



Forestry Department

Food and Agriculture Organization of the United Nations

BRIEF ON NATIONAL FOREST INVENTORY NFI

INDONESIA

Forest Resources Development Service

Rome, September 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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B. Compilation and Supervision

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General Information

Indonesia, officially the Republic of Indonesia, is a nation in Southeast Asia. Comprising 17,500 islands, it is the world's largest archipelagic state. With a population of over 200 million, it is the world's fourth most populous country. The nation's capital and largest city is Jakarta. The country shares land borders with Papua New Guinea, East Timor and Malaysia. Other neighbouring countries include Singapore, the Philippines, Australia, and the Indian territory of the Andaman and Nicobar Islands.

Map of the Country

Figure 1. Map of Indonesia



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

Land Area and Landuse

The total area of Indonesia is 1 904 570 square km and the following table presents the categorisation of land use in Indonesia for 1990, 2000 and 2005.

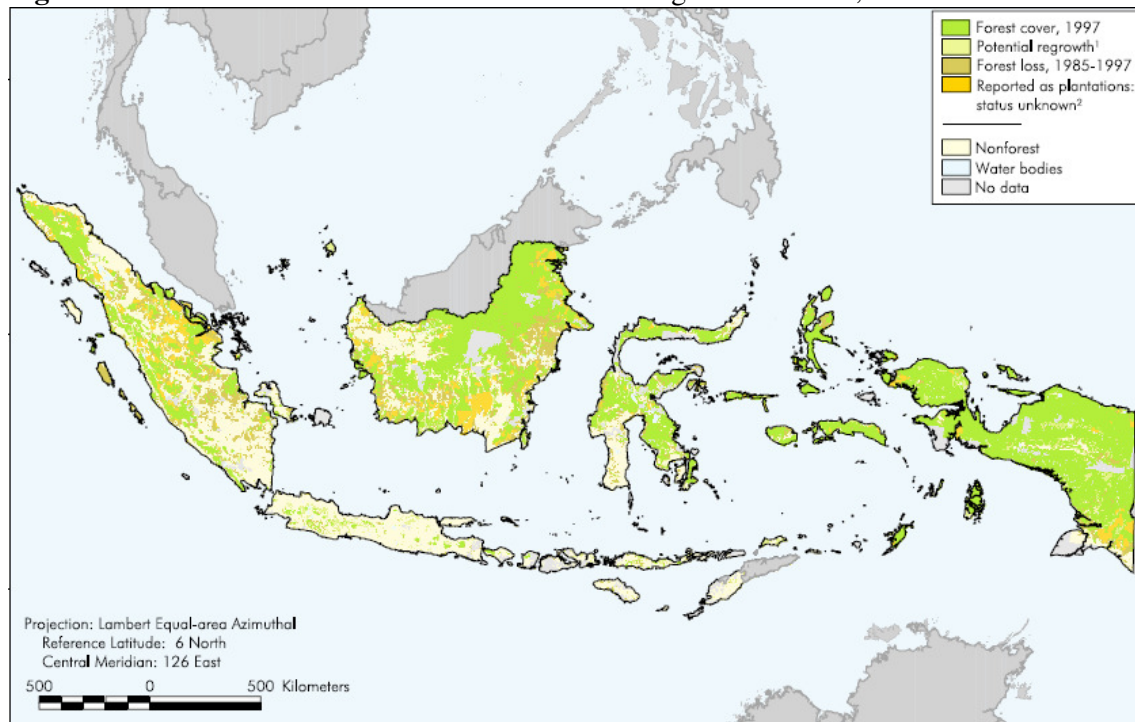
Table 1. Categorisation of land use in Indonesia.

FRA 2005 Categories	Area (1000 hectares)		
	1990	2000	2005
Forest	116 567	97 852	93 127
Other wooded land			
Other land	64 590	83 305	79 613
Other land of which with tree cover	7 857	9 051	98 417
Inland water bodies	9 300	9 300	9 300
TOTAL	190 457	190 457	190 457

Forests

The forests in Indonesia cover an area of more than 90 million ha., equivalent to 46 percent of total land area. This percentage has decreased since the 1980s when forests covered almost three quarters of Indonesia. Illegal activities, including over cutting of forests, cutting in unauthorized areas and theft, are the main causes of deforestation and forest degradation. Additionally, forest fires which repeatedly occurred in the late 1990s have been a major environmental issue to Indonesia because of their global impacts and forced the government to begin to develop an integrated forest fires protection system based on extensive mapping to classify forest areas having potential for serious forest fires. Figure 2 shows areas of forest cover (1997), areas of potential re-growth and areas of forest loss (1985-1997).

Figure 2. Forest cover and Natural Forest Cover Change in Indonesia, 1985-1997



Sources: Forest cover for 1997: GOI/World Bank, 2000. Forest cover for 1985: UNEP-WCMC, 2000 based on RePPProT data. Estate crops and plantations: GOI/FAO, 1996. Boundaries: ESRI Digital Chart of the World (DCW), 1993 and FWI, 2001.

In terms of natural forest, there are two major forest types in Indonesia: tropical rain and monsoon forest. The tropical rain forest is dominated by Dipterocarp family, such as Shorea, Dryobalanops, Dipterocarpus, Hopea, Vatica, Parashorea, Cotylelobyum and Anisoptera species. At present, these species are harvested for economical purposes.

Indonesian forests can be divided into the following types based on their use or function: (a) Conservation and Park Forest - the preservation and conservation of the sources of the biological species diversity as well as of the system for life support, development of knowledge, education and tourism. Conservation and Park Forest is divided into Nature Reserve, Wildlife Sanctuaries, National Park, Grand Forest Park, Nature Recreational Park and Hunting Park; (b) Protection Forest - forest area with specific physical characteristics which function mainly for water catchment and control; (c) Production Forest - forest area open for the production of wood, rattan, resin and other non timber forest products. Production Forest is divided into Limited Production Forest, Permanently Production Forest and Convertible Production Forest.

NFI data from 1996 indicated area of natural forest as 139.5 million hectares, of which 113.8 million hectares is permanent forest lands and 25.7 million hectares is convertible forest

lands. The permanent forest land consists of 30.7 million hectares of protection forests, 18.8 million hectares of conservation forests (national parks, nature reserves, etc.) and 64.3 million hectares of production forests. Additionally, over 3.1 million hectares of forest lands had been converted to agricultural crop land and 0.93 million hectares reserved for transmigration. More recent data based on interpretation of Landsat images of 2005, indicate a reduction of total forest area to 93.13 million ha, as shown in table 2, while table 3 shows forest area according to its designated function, indicating a decrease in production area and an increase of conservation areas.

Table 2. Categorisation of forests in Indonesia

FRA 2005 Categories	Forest Area (000 ha)		
	1990	2000	2005
Primary	70 419	55 941	47 358
Semi natural	43 939	38 909	42 634
Productive plantation	2 209	3 002	3 136
TOTAL	116 567	97 852	93 128

Table 3. Area of forest according to designated function

Forest Designated function	Area (1000 hectares)		
	1990	2000	2005
Production	75,310	56,908	53 622
Protection of soil and water	25,718	24,769	23 943
Conservation of biodiversity	15,539	16,175	15 562
Total- Forest	116,567	97,852	93 127

Brief History of Forest Inventories

Prior to the NFI Project, Indonesia had carried out national level planning however it was not supported by a national level inventory; nevertheless the inventory carried out in 1989 is considered as the first NFI. Although there have been many inventories at a concession level in the past decades, they all were independent of one another and focused on the needs for management and utilisation of the forest.

The National Forest Inventories (NFI) in Indonesia have been supported mainly by three projects/programs: (a) Forestry Institution and Conservation Project (1989-1996), financed by World Bank Loan and assisted by FAO, based mainly on interpretation of Landsat MSS / Landsat TM image year 1986-1991, SPOT image and aerial photograph. (b) Recalculation of Forest Resources (2003), financed by national budget, based on interpretation of Landsat TM/ Landsat 7 ETM+ image year 1999/2000 (c) Recalculation of Forest Resources (2005), financed by national budget, based on interpretation of Landsat 7 ETM+ image year 2002/2003.

Table 4. 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			
1996	Final Forest Resources Statistics Report (of NFI)	Ditjen INTAG, Ministry of Forestry, Government of	1990 - 1996	Landsat MSS 1986-1991	1:250 000	National	Complete	NF, OWL, FAC, TV, CV, PA, BD, WSP,
2003	Recalculation of Indonesia forest cover	Badan Planologi Kehutanan - MoF	2000-2001 (ground check)	1999-2000	1:250 000	National	Complete	24 classes of land covers
2005	Recalculation of Indonesia forest cover	Badan Planologi Kehutanan - MoF	2003-2004 (ground check)	2002-2003	1:250 000	National	Complete	24 classes of land covers

****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.

National Forest Inventory Design

A Systematic Sampling Design has been used for NFI in Indonesia since 1989 up to the latest NFI in 2006 (re-enumeration). The grid layout is set at ground distance of 20 km x 20 km, however, in the latest NFI the sampling density has been increased to a grid of 10 km x 10 Km.

Remote Sensing

Remote Sensing has been used for NFI in Indonesia since 1989. The purpose of Remote sensing in the latest NFI was to identifying forest types and boundaries and estimating forest cover. A total of 131 Landsat MSS prints from 1972 to 1982 at 1:1,000,000 (b&w band 5) were obtained however only about 60 were of quality sufficient to be utilized. Additionally, prints of Landsat TM from 1986-1990 were available for 34 percent of the country.

Recalculation of Indonesia land covers in 2003 and 2005 were based on Landsat images of year 1999/2000, and 2002/2003. It consists of 204 scenes of Landsat images to cover the whole country.

A set of 1:250,000 forest cover and land use maps was prepared for the whole of Indonesia except Java. Land cover was based on MSS satellite data from 1986-1991. All NFI maps have been digitized, edited and stored in a country-wide GIS database. Maps also served for post-stratification and interpretation of field survey results.

Field Inventory

Due to budget constraints, all areas which are not forest land and the forest lands occurring over 1000 m altitude with a function other than permanent production forest are not included.

A plot cluster consists of both temporary (TSP) and permanent sample plots (PSP) as indicated in figures 3 and 4. A total of 2735 plot clusters were enumerated each cluster consisting of 72 temporary plots and a 1-ha permanent sample plot.

The TSPs are located on nine tracts (100 m x 100 m) which are arranged in a square pattern and spaced 500 m apart from each other; therefore a cluster spans an area of 1300 x 1300 m. A set of subplots is enumerated at eight points around each tract, at the four corners and at the midpoints of the four sides. The set of sub-plots includes: a one-meter radius sub plot for seedlings (tree species), a two-meter radius subplot for tree samplings and *nipa* seedlings, a 2.5 m subplot for poles in plantations and mangrove forests, a five-meters subplot for poles, young rattan (less than 3 m stem) and *nipa*, a 10 m subplot for 3 meters stem and longer rattan, bamboo and *sagu*, and a point sample with Basal Area Factor 4.

The central tract also serves as a one-ha PSP divided into 16 record units (25 x 25 m).

Figure 3. Plot cluster layout

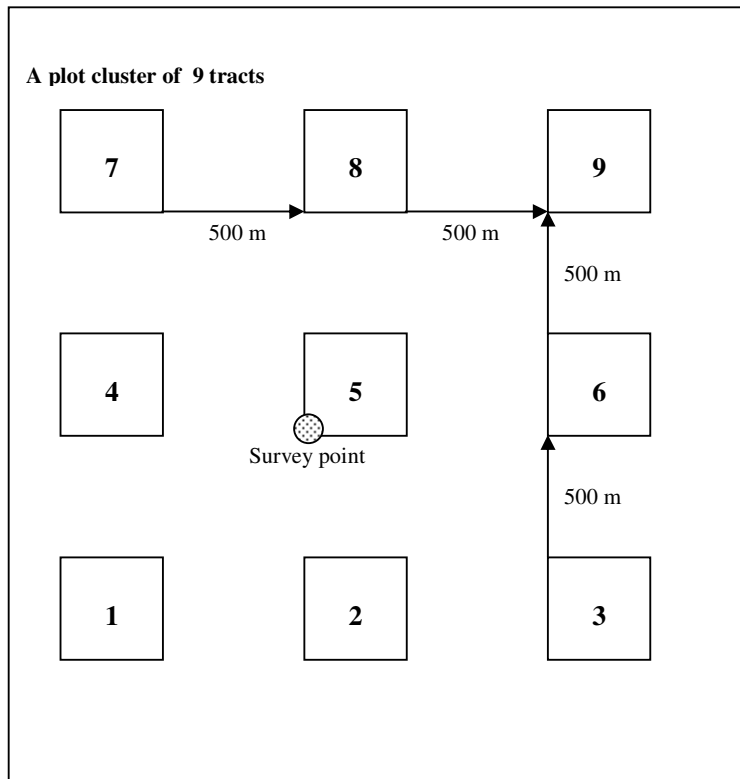
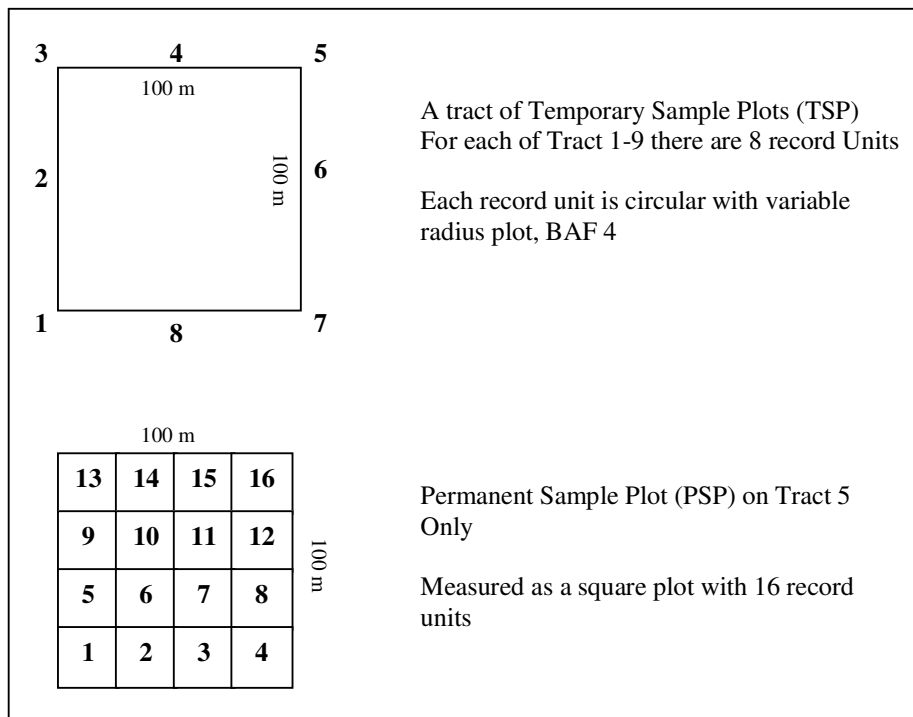


Figure 4. Temporary (TSP) and Permanent Sample Plot (PSP)



Content and Methodology of data collection in NFI

Geo-physical

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

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			Remote sensing survey
Area of forest canopy/crown cover	X			Remote sensing survey
Area under forest management	X			Map, Records
Area under formal forest management plan	X			Map, Records
Area under sustainable forest management	X			Map, Records
Forest area with certification				
Area under public owned forest	X			Map, Records
Area under private owned forest				

Forest characteristics (Naturalness) and forest type

	N	SN	MU	Methodology
Primary forest	X			Field Survey
Modified natural forest				
Semi-natural forest				
Productive plantation	X			Field Survey, Map
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, Maps
Forest area by ecological zone (tropical, subtropical, temperate, boreal, polar)	X			Field Survey, Maps

Use (designated functions) of forests

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

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			Remote sensing survey
Forest Characteristics	X			Remote sensing survey
Land use	X			Remote sensing survey, Maps
Administrative/political/legal boundaries	X			Maps
Designated functions of forests	X			Maps
Other wooded land				
Other land with tree cover				
Other land				

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	X			Field and remote sensing survey, local interview, records
Disturbance caused by other abiotic factors				

Biodiversity

	N	SN	MU	Methodology
Tree species	X			Field Survey, Local knowledge
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				
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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

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