Forestry Department

Food and Agriculture Organization of the United Nations

BRIEF ON NATIONAL FOREST INVENTORY NFI

THAILAND

Forest Resources Development Service

Rome, June 2007

MAR-SFM Working Paper 29/ 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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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 and many time define 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.

Note for NFI- Brief on Thailand

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B. Compilation and Supervision

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General Information

Thailand, formally the Kingdom of Thailand, is a country in South East Asia. To its east, lie Laos and Cambodia; to its south, the Gulf of Thailand and Malaysia; and to its west, the Andaman Sea and Myanmar (Burma). Its capital and largest city is Bangkok.

Map of the Country

Figure 1. Map of Thailand

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

Land Area and Landuse

The total area of Thailand is 513,115.02 km² and the following table presents the categorisation and projection of land use in Thailand for 1990, 2000 and 2005 (FRA 2005). The forest area includes 1 959 000 hectares of Rubber plantation in 1990, 2000 and 2005.

Table 4: Land area and landuse

FRA 2005 Categories	Area (1,000 hectares)		
	1990	**2000**	**2005**
Forests	15965	14814	14520
Other wooded land			
Other land	35124	36275	36569
…of which with tree cover			
Inland water bodies	223	223	223
TOTAL	51312	51312	51312

(Source: FRA 2005)

Forests

The forests of Thailand can be classified into eight types: i) tropical evergreen forest; ii) mixed deciduous forest; iii) dry dipterocarp forest; iv) swamp forest; v) scrub forest; vi) pine forest; vii) bamboo forest; and viii) mangrove forest (Table 2).

Table 5: Area of forest in different regions in 1998

	North	Northeast	Central	East	South	Total
Tropical Evergreen	21,161	7,107	7,435	6,428	10,066	52,198
Mixed Deciduous	32,325	6,285	4,673	771	-	44,056
Dry Dipterocarp	17,913	7,400	1,314	175	-	26,085
Swamp	-	170	-	-	564	734
Scrub	2	-	-	-	-	2
Pine	1,620	19	-	-	-	1,640
Bamboo	34	-	2,570	4	-	2,609
Mangrove	-	-	54	126	1,494	1,675
Total Forest Area	73,057	20,983	16,048	7,507	12,125	129,722
Total Land Area	169,644	168,854	67,398	39,502	70,715	513,115

(Source: FRA 2005)

Brief History of Forest Inventories

The history of forest management in Thailand is more than 100 year old. Its Royal Thai Forest Department was established on September 18, 1896. The forests at that time were regarded as sufficiently abundant for people to use them except for commercial use of Teak (Tectona grandis). The forest department controlled its harvesting and management. The following provides a brief description of the past inventories based on ITTO (2000). Table 1 provides a brief summary of the past inventories.

The forest inventories in Thailand were started as early as in 1953 by Mr. Gongryp, the FAO expert who recommended the "Profile Sample Plot Method" In 1955, Prof. Dr. F. Loetsch, the German expert from FAO revised the method of forest inventory using statistical method as its foundation and testing various suitable systems that could be conducted in Thailand. He concluded that the "Camp-Unit Systems" is the most suitable forest inventory method to be used in the tropical zone. In the subsequent years, the Camp-Unit System was applied as the forest inventory method.

From 1961 to 1962, Mr. E.J.G. Gaartner, the German expert from FAO conducted forest inventory in the northeastern part of Thailand using the same method. From 1963 to 1964 and the subsequent years, the "Camp-Unit System" was used as the working plan inventory method in Prachinburi province. Later on, the Royal Forest Department conducted the National Forest Inventories in southern, northern, eastern and western parts, respectively; the Camp-Unit System was used with some modifications.

In the 1969 fiscal year, the Royal Forest Department had planned to conduct the forest inventory in all provinces and promptly started its operations which were expected to be completed within 6 years. However, the project could only be accomplished in 1976 because of an urgent task of the department in Sukhotai province. The work covered only 80% of the project, while the remaining 20% which were located in sensitive areas could not be implemented. From 1977 to 1981, the Royal Forest Department had planned to repeat the same forest inventory on the existing forest areas but because of the problems caused by the sensitive areas, the forest inventory could not be accomplished as planned.

From the fiscal years 1982 – 1986, the Royal Forest Department used the Unit System, which was also called "Intensive Forest Inventory" for the working plan inventory in the concession forests in northern province on an annual rate of 3000 sq. km. In the fiscal years 1988 to 1991, the Royal Forest Department continued with the working plan inventory for some selected areas throughout the country.

From 2001, Thailand is using continuous national monitoring of forest resources and it measures plants (trees, seedlings, saplings, shrubs, herbs, moss and lichen, tree stumps), other forest crops (bamboo, rattan, and climbers), soils, and coarse woody debris (CWD). It also collects information on the impact of human activities and on signs and frequency of use of wildlife habitat.

Table 6: 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]			
1953	A forest inventory in Thailand	Forest Research Institute, Germany and FAO			1:48,000			
1992	Land Use Zoning in National reserved Forest	FRA, Royal Forest Department		1992	1:50,000	National	Complete	
1993-1999	Report on Provincial Forest Resource Inventory	Bangkok, FRA, Forest Research Office, Royal Forest Department			1:50,000	National	Complete	NF, CV
1993-1999	Report on Provincial Forest Resource Inventory	FRA, Forest Research Office, Royal Forest Department		1993, 1995 Landsat - 5TM	1:50,000	National	Partial, 99.4%	NF, OWL, FAC, TV,
1996	Rubber plantation area in Thailand (private sector, small scale)	Office of the Rubber Planting Aid Fund			1:250,000	National	Complete	PL, TOF
1996	Forest area plantation in Thailand (private sector, large scale)	The Forest Industry Organization				National	Complete	PL, WSP
1996	Rubber Area Plantation in 1996	Office of the Rubber Replanting Aid Fund		1996		National	Complete	PL, FO
1997	Forest Rehabilitation in Thailand	Planning Division/ Royal Forest Department				National	Complete	NF, PL, FAC, BD, FO
1997	Coconut and Oil Palm Plantation area in Thailand	Department of Agriculture Extension		1997		National	Complete	PL, FO
1997	Forest Rehabilitation in Thailand	Planning Division/ Royal Forest Department		1997		National	Complete	NF, PL, FAC, BD, FO

1998	Forest Situation of Thailand in Past 37 years (1961-1998)	FRA, Royal Forest Department	1998	1:250,000	National	Complete	NF
1998	Forest Types of Thailand in 1998	FRA, Royal Forest Department	1973-1977	1:15,000	National	Complete	NF
1998	Forest area plantation in Thailand (private sector, large scale)	Thai Plywood Plantation			National	Complete	PL
1999	Forest area plantation in Thailand (private sector, large scale and small scale)	Land Use Permission Sub-division / Royal Forest Department			National	Complete	PL, WSP
1999	Community Forestry Development and Extension Programme	Community Forestry Division/ Royal Forest Department			National	Compete	PL
1999	Area of Private Reforestation 1994-1998 (In Thai)	Private Reforestation Division / Reforestation Office/ Royal Forest Department			National	Complete	PL
1999	Thai Plywood Plantation	Reforestation Division Thai Plywood Company	1999		Sub-national	Partial	PL, WSP
1999	Community Forestry Development and Extension Program	Community Forestry Division/ Royal Forest Department	1999		National	Complete	PL

****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 Asse ssment 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

The remote sensing survey has had been in used since 1973 to support NFI. It was used to identify forest type and boundaries, and estimating forest cover, too. To develop the sampling design Hotspots (Thematic) were used for precision. The design was systematic, and it covered all types of forests. The criteria of stratification were forest types, ecological zones and others. The total number of sample sites was greater than 5000.

The objective of the ground sampling is to install a network of re-measured plots (permanent sampling plots) to quantify the overall baseline amount, and to track changes over time of various forest resources, and to determine the approximate location of the forest resources, e.g., the non-timber forest products that cannot be easily detected on satellite imagery.

A review of the old designs in detail is available in ITTO (2000). The following provides brief information on the inventory design used in the pilot project (ITTO, 2001) that forms the basis of the current inventory work in Thailand.

Ground Sampling

The ground sampling was based on a single-stage systematic sampling design. Monitoring points were selected based on a uniform fixed 1.5 km x 1.5 km grid. The grid intersections are the center of the sample plot and represent approximately 225 ha. The samples on the grid are used to compile statistics for each grid intersection, or combined to provide summary statistics for the entire forest or specific strata. Thematic maps, displaying the summary statistics for certain strata that are not easily detectable on satellite data or traditional aerial photographs, were also produced. The 1.5 km grid spacing is quite intensive and results in a reasonable number of plots. This grid also permits the analysis relating grid spacing (sample size) to the accuracy (sampling errors) of the estimates of the amounts of the variables of interest. The results from the ground sampling, when incorporated from data from other sources in a GIS environment, update the forest resources information and provide accurate change and trend data over time.

Pilot Plot Design

The plots to measure the various forest resources were established in clusters. The cluster size and plot sizes were dependent upon the amount of work that can be accomplished by a 6-person field crew, on average, in one day. All plots were circular and of fixed-area, or were line intercepts.

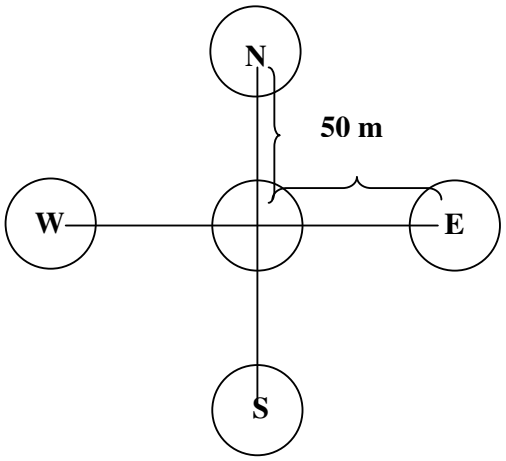


Figure 3. Sampling Inventory Plot

The permanent plots were installed at each grid intersection. The plot design was a cluster of fixed-area plots of different radii and line intercepts all anchored at the grid intersection.

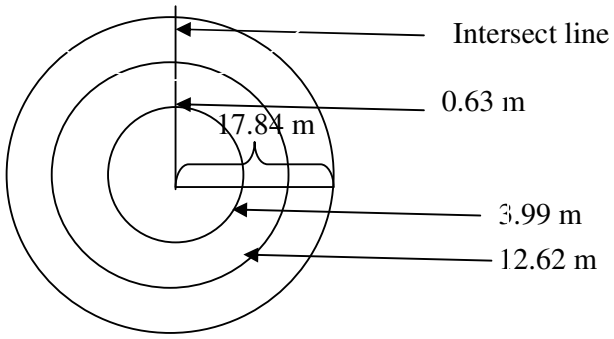


Figure 4. Circular Plot

Circular plots were preferred than rectangular plots because it was easier to apply slope correction with regard to plot boundary demarcation and checking borderline trees. They were also similar to the plots currently used by the department in the national forest inventory. A single cluster of plots, rather than several clusters at a point, was used to:

- To minimize the probability of the cluster straddling more than one land use type.
- For easier description of the land use type.
- To reduce the time it takes to make the measurements.

Measurements within pilot plots

Landuse is observed at the plot center. The inventories cover vvegetation, soil, coarse debris and rattan, disturbances, wildlife, botany, and biodiversity.

Vegetation

For purposes of measurement and description, the vegetation is divided into five vertical layers: lichen, moss, seedling, sapling and tree layers. The seedling layer consists of any undergrowth less than 1.3 m tall (including bamboo and erect rattan). The seedling layer is further divided into herb, shrub, and tree seedlings layers. The sapling layer consists of any undergrowth taller than 1.3 m and stem diameter (diameter at breast height, or dbh less than 4.5 cm). The tree layer consists of trees taller than 1.3 m and stem dbh at least 4.5 cm. The seedlings are counted in the plots with 0.631 meter radius. The percent cover of lichen, moss, herb, shrub, and tree seedling as well as number of sapling is recoded in the plots with 3.99 meter radius. The live bamboos, erect rattan and tree stumps (diameter at the top is at least 4.5 cm) are recorded in the plots with radius of 12.62 meters. The objective is to quantify biodiversity, to estimate total length of bamboo and erect rattan, and to estimate stump volume and the volume and number of trees cut (legally or illegally). Finally the trees (excluding bamboo and rattan) are measured in the plots with 17.84 meter radius. In addition, the volume of coarse woody debris (CWD), and the total length of live creeping rattan and climbers is also assessed during inventories. Further climbers measured must be alive and greater than 4.5 cm at point of intersection. The creeping rattan must also be living, but there is no minimum diameter limit.

Table 7. Thresholds for classification

Height limit			**Diameter limit**		
	< 4.5 cm		≥ 4.5 cm		≥ 0 cm
≥ 1.3 m	Sapling		Tree	Climbers	Bamboo Rattan
< 1.3 m	Seedling	Seedling	Stump		
Forest floor		Moss Lichen	CWD, Bamboo		
Attribute types	Frequency	% cover	Volume Biodiversity	Length and volume	

(Source: ITTO, Technical report 4 2001)

Soil

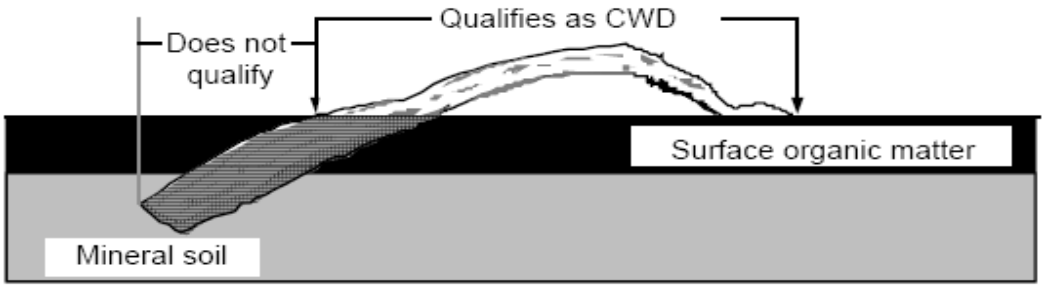
The objective is to provide an initial record of selected site and soil features at the sample locations that can be used in future for developing time trends and assist in interpreting future
site and vegetation changes at the sample locations. For this purpose soil pit is dug, where soil is representative of the soil at the centre of the plot. This pit should be approximately 6.62 m to the *Right* of plot centre (facing up slope). If this initial site is not suitable, the location is moved the location to the *Left* of plot centre (facing upslope) for the same distance. The soil pit is dug at least 30 cm deep, where possible. The slope (average of

slope 50 m above and 50 meter below the sample point), aspect, rocky substrate (within 12.62 meter radius), surface shape (concave, convex or straight), and relative slope position, and water table (whether it is within 30 cm and if present then its depth) with are recorded for the selected site in addition to the physical and chemical features, including structure, colour, texture, and pH. The soil samples are collected for further chemical analysis and estimation of bulk density measurement.

Coarse debris, rattan and climbers

The coarse woody debris (CWD) is dead woody material (including bamboo) located above the soil, in various stages of decomposition. The objective is to estimate the volume of CWD, and the total length of live creeping rattan and climbers. The CWD must be at least 4.5 cm in diameter at the intersection point, and not self-supporting. Felled and bucked logs can be CWD. However, trees (dear or alive), and whose stumps are intact in ground are considered self-supporting, and therefore are not CWD, and should not recorded. In addition, fallen trees with green foliage if they are no longer rooted to the ground, Large fallen branches and fallen broken tree tops, horizontal or leaning, Pieces that are physically attached (lengthwise) are considered to be one piece, uprooted (not self-supporting) stumps or climbers at least 4.5 cm in diameter and at least 1.3 m in length, and any exposed dead roots greater than 4.5 cm, CWD that lies above the soil. CWD is considered no longer above the soil when it is entirely buried beneath a layer of surface organic matter (forest floor) or mineral soil, should only be measured. Below is a diagram to illustrate the CWD:

Figure 5. Coarse woody debris



Disturbance

The objective is to identify main disturbances (activities), and determine their impact on health of forests. Thailand includes activities such aquaculture, agriculture, collecting NTFPs, dam construction, encroachment, excavation facility construction, forest fires, livestock grazing, mining, pest and disease, pollution, road construction, storms wildlife damage, erosion, flooding and landslides, and illegal and legal logging as the activities that disturb forest health. A circular plot of a 17.84 meters radius is used to collect information on the disturbances.

Wildlife

Information is collected on the number and the type of wildlife use at the site. The general procedure involves establishing 17.84 meters radius plot using the tape to record presence, number and behavior (use of habitat) of any wildlife (mammals and birds). Any signs of

wildlife (footprints and dung) are observed and measured; also presence of animals outside of the plot is noted, too.

Botany

Information is collected to identify the species and the number of species in various sites. In addition, 3 - 4 specimens of each species are also collected for future referencing and comparison (see the Technical Report 5 on Training Manual of a Pilot Project by ITTO for details of methods of specimen collection).

Biodiversity

The biodiversity measurements are done within 100m x 100 m permanent plots to develop statistics like species diversity index (Shannon- Weiner index); Importance value index; Species dominance (by basal area); Tree density and relative density; and Species frequency and relative frequency. The plots are divided into subplots of size 10 m x 10m. In each subplot the species, diameter at breast height and height of all tress equal or above 4.5 cm dbh are recorded. Further, shrubs and herbs, and saplings are counted in nested 4m x 4m subplot while seedlings are counted in a 1m x 1m nested subplots.

List of Variables

Each plot inventory provides data statistics on following variables.

1. Plot identification and location
2. Biodiversity
    - Species absolute and relative frequency
    - Species absolute and relative density
    - Species importance and value index
    - Species dominance
    - Species diversity indices
    - Species evenness /richness indices
3. Tree summaries
    - Total volume (outside bark)/ ha by species
    - Basal area / ha by species
    - Species percent by basal area
    - Mean height by species
    - Total volume and stem count by species and diameter class
    - Seedlings / ha by species
    - Saplings / ha by species
    - Number of logs / ha by species and timber quality class
4. Site disturbance
    - Percent cover and severity of disturbance by human or natural activity
5. Site description
    - Slope, aspect and elevation
    - Surface shape, and relative slope position
    - Percent cover water, and percent cover cobbles /stones or bedrock
    - Depth water table
6. Soil description
    - Roots abundance /size, color texture, coarse fragments by layer

- PH by layer
- Bulk density by layer
- NPK by layer

7. Coarse Woody Debris
    - Volume /ha by species
8. Stumps
    - Number and volume / ha

9. Bamboo
    - Number of clumps / ha
    - Number of culms / ha
    - Length /ha
    - Average diameter

10. Erect Rattan
    - Number of clumps / ha
    - Length / ha
    - Average diameter

11. Creeping Rattan
    - Length / ha

12. Wildlife
    - Number / ha wildlife seen by plant species and wildlife species
    - Number dung clumps / ha by animal species
    - Number footprints / ha by animal species
    - Frequency of wildlife behavior / ha by animal species

Secondary variables of interest and their plot design

The information on following variable is obtained through computing of the information on the primary variables list above.

Table 8. Variables of interest

Variables of interest	**Plot design**			
	Plot type	**Number**	**Radius or length (m)**	**Total area or length (ha)**
a) Seedling frequency	Fixed-area	4	0.631	0.0005
b) Percent cover lichen, moss, and seedlings	Fixed-area	1	3.99	0.005
c) Sapling frequency	Fixed-area	1	3.99	0.005
d) length and volume of bamboo and erect rattan	Fixed-area	1	12.62	0.005
e) Tree stump frequency and volume				
f) Density of other clumpy crops (e.g. banana, palm)				
g) Tree growing stock and condition	Fixed-area	1	17.84	0.1000

h) CWD volume	Line-intercept	2	17.84	35.68
i) length and volume of creeping rattan and climbers				
j) Site (vegetation) disturbance type and severity	Fixed-area	1	17.84	0.1000
k) Wildlife habitat use	Fixed-area	1	17.84	0.1000
l) Site description – physical and chemical properties	soil-pit	1	-	-

(Source: ITTO Technical report 4 2001)

Content and Methodology of data collection in NFI

Geo-Physical

	N	SN	FMU	Methodology
Geo-Coordinates	**X**			Inventory and Survey
Altitude	**X**			Inventory and Survey
Topography	**X**			Inventory and Survey
Orientation (or Aspect)	**X**			Inventory and Survey
Slope	**X**			Inventory and Survey
Soil	**X**			Inventory and Survey
Geological structure	**X**			Survey and Records
Rainfall	**X**			Records

Bio-Physical

	N	SN	FMU	Methodology
Number of trees	**X**			Inventory and Survey
Diameter of trees	**X**			Inventory and Survey
Height of trees	**X**			Inventory and Survey
Length of stem	**X**			Inventory and Survey
Stump height	**X**			Inventory and Survey
Age class (for plantation and/or natural Branches regeneration)	**X**			Inventory and Survey
Branches				*Info not available*
Twigs				*Info not available*
Bark				*Info not available*
Leaves				*Info not available*

Forest extent

	N	SN	FMU	Methodology
Forest land area	**X**			Inventory and Survey
Area of forest canopy/crown cover	**X**			Survey
Area under forest management	**X**			Records
Area under formal forest management plan	**X**			Records and survey
Area under sustainable forest management				
Forest area with certification				*Natural forest are not harvested*
Area under public owned forest	**X**			*No survey and all forests are assumed to be publicly owned (FRA 2005)*
Area under private owned forest	**X**			*No survey and all rubber plantations are assumed to be privately owned not available (FRA 2005)*

Forest characteristics (Naturalness) and forest type

	N	SN	FMU	Methodology
Primary forest	**X**			Inventory, Survey and record
Modified natural forest				*Info not available*
Semi-natural forest				*Info not available*
Productive plantation	**X**			Inventory, Survey and Records
Protective plantation	**X**			Inventory, Survey and Records
Coniferous	**X**			Inventory and Survey
Broadleaved	**X**			Inventory and Survey
Mixed forest	**X**			Inventory and Survey
Forest area by dominant species (bamboo, mangroves, rubber)	**X**			Inventory and Survey
Forest area by ecological zone (tropical, subtropical, temperate, boreal, polar)	**X**			Inventory and Survey

Use (designated functions) of forests

	N	SN	FMU	Methodology
Area of forest under production				*Natural forest are not harvested*
Area of forest for protection of soil and water				*Info not available*
Area of forest for conservation of biodiversity	**X**			Survey and records
Area of forest for social services				*Info not available*
Area of forest for multiple purpose				*Info not available*
Forest area available for wood supply				*Natural forest are not harvested*
Forest area within protected areas	**X**			Survey and records

Social Services

	N	SN	FMU	Methodology
Area of forest managed for recreation	**X**			Survey and records
Area of forest managed for tourism	**X**			Survey and records
Area of forest used for education				*Info not available*
Area of forest managed for conservation of cultural/spiritual site				*Info not available*

Mapping of forest distribution

	N	SN	FMU	Methodology
Distribution of forests	**X**			Inventory and Survey
Forest Characteristics	**X**			Inventory and Survey
Land use	**X**			Survey
Administrative/political/legal boundaries	**X**			Survey
Designated functions of forests	**X**			Inventory and Survey
Other wooded land	**X**			Survey
Other land with tree cover	**X**			Survey
Other land	**X**			Survey

Status of the forest and disturbances affecting forest health and vitality

	N	SN	FMU	Methodology
Disturbance by insects	**X**			Survey
Disturbance by diseases	**X**			Survey
Disturbance by other biotic agents	**X**			Survey
Disturbance by fire	**X**			Survey
Disturbance caused by other abiotic factors	**X**			Survey

Biodiversity

	N	SN	FMU	Methodology
Tree species	**X**			Inventory and Survey
Shrub species	**X**			Inventory and Survey
Herbs species	**X**			Inventory and Survey
Endangered species	**X**			Records
Critically endangered species	**X**			Records
Vulnerable species	**X**			Records
Native species	**X**			Records
Endemic species	**X**			Records
Introduced species	**X**			Records

Beneficiaries of forest goods and services

	N	SN	FMU	Methodology
By locality of user (e.g. indigenous/local/national)?	**X**			Record
By good/service (e.g. timber, fuelwood, NWFP, bamboo/rattan, water, etc) used by them	**X**			Record
By economic class of the beneficiaries (high, medium, low income)				*Info not available*
By level of dependency on forest (as percentage of total employment)				*Info not available*
By physical accessibility to the forest (distance from forest)				*Info not available*

Economic value

	N	SN	FMU	Methodology
Removal of timber	**X**			Survey and records
Removal of fuelwood	**X**			Survey and records
Removal of other wood products	**X**			Survey and records
Removal of wood products derived from forest under sustainable management				*Info not available*
Removal of wood products derived from forest plantations	**X**			Survey and records
Removal of non wood forest products				*Info not available*
Annual allowable cuts/yields				*Info not available*
Social services				*Info not available*

Environmental services			*Info not available*
Employment			*Info not available*
Support to livelihood of communities			*Info not available*
Market price/cost of wood in forest	**X**		Survey and records
Market price/cost of non wood forest products	**X**		Survey and records
Estimate of value of social services			*Info not available*
Estimate of value of environmental services			*Info not available*
Estimate of value of employment			*Info not available*
Estimate of the contribution of forest sector to national economy	**X**		Survey and records

Policy, legal and institutions (PLI) framework

	N	**SN**	**FMU**	**Methodology**
Forest policy	**X**			Records
Forest legislation	**X**			Records
Forest administration	**X**			Records
Forest education and research	**X**			Records
Annual outlay, expenditure, investment in forestry sector	**X**			Records

Bibliographies and References for further reading

FAO 1993. *Forest Resource Assessment 1990- Tropical countries.* FAO Forestry Paper 112. Report prepared by FAO, Rome. (http://www.fao.org/docrep/007/t0830e/T0830E00.htm#TOC)

FAO 2000. *Forest Resource Assessment – Thailand Country Report.* Rome. (http://www.fao.org/docrep/007/ae343e/AE343E00.HTM)

FAO 2005. *Forest Resource Assessment – Thailand Country Report.* Rome (http://www.fao.org/forestry/site/32179/en/)

Forest Research Office, Royal Forest Department/ ITTO 2000. *Review of Current Forest Resources Inventory and Monitoring Practices.* PD 2/99 Rev. 2 (F). Technical Report No. 2. Report prepared by Forest Research Office, Royal Forest Department/ITTO. Bangkok. (http://www.forest.go.th/ITTO/.%5Cdocument%5CReviewExistingInventoryAndMonitoringSystems.pdf)

Forest Research Office, Royal Forest Department/ITTO 2001. *Ground Sampling Design.* (http://www.forest.go.th/ITTO/5Cdocument/5CGroundSamplingDesign.pdf)

Forest Research Office, Royal Forest Department/ITTO 2001. Pilot Project Training Manual PD 2/99 Rev. 2 (F). Technical Report No. 5. Report prepared by Forest Research Office, Royal Forest Department/ITTO. Bangkok. http://www.forest.go.th/ITTO/document/TrainingManual.pdf

LOETSCH, F 1957. *A forest inventory in Thailand.* An international journal of forestry and forest industries. Unasylva Vol. 1, No. 4. FAO, Rome. (http://www.fao.org/docrep/x5385e/x5385e06.htm)

Pelz, Dieter R. *Forest Inventories in tropical forests in SE Asia (Thailand and Malaysia).* (http://www.ffu.uni-de/ biometrie/Aktuelles/Veroeffentlichungen/Downloads/forest _inventories_in_tropical_forests.pdde/ pdf)

Rapid Survey 2007. Thailand Working Paper Series.

Sukhotanang, Anawat. 2007, Country Powerpoint Presentation at China Workshop on Broadening, Harmonization and Cross-Sectoral integration of National Forest Inventories in Asia Pacific Region' at Beijing, 26-31 March 2007 - MAR, INBAR, SFA.