Forestry Department

Food and Agriculture Organization of the United Nations

BRIEF ON NATIONAL FOREST INVENTORY NFI

SRI LANKA

Forest Resources Development Service

Rome, June 2007

MAR-SFM Working Paper 28/ 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 tack force on streamlining the reporting on forests with particular focus on national capacity building.

The MAR 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 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 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 Sri Lanka

A. National Focal Point

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B. Compilation and Supervision

This report has been compiled by Mr. Kulranjan Kujur under supervision of Dr. Kailash Govil, Senior Forestry Officer, MAR.

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General Information

Sri Lanka, officially the Democratic Socialist Republic of Sri Lanka (known as Ceylon before 1972) is an island nation in South Asia, located about 31 kilometers off the southern coast of India. Its capital is Sri Jayawardenapura-Kotte while the largest city is Colombo.

Map of the Country

Figure 1. Map of Sri Lanka
(Source: https://www.cia.gov/library/publications/the-world-factbook/geos/ce.html)

Land Area and Landuse

The total area of Sri Lanka is 65 610 square kilometres and the following table presents the categorisation and projection of land use in Sri Lanka for 1990, 200 and 2005 (FRA 2005). The forest area includes in 1990, 2000 and 2005.

Table 1. Land area and landuse

FRA 2005 Categories	Area (1,000 hectares)		
	1990	**2000**	**2005**
Forests including rubber	2350	2082	1993
Other land	4113	4381	4530
Inland water bodies	98	98	98
TOTAL	6561	6561	6561

(Source: FAO, FRA 2005)

Forests

Sri Lanka's forest cover amounts to approximately 2.1 million hectares representing 32 % of the total land area. Of this extent 2.04 million hectares represent natural forest and 0.7 million hectares planted forest. Of the area under natural forests, 1.58 million hectares are close canopy forest covering 23.9% of the land area. The natural forests are very unevenly distributed with 86% being concentrated in the dry and intermediate zones. These two zones carry 85% of the closed canopy forests in the country and 90% of the sparse and open forest.

The forests of Sri Lanka can be classified into nine forest types: i) montane forest; ii) sub-montane forest; iii) lowland rain forest; iv) moist monsoon forest; v) dry monsoon forest forest; vi) riverine dry forest; vii) mangroves ; viii) sparse forest; and ix) forest plantations excluding rubber. Figure 2 and Table 2 below provide details of forest distribution and area by type..

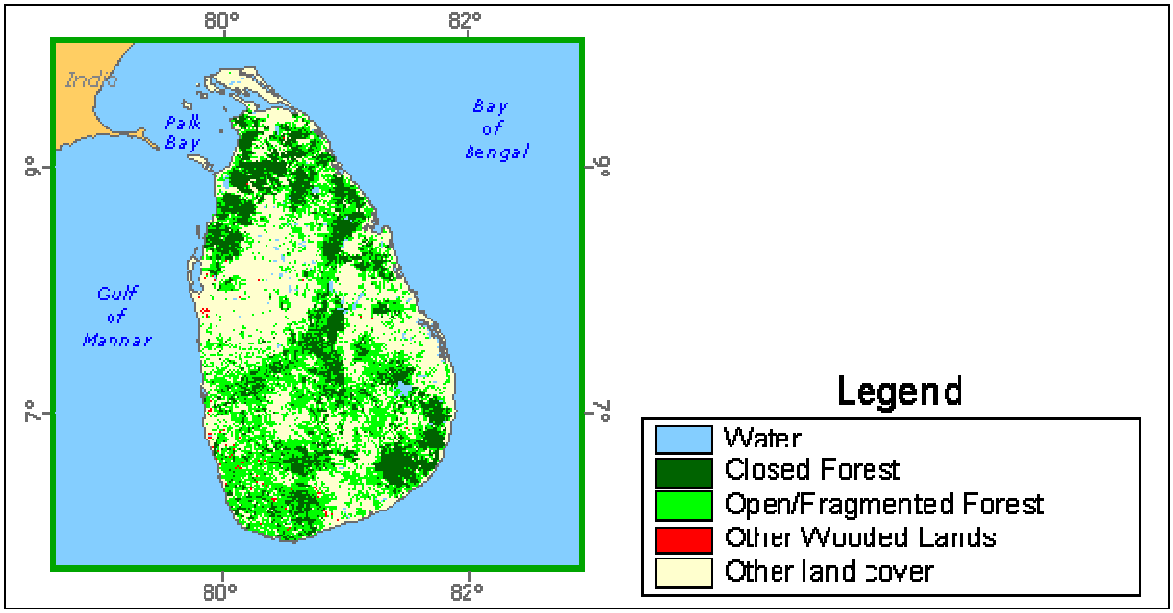

Figure 2. Forest Cover Map – Sri Lanka
(source: Source: FAO Global Forest Resources Assessment 2000)

Table 2. Area of forest in different regions in 1998

Forest Class	1992 (ha)	1996 (ha)
Montane Forest	3,108	3,099
Sub-montane Forest	68,838	65,792
Lowland Rain Forest	141,549	124,340
Moist Monsoon Forest	243,877	221977
Dry Monsoon Forest	1,094,287	1,027,544
Riverine Dry Forest	22,411	18,352
Mangroves	8,687	9,530
Sparse Forest	463,842	471,583
Forest Plantations Excluding Rubber	72,340	79,940
Total Forest Area	2,118940	2,022160
Total Land Area	6,586,509	6,616,628

(Source: FAO, FRA 2005)

Brief History of Forest Inventories

Sri Lanka's history of forest inventory dates back to 1956. A national forest inventory based on aerial photography and field sampling was carried out as part of the Canada-Ceylon Colombo Plan Resources Survey in 1958-60. In addition to this, a development survey of selected blocks of natural as well as plantation forests was done by FAO/UNDP in the years 1965-1967 to update the findings of the earlier forest inventory survey.

In 1979 the Government of Sri Lanka requested assistance from the United Nations Development Programme in preparing a project proposal for a National Forest Inventory with the Forest Department of Sri Lanka. In November/December 1980 FAO representatives in collaboration with UNDP, prepared a project proposal titled "National Forest Inventory".

The project was approved for three years and became operational in January 1982, with FAO designated as Executing Agency. The Sri Lanka Forest Department under the Ministry of Lands and Land Development was appointed as the Counterpart Agency. The only complete National Forest Inventory was carried out over a four year period (1982-85) with in 1986

With this practice of planning in forestry the Sri Lankan government, with technical support from FAO and World Bank, developed its Forestry Sector Master Plan in the year 1995.

The following table presents the Natural Resource Management Programmes implemented in Sri Lanka during the last three decades with the donor assistance.

Table 3. Natural Resource Management Programmes implemented in Sri Lanka

Source of Funding	Period	Implementing Organization	Major objectives of the programme
FAO	1975	Department of Agriculture	Measurement of soil erosion under various land-use patterns
USAID	1980	Forest Department	Watershed management in upper catchments, Reforestation of 10,000 ha in steep degrades areas of the island, forestry extension, forestry research, forestry training and forest protection
ADB	1983	LUPPD of the Ministry of Agriculture	District level land use planning and mapping.
Canadian Aid	1984	Forest Department	IDRC Research Project on Bamboo and Rattan
Norad –IUCN	1988	Forest Department	Knuckles Conservation Project
British ODA	1989	Forest Department and Mahaweli Ministry	Mapping of upper watershed (Peak Wilderness and Knuckles Range – 3400 km^2 (producing of 1:10,000 land use maps with following information: Vegetation, contours, slopes, rivers, rain fall erosivity and roads. Land-use planning and watershed `conservation.
German – Sri Lanka (GTZ)	1990	Ministry of Mahaweli (MASL)	Watershed Management in the upper Mahaweli catchments, improvement of micro-watersheds, conservation of tea plantations, awareness building of the rural communities
NORAD	1990	Forest Department	Faunal and Floral inventory of all natural forests above 200 ha situated in the entire island.
NORAD IUCN	1991	Forest Department	Mangrove Conservation and Management Project
USAID	1992	Ministries of Forestry and Agriculture	Shared control of natural resources, Practice sustainable agriculture and resource management in two pilot watersheds.
ADB	1990	Forest Department	Community forestry project CFP
ADB, Aus Aide and GOSL	1995	Forest Department	Participatory forestry project PFP
ADB	2000	Forest Department	Forest resource management project FRMP

WB GEF	1995 - 2005	Ministry of Indigenous Medicine	Conservation and Sustainable use of Medicinal Plants
ADB	1995	Ministry of Environment and Natural Resources	Watershed management in upper catchments of Walawa gangar and Uma Oya
ADB, World Bank and the Government of Netherlands	2000 - 2007	Ministry of Environment and Natural Resources – Department of Wildlife Conservation	Protected Area Management and Wildlife Conservation Project
UNDP	2000 - 2005	Forest Department	Conservation of South West Rain Forests
AUSAID	2003	Forest Department	Natural Resource Management / Joint resource management in two pilot districts
UNDP, NORAD and ADB	2000 - 2005	Ministry of Fisheries and Ocean Resources	Conservation of Biodiversity in the Rekawa, Ussangoda and Kalametiya (Southern Coast)

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]			
2000	Forest Cover Mapping	Government of Sri Lanka		1996				Vegetation types and canopy cover
1995	A 1:50,000 scale Forest Map of Sri Lanka: The basis for National Geographic System	Sri Lanka		1992	1:50,000	National	Complete	NF, PL, FAC
					1:63,360	District	Compete	
1995	Sri Lanka Forestry Sector Management Plan 1995	Sri Lanka		1992	1:500,000	National	Complete	NF, PL, FO
						District	Complete	

****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

Design of Forest Inventories

The only complete National Forest Inventory (1986) was carried out during the period 1982 to 1985. The inventory was designed to provide nation wide data suited to meet the requirements of the Master Plan which became operational in 1983. A systematic sampling design was adopted for the assessment of plantation areas with a sampling intensity of 0.2%.

Aerial Photography and Mapping

During 1981/82 a photo-flying programme was carried out by the Survey Department over the whole country. Photo scales varied from 1:20,000 to 1:50,000. Forest areas in the wet zone (south-western quarter of the island) were flown over and images became available in 1983 1:20,000 scales. Aerial photographs of scale 1:50,000 covering large areas of the Dry zone and up-country are less suitable for forest interpretation purposes due to the irregular physiographic nature of the land and presence of scattered forests areas.

Mapping activities concentrated on the compilation of forest maps at 1:25,000 scale or larger from interpreted air-photos. The lack of accurate base maps and precise identification of forest boundaries required further work which resulted in a series of maps at 1:12,000 scale only covering a fraction of the total forest area. Thus, these maps are sufficient for overall planning purposes but not for management implementation.

Satellite Images were also used. The images were Landsat MMS (1:1,000,000) and Landsat RVB (1:500,000) colour frames supplied by NASA, dated 1981 and 1983.

Remote Sensing

The National Physical Planning Department has setup a GIS Laboratory to cater to National Physical Planning of Sri Lanka and acquired a full Landsat 7 ETM+ coverage of the Island for 1999-2001 in the purpose of updating the island-wide Land Use Mapping. Closed Canopy forest mapping was undertaken by the staff of the GIS laboratory for the purpose of deriving district-wise information of forest cover changes over the last 20 years. The method used for classification of the forest land cover was a semi-automated update of previously available map. A set of 3 Districts of fast decreasing forest cover and of 5 Districts of substantial increase of forest cover have been identified out of 25 districts of Sri Lanka in the period of 1992-2001 (see figure 3). District changes highlight planning policies options of critical importance for the implementation of the National Policy at District level.

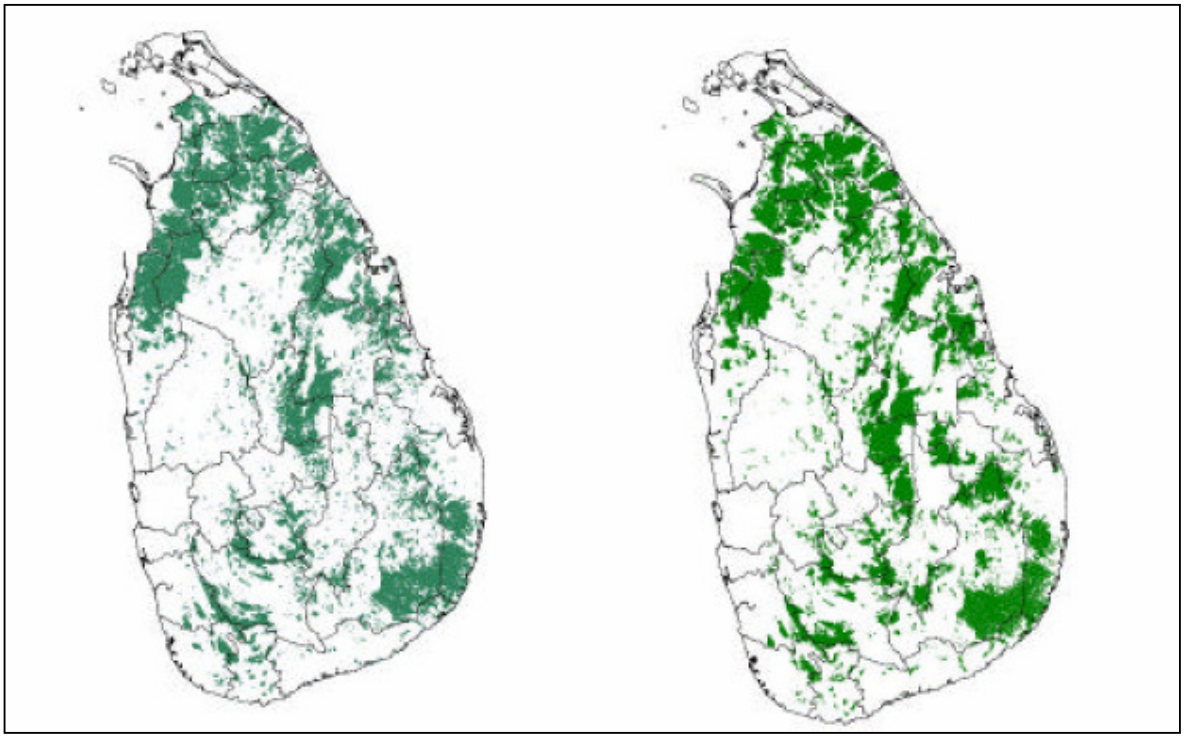

Figure 3. District forest cover of Sri Lanka in 1991-92 and 1999-2001.

Field Inventory

Field sampling was undertaken during three different phases: for management planning of Wet zone natural forests, for management planning of existing plantations island-wide and for indicative assessment of all other forest cover (largely in the Dry zone natural forests). A total of 162 clusters of samples were measured in 42 locations in the wet zone and 29 clusters in 10 locations in the Dry zone and upcountry natural forests.

Three different sampling designs were employed:

(i) Clustered-plot sampling: each cluster containing 9 plots, 3 plots in a line at a distance of 100 meters between plots and 100 meters between lines, direction north. This design was applied to relatively large blocks of Wet Zone forests. (see figure 4)

(ii) Strip-plot sampling: along lines 200 meters apart, parallel in a pre-determined direction from a baseline or surveyed road. This design was applied in relatively small blocks of wet zone forests. (see figure 4)

(iii) Line-plot sampling: along a line in a pre-determined direction from a recognized point on a road. This design was applied in selected locations of large blocks of dry zone forests. (see figure 5)

Tree measurements

In both cluster and line sampling, the plots were designed for the enumeration of trees of dbh greater then 30 cm. For smaller size classes 15-30 cm dbh (bigger poles) and 5-15 cm dbh

(smaller poles), sub plots were laid out inside the principal plots of, respectively, 400 square meters (100 x 4 meters) in cluster and 80 square meters (20 x 4 meters) in strip plots.

The information recorded in each plot and sub-plot includes (i) General information: year, forest division, cluster line number, plot number, etc. (ii) Plot information: slope, aspect, ground conditions, altitude, soil type, geology, presence of bamboo / fern, etc. (iii) Stand information: forest type (unlogged, logged, overcut, dense, open) and inventory type (cluster sampling, strip sampling, indicative inventory) (iv) Tree information: species, damage, dbh, number of log lengths, quality of logs, vigour, height (in plantations only).

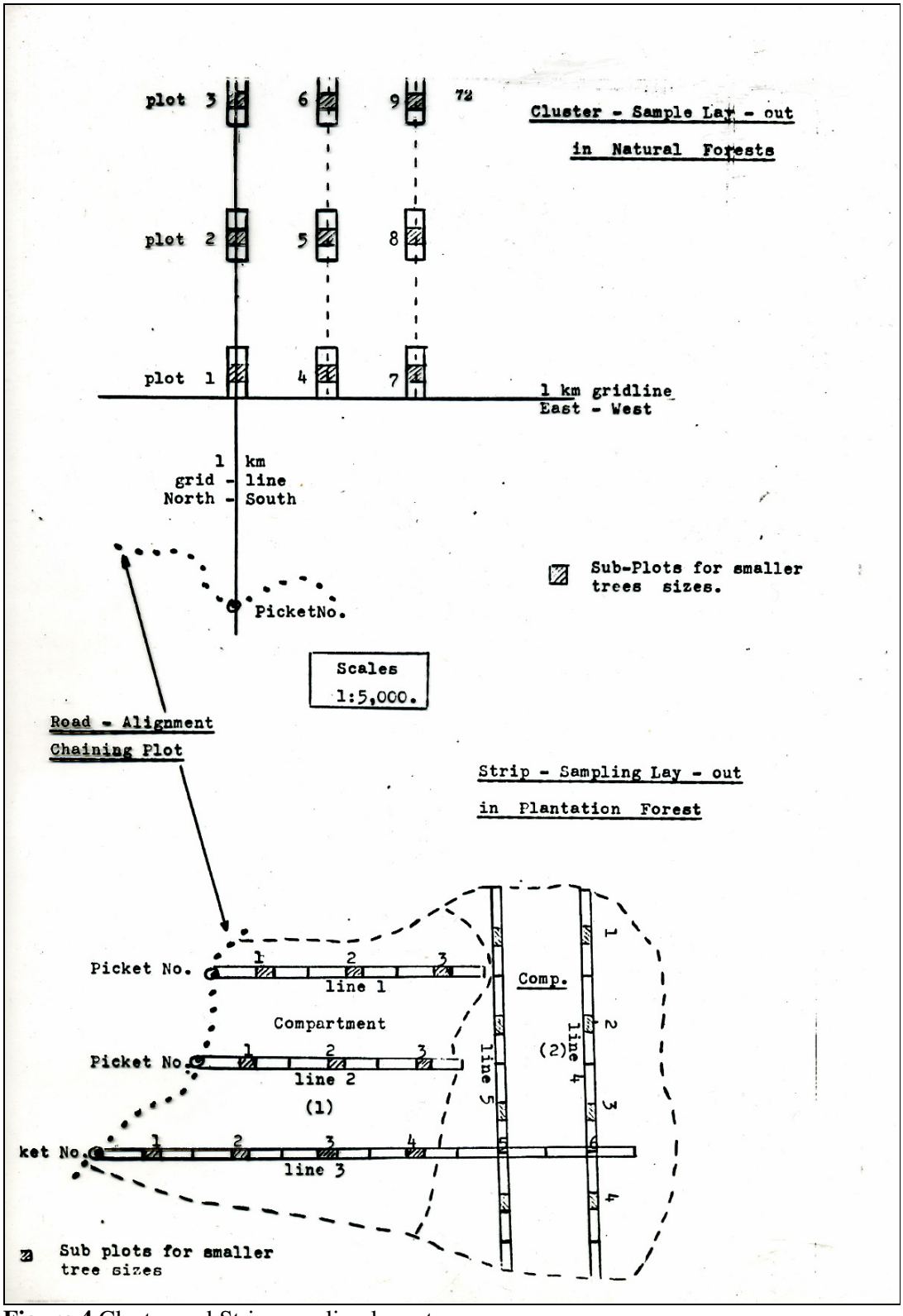

Figure 4.Cluster and Strip sampling layout

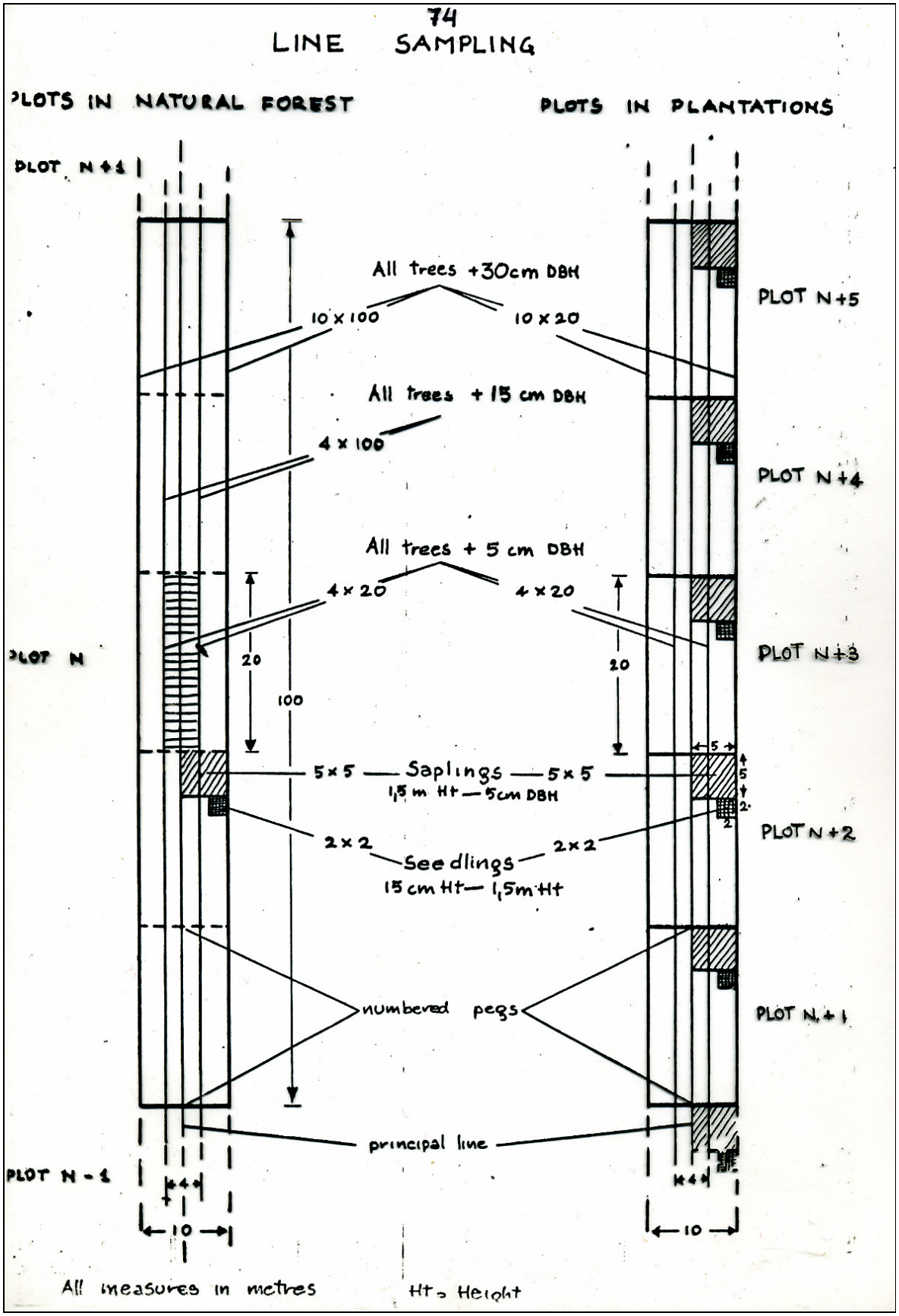

Figure 5. Line Sampling Layout

Content and Methods of Data collection

Geo-Physical

	N	SN	FMU	Methodology
Geo-Coordinates	**X**			Maps and GIS
Altitude	**X**			Maps and GIS
Topography	**X**			Maps and GIS
Orientation (or Aspect)	**X**			Maps and GIS
Slope				*Info not available*
Soil				*Info not available*
Geological structure	**X**			Maps and GIS
Rainfall	**X**			Maps and GIS

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 regeneration)	**X**			Records
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**			RS	Inventory, Survey, Maps and
Area of forest canopy/crown cover	**X**				RS
Area under forest management	**X**			RS	Inventory, Survey, Maps and
Area under formal forest management plan	**X**			RS	Inventory, Survey, Maps and
Area under sustainable forest management					*Info not available*
Forest area with certification					*Info not available*
Area under public owned forest					*Info not available*
Area under private owned forest					*Info not available*

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				*Info not available*
Forest area by dominant species (bamboo, mangroves, rubber)				*Info not available*
Forest area by ecological zone (tropical, subtropical, temperate, boreal, polar)				*Info not available*

Use (designated functions) of forests

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

Social Services

	N	SN	FMU	Methodology
Area of forest managed for recreation	**X**			Survey, maps and GIS
Area of forest managed for tourism	**X**			Survey, maps and GIS
Area of forest used for education	**X**			Survey, maps and GIS
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**			Campus survey of some plantations
Forest Characteristics	**X**			GIS, & Aerial photos, Survey department maps
Land use	**X**			Aerial photos
Administrative/political/legal boundaries	**X**			Survey department maps & digital data
Designated functions of forests	**X**			GIS and aerial photos
Other wooded land	**X**			GIS and aerial photos
Other land with tree cover				*Info not available*
Other land				*Info not available*

Status of the forest and disturbances affecting forest health and vitality

	N	SN	FMU	Methodology
Disturbance by insects				*Info not available*
Disturbance by diseases				*Info not available*
Disturbance by other biotic agents				*Info not available*
Disturbance by fire				*Info not available*
Disturbance caused by other abiotic factors				*Info not available*

Biodiversity

	N	SN	FMU	Methodology
Tree species	**X**			Inventory and Survey
Shrub species				*Info not available*
Herbs species				*Info not available*
Endangered species				*Info not available*
Critically endangered species	**X**			Records
Vulnerable species				*Info not available*
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)?				*Info not available*
By good/service (e.g. timber, fuelwood, NWFP, bamboo/rattan, water, etc) used by them				*Info not available*
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**			FORDATA based, statistical analysis
Removal of fuelwood	**X**			FORDATA based, statistical analysis
Removal of other wood products				*Info not available*
Removal of wood products derived from forest under sustainable management				*Info not available*
Removal of wood products derived from forest plantations	**X**			*Info not available*

Removal of non wood forest products				*Info not available*
Annual allowable cuts/yields	**X**			
Social services	**X**			
Environmental services	**X**			
Employment				*Info not available*
Support to livelihood of communities				*Info not available*
Market price/cost of wood in forest				*Info not available*
Market price/cost of non wood forest products				*Info not available*
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**			Reports and documents
Forest legislation	**X**			Reports and documents
Forest administration	**X**			Reports and documents
Forest education and research	**X**			Reports and documents
Annual outlay, expenditure, investment in forestry sector	**X**			Annual budget, Expenditure, Forest Programme

Bibliographies and References for further reading

GOSL/UNDP/FAO 1986. Forest Inventory for Management Planning,. A National Forest Inventory of Sri-Lanka (1982-85). Colombo, Sri Lanka

EU UNDP 2004. Regional Strategic Framework Country Guideline Paper – Sri Lanka (2004-2007). Colombo, Sri Lanka.

FAO 2005. Forest Resources Assessment 2005. Country Report- Sri Lanka, WP 123 http://www.fao.org/forestry/site/32245/en/

Ratnayake, J. et al. 2002. District-wise forest area variation in Sri Lanka from 1992 to 2001 for supporting the National Physical Planning Policy. Information and Scientific Research Unit - National Physical Planning Department. Ministry of Western Region Development, Government of Sri Lanka