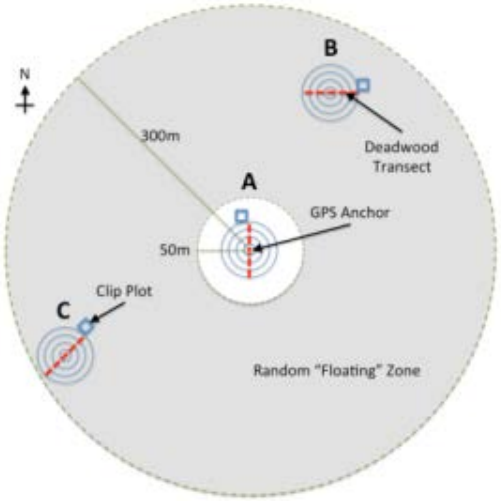


Figure 3-15 Floating Type Cluster Design

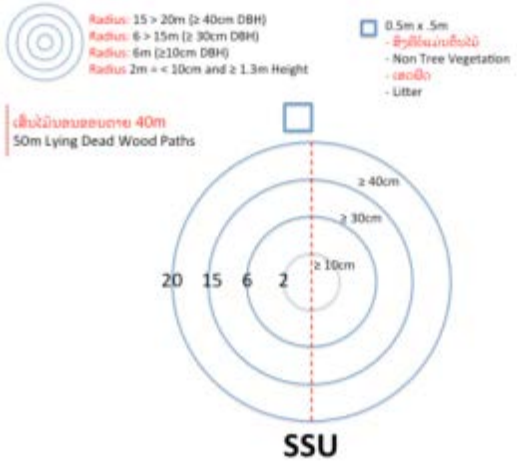


Figure 3-16 Plot design

(2) Results of Survey of Each Forest Type

Figure 3-8: Results of Survey of Each Forest Type shows the carbon stock (tC/ha) for each forest type, standard deviation, number of survey plots, etc. As Lao PDRs' own allometric equation will be completed in June 2016, Chave et al 2005, which is widely used in tropical regions, was used to calculate the carbon stock. Details of the equation are shown below.

$$< AGB >_{est} = \rho \times \exp(-1.499 + 2.148\ln(D) + 0.207(\ln(D))^2 - 0.0281\ (\ln(D))^3)$$

Where:

ρ = a default wood density of 0.6 (g/cm^3)

D = measured diameter at breast height of the tree (cm)

Table 3-30 Results of Survey of Each Forest Type

Strata	Mean tC/ha	Std. Dev	Plots	Max	Min	CI	Uncertainty
Dry Dipterocarp	62.69	21.42	13	18.40	103.31	12.94	21%
Mixed Deciduous	169.24	74.54	33	65.13	344.50	26.43	16%
Evergreen	252.01	61.26	2	208.69	295.33	550.41	218%

※CI:Confidence Interval

As only two plots were surveyed for evergreen forests due to access and time restrictions, few data were obtained. With regard to mixed deciduous forests on the other hand, over 30 plots were surveyed and such forests are thought to be adequate. The average carbon accumulation value (tC/ha) showed no major deviation from the existing results and was deemed appropriate. Based on the fact that the survey was conducted in the province, there is little uncertainty surrounding mixed deciduous forests. The suitability of the plot design to the forests in Lao PDR and the fairly high survey accuracy are considered to be the primary factors.

Development of Analysis Tool (R-Script)

The tablets used in the pilot survey are designed so that the entered survey data is automatically uploaded to the server when the tablet is connected to the internet, making it possible to check the survey plots and survey data daily from the capital.

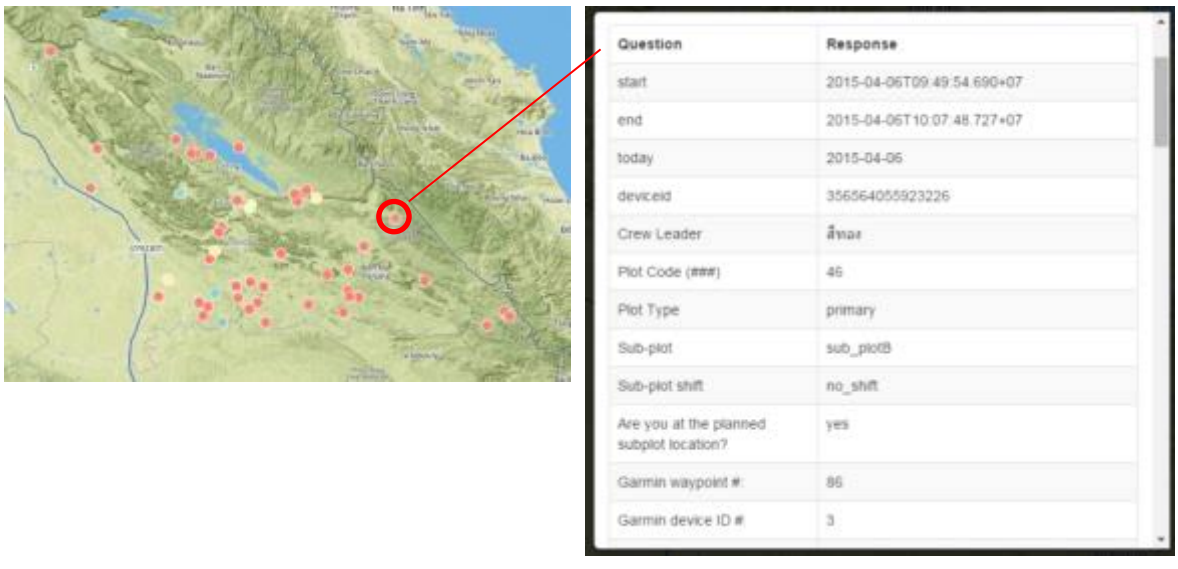


Figure 3-17 Data of the survey plots and the plot information

On the other hand, the survey data were analyzed using Excel as in the past, resulting in human errors in manual operation and a time lag until the analysis results was obtained. So a script was developed in the free statistical analysis software called "R" that enables output of the analysis results (carbon stock per stratum, standard deviation, DBH dissemination, etc.) in 10-15 seconds.

3.3.5 Final Draft of Next National Forest Inventory Manual

The changes from the manual (draft) created in 3.4.2, based on the above-mentioned pilot survey, are described below.

Plot Design

As the effectiveness of the floating type plot design was verified in Khammuane Province where the pilot survey was conducted and in Houaphane Province where the CliPAD project was implemented, it was decided to use the floating type plot design instead of the L-shape in the next NFI.

Carbon Pools

As described in 3.4.3, the results of the pilot survey and the survey in Houaphane Province led to the conclusion that only a negligible amount of carbon was stocked in deadwood. On the other hand, since the results were only from two provinces, the survey time was very short and carrying out a deadwood survey may be used in future analysis of forest degradation, illegal logging, etc., they will be included in the survey items in the next NFI.

Survey Structure

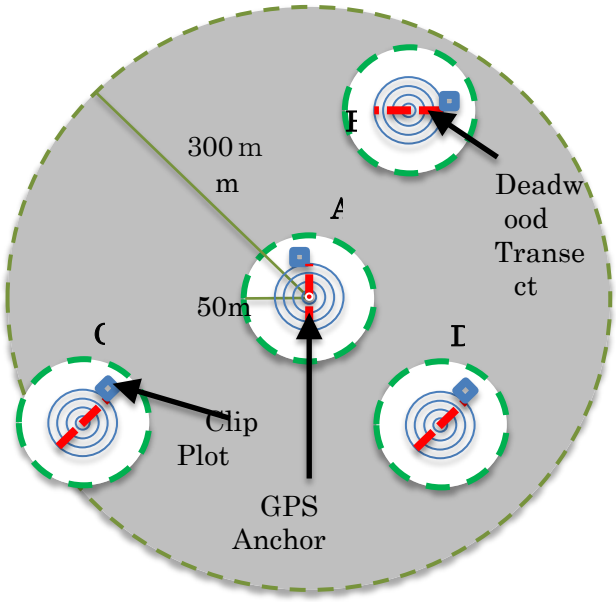
Following discussions with the C/P, based on the results of the pilot survey, it is expected that the next NFI will be conducted using the following survey structure.

- Team leader/data input (FIPD)
- DBH measurement 1 (FIPD)
- DBH measurement 2 (PONRE or PAFO)
- Deadwood and clip plots (PONRE, PAFO, DONRE or DAFO)
- Others (DONRE, DAFO or local residents)

Collaboration with the DFRM Forest Inventory Division was confirmed with the C/P, but the precise responsibilities need to be reviewed in future.

Plot Design

In the pilot survey, in order to handle data per cluster, a rule was established that surveys would be conducted of at least two plots. In the event that both plots happened to be non-forested areas, the team would move on to the next cluster without surveying a third plot. It was also confirmed that, even if a three-plot survey is conducted, some clusters show big variation in data. Therefore, with the aim of increasing the probability of surveys of two or more plots and minimizing variation in data, it was decided to increase the number of plots to four instead of three. It was also confirmed that the plots are located within 300m of the center point and that even when one cluster is surveyed per day, there is 20 or 30 minutes' grace, so increasing the number of plots has little impact on the efficiency of the survey.



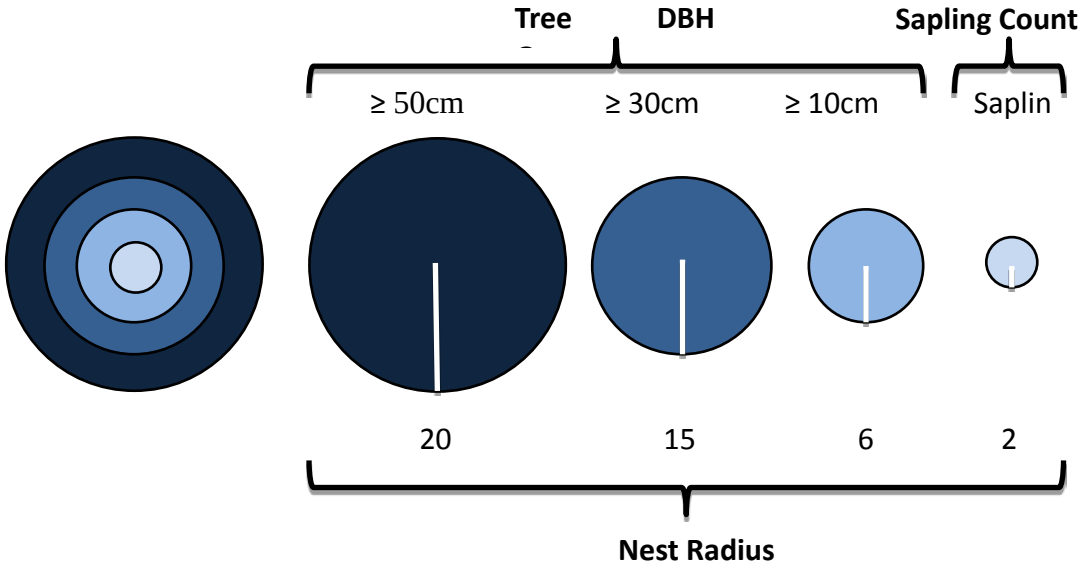


Figure 3-18 Targeted DBH and Nest size

Number of Survey Plots in the Next National Forest Inventory

The required number of survey plots was calculated based on the data obtained from the first NFI, Houaphane data from the CliPAD project and Khammuane data from the pilot project. The average carbon stock per stratum, standard deviation and obtained uncertainty were used in the calculation. The precise equation is shown below.

$$number\ of\ plots\ for\ strata\ = (t * \frac{standard\ deviation}{0.10 * x})\text{^}2$$

t = Critical value from a two tail-test with n-1 degrees of freedom, based on target confidence level (e.g. 90%)

A list of the collected data is shown below.

Table 3-31 List of the data for calculation of survey plots

Survey	Stratum Name	Number of Plots Surveyed	Mean AG Tree Carbon (t C ha^{-1})	Standard Deviation (t C ha^{-1})
1st NFI	EF	56	110	50
Khammouane	EF	2	185	31
1st NFI	MD	805	60	41
Houaphan	MD	82	92	63
Khammouane	MD	33	114	51
1st NFI	DD	636	43	26
Khammouane	DD	13	48	16
1st NFI	CF	27	32	26
1st NFI	MCB	74	80	48
1st NFI	RV	102	7	10

Table 3-32 shows the results of calculation of the minimum number of survey plots.

The results take into account the fact that as provincial data are used, the standard deviation is lower than at national level and the percentage of conifers in the forest area is low, as noted in Output 1. However, the results are provisional and the number of survey plots is not necessarily deemed to be the optimal number.

Table 3-32 Required Number of Survey Plots in the Next National Forest Inventory (Provisional)

Strata Level 2	Minimum number of Plots	Error Target
Evergreen Forest	70	<10% Error at 90% CI
Mixed Deciduous Forest	200	<10% Error at 90% CI
Dry Dipterocarp Forest	120	<10% Error at 90% CI
Coniferous Forest	50	<20% Error at 90% CI
MCB	120	<10% Error at 90% CI

3.4 Output 4

3.4.1 Investigation of Method of Preparation of REL/RL

Comparison and points of reference with Brazil's FREL/FRL

Table 3-33 FREL/REL Comparison between Brazil and Lao

Item	Brazil	Lao PDR
Target region	Amazon Biome in this case (to be expanded to national level in the future)	The whole country (it is possible to classify FREL/FRL regions according to differences in forest carbon change trends and their drivers)
Reference period	From 1996 to 2005	From 2000 to 2015
Reference data frequency	Annually	Every 5 years
AD	Newly cleared areas determined yearly mainly by Landsat.	Amount of change determined every 5 years by Landsat in 2000, by SPOT4 in 2005, and by Rapideye in 2010 and 2015, each with different resolution (the 2010 forest maps are the base maps)
EF	EF obtained by converting 1970s to 1980s survey data using an allometric equation used for the reference period and for preparation of FREL/FRL.	Converted into carbon stock using an allometric equation in accordance with stratification of forest survey data for the 2 points of the 1990s and 2018-2018.
Target REDD+ activities	Reduction in emissions due to reduction in forest reduction from the AD estimation method only (methods of including degradation, etc., in the future are being investigated)	From the AD and EF estimation method it is possible to estimate any of the reduction, degradation, increase, and net change. Determined based on the FREL/FRL estimation method, likely amount of credits, etc.
Monitoring frequency	AD is monitored annually	AD is monitored every 5 years (First monitoring to be carried out in 2020)
FREL/FRL preparation method and period	(1) Average amount of emissions due to the reduction from 1996 (2) 2006-2010 is the first FREL/FRL preparation period, 2011-2015 is the second period.	(1) Determined after trials (Average and trends, etc.) (2) Likely to be in the 5 year period from 2016 to 2020.
Consistency with GHG inventory	Consistent with the GHG inventory in the second national report (as of year 2000)	The GHG inventory in the second national report is in accordance with the 1996 IPCC guidelines, so it does not have area data, etc.

Table 3-34 Consistency with the main evaluation items of the Technical Evaluation Guidelines for FREL/FRL by UNFCCC

Evaluation item	Brazil	Lao PDR
Consistency with GHG inventory	Said to be consistent (not confirmed in this Project)	The second national report does not contain area data, etc., so it is necessary to prepare the GHG inventory for the next national report or the biannual report in accordance with the 2003 IPCC guidelines. The data enables a matrix of the 2005-2010 forest area / change in carbon stock per unit area / change in forest carbon to be used.
Use of past data	Based on the past data as the average of the past data.	The method is not clear, but it is likely that it is based on past data.
Transparency, completeness, consistency, and correctness of information provided (including information regarding methods)	Transparency All disclosed on the web Completeness All the information is provided Consistency AD is estimated from satellites of the same resolution and by the same organization, so it is consistent. Correctness Calculation of uncertainty for AD, EF, and change in carbon stock has not been carried out, but uncertainties clearly exist, and this is to be dealt with in the future.	Transparency For investigation in the future Completeness All the data can be provided Consistency The image resolution is not consistent, but the 2 most recent years have the same resolution, and the change in AD quantity has been determined by the same organization by comparison with the 2010 base maps, so it can be said to be consistent. However, the forest definitions are scheduled to be changed, and the forest maps for each year must be interpreted in accordance with the new definitions. Correctness The uncertainty in the A/D and EF, etc., can be estimated and stated.
Description of appropriate REDD+ measures, etc.	An action plan to prevent and regulate the reduction of forests in the Amazon has been published.	In the future it is necessary to proceed smoothly with the preparation of an REDD+ strategy.
Target pools, gases, REDD+ activities clearly stated, and statement of the unimportance of excluded pools, etc.	Each clearly stated. Reasons for not including excluded pools (soil carbon), and activities other than reduction are not clearly stated	Can be clearly stated. Target pools and gases are not identified, but it is likely that soil is not included, and data to explain its unimportance is required.
The description of forest definitions and the definitions used in the GHG inventory, etc., are the same	Definitions are clearly stated, and are the same as the definitions in the data submitted to the FRA of the FAO.	The forest definitions are scheduled to be changed, but can be stated. The preparation and submission of future GHG inventories is likely to be carried out based on the new definitions. The same response can be made for FAO FRA.

Reference Points for FREL/FRL Preparation in Lao PDR(Brazil)

(1) Data, etc.

Data for AD and EF applicable to Lao PDR is scheduled to be collected and summarized, and there is no particular reference data.

(2) Preparation methods and periods

The target period for FREL/FRL is from 2006 when reduction of the forest reduction started, for FREL the average of the past amount of emissions as far back as there was data is used. This is considered to be the method to maximize the amount of credits, and Lao PDR can also investigate methods from this point of view.

Reference Points for FREL/FRL Preparation in Lao PDR(Mexico)

In Lao PDR there is slash and burn land over a wide range. For Mexico's forest fires, the amount of emissions of GH gases other than CO_2 is calculated, but in the case of Lao PDR it is essential to estimate the GH gases emitted associated with the area of slash and burn land, formation of agricultural land such as plantations, etc., and clearing, plowing, and burning of existing vegetation.

Methodological Framework of the FCPF Carbon Fund

The FCPF provides the Carbon Fund to implement a pilot scheme for results-based payments in various countries. Countries wishing to participate prepare an Emission Reduction Program (ERP), and conclude an Emission Reduction Purchase Agreement (ERPA) with Carbon Fund contributors (countries, private sector, NGOs, etc.) via the World Bank, and receive payments via MRV results. The methodological framework differs from the specific standards for FREL/FRL preparation or MRV in that criteria and indicators are set for preparation of the ERP by countries wanting to participate, and apart from FREL/FRL and MRV rules and indices are indicated for uncertainties, dealing with displacement of emissions, dealing with impermanence, SG, allocation of benefits, non-carbon benefits, etc.

Present Status of Data for Preparation of FREL/FRL in Lao PDR and Prospects for Preparation

(1) Change in forest area

As a result of the support of this Project, forest distribution maps for 2000, 2005, and 2010 are scheduled to be prepared by the end of August 2015. In the Environment Program Grant Aid Forest Conservation Program satellite images covering the whole country from the end of 2014 to the beginning of 2015 are scheduled to be procured for the 2015 forest coverage survey, and the 2015 forest category maps can be created in 2016 with support from the Integrated Technical Program full-scale phase, etc.

(2) Carbon stock per unit area

The data of the first nationwide forest survey conducted in the 1990s has been converted into the carbon stock using some default equations and values through support from SUFORD. However the year of the survey varies (from 1991 to 2000) depending on the province.

This Project is investigating stratification due to other factors, and not just forest type, based on this data. Based on the above stratification results, an allometric equation applicable to Lao PDR is scheduled to be developed by the middle of 2016 in the Environment Program Grant Aid Forest Conservation Program.

Also, the next period nationwide forest survey has been designed with support from this Project, and if this is implemented and summarized with support in the integrated full-scale phase then in 2017 or 2018 it will be possible to calculate the forest carbon stock using the allometric equation. Also, the first forest survey data is also likely to be converted into the carbon stock in the same way.

(3) Target pools and GHG types

In Houaphanh and Khammouane Provinces basically the only target pool is living trees with roots, based on the results of biomass surveys.

Slash and burn is widely practiced in Lao PDR, and on plantation land also remaining vegetation is burned, so it is necessary to estimate the amount of NH_4, etc., generated as a result, and convert it into CO_2. In this case it is necessary to estimate the burn area and the burn percentage (the biomass burned as a percentage of the biomass stock on the land/forest).

(4) Prospects for preparation of FREL/FRL

As described above, during 2016 the change in area over 3 periods will be determined.

The carbon stock per unit area is also likely to be capable of estimation by some method for the periods 2000, 05, 10, and 15, although this depends on the stratification and the status of the change in carbon stock in the 90s and 2017-18. From the above, it is likely that the forest carbon stock can be estimated for the 4 points in time of the 3 time periods in each stratum for the reduction, degradation, and increase.

By analyzing the factors for the change in the 3 periods, REDD+ activities will be identified, and if necessary local classification, etc., will be carried out for preparation of FREL/FRL, trials will be carried out by preparing averages, trends, and models, and the Lao PDR national REDD+ forest FREL/FRL will be prepared for submission to UNFCCC.

(5) Prospects for MRV

Construction of the national forest monitoring system in Lao PDR as agreed with UNFCCC and establishing the systems for MR of the MRV are tasks for the future. However taking into consideration the national development plan period (5 years) and the capabilities of Lao PDR, it is considered that the change in forest area can be determined every 5 years. However, it is not clear that a nationwide forest survey to determine the carbon stock per unit area of Lao PDR can be carried out every 5 years.

3.4.2 Investigation of MRV Adjustments

Regarding the method of adjusting MRV between national level and sub-national/ project level, the following are the interim results of an investigation into a uniform concept of verification and registration with the UNFCCC of the current sub-national/project level REDD+ and national level REDD+. In Lao PDR the sub-national/ project level REDD for which there is a possibility of verification by a system other than UNFCCC include the following 3 cases. Note that the verification periods are postulated.

(1) VCS verification, monitoring, issuing of credits, and sale for SN-REDD in Savannakhet Province at a similar time period and time (VCS rules state that the baseline period for REDD projects is 10 years).

(2) A JCM/REDD development survey is being carried out in Phonxay District, Luang Prabang Province, that will be verified and registered in 2016 with 2016-2020 as the 5 year baseline period (at present JCM is until 2020, and can be extended by bilateral agreement). Monitoring, issue of credits, and sale is envisaged in 2020.

(3) FCPF Carbon Fund Emission Reduction Program (6 provinces in the north including LPB Province; sub-national): It is not clear at present whether or not it is possible to participate, but if participation is possible, national level data is used, REL/RL is submitted at the same periods as for UNFCCC (2017-18 with final standard year 2015), MRV will be carried out in about 2018-19, but there is an obligation to measure AD twice during the credit period, and the second independent MRV will be carried out in 2021-22.

The locations of (1) and (2) above are different, so it is not necessary that the target REDD+ activities or carbon pools, etc., are consistent between the two, verification and monitoring, etc., will be carried out under their respective systems, and credits can be issued and sold. However, the

regulations and requirements of each system specify that the forest definitions be in accordance with host country's national regulations.

Therefore, it is considered that consistency will be necessary in the case of REDD+ of (1) and (2) and receiving incentives for monitoring results for the registration of FREL/FRL in the two cases of national level (UNFCCC) and Carbon Fund and national level (UNFCCC) (in UNFCCC there are no regulations for "verification" of FREL/FRL, "registration", and "issuing credits", but this terminology is used for ease of comparison). Number ② is located within a Carbon Fund region, so consistency is necessary, but a method of achieving consistency between project and national level can be used.

3.4.3 Study on information developed approaches to safe guard

Organization and Analysis of SG Information Outline in Brazil Submitted to UNFCCC

(1) Major items of the submitted document

1) Introduction: Description of SG, submission of the outline thereof, relationship with the UNFCCC resolution relevant to the SG information system (SIS) (conditions for result-based payment, etc.) and observance
2) Method: Description of the fact that the submitted SG outline is based on the "Survey to identify information and sources to feed the Safeguards Information System (April 2013)" compiled by a technical panel comprised of members chosen from the private sector, the draft SG outline was publicized on the REDD+ website of Brazil for two weeks to collect opinions from the public, after thorough examination by the technical panel for revision and other experts, final version was prepared and sent to the Ministry of Science, Technology and Innovation, which is in charge of national report, by the Ministry of the Environment and that this outline was submitted to UNFCCC for publication on the REDD+ website of UNFCCC in accordance with the resolution of COP19.
3) REDD+ of Brazil: Introduction of action program to combat forest decline concerning the Amazon biosphere, which is the target area of FREL, and national and state programs under the action program, after describing the fact that Brazil has already submitted FREL to receive the result-based payment, Brazil has a national REDD+ strategy and that data and information for the MRV are attached to the BUR submitted at the end of 2014. Also, introduction of the types, outline, etc. of projects implemented by the Amazon Fund.
4) Explanation of the interpretation of each SG item, application and observance of SG in the activities in the Amazon biosphere.
5) Introduction of existing information systems relating to the development of SIS and description of the intent of the development of SIS.

(2) Features

1) Submission of SG information outline prior to the establishment of SIS
   Since SIS is specified as one of the REDD+ elements to be developed by developing countries in the Cancun Agreements and submission of the SG outline is a condition for receiving the result-based payment according to the Warsaw Framework for REDD+, it is generally understood that after the establishment of SIS, SG outline generated by the SIS should be reported to the UNFCCC. However, Brazil defines in its SG outline that the SIS and the SG outline are different. It is considered that this is basically due to the fact that Brazil has already submitted FREL (at the subnational level; Amazon biosphere) and the BUR including the MRV of the area in question and that the submission of the SG outline will suffice as a condition to receive the result-based payment since SIS will require long time for establishment. However, it remains to be seen whether or not the UNFCCC will determine that Brazil satisfies the condition for the result-based payment even though the SIS has not been developed yet.

2) Relationship with the submitted FREL
   Since the FREL submitted after the technical assessment by the UNFCCC covers the Amazon

biosphere, this document mainly describes national policies and plans, national and state programs that mainly cover the Amazon biosphere as well as the application and observance of SG in the REDD+ programs implemented with the support of the Amazon Fund. It is considered natural as the initial result-based payment targets the Amazon biosphere.

3) Outline of the description concerning each SG item

(a) The national forest program and relevant international conventions and agreements shall be complemented and consistent activities shall be facilitated and supported.

(b) Transparent and effective national forest governance in consideration of the laws and regulations as well as the sovereignty of the host country shall be facilitated and supported.

(c) The knowledge and rights of indigenous peoples and community residents shall be respected while taking into consideration relevant international obligations as well as the conditions and legal system of each country and taking note of the UNDRIP (United Nations Declaration on the Rights of Indigenous Peoples)

(d) Adequate and efficient participation of stakeholders (particularly, indigenous peoples and community residents) shall be supported

(3) Existing information systems in Brazil

The technical panel has confirmed the existence of existing information systems and databases. They are all independent and none of them are connected to each other, but they can be the foundation for the SIS to be constructed in the future. Nine information systems, including forest information system, Amazon forest monitoring system information system, biodiversity and ecosystem information system, are listed.

(4) Comments and applicability to the development of SG information in Lao PDR

1) First submission of SG information outline

As Brazil is the first country to submit the SG outline, this case of Brazil may serve as an important reference for other countries, especially those that have already submitted FREL/REL, to prepare the SG outline to submit. It has been considered that development of the SG information and submission of the SG outline are complicated work requiring a lot of labor, but the case of Brazil will serve as a precedent for other countries as it suggests the information to be collected and the way to prepare the outline, thereby helping them to develop the SG information.

2) Amazon biosphere and national level SG information outline

The SG information outline of Brazil briefly introduces the national level initiatives in the information outline of each SG item first. Then, it provides detailed information about the Amazon biosphere, which is the target area of the FREL and the result-based payment.

3) List of issues

With respect to socio-environmental SG items, in addition to the introduction of legal systems and guidelines, issues in implementation are presented in the form of comments by the technical panel members. It must be possible for Lao PDR, which has serious problems particularly in the enforcement of laws and regulations, to organize and present ongoing and future issues in preparing the SG information outline.

4) Applicability to the development of SG information in Lao PDR

Items 1) and 3) above must be applicable also to Lao PDR. With respect to 3), however, political and social conditions of Lao PDR are greatly different from those of Brazil, which is a democratic country with a long history of tackling and solving the issues of forest decline and indigenous peoples in the aspects of systems and implementation. Therefore, it is considered that Lao PDR

needs to make efforts to ensure proactive and effective participation of residents in forest management (from planning to implementation and monitoring) in both the aspects of systems and implementation in the future.

Multi-process initiatives relating to SG

Most of the developing countries tackling REDD+ are supported by the FCPF or UN-REDD. Initiatives relating to SG have been carried out also in these processes. With respect to the FCPF, World Bank has set up guidelines concerning environmental and social impacts in implementing projects and other support programs. Based on these guidelines, Strategic Environment and Social Assessment (SESA) is carried out in the R-PP to check the REDD+ strategy and activities in advance and it is mandatory to formulate the Environment and Social Management Framework (ESMF) to address the socio-environmental risks identified in the SESA. The SESA and the ESMF do not have specific check items like the seven SG items, but they attach more importance to establishing thorough examination procedures involving a wide range of parties concerned.

The UN-REDD has taken a more specific approach and determined the Social and Environmental Principles and Indicators (SEPC) to be applied in formulating the REDD+ programs in each country. The SEPC indicates study items in more detail than SESA which consist of seven principles and 25 standards and relevance to the seven SG items is also clearly indicated. Also, guidelines concerning specific application of the SEPC have been prepared.

Initiative in Lao PDR

Lao PDR is one of the 14 countries that initially participated in the FCPF. Its R-PP was submitted in August 2010 and approved by the FCPF committee in December 2010 after modification. However, as the SESA was fully incorporated into the September 2010 version of the R-PP template for the first time and since Lao PDR uses a template prior to that, its R-PP does not include the SESA or the resultant development of ESMF. It was decided that the SESA and the development of ESMF with regard to the R-PP or the REDD+ national strategy, which is expected to be newly formulated, will be implemented in the FCPF preparation project (USD 3.6 million). The preparation project was delayed due to the impact of the split of the function of forest management organization into two ministries and started at the end of 2014. However, selection of consultants who will be mainly in charge of establishing the four REDD+ elements has just begun and as such, it is expected that the project will actually be put to operation in the beginning of 2016.

Ensuring safeguards and direction of response under the current legal system of Lao PDR

The status of SG application, observance and response measures under the current legal system of Lao PDR is summarized as follows.

The SG information outline to be submitted to the UNFCCC will be prepared in accordance with the guidance agreed in the SBSTA42, but it is considered necessary to explain centralized management of natural resources including forests by the national government and on-going efforts and issues involved in the improvement of forest governance to describe the status of the country and indicate the interpretation of each SG item in accordance with the status as shown below.

SG items	Specific items in Lao PDR	Relevance to REDD+activities and response measures
(a) The national forest program and relevant international conventions and agreements shall be complemented and	1.National forest program: Forest-related target in the Forest Strategy 2020 and the 8th National Economic and Social Development Plan	1.Considering the objective, the REDD+ activities may contribute to the achievement of the target 70% (complementing). Also, to ensure consistency with the REDD+ activities, it is necessary to match the content of the

SG items	Specific items in Lao PDR	Relevance to REDD+activities and response measures
consistent activities shall be facilitated and supported.	(2016-2020) : More specifically, forest coverage of 70% 2.Relevant international conventions and agreements Lao PDR is a contracting party to the CBD and the Ramsar Convention in addition to the UNFCCC.	REDD+ strategy and action plan to be formulated in the future with that of the national forest program. 2.The CBD requires formulation of national biodiversity strategy and action plan as well as annual reporting, but since the current strategy and action plan are effective only up to 2010, it is necessary to revise them and determine the positioning of the REDD+ activities to ensure complementarity and consistency.
(b) Transparent and effective national forest governance in consideration of the laws and regulations as well as the sovereignty of the host country shall be facilitated and supported.	1. Administrative organization including the national and provincial governments with clear and integrated definition of authorities and responsibilities concerning forests (transparency) 2.System with the capacity, budget, etc. capable of developing the policies and activities to achieve the target in the national forest program (effective).	1. Since authorizes and responsibilities of the central forest administration, which are divided according to forest type between the Ministry of Agriculture and the Ministry of Natural Resources and the Environment, agencies relating to sale of lumber (Ministry of Agriculture and Forestry, Ministry of Commerce and Industry and Ministry of Finance), agencies relating to illegal logging and logged material (MONRE, MAF, Police, etc.) and their provincial branches are unclear and overlapped, it is essential to reorganize, disseminate and publicize them to implement the REDD+ activities. 2.Specific forest management activities are not implemented efficiently, because they are carried out by each of the relevant organizations described in 1 with no uniformity. Moreover, as they are dependent on activities and supports by donor projects, the implementation system is not effective. It is necessary to strengthen the system in terms of capacity and budget as well as in other aspects through the implementation of the REDD+ activities and the result-based payment.
(c) The knowledge and rights of indigenous peoples and community residents shall be respected while taking into consideration relevant international obligations as well as the conditions and legal system of each country and taking note of the UNDRIP (United Nations Declaration on the Rights of Indigenous Peoples) (The act of respecting the knowledge and rights of indigenous peoples and	1. Consideration of the conditions and legal system (concerning the knowledge and rights of community residents) of Lao PDR The Constitution, the Land Act and the Forest Act of Lao PDR stipulate that forests and other natural resources belong to all people and the national government distributes the rights to use them to individuals, households and organizations. With respect to forests, forests	1. It is impossible to change the basic provisions about the ownership and distribution of natural resources in the current Constitution and other acts. 2. It is highly likely that the village land use plans, which are formulated, approved and implemented based on the PLUP in each project, will become a major element of the REDD+ activities. However, it is necessary to resolve the following issues: 1) It is not clear if such plans have legal force against third party (For example, they may not be subject to concession by the national government or discussions with the villages concerned may be essential for the government to grant concession.), 2) Relationship between the

SG items	Specific items in Lao PDR	Relevance to REDD+activities and response measures
community residents shall be facilitated and supported, while considering relevant international obligations, and conditions and legal system of each country and giving due consideration to the UNDRIP (United Nations Declaration on the Rights of Indigenous Peoples))	for village use are those that villages are allowed to use, but it is not clear if such villages can have externally effective rights of use. (In a small portion of villages, village rights of use were established on a trial basis, but it is unclear if these rights are publicly recognized or still effective.) With regards to production forests, a system allowing relevant villages to participate in the formulation and implementation of management plan and receive part of the revenue from the sale of lumber has been established and it seems that the knowledge and rights of community residents are respected in this process. In other forests, collection and use of forest products are allowed only to a limited extent. According to new national land policies under examination, setting of shared land will be allowed. On the other hand, it seems that the possibility of land expropriation by the national government for the purpose of private development (currently for public development only) is also studied. 2. Respect of the knowledge of community residents 2.1 Knowledge of residents concerning forest and water resources shall be respected in designating forests for village use and formulating and approving the rules of use (authority of the district headman). 2.2 Knowledge of community	PLUP within protection forests and regulations on protection forests is not clear. 3. Currently, type 3 forests including protection forests are being reexamined (the method of reexamination is being developed). The result of this reexamination will make a great impact on the REDD+. As such, from the viewpoint of respecting the knowledge and rights of community residents, the reexamination method and implementation of the method should respect the knowledge and the rights of conventional use of community residents. 4. It is expected that laws relating to land, such as the Land Act and the Forest Act, will be amended in accordance with the decision of the national land policies. It is necessary to pay attention to the amendment direction from the viewpoint of respecting the knowledge and rights of community residents. 5. In order to support and facilitate effective national governance as in item (b) above, it is important to respect the knowledge and rights of community residents who actually utilize the forests in implementing the REDD+ activities.

SG items	Specific items in Lao PDR	Relevance to REDD+activities and response measures
	residents concerning the status of forests, water resources, the NTFP etc., shall be utilized and respected in the formulation and implementation of other forest management plans. 3. Respecting the rights of community residents 3.1 Conventional status of use shall be reflected in the designation of forests for village use and formulation of the rules of use. 3.2 Conventional use of forests, water resources, the NTFP, etc. by community residents shall be respected in the formulation and implementation of other forest management plans.	
(d) (Adequate and) efficient participation of stakeholders (particularly, indigenous peoples and community residents) shall be facilitated and supported.	1. Community residents shall participate in the process of formulation including decision-making and implementation of various forest management plans and action plans relating to forests. (This is also an important element of (b) effective forest governance.) As described in item (c) above, under the current legal system, community residents do not (adequately and) efficiently participate in the formulation of various forest management plans except for those of production forests. Hearing of opinions from stakeholders is not in practice, either.	1. It is necessary to study the development of schemes and systems for phase disclosure of the process to determine the draft of REDD+ strategy and activities at the national and provincial levels. (This should be carried out before the development of the SG information system.) 2. It is necessary to study how and in what level of the formulation of management plans of protected forests, which spreads widely and include many villages, should community residents (or their representatives) participate to achieve maximum effectiveness and efficiency.

SG items	Specific items in Lao PDR	Relevance to REDD+activities and response measures
(e) Actions that will maintain consistency with the conservation of natural forests and biodiversity, will not convert natural forests, will grant incentives concerning the protection and preservation of natural forests and ecosystem services and will enhance the benefits to society and the environment shall be facilitated and supported.	1. Consistency with conservation of natural forests and conservation of biodiversity With respect to conservation of natural forests, it is necessary to grasp the position, area, etc. of existing natural forests (certain definition would be needed) and take measures for conservation, such as incorporation into conservation forests. With respect to biodiversity, as described in item (a) above, Lao PDR is a contracting party to the CBD, but has not been able to perform the obligations. 2. Grant of incentives for the protection and conservation of natural forests and ecosystem services This is one of the objectives of the REDD+ but domestically, fair and transparent distribution system of the REDD+ benefits and definite forest management rights, which are a prerequisite of such system will be needed. 3.Facilitation and support of actions that will enhance other social and environmental benefits It is also necessary to examine payment system to other forest environment services through the REDD+ and implement such system.	1. As the REDD+ activities generally facilitate conservation of natural forests and conservation of biodiversity, it is considered that consistency exists. However, to ensure in detail, it is necessary to revise the biodiversity strategy and make sure that the revised strategy is consistent with the REDD+ strategy. In addition, it is necessary to grasp the position, area, etc. of existing natural forests (certain definition would be needed) and take measures for conservation, such as incorporation into conservation forests. 2. It is essential to clearly define “fair and transparent distribution system of the REDD+ benefits” and definite forest management rights as a prerequisite of such system. 3. It seems that this refers to the enhancement of non-carbon benefits in the REDD+, but it is considered to be ensured by securely implementing 1 and 2 above. There has been a move to institutionalize payment for the forest conservation activity in the water source area by hydro power generators. Since forest conservation in water source area is also effective to the REDD+, it is necessary to consider provision of support.
(f) Activities that do not cause rebound (eventually contributing only to temporary emission reduction and absorption) shall be facilitated and supported.	1. Continuation of necessary support to forest managers 2. Decision and communication of countermeasures against rebound	1. Methods contributing to long-term forest conservation, such as spending allocated REDD+ benefits on infrastructure investment for forest management, should be studied. 2. With respect to addressing national level rebound, establishment of an international system is likely to be examined. For regional rebound in the country, examination, decision and communication of countermeasures are

SG items	Specific items in Lao PDR	Relevance to REDD+activities and response measures
	3. Forest monitoring	needed in accordance with the causes. 3. Accurate and periodic forest monitoring is essential for suppressing and checking rebounds at the national and regional levels.
(g) Activities to suppress emission displacement shall be facilitated and supported.	1. Depending on the causes of forest decline and deterioration, it is necessary to carry out REDD+ activities with a high displacement potential, such as strengthening of illegal logging control, in the whole area where the activity may cause displacement.	1. Same as left

Chapter4 Issues for Project Implementation and Management

4.1 Issues for All Outputs

4.1.1 Adoption of Project Output as National System and Data

Major output of this Project consists of forest type maps of three points in time, stratified carbon map and designing of the next NFI. Forest definition and forest/land classification, which are the basis of the Project, are described in the report of forest coverage survey that has been conducted every ten years, but the national government has not decided official definition or classification. Discussions were held over this issue with the DOF, which is the C/P, and other project members and an agreement was reached in the form of a minute, which was a step taken forward.

MONRE is the contact for the decision and submission of the next GHG inventory and REDD+ reference level and DOF has conducted discussions with the departments under MONRE (Department of Climate Change and Disaster and Department of Land Management) and the Ministry of Agriculture and Forestry (Department of Farmland Development) for early adoption of the project output as the national definition and classification and minutes have been prepared for confirmation and to facilitate and support the adoption process. Also, staff of the Department of Climate Change and Disaster in charge of GHG inventory and relevant staff of the Ministry of Agriculture and Forestry were invited to the WS (May 2015) on the NFMS of REDD+ organized by the F-PREP and to the final report meeting of NFIS (July 2015) to call for their cooperation in these discussions.

4.1.2 Improvement of the Ownership of C/P

The project director (PD) of this Project is a director of FIPD. As he does not have much knowledge in accuracy verification and other technical issues, during the early period of the Project, he seldom took the initiative in giving an explanation to the DOF executives and it often happened that Japanese experts met with the deputy director in charge of REDD+ for explanation and consultation, and when important issues had to be dealt with, the Japanese experts consulted with and asked for the opinions of the acting director general or the director general.

However, as a result of frequent discussions and consultations with the PD while emphasizing the fact that the output of this Project comprises the most fundamental part of the promotion of REDD+ construction and sustainable forest management in Lao PDR, the PD has come to involve himself in discussions with the executives and make comments in meetings and WS more frequently and proactively, which resulted in reducing the workload of the experts. This shows that ownership has been formed on the Lao PDR side.

4.1.3 Collaboration and Coordination with Other Donors

Projects engaged in activities relating to this Project include FSCAP/F-PREP, PAREDD, SUFORD-SU, CliPAD and SN-REDD, and collaboration and coordination with the teams of these projects were sought in accordance with the details of the technology and skills held by them.

CliPAD is engaged in the REDD+ subnational activities in two districts in Houaphane Province, and they have been on good terms with this Project since the time of FIM, and during the implementation of this Project, WS on forest definition and classification was jointly organized with them, which helped in reaching an agreement with DOF and other organizaions concerned. The Project has also been able to maintain good collaboration with SUFORD-SU, as they cooperated with us in the operations of forest classification and we cooperated in the development of forest landscape management method by SUFORD.

Also, in order to collect data and information necessary for designing the next NFI, DOF will send a document to request for submission of such data and information to PAREDD, WWF and SN-REDD to get response from them. With respect to forest definition and land/forest classification, an agreement has been reached with the DOF/DFRM, although the final decision has not yet been made. It is also necessary to send such national-level information about this Project to the subnational and project level REDD+.

4.1.4 Creation of REDD+ Process Chart

In relation to 4.1.1 above, REDD+ will be included as part of the next framework concerning climate change. Preparation of resolutions and framework by the UNFCCC concerning REDD+ has almost finished, and Brazil and several other countries have already submitted a reference level. Moreover, Brazil submitted BUR with the result of MR(V) for the reference level attached as a technical annex at the end of 2014 and the safeguards information outline in May 2015.

Players are getting ready in Lao PDR as well, exemplified by the fact that a project to support the preparation of the FCPF, which will play a key role in the development of the REDD+ strategy, has started. Also, it has been decided that support will be provided to the creation and submission of reference level, construction of NFMS and implementation of the first MRV in accordance with data development through this Project and Sustainable Forest Management and REDD+ Support Project in The LAO PDR. In light of these international and domestic situations, creation of a process chart that covers the development of REDD strategy, creation and submission of reference level, construction of national forest monitoring system, etc. by the REDD+ taskforce was called for at the third REDD+ Taskforce Conference (July 2015) to obtain a basic agreement since creation of such process chart and gaining an agreement on it are effective and essential for efficient promotion of the implementation of each operation and identification of supporting organizations as well as identification of incidental operations and coordination of such operations.

4.2 Issues for Forest Type Map

4.2.1 Consensus Building with the Non-Forest Sector regarding Forest Definitions and National-level Classification System

This project revised the forest definitions and national-level classification system, and successfully obtained consensus among the forest-sector government organizations, other donors, and forestry experts at universities. However, consensus building with other sectors is also required because the forest definitions and national-level classification system influence not only the forest sector but also many other sectors such as agricultural and land management sectors. Therefore, a request was made to the C/P to promote consensus building, but further efforts should be made to encourage this consensus building.

4.2.2 Continuous Enhancement of Image Interpretation Capabilities

The interpretation capabilities of the C/P RS/GIS technical experts were not uniform due to the impact of personnel relocation and other such factors. Therefore, taking into consideration of the ground truth survey implemented in the first year, the interpretation keys used for correction of the forest type maps were unified and, using this, OJT was provided to strengthen the interpretation capabilities of the C/P. As a result, the C/P came to have better interpretation capabilities, but there still remains a difference in their capabilities. Since the image interpretation capabilities cannot be acquired in a short period of time, it is important to provide technical assistance continuously in the future.

4.2.3 Enhancement of Ground Truth Survey Capabilities

During the ground truth survey, C/P said that some of the technical experts had little experience in field surveys and had difficulty in accurately determining a forest type in the field, and that training corresponding to the vegetation of each region was required. During the report meeting of the first year survey also, the same opinion was heard from Mr. Khamphay, who was Acting Director General of DOF at the time. In this project, the Japanese technical experts joined each of the teams for one or two days during the ground truth survey and provided field training to them. In the future, it is necessary to prolong the field training period and/or provide field training to the representatives of all the teams gathered in one place, putting more focus on the cultivation of a common understanding.

4.2.4 Issues in Classification of Forest/Agricultural Plantations

The forest/agricultural plantations classified in forest type maps developed in this project cannot be classified easily on satellite images and therefore are often classified based on the knowledge of the C/P staff who know the local circumstances well through the GT survey. Furthermore,

forest/agricultural plantations in mountainous areas do not have apparent divisions that are characteristic of plantations and therefore cannot be easily distinguished from fallow land after slash and burn agriculture. Concession data converted to GIS format will be effective in improving the classification accuracy. However, little concession data has been converted to GIS format at present. Moreover, actual plantations are located in these concession areas that are widely permitted for use as available areas, but the acquirers seldom report about their land development and planting areas, making data conversion difficult. In the future, it will be necessary to pursue conversion of concession data to improve the classification accuracy of plantations. Meanwhile, the execution of this pursuit is expected to be difficult because various interests are going to be involved.

4.3 Issues for Carbon Stratification

4.3.1 Development of the Data Necessary for Evaluation of Uncertainty

It is desirable that carbon stratification be investigated based on evaluation of the overall uncertainty, but at the present time the available data is only the first NFI data for which the national level EF data is an issue, so it was difficult to obtain a conclusion. The next period NFI data is ideal, but forest surveys are being carried out by Finland/World Bank SUFORD-SU for the nationwide production forests, CliPAD of Germany in the northern provinces, this project in the central provinces with the NFI pilot, and the private sector SN-REDD in the southern provinces. It is considered that the next best thing is to compile this data and study it.

4.3.2 Consensus Formation regarding Carbon Stratification

In Section 4.3.1 it was shown that the carbon stratification scheme can be investigated, but in order to determine the final carbon stratification it is essential that there be consultations for consensus formation among those involved. Those involved in carbon stratification include not only the forestry sector, but it is considered that it is also necessary to consult with the departments associated with climate change, as the contacts for international reporting. It is considered that continued support is necessary for consensus formation.

4.4 Issues for Forest Information DB Design

4.4.1 Integration with Existing Forest Information Databases

Integration with Existing Forest Information Databases

This project analyzed the first NFI's DB (ForestCalc) and FIM inventory DB (FoCAS) to discover that the characteristics of them do not completely agree with each other and that there are issues to be solved in order to use their data in combination. Therefore, it is necessary to store them in the same DB physically, design tables and relations while using the existing DBs as examples, and inherit the functions that have been implemented but avoid integration of tables and data and implement a system for extracting data as required.

Integration with Production Forest Management and Monitoring DB

The production forest management and monitoring DB promoted by SUFORD SU was still in the internal review and design stage when this project was implemented. Although discussion was held on the roles and future directions of the two DBs, no sufficient consensus was reached on the specific operation and technical details such as which data should be shared (input/output) and how sharing should be realized. The next project needs to recheck the progress statuses of the two projects to allow the engineers of the C/P and both the parties to have discussions as required in order to reach consensus on the operation and technical details.

4.4.2 Implementation of Functions for Statistics/Reporting

Automation of Importing and Conversion of Survey Data to DB

The scope of this project was the design of a prototype DB. However, a demo-version R script for promptly analyzing pilot survey data of NFI was also developed. On the other hand, this project did not realize a function for automatic importing and conversion of survey records into a relational DB although a relational DB structure was adopted for the design in consideration of a use in combination with other existing data. The next project needs to organize the future operation methods again and implement a function for importing and conversion if required.

Organization of Requirement Specifications of Domestic Reports

It was confirmed that the types of reports required in Laos were organized through FPP/TA2 activities. However, no specific consensus was reached on the details because neither the carbon stratification nor the NFI survey details were settled at that time. Since the activities of this project have settled the carbon stratification and the NFI survey details and organized the data owned by the concerned ministries and departments, the next project is expected to conduct review and discussion with the C/P and other stakeholders again while providing specific samples.

Customizable Statistics and Report Functions

This project organized data, calculation formulas, constants and information required for international reports. For actual use, it will be convenient if there are statistics and report functions that can be customized according to user needs. Apart from Report Builder of MS, new browser-based services customizable on an interactive basis are being released. Therefore, specific implementation should be conducted while checking the trends and situations of new technologies as required.

4.4.3 Collection and Disclosure of Forest Information Data

Consultation about Information Data Collection

The activities of this project surveyed and confirmed the existence of forest information data in the Department of Forestry and concerned ministries/departments (and acquired part of it as samples). Next, it is necessary to formally request for supply of the data and actually acquire it. It is also necessary not only to collect data but also to inform advantages and feedback information from NFIDB to data suppliers. For this purpose, individual consultation must be conducted regarding the purposes and conditions of using data.

Information Disclosure via Forest Information Platform

This project conducted a demonstration of information disclosure via the forest information platform using collected sample data. Before information disclosure, however, it is necessary to organize the operation processes and regulations regarding, e.g., which data can or should be disclosed, which data should be limited to internal use or browsing, and how approval should be given. Furthermore, the integration of the platform with the ordinary portal sites of ministries/departments and a phased-in realization method must be organized.

4.4.4 Development and Operation of National Forest Information Database

Capability of C/P Staff and Concentration of Workload on C/P Staff in Charge

The forest-sector organizations of Laos have a limited number of C/P staff with related technical skills or knowledge about IT. Through the technical assistance activities so far, some of the C/P staff have acquired a capability of modifying and operating a system by themselves. However, the number of them is limited so that the workload is concentrated on the C/P staff in charge. Therefore, an increase in the number of such C/P staff is urgently required. Even C/P staff who acquired the required capabilities does not yet have sufficient experience to carry out all the DB design and development of the country. Therefore, the utilization of local human resources is essential.

Development System and Future Maintenance and Operation

In Laos, there are insufficient IT-enabled local human resources who understand the forest-sector operations so that workload is concentrated on part of the staff, which remains as an issue to be solved. Therefore, it is necessary to review the development and operation systems including the resources not only in Laos and the forest sector but also in neighbor countries (particularly Thailand with a similar language). The development of a DB using limited assignment to the Japanese consultant is not realistic. In the next project, therefore, it is necessary to secure a DB development budget using local resources and construct development and operation systems involving C/P.

4.5 Issues Concerning design of Next National Forest Inventory

4.5.1 Ability of C/P

Design of NFI

As confirmed through the inventory piloting, FIPD inventory team, which is required to play a key role at least during the on-site survey, is considered to have acquired necessary skills. On the other hand, it has to be admitted that the team has a low understanding of inventory design, such as

the reason for adoption of a particular plot design. Inventory design does not simply mean developing the method for grasping carbon stock efficiently, but it should be carried out based on the understanding of the accuracy required of the international community and the method of use, limitation and advantages of each and every piece of equipment among many other factors. It is considered that the director-level staff of C/P has some understanding as they have experience with the 1st NFI, but the level of understanding of the field staff is far from satisfactory. Although the points described above have been repeatedly explained in the technical workshops and inventory piloting training in this Project, they do not seem to get across. It is not necessary to require all the staff to understand 100%, but with respect to several leading members of the inventory team, additional capacity building is necessary when the next NFI is implemented.

GIS and DB skills

As described earlier, FIFD inventory team is considered to have fully acquired the skills required for surveying in the on-site survey and use of tablet. On the other hand, they still need to be supported for the placement of survey plots and setting and preparation of data for tablets. Also, with respect to statistical software R, which was developed immediately before the end of the Project, they have only seen a demonstration on the way to use it and have not been trained in the method of use. Although a high level of technology is required for the development of R, the method of use is very simple. As such, it is expected that training in the method of use will be implemented for the next NFI. Since a certain level of IT literacy (especially in GIS) is needed for the placement of survey plots and data setting for tablet, it will also be necessary to establish a structure for cooperation with the GIS/RS teams of FIPD.

4.5.2 Survey permit and license

The biggest reason for the failure to obtain sufficient number of survey locations in the inventory piloting was that it took longer time than expected to obtain permit for the conservation forests and protection forests managed by the DRFM. After the statement of the survey outline and the letter are submitted by the FIPD to the DOF, the survey license is granted following the course of DFRM, PONRE and DONRE. To avoid such problem, it was confirmed at the final workshop that for the next NFI, a steering committee should be set up before the start of survey, and a meeting should be organized to explain the survey outline and permit and license with the attendance of organizations concerned. Also, it is expected that inclusion of the DFRM staff in the surveyors will facilitate the process of acquiring the permit and survey in the protection forests and conservation forests.

4.5.3 Finalization of Next NFI Manual

As described in Chapter 3, it took longer time than expected to collect data from the projects implementing surveys relating to inventory. Some of the data have not yet been obtained as of now even though the project has completed. Moreover, some projects, such as the allometric equation development project, are scheduled to complete between 2016 and the dry season of 2017, when the next NFI will be implemented. It is necessary to continue collecting such data and reports to finalize the NFI manual in the next integration project. At present, the following points are considered to require modification.

- Survey method of regenerating vegetation and bamboo

  For example, in the allometric equation development project, it is not yet decided if the parameter of the equation for regenerating vegetation should be DBH or the number of years after burning. It is necessary to finalize the NFI manual in accordance with the report of the allometric equation development project.

- Number of survey locations

  It may be possible to reduce the number of survey locations in PFA by analyzing the PFA report to be completed by SUFORD in December 2016. It is necessary to recalculate the number of necessary locations after collecting and analyzing other data as well.

- Plot design

  As described in Chapter 3, with respect to DBH measurement for each nest, tentative decision has been made, but it is not based on the result of analyzing sufficient amount of data. It is necessary to continue the analysis with the data to be obtained, particularly raw survey data of the PFA report, to finalize the manual.

Chapter5 Suggestions For Achievement of the Overall Goal

Contribution to formulation of REL/RL and implementation of MRV

As the design and development of the national forest information system will be carried out in parallel with the formulation of REL/RL (first version) of Lao PDR, it is expected that the content of REL/RL will be reflected in the design and development of the system and MRW, which is consistent with the REL/RL, will be implemented by utilizing the national forest information system in actuality.

At the Third National REDD Taskforce (NRTF) Conference held in July 2015, it was decided to organize six technical WGs (TWG) including that of REL/MRV. It is expected that the TOR and composition of each TWG will be proposed and agreed at the Fourth Conference scheduled in September. It is desired that the full-scale phase of the integrated technical cooperation project will greatly contribute to the REL/MRV operations and the construction of the NFMS, which is the means of these operations, as the lead donor of REL/RL TWG by leveraging on the outcome of this Project.

Contribution to construction of NFMS and operation of SIS

The national forest information system is the foundation of monitoring by the NFMS and should be the storage of update information obtained by monitoring. With respect to the NFMS, it is necessary to continuously acquire satellite data and ground test data and register the analysis result of these data to the national forest information system with the data of each REDD+ activity. Moreover, it is also necessary to disclose information relating to the REDD+ activities by using the forest information platform, which will be installed as a function of the national forest information system, to help in the operation of SIS specific to Lao PDR.

Ensuring consistency with GHG inventory

The MRV of REDD+ under the UNFCCC is supposed to be submitted as an annex of the national level GHG inventory (GHG-I). As such, it is required that the GHG-I in AFOLU sector be consistent with the REL/RL and MR of REDD+. With respect to GHG-I, it is necessary to capture the carbon stock and the area of land for other uses in order to calculate carbon stock changes accompanying the conversion of forest land to land for other uses, especially farmland or grassland with certain biomass stock, or conversion of such land to forest land. For this purpose, it is essential that the Department of Climate Change and Disaster and the Department of Land Management of MONRE, which are in charge of GHG-I, collaborate with the Department of Farmland Management of MAF. Accordingly, it is necessary to include the staff of these departments concerned in the members of TWG for REL/MRV organized under the NRTF to facilitate the collaboration through discussions in the TWG.

Collaboration and coordination with relevant projects

The other projects described in Chapter 3 are not engaged in data development at the national level, but they have obtained knowledge on REL/RL, SG and other information relating to REDD+ through field activities. Also, Readiness Support Project of the FCPF, which started at the end of 2014, has an REL/MRV component. As such, it is necessary to endeavor to collaborate with these projects in an adequate manner to construct an efficient and user-friendly national forest monitoring system.

Promoting formulation of REDD+ strategy

REDD+ strategy should be developed by the country implementing REDD+, together with reference level, national forest monitoring system (NFMS) and SG information outline. Also, as described in Chapter 3, content of the strategy and the SG information are closely related to each other. The REDD+ strategy that will be created mainly by the FCPF project is not likely to be greatly different from the strategy option described in R-PP, but it may be changed depending on the trend of carbon stock changes identified by this Project and the result of NFI/forest area survey in 2015. As support to strategy formulation is also scheduled in the integrated full-scale phase, reflecting on the result of this Project, it is necessary to urge the C/P to formulate an appropriate strategy as early as possible with no difference in timing from the development of REL/RL and other elements in order not to cause any delay in submission to the UNFCCC.