



Forestry Department

Food and Agriculture Organization of the United Nations

BRIEF ON NATIONAL FOREST INVENTORY NFI

CHINA

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

The People's Republic of China, commonly known as China, is the largest country in East Asia. With over 1.32 billion people, it has the largest population of any country in the world. and it is the world's fourth largest country in terms of total area. Its capital is Beijing while its largest cities are Hongkong and Shanghai.

Map of the Country

Figure 1. Map of China



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

Land Area and Land use

The total area of China is 9 598 050 square km and the following table presents the categorisation and projection of land use in China for 1990, 2000 and 2005 (FRA 2005).

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

FRA 2005 Categories	Area (1000 hectares)		
	1990	2000	2005
Forest	157 141	177 001	197 290
Other wooded land	101 498	97 683	87 615
Other land	674 103	658 058	647 837
Other land of which with tree cover			
Inland water bodies	27 063	27 063	27 063
TOTAL	959 805	959 805	959 805

Note [1]: The figures of total country area and inland water bodies have been taken from FAOSTAT

Forests

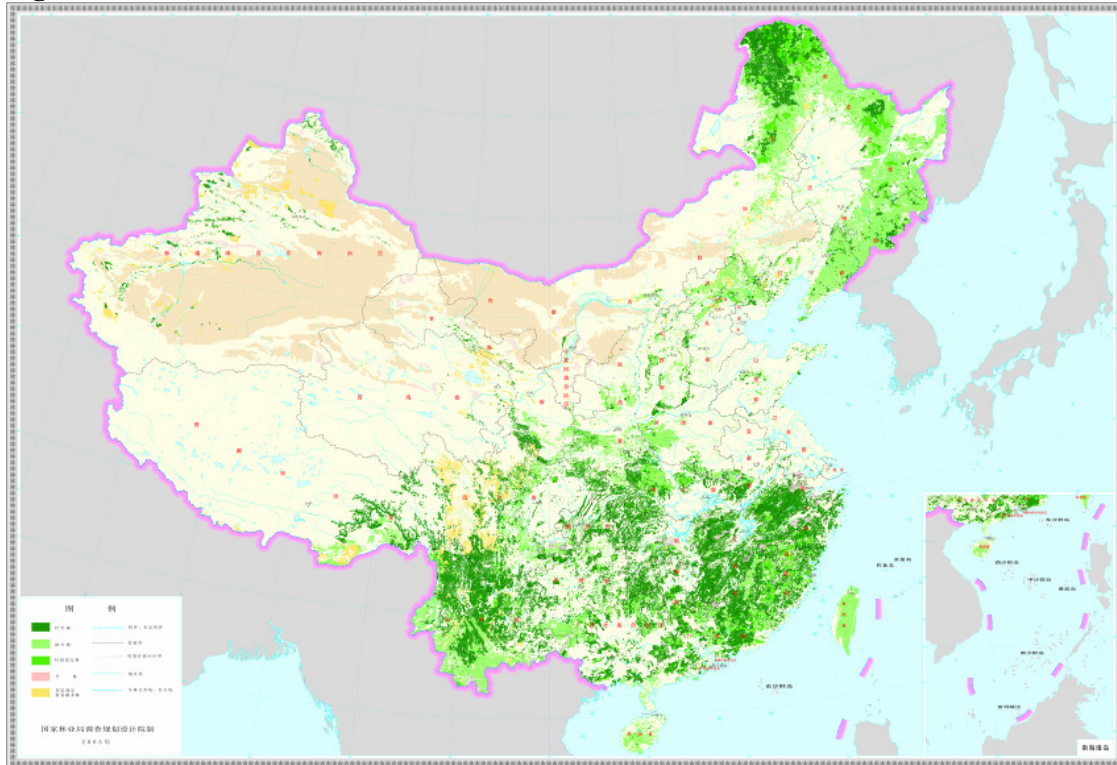
China is primarily located in temperate and subtropical climates, with only a small area in southernmost China belonging to the tropical region. Vegetation in China is strongly influenced by topography and the unique summer monsoon systems. Generally, the western two-thirds of China are at high altitudes, descending from west to east. In this large region, moisture availability is low and the land is largely arid. Eastern China is within the reach of both the Pacific and Indian monsoon systems, with ample precipitation on the plains.

The types of natural vegetation and their floristic composition are very diverse. Currently China has over 8 000 species of woody plants, 190 of which have been listed as rare and endangered and are under state protection.

The woody vegetation in China has its unique characteristics: the majority of China's natural forests are closed forests, the evergreen and deciduous/evergreen forest/shrub vegetation in southern China is unique in the world, and the number of endemic woody species is high.

The forests can be classified into following ten forest types: Mid-temperate mountain coniferous forests; South temperate deciduous broadleaf forests; South temperate desert river-bank poplar forests; Plateau climatic mountain coniferous forests; Mid-subtropical evergreen broadleaf forests; North temperate coniferous forests; Mid-temperate mixed coniferous and broadleaf forests; North subtropical evergreen broadleaf forests; North tropical monsoon rain forests and tropical rain forests; South sub-tropical mangrove forests.

Figure 2. Forest Distribution in China



The distribution of forest area in China is shown in Figure 2 while Table 2 presents a summary of the categorisation and projection of forest area with data from FRA 2005. The total area of forest, not including other wooded land equals 197 290 (000ha) in 2005 corresponding to roughly 20% of total land area.

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

Category	Area (000 ha)		
	1990	2000	2005
Primary	11 632	11 632	11 632
Modified Natural	101 754	110 956	114 332
Semi-natural	25 289	30 489	39 957
Productive Plantation	17 131	21 765	28 530
Protective Plantation	1 335	2 159	2 839
Total	157 141	177 001	197 290

Brief History of Forest Inventories

Forest resources monitoring system was initiated in China in 1950. Forest survey covering most state owned forest areas was carried out to make clear quantity of forest resources in China, including forest area and volume, and ended in 1962.

The first inventory of forest resources at national level was initiated by Ministry of Forestry from 1973 to 1976, counties or state owned forest bureaus were taken as inventory units, and pilot projects were conducted in North and South of China respectively. Varied inventory methods were adopted in different regions, and sample plots were introduced in some provinces. Since 1977, a national system of continuous forest resources inventory was regularly organized by Ministry of Forestry (before 1998) and State Forestry Administration (after 1998), and sample technique is taken as common method used in ground-survey. A summary of past inventories in China is presented in Table 3

NFI system is carried out by the provinces (autonomous region or municipalities) throughout the country since 1973 at five years intervals, based on fixed ground sample plots and regular measuring. Up to 2003, six national forest inventories have been conducted, including the 1st NFI (1973-1976), the 2nd NFI (1977-1981), the 3rd NFI (1984-1988), the 4th NFI (1989-1993), the 5th NFI (1994-1998) and the 6th NFI (1999-2003). The latest NFI was put into practice at the beginning of 2004 and will end in 2008.

Thanks to technological and methodological developments during the last 20 years, the currently implemented NFI exhibits considerable advances in many aspects such as the technical approaches, the products generated, and intensity and organization of the inventory. New technologies and methodologies such as remote sensing, GPS, GIS, and modelling methods are widely used for NFI, which improve efficiency and quality of measurement.

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			
1978	National Forest Resources Statistics (1973-76) 1 st NFI	Ministry of Forestry P.R. China	1973-76			National	Complete	NF, PL, OWL, FAC, TV, FO, TOF
1982	National Forest Resources Statistics (1977-81) 2 nd NFI	Ministry of Forestry P.R. China	1977-81			National	Complete	NF, PL, OWL, FAC, TV, FO, TOF
1989	National Forest Resources Statistics (1984-88) 3 rd NFI	Ministry of Forestry P.R. China	1984-88			National	Complete	NF, PL, OWL, FAC, TV, FO, TOF
1994	National Forest Resources Statistics (1989-93) 4 th NFI	Ministry of Forestry P.R. China	1989-93	1989	1:50,000	National	Complete. approximately 220,000 fixed plots. Sat. images in some provinces.	NF, PL, OWL, FAC, TV, FO, TOF
1999	National Forest Resources Statistics (1994-98) 5 th NFI	State Forestry Administration P.R. China	1994-98	1994	1:50,000	National	Complete. approximately 270,000 fixed plots. Sat. images in some provinces.	NF, PL, OWL, FAC, TV, FO, TOF
2004	National Forest Resources Statistics (1999-03) 6 th NFI	State Forestry Administration P.R. China	1999-03	1999	1:50,000	National	Complete	NF, PL, OWL, FAC, TV, FO, TOF
2006	National Forest Resources Statistics (2004-08) 7 th NFI	State Forestry Administration P.R. China	2004-08	2004	1:50,000	National	Complete. 415,000+ fixed plots. Sat. images in some provinces.	NF, PL, OWL, FAC, TV, FO, TOF, BD

****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.

Latest National Forest Inventory Design

The National forest inventory (NFI) is designed for monitoring the macro-changes of forest resources at national and provincial levels on a continuing basis (every 5 years) in terms of forest quantity, quality and functions. The main objectives of the NFI are to identify forest extent, volume, growth, consumption, function and their dynamics during the interval of NFIs. Additionally the NFIs provide basic statistics to guide forest management, forest policy making, and development of plans for forestry development and ecological conservation.

The inventory design which has been used since the first NFI is Equal-distance Systematic Sampling. Such sampling design is used to ensure that NFI results are comparable on a continuing basis, to facilitate field work and to produce national and provincial statistics of forest resources. It should be noted however that, at the province level, the framework of sampling design in different provinces can vary and about one fifth of the provinces are inventoried annually.

Remote Sensing

Remote sensing has been used in National Forest Inventories since 1994. The purpose of using remote sensing in the latest NFI is to: (a) identify geo-spatial distribution of forest changes; (b) improve precision of other wooded land types with a low area proportion in population, for example, un-established forest, fired-over land and cut-over land; and (c) prevent biased estimate of field measurements.

Equal-distance systematic sampling is used to set RS-based plots. In general, intensity of RS-based plots is at least 4 times as that of ground plots, and the distance between plots is less than 2×2 km. (this is decided according to the required intensity of ground sampling plots and estimate precision in a specific population). Thematic measurement of forest resources focuses on specific issues, such as area estimation, mapping, and monitoring of catastrophic events.

The extent of application of the remote sensing techniques mostly depends on the availability of satellite data. In China the satellite data available include NOAA (AVHRR) and Landsat TM. The resolution of NOAA is rather low but it can be used for broad land type classification and small scale maps. On the other hand, the resolution of Landsat TM images is quite high but it is almost impossible to obtain non-interference images covering a vast tract of land, so they can be used at provincial level and for detailed interpretation of land classes. Comparing areas within the vast territory of China, it can be stated that the provinces in the north have the advantage of employing remote sensing techniques to their provincial level forest inventory while in the south, due to the highly mountainous nature of the land, the application of remote sensing is more difficult.

Field Inventory

For the 7th NFI, 415 000 fixed ground sample plots were established throughout the whole country. The density of ground plots is set according to the required estimate precision of forest land area, growing stock, plantation area, amount of growth and consumption. Distance can vary from 2×2 km to 8×8 km.

The shape, area and size of sample plot can vary among different populations, however they are unique within a specific population. Usually sampling plots have a square shape (Figure

3) but can also be rectangular, round or diamond-shaped. The square shaped plots have a size of 25.8×25.8m equal to 0.0667 ha. (but can range between 0.06 - 0.1ha)

Figure 3. Example of square sample plot and tree enumeration within plot



The ground (sampling plot) survey is composed of two main parts: sampling plot factors and sampling tree factors. Sampling plot factors include more than 70 sub-factors, such as land use, land cover, growing condition, soil, characteristics and functions of forest and ecological status. Sampling tree factors include tree number, species, diameter at breast height, etc. Although the amount of data collected can vary according to different populations, the data which are normally collected are listed in Table 4.

The sample plots are systematically laid out on the grid dots of topographic maps (scale 1:50,000) according to the forest conditions of the province to be inventories. In the field the sample plots are permanently marked with stakes.

Table 4. Variables normally collected at plot level.

1	Longitude	13	Average Dbh
2	Latitude	14	Average Height Of Stand
3	Land Use Type Class	15	Site Class
4	Ownership	16	Canopy Density
5	Elevation	17	Volume Of Growing Stock
6	Geo-Morphology	18	Volume Of Stand
7	Slope	19	Volume Of Dead Trees
8	Soil	20	Volume Of Removals
9	Forest Type	21	Stem Number Of Bamboo
10	Dominant Species	22	Species Or Species Group
11	Average Age	23	Mortality
12	Age Class		

Measurements

All trees with diameter at breast height greater than 5 cm are measured and geo-referenced. Permanent sample plots are maintained to estimate change of forest resources over time and space. Growing stock in a forest is estimated by multiplying its mean volume/plot by ratio of plot area to population area. NFI are using GPS since 1999. It allows for the improvement of efficiency during field visit, improvement of precision of geographic coordinate of ground plots, enhancement of restoring ratio of re-measured ground plots with GPS track map and an improved performance of quality control. Beginning in 2001 NFI surveying crews started to

adopt a Personal Digital Assistant to enhance the efficiency of information collection, reduce errors and switch to a non-paper operation of field measurement.

Content and Methodology of data collection in NFI

Geo-physical

	N	SN	MU	Methodology
Geo-Coordinates	X			Field Survey
Altitude	X			Field Survey
Topography	X			Field Survey
Orientation (or Aspect)	X			Field Survey
Slope	X			Field Survey
Soil	X			
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				
Stump height				
Age class	X			Field Survey
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	X			Record
Area under private owned forest	X			Record

Forest characteristics (Naturalness) and forest type

	N	SN	MU	Methodology
Primary forest				
Modified natural forest				

Semi-natural forest				
Productive plantation				
Protective plantation				
Coniferous	X			Survey
Broadleaved	X			Survey
Mixed forest	X			Survey
Forest area by dominant species (bamboo, mangroves, rubber)	X			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	X			
Area of forest for protection of soil and water	X			
Area of forest for conservation of biodiversity				
Area of forest for social services	X			
Area of forest for multiple purpose				
Forest area available for wood supply	X			
Forest area within protected areas				

Social Services

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

Mapping of forest distribution

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

Status of the forest and disturbances affecting forest health and vitality

	N	SN	MU	Methodology
Disturbance by insects	X			Field Survey
Disturbance by diseases	X			Field Survey

Disturbance by other biotic agents				
Disturbance by fire	X			Field Survey
Disturbance caused by other abiotic factors	X			Field Survey

Biodiversity

	N	SN	MU	Methodology
Tree species				
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)?	X			Records
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	X			Documents
Forest legislation	X			Documents
Forest administration	X			Documents
Forest education and research				
Annual outlay, expenditure, investment in forestry sector	X			Documents

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