



Forestry Department

Food and Agriculture Organization of the United Nations

BRIEF ON NATIONAL FOREST INVENTORY NFI

LAO PDR

Forest Resources Development Service

Rome, June 2007



Strengthening Monitoring, Assessment and Reporting (MAR) on Sustainable Forest Management (SFM)

FAO initiated activities to strengthen Monitoring, Assessment and Reporting on Sustainable Forest Management in January 2006 with the objective to facilitate development of harmonized forest related national monitoring, assessment and reporting (MAR) for contributing directly to the improvement of national sustainable forest management (SFM) regimes. It also aims to catalyze national discussions, analyses, policy actions and planning that promote national SFM regimes besides clarifying the contribution of forests to global environment and to human well-being. This initiative shares the ambition of the Collaborative Partnership on Forests (CPF) about simple, harmonised, efficient and action oriented MAR systems both at international and national levels and thus provides a response to some of the key recommendations made by the CPF task force on streamlining the reporting on forests with particular focus on national capacity building.

The MAR initiative has recently updated goals include country capacity building for better, consistent and regularly updated information to facilitate implementation of non-legally binding instrument (NLBI) on SFM, adopted at UNFF 6 (2007) that aims to,

- Strengthen political commitment and action at all levels to implement effectively sustainable management of all types of forests and to achieve the shared four global objectives ((a) reverse the loss of forest cover worldwide, (b) enhance forest-based economic, social and environmental benefits, (c) increase significantly the area of protected forests worldwide, and (d) reverse the decline in official development assistance for SFM;
- Enhance the contribution of forests to the achievement of the internationally agreed development goals, including the Millennium Development Goals, in particular with respect to poverty eradication and environmental sustainability; and
- Provide a framework for national action and international cooperation.

All countries can participate in this initiative, although the actual level and intensity of their involvement may vary among them. The initiative is organized under the Forest Resources Development Service (FOMR) of FAO Forestry Department. The contact persons are:

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The MAR-SFM Working Paper Series is designed to reflect the activities and progress of the MAR on SFM programme of FAO. Working Papers are not authoritative information sources – they *do not* reflect the official position of FAO and should not be used for official purposes. Please refer to the FAO forestry website (www.fao.org/forestry) for access to official information.

The MAR-SFM Working Paper Series provides an important forum for the rapid release of preliminary findings needed for validation and to facilitate the final development of official quality-controlled publications. Should users find any errors in the documents or have comments for improving their quality they should contact Kailash.Govil@fao.org or Dan.Altrell@fao.org.

Brief Note on MAR-SFM Working Paper Series (AP) on NFI- Brief

The NFI – Brief for a country attempts to provide a bird’s eye view of the National Forest inventories (NFI). However, some countries conduct forest inventories at sub-national and or field management unit level. Therefore, this brief presents brief information on the forest inventories in a country at national level, sub-national level and or field management level depending on the available information.

It is useful to regularly update our understanding of elements and specifications of forest inventories because the information generated by forest inventories is simply manifestation of its span, design and methods to collect and analyse the primary information during its implementation. This is important because the NFI provides information on the state and trends of forest resources, their goods and services, and other related variables that support. It also defines the policy and trade decisions, science and field initiatives, national and international reporting, and direct and indirect contribution of forests to society like poverty alleviation. Regular updates are necessary because countries do change the set of elements, their specifications, designs and methods over period of time to address new emerging demands and to take advantage of new technologies.

The purpose of developing the NFI-briefs is, therefore, to document (working paper) the current and historical span of elements (variables or fields), their specifications, sampling designs and methods used in NFI. The document may serve as data source as well as reference material.

These briefs have been initially developed on the basis of the country submission to FAO. The initial draft of this report was sent to following national focal point for review and country validation before its finalisation.

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General Information

Laos, officially the Lao People's Democratic Republic, is a landlocked state in southeast Asia, bordered by Myanmar and China to the northwest, Vietnam to the east, Cambodia to the south, and Thailand to the west. Its capital and largest city is Vientiane.

Map of the Country

Figure 1. Map of Laos



(Source: <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html>)

Land Area and Landuse

The total area of Lao is 236 800 square km and the following table presents the categorisation and projection of land use in Lao for 1990, 2000 and 2005 (FRA 2005).

Table 1. Categorisation and projection of land use in Lao (FRA 2005).

FRA 2005 Categories	Area (1000 hectares)		
	1990	2000	2005
Forest	17 314	16 532	16 142
Other wooded land	2 875	4 053	4 643
Other land	2 891	2 495	2 295
Other land of which with tree cover	n.a.	n.a.	n.a.
Inland water bodies	600	600	600
TOTAL	23 680	23 680	23 680

Forests

Compared with most Southeast Asian countries, Lao PDR has a large area of land covered with natural forest. Seventy-nine percent of the country is regarded as mountainous area with elevation ranging from 80 meters, where the Mekong River leaves the country in the extreme South, to 2820 meters, the summit of Phobia Mountain in Xiangkuang province..

Available data (FRA 2005, see Table 2 and Figure 2) indicate that forests cover an area of over 16 million ha., nearly 70 percent of the total land area. During the past 30 years there has been a significant decline in forest due to population pressures, and associated shifting cultivation, agricultural expansion and logging for commercial purposes.

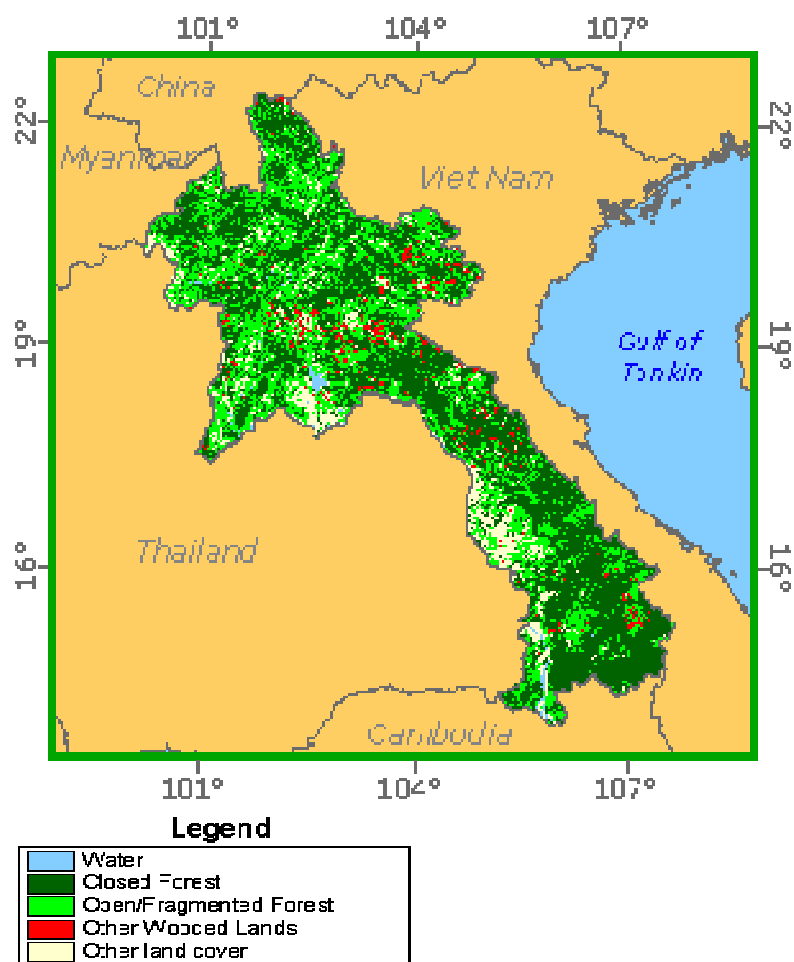
Laos has two distinct climatic zones: tropical monsoon in the plain areas and subtropical climate in the mountainous areas above 1,000 meters altitude. Most of the forest is mixed deciduous forest, with smaller areas of *Dipterocarp* forest and dry evergreen forest. The remaining forest area is coniferous and mixed-coniferous forest.

The vegetation comprises various species of plants, ranging from small short-lived herbs to long-living trees. At low and medium altitudes (100-500 meters) *Dipterocarp* species have commercial value as hard wood. At higher elevations numerous medium size broad-leaved trees are of commercial value, the same as tropical pines species and other important coniferous species such as *Araucaria cunninghamia*. Non-timber forest products typical of the region include bamboos, rattans, cardamoms, benzoin resin, latex, bark resin, gum etc. The forests of Laos also harbour uncountable species of fauna including large mammals such as elephants, wild cows and buffalos.

Table 2. Categorisation and projection of forest area in Lao (FRA 2005)

	Area (1000 ha)		
	1990	2000	2005
Primary	1490	1490	1490
Modified natural	15 820	14 943	14 428
Semi natural			
Productive plantation	3	98	223
Protective plantation	1	1	1
TOTAL	17 314	16 532	16 142

Figure 2. Forest Cover of Lao P.D.R.



Source: FAO Global Forest Resources Assessment 2000

Brief History of Forest Inventories

Prior to 1980s there has been considerably limited forest assessment in Lao PDR. The most notable effort has been the Lao-Canadian Reconnaissance Survey of Lowland Forest of Laos which was completed in 1969. The survey covered three lowland regions (Vientiane, Savannakhet and Champasack provinces) without aiming at producing countrywide estimates.

In the early 1980s the first nationwide reconnaissance survey was conducted with support from the former USSR however, documentation and methodology was not complete. In 1987 the second Nationwide Reconnaissance Survey was initiated by the Department of Forestry (National Office for Forest Inventory and Planning [NOFIP]) with support from SIDA. The survey, which has been based on remote sensing and designed as a sample plot inventory, was completed in 1992.

Thereafter a “Nationwide Reconnaissance Survey” of land use and forest cover (NRS) was initiated in 1987 under the Lao-Swedish Forestry Cooperation Programme. This survey, conducted by the Lao Forest Inventory and Planning Centre, updated the previous forest cover map of 1973/1974 to 1982 through interpretation of aerial photographs from 1982 with nearly complete national coverage (missing some border areas). Change estimates and projection of the area data to 1989 were made with the aid of satellite images from between 1987 and 1991.

The survey thereby provided area data for 1982 and 1989. Field checks were carried out by the photo interpreters in accessible areas throughout the NRS period.

The main objective of the NRS has been to develop a feasible inventory method, to provide information on the status and change of forest cover and to upgrade and develop the capacity of the Department of Forestry to carry out inventory work.

In order to provide more detailed information, a national forest inventory (NFI) based on ground survey was initiated in 1991. The objectives of the NFI were: (i) to further develop methods, training and organization for a fieldwork-based national forest inventory; (ii) to provide information about forests and land use, particularly on standing volume, but also on fellings and site conditions in accessible areas; (iii) to collect data for elaboration of volume functions; (iv) to provide ground truthing for soil, vegetation and land use maps; (v) to improve definitions for any variables when necessary. The inventory has produced land use and forest type maps (1:50 000, 1:100 000 [standard topographic map grid] and 1:250 000 [provincial maps]). It has also developed a field manual for the inventory work, databases for data management, volume functions and volume estimation models for Laotian tree species and a compilation of regional and provincial statistics on land use, forest types, topography and accessibility of forested areas.

The NRS/NFI was used as the government-validated information source to provide information to the Global Forest Resources Assessment 1990 (FRA 1990) and FRA 2000.

Mekong River Commission/German Agency for Technical Cooperation has also mapped the forest resources of the Lao People's Democratic Republic at the national level at two points in time through its Forest Cover Monitoring Project (FCMP). The mapping was based on 1992/1993 and 1996/1997 Landsat TM satellite images. FCMP has established a geographic information system (GIS) with mapping and database components for information on natural resources and forest cover monitoring and trend analysis.

However, the FCMP and the NRS/NFI were performed independently and by different institutions and therefore resulted in two independent sets of forest cover information for the Lao People's Democratic Republic, each providing information for two points in time. Differences between the two sets of information may be attributed to the use of different definitions of forest, in addition to subjectivity in interpretation, effects of time, differences in classification systems and differences in scales of source data.

Table 3. History of Assessments

Publication Year ¹	Title ²	Institution ³	Ground Inv. Year(s) ⁴	Remote Sensing		Estimation Level ⁷	Country Coverage (Full/Partial, %) ⁸	Thematic cover**
				Data Year(s) ⁵	Scale of Interpretation ⁶			
1969	Lao-Canadian Reconnaissance Survey of Lowland Forest of Laos		1969			Regional	three lowland regions: Vientiane, Savannakhet and Champasack provinces.	
1991	Survey of Forest Plantations in Lao PDR.	Lao Swedish Forestry Co-operation Programme – Forest Inventory Report no 1. Forest Inventory and Management Office, Department of Forestry, Ministry of Agriculture and Forestry, Vientiane Lao P.D.R.						PL
1992	Forest Cover and Land Use in Lao P.D.R. – Final report on the Nationwide Reconnaissance Survey (NRS). Report No 5.	Lao Swedish Forestry Co-operation Programme – Forest Inventory. Ministry of Agriculture and Forestry, Department of Forestry, National Office of Forest Inventory and Planning	1987-1989			National	Full – Results presented on a provincial basis, plus country totals.	NF, PL, OWL, FAC
1997	Summary of ADB Credit Practice in Tree Plantation from 1996 to 1998 and Plan for 1998 – 1999	Agricultural promotion Bank						PL
2000	National Forest Inventory	Department of Forestry, Ministry of Agriculture and Forestry, Vientiane Lao P.D.R.	1991-1999			National	Complete	NF, OWL, TV

****Legend:** NF=Natural Forest; PL=Plantations; OWL=Other Wooded land; FAC=Forest Area Change; TV=Total Volume; TB=Total Biomass; CV=Commercial Value; PA=Protected Areas; BD=Biodiversity; FO=Forest Ownership; WSP=Wood Supply Potential; NWGS=Non-wood Goods and services; TOF=Trees outside of forest; FF=Forest Fires

Legend:

[1] Publication Year	Year in which the assessment was published
[2] Title	Title of the assessment
[3] Institution	Institution(s) responsible for the Assessment
[4] Ground Inventory Year(s)	Year or Interval of years during which the field inventory has been carried out
[5] Remote Sensing Data Year(s)	Year(s) of the Remote Sensing Images
[6] Remote Sensing Scale of Interpretation	Scale of Remote Sensing Images (e.g. 1:250,000)
[7] Estimation Level	Whether the Assessment was at National, Sub-national, District, Management Unit, etc. level
[8] Country Coverage (Full / Partial, %)	Amount of country area covered by the assessment (e.g. full, partial). If partial, indicated by % of total area.

Current National Forest Inventory Design

The inventory design is a stratified systematic cluster sampling. Normally the area is classified into five stratas (current forest, permanent agriculture, potential forest, other wooded areas and other land use). Tracts are laid out on Land Use Maps (based on SPOT satellite images) in a systematic way according to the map grid and classified according to their land use for their assignment to one of the strata. In the second phase tracts in each stratum are selected for field inventory. This selection is done systematically with a random initial point. The sample plots of varying designs (Figure 3) are arranged in clusters. About 50% of such clusters are selected for inventory purposes.

Field Inventory

The cluster consists of square (Figure 4) or L-shaped (Figure 5) tracts with each side 1000 m. in length. The tracts are drawn on 1:100,000 scale topographic maps and on Land Use maps during the first phase of the inventory. There are four different types of sample plots in a tract (Figure 3).

Type A: Square plots (20 x 20 m) located in the corner and in the middle of each tract's side. There are eight plots of this type in a square tract and five plots in an L-shaped tract. (Figure 5 – look for plot with numbers 4 and 8) on each side. All trees with diameter more than 10 cm are enumerated.

Type B: Rectangular plots (20 x 40 m) located directly before and after each plot of type A. There are 16 plots of type B in a square tract and 8 in a L-shaped tract. (Figure 5 - look for plot numbers 1, 3, 5 and 7). All trees with diameter more than 30 cm are enumerated.

Type C: Rectangular plots (20 x 400 m) located between the plots of type B covering the whole tract line that is not covered by plots of type A and B. There are eight plots of type C in a square tract and four in an L-shaped tract (Figure 5 – look for plot numbers 2 and 6 on each side). All trees with diameter of 60 cm are enumerated.

Type D: A triangular sub-plot ($1/16^{\text{th}}$ of whole plot) is defined in the left front quarter of plot type A for the enumeration of saplings (Figure 3). All saplings of commercial tree species with diameter less than 10 cm are enumerated. These saplings are classified in two groups; sapling with height equal of more than 1.3 meters and saplings less than 1.3 meters in height.

Sample trees within these four types of plots are selected for measurement among the enumerated trees according to following thresholds.

- All tree with Dbh > 60 cm on every type of plot are measured
- All trees with Dbh between 30-59 cm in plot type A and B that are standing on the left side of the centre line are measured. This leads to 50% of the area and therefore measurement of roughly 50% of trees in these types of plots.
- Trees with Dbh 10-29 cm: All trees on plot type A standing on the left hand front quarter (Figure 5) are measured. This leads to 25% of the area and therefore measurement of roughly 25% of trees plot type A.

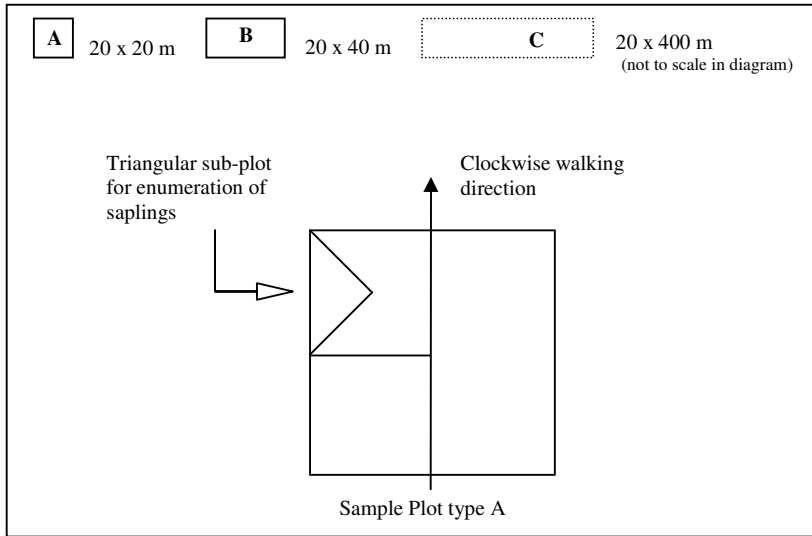


Figure 3 . Different types of plots

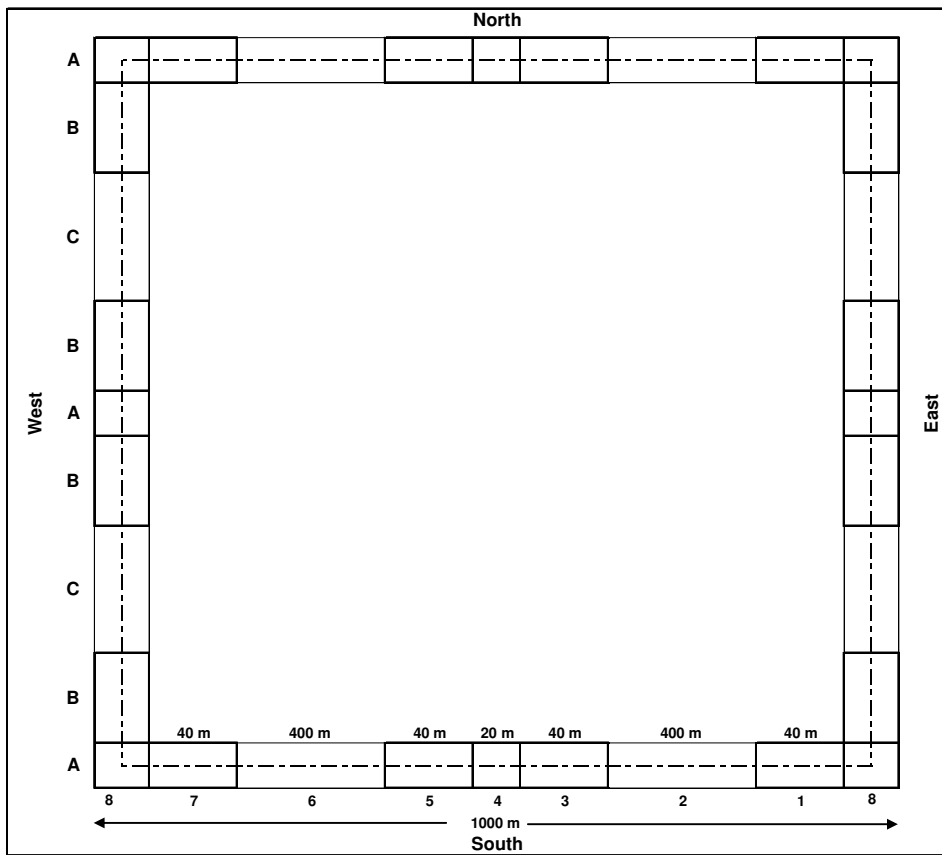


Figure 4. Tracts and plots in Square cluster design

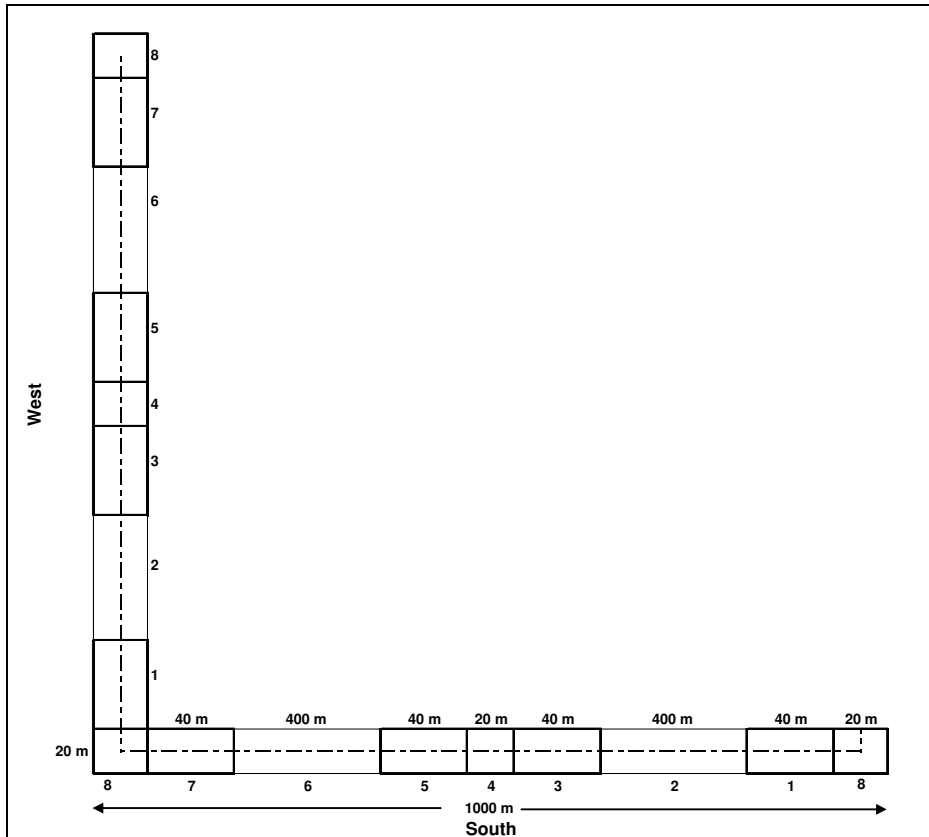


Figure 5. Tracts and plots in square type of cluster design

Content and Methodology of data collection in NFI

Geo-physical

	N	SN	MU	Methodology
Geo-Coordinates	X			Map
Altitude				
Topography	X			Map
Orientation (or Aspect)	X			Map
Slope	X			Map
Soil				
Geological structure				
Rainfall	X			Records

Bio-Physical

	N	SN	MU	Methodology
Number of trees	X			Field Survey
Diameter of trees	X			Field Survey
Height of trees	X			Field Survey
Length of stem	X			Field Survey
Stump height	X			Field Survey
Age class				

Twigs				
Bark				
Leaves				

Forest extent

	N	SN	MU	Methodology
Forest land area	X			Survey
Area of forest canopy/crown cover	X			Survey
Area under forest management				
Area under formal forest management plan				
Area under sustainable forest management				
Forest area with certification				
Area under public owned forest				
Area under private owned forest				

Forest characteristics (Naturalness) and forest type

	N	SN	MU	Methodology
Primary forest				
Modified natural forest				
Semi-natural forest				
Productive plantation				
Protective plantation				
Coniferous	X			Field Survey
Broadleaved	X			Field Survey
Mixed forest	X			Field Survey
Forest area by dominant species (bamboo, mangroves, rubber)	X			Field Survey
Forest area by ecological zone (tropical, subtropical, temperate, boreal, polar)				

Use (designated functions) of forests

	N	SN	MU	Methodology
Area of forest under production				
Area of forest for protection of soil and water				
Area of forest for conservation of biodiversity				
Area of forest for social services				
Area of forest for multiple purpose				
Forest area available for wood supply				
Forest area within protected areas				

Social Services

	N	SN	MU	Methodology
Area of forest managed for recreation				
Area of forest managed for tourism				
Area of forest used for education				
Area of forest managed for conservation of cultural/spiritual site				

Mapping of forest distribution

	N	SN	MU	Methodology
Distribution of forests	X			Survey
Forest Characteristics				
Land use	X			Survey
Administrative/political/legal boundaries	X			Map
Designated functions of forests	X			Records
Other wooded land	X			Survey
Other land with tree cover				
Other land	X			Survey

Status of the forest and disturbances affecting forest health and vitality

	N	SN	MU	Methodology
Disturbance by insects				
Disturbance by diseases				
Disturbance by other biotic agents				
Disturbance by fire				
Disturbance caused by other abiotic factors				

Biodiversity

	N	SN	MU	Methodology
Tree species	X			Field Survey
Shrub species				
Herbs species				
Endangered species				
Critically endangered species				
Vulnerable species				
Native species				
Endemic species				
Introduced species				

Beneficiaries of forest goods and services

	N	SN	MU	Methodology
By locality of user (e.g. indigenous/local/national)?				
By good/service (e.g. timber, fuelwood, NWFP, bamboo/rattan, water, etc) used by them				
By economic class of the beneficiaries (high, medium, low income)				
By level of dependency on forest (as percentage of total employment)				
By physical accessibility to the forest (distance from forest)				

Economic value

	N	SN	MU	Methodology
Removal of timber				
Removal of fuelwood				
Removal of other wood products				
Removal of wood products derived from forest under sustainable management				
Removal of wood products derived from forest plantations				
Removal of non wood forest products				
Annual allowable cuts/yields				
Social services				
Environmental services				
Employment				
Support to livelihood of communities				
Market price/cost of wood in forest				
Market price/cost of non wood forest products				
Estimate of value of social services				
Estimate of value of environmental services				
Estimate of value of employment				
Estimate of the contribution of forest sector to national economy				

Policy, legal and institutions (PLI) framework

	N	SN	MU	Methodology
Forest policy				
Forest legislation				
Forest administration				
Forest education and research				
Annual outlay, expenditure, investment in forestry sector				

Bibliographies and References for further reading

DOF 1993. Lao National Forest Inventory Field Manual 1993 / 94. Department of Forestry, Ministry of Agriculture and Forestry, Vientiane, Lao P.D.R.

DOF 1997. Country report on National forest inventory and biodiversity conservation areas in Lao PDR. Paper for FAO workshop on FRA 2000, 15-19 December 1997 Hanoi, Vietnam. Department of Forestry, Ministry of Agriculture and Forestry, Vientiane, Lao P.D.R.

FAO 1998. Asia-Pacific Forestry Sector Outlook Study: Summary of the Country Outlook: LAO PDR. Working Paper Series: Asia-Pacific Forestry Towards 2010. Working Paper No: APFSOS/WP/38.

FAO 2000. Forest Resources Assessment 2000. Country Report- Lao P.D.R

FAO 2005. Forest Resources Assessment 2005. Country Report- Lao P.D.R., WP 182
<http://www.fao.org/forestry/site/32245/en/>

Michalak, R. et al. 2002. Forest inventory and assessment: country experiences and needs. Unasylva, Vol. 53 2002/3

Sanonty, S. 2000. Lao P.D.R. Country Report on Information Processes and Planning. In: Proceedings of the Programme Inception Workshop: Forestry Information Processes and Planning - Bangkok, Thailand 10-12 July 2000. EC-FAO Partnership Programme (2000-2002).