सत्यमेव जयते

MANUAL FOR
FOREST COVER MAPPING

FOREST SURVEY OF INDIA

(Ministry of Environment, Forest & Climate Change, Government of India)

Dehradun

सत्यमेव जयते
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FOREWORD

Forests are important life support system, ensuring the ecological security of the planet. Forest ecosystems are dynamic and are under constant pressure due to growing population and demand for resources and space. Their change of state affects climate, ecosystem services, resource availability, livelihoods of the people and overall well being of the country. It is therefore, important to know the status of forest on regular basis.

Use of geospatial technology including remote sensing techniques using satellite imagery provides a synoptic view and its repetitiveness facilitates mapping and monitoring of forest resources. Forest Survey of India (FSI) under the Ministry of Environment, Forest and Climate Change, Government of India has been mandated to carry out Forest Cover Mapping on biennial basis using satellite data. FSI does the nation-wide forest cover mapping on 1:50,000 scale using multispectral IRS (LISS III) satellite data since 2001.This has ensured thematic and spatial consistency which is very important to generate comparable estimates over time and monitor trend of the forest cover changes in the country.

This manual has been brought out for the use of technical personnel of Forest Geo-Informatics Division responsible for forest cover mapping to essentially standardize the methodology and classification approach keeping in mind the forest diversity in different physiographic regions of the country. The manual provides a brief introduction about the organization and its activities followed by separate chapters on the Implementation Plan which details the internal processes, time lines and Quality Control and Quality Assurance mechanism. The subsequent chapters deal with detailed methodology, examples and a manual describing the sequence of steps involved in Forest Cover Mapping.

Apart from the technical personnel of FSI, I hope this manual will be found useful by scientists and foresters associated with forest mapping and monitoring using geospatial approaches in different institutions and State Forest Departments.

I congratulate the entire team of Forest Geo-informatics Division under the leadership of Smt. Meenakshi Joshi, Joint Director, Geo-Informatics Division for bringing out this manual.

Dr. Subhash Ashutosh

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Meenakshi Joshi

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GLOSSARY

Block Plantation
Tree plantations in compact blocks of more than 0.1 ha on lands outside recorded forest areas.

Canopy
The cover of branches and foliage formed by the crowns of trees.

Canopy Cover
The percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants.

Canopy Density
Percent area of land covered by the canopy of trees. It is expressed as a decimal coefficient, taking closed canopy as unity.

Cartographic Limit
The minimum area of a feature which can be presented on a map at a given scale.

Change Matrix
It presents change in forest cover classes for a given region (State/UT) during the period of two consecutive assessments in a matrix form by showing the changes of area from one class to another.

Crown Area
It is the area of horizontal projection of a tree crown on the ground.

Dense Forest
All lands with a forest cover having a canopy density of 40 percent and above.

Digital Image Processing (DIP)
Interpretation and classification of digital satellite data using computer and a DIP software.

Error Matrix (Confusion matrix)
It is a means to quantitatively assess the accuracy of classification of a interpreted satellite data. Under this, the reference data (ground truth) is compared with the corresponding results of the classification on the randomly selected locations on category-by-category basis. It is presented in a square matrix.

False Color Composite
The image generated by projecting any three spectral bands of the satellite data on the red, green and blue channels and does not show features in true colours.

Farm Forestry
The practice of cultivating and managing trees in compact blocks on agricultural lands.

Forest Area
The area recorded as a forest in the Government records. It is also referred to as “Recorded Forest Area”.

Forest Blank
A patch within a forest which bears few or no trees.

Forest Cover
All lands, more than one hectare in area, with a tree canopy density of more than 10 percent irrespective of ownership and legal status. Such lands may not necessarily be a recorded forest area. It also includes orchards, bamboo and palm.

Geographic Information System (GIS)
A computer based system for capturing, storing, manipulating, analyzing and displaying data, which are spatially referenced to the earth.

Green Wash
The extent of wooded areas generally shown in light green colour on the SoI toposheets.

Hill District
A district with more than 50 percent of its geographic area under 'hill talukas' based on criteria adopted by the Planning Commission for Hill Area and Western Ghats Development Programmes.

Land Cover
Broad land use classes interpreted from satellite data. It includes very dense forest, moderately dense forest, open forest, scrub and non-forest for the purpose of this report.

Mangroves
Salt tolerant evergreen forest ecosystem found mainly in tropical and sub-tropical coastal and/or inter-tidal regions.

Mangrove Cover
Area covered under mangrove vegetation as interpreted from remote sensing data. It is included in the forest cover.

MMU (Minimum mapping unit)
The MMU (minimum mapping unit) is the size of the smallest feature of a class that can be reliably mapped (2mm x 2 mm) which corresponds to1 ha. on 1:50,000 scale for LISS III.

Moderately Dense Forest
All lands with forest cover having a canopy density between 40 to 70 percent.

Net Change (in Forest Cover)
The sum of positive and negative changes in forest cover over a period of two assessments for a given area.

Non Forest Land
Land without forest cover.

Open Forest
Lands with forest cover having a canopy density between 10 to 40 percent.

Protected Forest (PF)
An area notified under the provisions of the Indian Forest Act or other State Forest Acts, having limited degree of protection. In protected forest all activities are permitted unless prohibited.

Recorded Forest Area (RFA)
Geographic areas recorded as forest in Government records.

Remote sensing
Remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation.

Reserved Forests (RF)
An area so constituted under the provisions of the Indian Forest Act or other State Forest Acts, having full degree of protection. In Reserved forests all activities are prohibited unless permitted.

Scrub
Degraded forest lands having canopy density less than 10 percent.

Spatial Resolution
The minimum area on earth's surface that can be captured by a satellite sensor as being separate entity from its surroundings and is represented by a “pixel”.

Spectral Resolution
The range of wave lengths that a satellite imaging system can detect. It refers to the width and number of spectral bands. The narrower the bands, the greater the spectral resolution.

Trees Outside Forests (TOF)
Trees growing outside recorded forest areas.

Tribal Districts
Districts identified as tribal districts under Tribal Sub-Plan (Government of India).

Unclassed Forests
An area recorded as forest but not included in reserved or protected forest category. Ownership status of such forests varies from state to state.

Very Dense Forest
Lands with forest cover having a canopy density of 70 per cent and above.

Visual Interpretation
A manual method of satellite data interpretation, which is based on man's ability to relate colours and patterns in an image to real world features.

ACRONYMS AND ABBREVIATIONS

AOI	-	Area of Interest
APM	-	Automatic Point Measurement
AWiFS	-	Advanced Wide Field Sensor
CAMPA	-	Compensatory Afforestation Fund Management and Planning Authority
CBD	-	Convention on Biological Diversity
CF	-	Correction Factor
DEM	-	Digital Elevation Model
DF	-	Dense Forest
DIP	-	Digital Image Processing
DN	-	Digital Number
FAO	-	Food & Agriculture Organization
FCC	-	False Colour Composite
FRL	-	Forest Reference Level
FSI	-	Forest Survey of India
GA	-	Geographic Area
GCP	-	Ground Control Point
GFRA	-	Global Forest Resource Assessment
GHG	-	Greenhouse Gas
GIS	-	Geographical Information System
GPS	-	Global Positioning System
GW	-	Greenwash
ISFR	-	India State of Forest Report
IRS	-	Indian Remote Sensing (Satellite)
ISRO	-	Indian Space Research Organization
IWDP	-	Integrated Wasteland Development Project
LANDSAT	-	Land Remote Sensing Satellite
LISS	-	Linear Imaging and Self-scanning Sensor
LULUCF	-	Land use, land-use change and forestry
MDF	-	Moderately Dense Forest
MGNREGS	-	Mahatma Gandhi National Rural Employment Guarantee Scheme
MLE	-	Maximum Likelihood Estimation
MMU	-	Minimum Mapping Unit
MSS	-	Multi Spectral Scanner

Mx	-	Multi Spectral
NDVI	-	Normalized Difference Vegetation Index
NF	-	Non-Forest
NRSC	-	National Remote Sensing Centre
NDWI	-	Normalized Difference Water Index
OF	-	Open Forest
OSM	-	Open Series Map
PA	-	Protected Area
PAN	-	Pan-Chromatic
PF	-	Protected Forest
PISFR	-	Pre-investment Survey of Forest Resources
QA	-	Quality Assurance
QC	-	Quality Control
REDD+	-	Reducing Emission from Deforestation and Forest Degradation
RF	-	Reserved Forest
RFA	-	Recorded Forest Area
RMSE	-	Root Mean Square Error
SFD	-	State Forest Department
SoI	-	Survey of India
SRTM	-	Shuttle Radar Topography Mission
TM	-	Thematic Mapper
ToA	-	Top of the Atmosphere
TOF	-	Trees Outside Forest
UNDP	-	United Nations Development Programme
UNFCC	-	United Nations Framework Convention on Climate Change
USGS	-	United State Geological Survey
UT	-	Union Territory
UTM	-	Universal Transverse Mercator
VDF	-	Very Dense Forest
WP	-	Working Plan