National Forest Type Mapping

Introduction

The revised forest type classification of Champion and Seth (1968) is the most widely used classification systems for India's forests. They classified forest into five major groups based on climatic factors. These major groups have been further divided into 16 type groups based on temperature and moisture contents. A few of these type groups have been further divided into several subgroups. Ultimately the type groups have been classified into 202 forest types and subtypes based on location specific climate factors and vegetation formation. There have been no significant efforts till recently to show spatial distribution of forest types in India.

The Standing Committee on Bio-resources and Environment (SC-B) of the National Natural Resource Management System (NNRMS), in its 18th meeting on 21st January 2003 identified a Task Team for Forest Type Mapping. The Director, Forest Survey of India, Dehradun was nominated as the Chairman of the Task Team. The terms of reference of this Task Team was to prepare a detailed proposal for forest type mapping.

The Task Team met on 10th April 2003 and deliberated on this issue. Based on detailed discussion it was decided that 1:50,000 scale forest type maps need to be prepared addressing 202 forest types identified in the revised classification of forest types by Champion & Seth (1968). It was decided that pilot studies need to be undertaken to understand the feasibility of generating forest type information in different parts of the country and to test the methodology proposed for this work. FSI thereafter submitted a proposal to the NNRMS technical committee in the Ministry of Environment & Forest, Government of India, New Delhi. The proposal included taking up pilot study in three districts namely Chandrapur (Maharashtra), East Garo Hills (Meghalaya) and Coimbatore (Tamil Nadu)..

Based on the outcome of the pilot study og East Gharo Hills District, a proposal was put up in the 19th Meeting of NNRMS-SC-B, held on 31st Dec. 2003 under the Chairmanship of the Secretary (MoEF). The project was approved in December, 2004 for an outlay of Rs. 300.00 lakhs to be completed in three years.

METHODOLOGY:

Methodology followed by FSI is GIS based. It involves two major steps-(i) Preparation of Forest Type Reference Maps using existing thematic maps and other data. (ii)Preparation of final maps depicting spatial distribution of forest types by collecting new information through ground verification and using recent satellite data and incorporating the same on Reference Maps.

(i)   **Preparation of Forest Type Reference Maps**

FSI has huge data on forest resources in form of thematic maps (based on interpretation of aerial photographs and on 1:50,000 scale), field inventory reports and field forms, vegetation type maps (prepared in 1981-83 on 1:2 million scale) and forest cover maps. It is envisaged to integrate these information in a single unit area (grid of appropriate size) to present the most likely forest type in a particular grid.

For this purpose the whole country is divided into a geo-referenced vector layer of' grids using Arc Info software (8.2version). The grid size of 2½′ x 2½′ which on an average encompasses 20 km^2 of area, has been chosen as the most appropriate size. In the conventional field inventory of FSI, a systematic random sampling has been used where the area is divided into grids of 2½′ x 2½′ and all the ground information is collected from the sample plots laid out in this grid. The information of thematic maps available on 1:50,000 scale can be conveniently overlaid on these grids containing 36 grids of size 2½′ x 2½′. Firstly spatial database at country level is created having vector coverage comprising 171,028 grids (Fig. 34). A unique ID is given to each grid so as attach attribute data to it. The description of the attribute data attached to each grid is as follows:
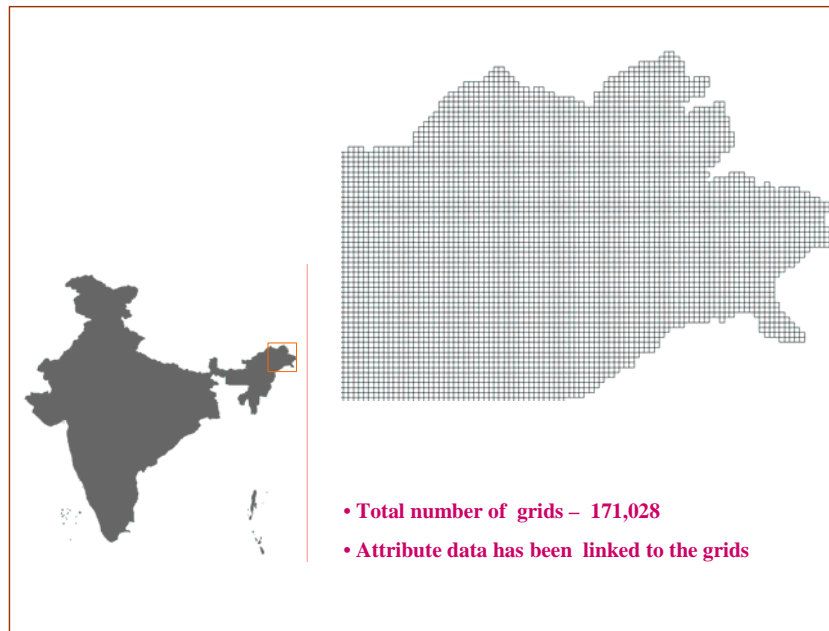

• **Total number of grids – 171,028**

• **Attribute data has been linked to the grids**

Fig. 34: Nationwide Vector Coverage of Grids of 2½′ x 2½′

a. **Forest Inventory of FSI**: Since its inception in 1965 as PISFR (Pre-Investment Survey of Forest Resources), FSI has carried out field inventory of forest resources. In addition to enumeration of trees,

information on soil, species composition, density etc. of each grid in the inventory area is also available in the field forms. FSI has covered more than 80% of countries forest area under field inventory.

b. **Thematic maps prepared by FSI:** Till late nineties, FSI had been preparing thematic maps on 1:50,000 scale based on interpretation of aerial photographs. These maps in all show 48 forest land use classes and 15 non-forest land use classes. Under thematic mapping FSI has covered approximately 72% of the country's forest area. Though these maps are old but they had provided valuable base line information on species composition as usually there is not appreciable change in species composition of area over a period of time.

c. **Forest species composition maps:** For a study taken up by FSI recently, FSI had prepared forest species composition maps integrating information of thematic maps and inventory records.

d. **Vegetation type maps:** FSI prepared vegetation type maps on 1:2million scale in 1981-83. These maps were partially based on aerial photographs (thematic maps) and partially on inputs received from State Forest Departments. These maps also have provided valuable information in preparation of forest type reference maps.

e. **Latest ground truth information:** In accordance with its mandate, FSI carries out assessment of forest cover on a 2-year cycle and generates forest cover maps. These maps are based on interpretation of satellite data and extensive ground truthing is done before preparing final maps. In each cycle about 2500 points in the forest areas are visited for ground truthing. In the ground truth field forms, information on species composition is also collected.

f. **Soil Maps:** Soil maps prepared by National Bureau of Soil Survey and Land Use Planning on 1:1million scale has been procured. These maps have been scanned and are being used to delineate forest types where soil composition is playing a significant role in classification of forest types.

g. **Spatial Information on Climate:** Information on temperature and rainfall on a 10' x10' grid size has been obtained from the Centre for Ecological Sciences, Indian Institute of Science, Bangalore. The mean annual values have been used as attribute climate data for each grid.

h. **Forest type maps prepared by other organisations:** In the year 2002, IIRS (Indian Institute of Remote Sensing) produced Biodiversity characterization maps of parts of the country like Andaman & Nicobar Islands, North Eastern region etc., Similarly, mapping work has been done by the French Institute of Pondicherry

in the Western Ghats region. These maps will be used to update the reference map. Fig. 35 describes methodology of Stage 1 in brief.
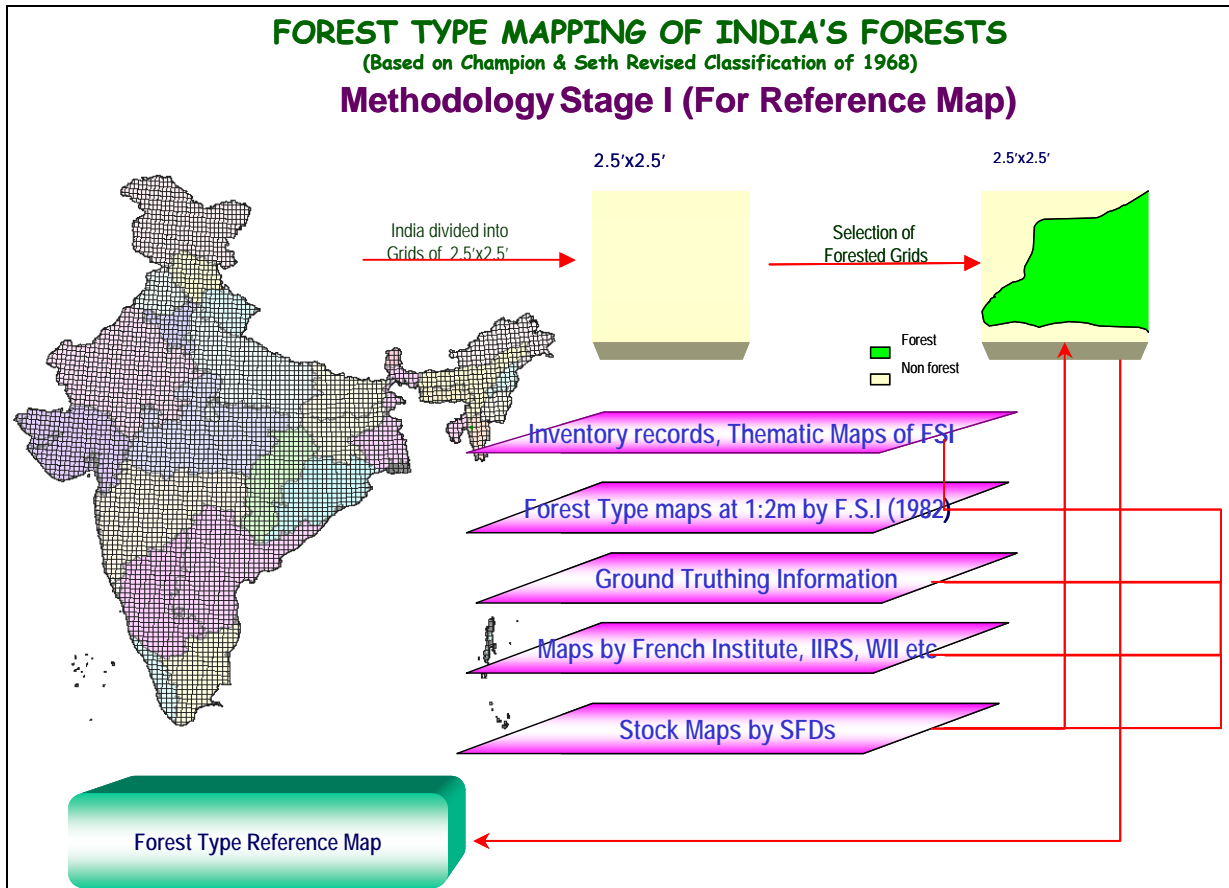

Fig.35: Methodology for Stage I for Forest Type Mapping

(ii)   **Preparation of final maps using new data**:

The grid based forest type reference maps are being used for extensive ground verification using GPS. During ground verification, ancillary information from the State Forest Departments as available in working plans, stock maps, species composition, forest types, soil, climate, past treatment etc are also being collected. The latest satellite data of IRS 1D (LISS-III) with a spatial resolution of 23.5m X 23.5m for the year 2002 will be used for forest type classification. Multi-temporal satellite data including that of dry season and high-resolution data will also be used in specific cases. Digital image processing is being done using ERDAS Imagine Professional software (latest version). Following steps are being used in the digital image processing:

1. **Geometric corrections:** Images (False Colour Composites-FCC) in digital forms are first downloaded onto the computers and then registered geometrically using appropriate numbers of GCPs (Ground Control Points) of corresponding Survey of India (SOI) toposheets on 1:50,000scale. The area of interest (i.e., the District) is then extracted by overlaying digitised boundary of the district.

2. **Digital Image Processing:** FCC of the extracted area is then digitally interpreted using a hybrid approach consisting of unsupervised as well as supervised classification using maximum likelihood classifier algorithm. Ortho-rectification and NDVI (Normalized Density Vegetation Index) programmes are also run wherever needed. Rule based classification has been used in areas where topographical features and soil play dominant role in deciding forest type. The NDVI is used not only to detect spatial pattern of biodiversity but also the distribution of biophysical parameters as difference in vegetation type are primarily due to variation in soil, moisture, temperature and rainfall.

3. **Editing of Classified Forest Type Maps:**   Classified   forest   type maps will be further edited on the basis of ground information, data on soil, climate, altitude etc Based on this post classification editing and refinement, final forest type maps will be produced on 1: 50,000 scale. Fig 36 shows methodology of Stage 2 in brief.
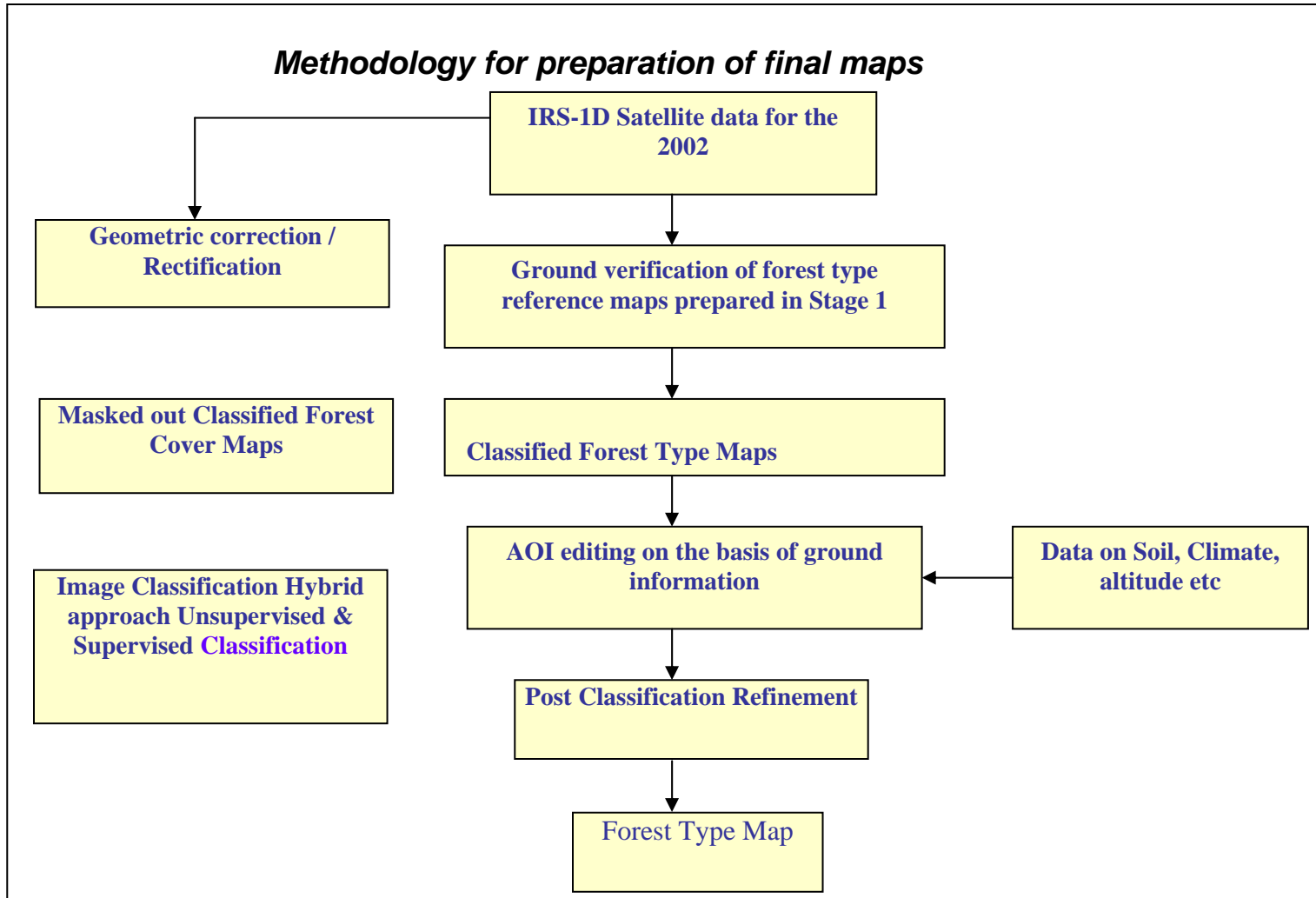
Methodology for preparation of final maps

	IRS-1D Satellite data for the 2002

Geometric correction / Rectification	Ground verification of forest type reference maps prepared in Stage 1
Masked out Classified Forest Cover Maps	Classified Forest Type Maps
Image Classification Hybrid approach Unsupervised & Supervised Classification	AOI editing on the basis of ground information

Data on Soil, Climate, altitude etc

Post Classification Refinement

Forest Type Map

Fig. 36: Methodology for stage II –Preparation of Final maps.

(iii)   Validation of Forest Type Maps:

These maps will then be sent to all concerned State/UT Forest Departments for verification and validation. In case of variation, joint verification with the Forest Department will be carried out to correct the error if any. Since these maps are generated using a GIS based methodology, it will be possible to incorporate any change even if found at a later stage.