CHAPTER I

INTRODUCTION
1. INTRODUCTION

Forests are the world's air-conditioners and Earth's blanket. These rid the air of excess carbon dioxide and replenish the oxygen. They also shelter the ground beneath them, and all the animals and smaller plants dwelling these, from the wind and rain and the heat and cold.

Without trees and other green plants there would be no advanced life on earth. They have the unique ability of photosynthesis to capture the light energy from the sun, in the presence of their green pigment chlorophyll, and use it to convert water, carbon dioxide and minerals into oxygen and energy rich organic compounds. Were it not that plants absorb the carbon dioxide that animals exhale (and man creates by burning fossil fuels), and use it to grow and expel oxygen back into the air, the atmosphere would become devoid of oxygen and all life would cease. Forests, with their huge green plants - the trees - raised high up to trap maximum solar energy, play an important role in this recycling process.

Unlike all the other creatures that lived in the great forests of the Earth, man, with his early discovery of the deadly weapon fire and the lesser one, the axe, fought the forests to gain advantage over it. His wish to settle
in one place, grow crops and graze animals required destruction of forests. For centuries this process continued as forests appeared inexhaustible. But this was an illusion. In nineteenth century with the increase in population, industrial revolution, demand of forests resources increased and soon forests started disappearing. In order to maintain regular supply from forests, forestry as a practiced science emerged.

The world looked to the European Nations that had pioneered the science of forestry - Germany and France - to provide the expertise needed to regenerate the land stripped of trees and to ensure good management of those forests still standing.

In India scientific management of forests was started by Brandis in 1862. Today, nearly seventy five percent of the total forests in India are managed scientifically.

Although the chief objective of the forester remains the growing of timber, the forests having close association with land and water, has to be managed in totality. Conflict between competing interests of watershed and erosion protection, wildlife conservation and recreation must be avoided. To achieve this, a high degree of sophistication in forest management is necessary. The modern
forester has to operate in an increasingly complex situations and has to be careful of the constraints imposed by ecology, economics and politics.

In India most of the forests are state owned excepts in North - East regions where still large chunks of forests are owned by tribals (still practicing shifting cultivation). The management of forests is the responsibility of State Governments. However, with the inclusion of forestry in the concurrent list, now Central Government has also a say in framing forest policies.

1.1 INDIAN FORESTS

Forest Area

The forest area in India is about 22.7 percent of the total geographical area as against 33 % of the world average. Recent studies by Forest Survey of India of satellite imagery indicated, hardly 14-16 % of the total geographical area under fairly dense tree cover, which is not even 50 % of the prescribed limit by forest policy.

Forests in India are varied in composition and character. The area is not large enough in relation to the population of the country, necessary for its proper maintenance. The per capital forests area is much low in comparison to other countries of the world.
The National Forest policy enunciated on 12th May, 1952, embodied in the Resolution No. 13-1\52 F laid down that India as a whole should aim at maintaining one third of its land under forests, the proportion being, 60 percent in hilly regions and 20 percent in plains. A planned extension of regular forests is therefore urgently required. The efforts in this direction since 1952 have been dismal. We have lost substantial forest area since 1952. Today's forest area is smaller than what it was in 1952. The loss in forest area has been in the following manner.

i. Release of large forest areas for agriculture.

ii. Submergence, of forest areas in the artificial lakes of river valley projects.

iii. Release of forests for rehabilitation of people.

iv. Loss on account of mining.

v. Release for establishment of large industrial colonies.

vi. Conservation of forest areas into plantations of Rubber, coconut, tea, coffee, and other commercial crops.

vii. Provision of land to the landless.

viii. Extension of shifting cultivation.

The forest area has decreased both in plains and hills, because of continuous increasing pressure on the land due to increase in population and various development activities. At present total area under the charge of forest Dept. is 74.6 million ha. of which only two third is wooded.
By composition, India’s forests are predominantly non-coniferous. Coniferous forest occupy only about 5.6 percent of the total forest area. These are confined to Himalayas in the states of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and to a smaller extent in West Bengal, Sikkim, Assam and Manipur. Important Indian conifers are deodar (Cedrus deodara), chirpine (Pinus roxburghii), Spruce (Picea smittiana), silver fir (Abies pindrow) and Khasi pise (P.khasya).

Broad leaved forests occupy about 70 million hectares forming about 94% of the total forest area. These forests are composed of a very large number of species. The important timber species are teak (Tectona grandis) Sal (Shorea robusta), sadad (Terminalia tomentosa), bijasal (Pterocarpus marsupium), Sisso (Dalbergia sissoo), rose wood (Dalbergia latifolia), Padauk (Pterocarpus dalbersiodes), Kala siris (Albizzia lebbak), arjun (Terminalia arjuna), toon (Cedrela toona), walnut (Juglans regia), Oaks (Quercus spp), Sandal (Santlum album), shevan (Gmelina arborea), hollong (Dipterocarpus Spp) etc.

Teak forests are found largely in the states of Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Kerala, Karnataka, and Rajasthan. The total area including
Small areas in other states is about 86,870 sq.km.

Sal Forests occur over an area of about 99,730 sq.km. mainly in the states of Assam, Bihar, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal.

Miscellaneous forests occupy about 5,18,180 sq.km. forming about 70 percent of the total area. These include the magnificent evergreen, Semi-evergreen, and moist mixed deciduous forests of Assam, West Bengal, Andamans, Kerala, Karnataka and Tamilnadu. However, bulk of miscellaneous forests are comprised of dry deciduous forests. Two species of bamboo, Dendrocalamus strictus and Bambusa arundinacea are often found in these forests. Bamboos play an important role in national economy as a important raw material for paper and pulp and as important housing material for most of the rural population. About 36000 sq.km. of forests may be carrying bamboo stands. These include considerable areas of important forests of teak and mixed miscellaneous forests where bamboos occur in the second storey.

Legal Status and Ownership:

Most of the forests of the country are owned by Government. The forests under corporate bodies and private individuals are hardly 4.8 percent. This is contrary to European forestry where private forests constitute more than 50 percent in a number of countries. About 47 percent of the
area is under reserved forests. The area under protected and unclassed forests is about 33 percent and 20 percent, respectively.

1.2 FOREST TYPES

A forest type may be defined as a unit of forest which possesses broad characteristics in physiogamy, structure, composition and floristics which may permit its differentiation from other such units (Champion and Seth, 1968). Forests have been classified in three different ways:

i. Classification based mainly on vegetation
ii. Classification based on climate
iii. Classification based mainly on ecosystems.

i. Classification based mainly on vegetation:

In this system, forests have been classified according to their structure, composition, physiogamy, floristic etc. The classification of Beard (1944), Fosberg (1958) and Webb (1959) are important classifications in this category.

ii. Classification based mainly on climate:

Various classifications of forests based mainly on climate have been enunciated by many workers. The important
variables of climate e.g. temperature, rainfall, wind etc. form the basis of these classifications. Mayr (1909) based his classification on temperature with altitude and latitude. Rubber (1925) classified on the basis of mean monthly temperature. Koppen (1931) suggested classification based on temperature, rainfall and its season. Thornthwaite (1933), in his classification used the concept of potential evapotranspiration. Subramanyam (1956) on the above basis determined the various climatic type of India. Paterson (1956) attempted to classify the forests based on the potential productivity of the forests taking climatic factors as the basis.

iii. Classification based mainly on Ecosystem:

This system of classification gives sufficient weightage to both vegetation and climate. Champion classification of forests of India and Burma into different forest types was important classification under this category. Puri suggested the classification of forest types of India taking into consideration ecological status and climate. Though this classification is not much different than the previous but raises certain important points which need further investigation. Champion and Seth classification which is now a days widely used by foresters of this country belongs to this category. The classification of Indian forests based on this system is discussed in detail as under:
<table>
<thead>
<tr>
<th>Major groups</th>
<th>Type groups</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Tropical</td>
<td>1. Wet Evergreen Forests</td>
<td>Dense tall forests entirely evergreen or nearly 80%.</td>
</tr>
<tr>
<td></td>
<td>2. Semi-evergreen forests</td>
<td>Dominants include deciduous species but evergreens predominates.</td>
</tr>
<tr>
<td></td>
<td>3. Moist deciduous forests</td>
<td>Dominants mainly deciduous but some dominants and lower storey largely evergreen.</td>
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<td></td>
<td>4. Littoral and swamp forests</td>
<td>Mainly evergreen of varying density and height but always associated predominantly with wetness.</td>
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<tr>
<td></td>
<td>5. Dry deciduous forests</td>
<td>Entirely deciduous or nearly so. Top canopy rather light and rarely over 25 m height.</td>
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</tbody>
</table>
6. Thorn forests
Deciduous with low thorny trees and xerophytes predominating. Canopy more or less broken. Height under 10 m.

7. Dry evergreen
Hard leaved evergreen trees predominate with some deciduous emergents often dense but under 20 m height.

II. Montane 1. Sub-tropical
Sub-Tropical broad leaved evergreen high forests
Forests hill forests

2. Sub-tropical pine forests

3. Sub tropical dry evergreen forests

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Sub-Tropical broad leaved evergreen high forests
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III. Montane 1. Montane wet temperate forests without conifers.

7. Dry evergreen
Hard leaved evergreen trees predominate with some deciduous emergents often dense but under 20 m height.
Fig. 1 Forest type of India (Source: Champion and Seth, 1968)
2. Himalayan moist temperate forests

Evergreen forests mainly sclerophyllus oaks and conifers.

3. Himalayan dry temperate forests

Open coniferous forests with sparse xerophytic under growth.

IV. Sub Alpine

1. Sub alpine forests

Stunted deciduous or evergreen forests usually in close formation with or without conifers.

V. Alpine

1. Moist alpine scrub

Low but often dense scrub.

2. Dry alpine scrub

Xerophytic scrubs in open formation.

1.3 FOREST MANAGEMENT

Management of forests is one of the most important and complicated subject and is guided by variety of factors. The important factors may be forest resources condition, forest policy, local requirements, industrial commitments, economic and ecological considerations etc. Once the decision about the objectives of the management of the forests is taken, the detailed procedure of felling,
regeneration, management systems, control of yields and other operations can be easily worked out. For deciding the management of forests in an area, the following steps are necessary:

i) Forest resources inventory

ii) Physical, ecological and economical considerations

iii) Formulation of efficient management system

**Forest Resources Inventory**

Unless we know what, where and how much exist in the forest area, proper and efficient management can not be decided. Forest resources inventory provides qualitative and quantitative estimates of various forest resources characteristics. Forest inventory helps in taking management decisions. Under modern conditions, national productivity depends mainly upon the development of industries. Such industries require adequate and continuous supply of raw materials. Wood, a major forest produce, is used for manufacture of variety of products. With increase in population, demand for the forest produce is increasing day by day. All these factors lead to heavier removal of forests. Therefore, proper forest management is needed. This is not possible without the inventory data.

The important information which are included in inventory of forest resources are (i) area under various
land uses, forest types and sub-types, (ii) growing stock-gross and net, (iii) volume by forest types, (iv) accessibility and economic leads (v) volume by species and girth classes, (vi) minor forest produce, (vii) increment, (viii) special studies, market and demand study etc. In short, forest inventory is an attempt to describe the quantity and quality of forest trees and many characteristics of land area upon which the trees are growing.

Forest areas can be estimated by (a) maps and photographs. Accurate estimate of area is essential for working out the total growing stock. If detailed topographical maps are available, various types of forests can be identified on maps and area can be worked out.

Physical, ecological and economical considerations

National forest policy about management of forests, need careful consideration while deciding the management of forests on larger areas. Local considerations some times prevail over long term national objectives. Similarly, other physical and ecological factors will also need careful consideration as these may ultimately affect the future crop. A sound management practice should aim to provide sustained increasing yields of goods and services needed for the prosperous life of the people. Soil and water conservation and recreational needs of the people may desire
a different type of management of forest resources. Industrial commitments and wants of the local population may lead to altogether different management practices. All these considerations have to be properly examined before taking management decisions for a particular area. It may be necessary to allocate different areas for different purposes and suitable management details have to be worked out for each forest area.

Management Systems

There are three important operations viz. regeneration, tending and removal of mature trees, which decide the silvicultural system. The method of regeneration may be natural or artificial. The natural regeneration may be of seedling or of coppice origin. Tending operations help in development of particular type of stand. The removal of mature crop may consist of clear felling or successive fellings or selection fellings. Various classifications of silviculture systems have been developed depending upon the mode of regeneration, production of even aged or unevenaged crop and removal of mature crop etc. The following classification of silviculture systems cover the entire range of system practiced in this country.

A. High Forest Systems:

i. Clear felling systems
ii. System involving successive regeneration fellings  
e.g. shelter wood systems

iii. Selection system

B. Coppice Systems:

i. Simple coppice system

ii. Coppice with standard system or coppice with reserve

iii. Coppice selection systems

Forest Management Planning:

In India, almost all forests are Government owned. For proper and efficient management of these forests, working plans or management plans are prepared.

A working plan is a written document, which is meant for enforcing systematic, obligatory and mandatory regulations for continuous management of a given forest area. In practice, working plans are the basis for enforcing a set or management prescriptions. Working plans are generally prepared on the basis of forest divisions. It provides annual plan of operation for each area. These are generally prepared for a period of 10-15 years. After the expire of the working plan period, it is revised.
The main components of working plan preparation are, survey, demarcation, formation of compartments and subcompartments, checking of internal details, updating area registers, stock mapping, inventory of forest resources, estimating social and industrial demands, laying out of annual coupes, formulation of treatments to different types of areas and writing of working plan report.

1.4 FOREST ORGANISATION

Forests occupy about 22.7 percent of the total geographical area of the country. These forests do not occur in a compact block but are usually scattered all over the country almost in all the states. The application of various silvicultural practices and management in these forests need a proper division of these forest into workable units. This will help in describing, locating and working the area. For carrying out various silvicultural and management practices in forests, a definite organisation with definite set up is required. The forest organisation is therefore discussed from the following points of view:

i. Territorial
ii. Silvicultural
iii. Administrative

Territorial Division of the Forests

The forests from the point of view of territory
are classified into:

i. Blocks

ii. Compartments

i. Blocks

A block is a main territorial division of the forest, generally bounded by natural features, bearing a local proper name. These have clear cut boundaries all around with numbered pillars along it. The formation of a forest block takes place from the point of view of separation of forest area from the adjoining land of different landuse, ownership etc. The blocks, in fact are sub-divisions of large forest area and identified with the help of local name and with no significance from the point of view of the management of the forests. It is a common practice to adopt the name of an important village in naming a forest block.

ii. Compartments

A block is further divided into compartments which are defined as territorial units of a forest permanently defined for the purpose of administration, description, location and record. A compartment is a permanent working plan unit and is usually distinct on the ground as well as on the map. A compartment is kept as far as possible, homogeneous throughout its extent with regard to the
composition of growing stock, soil and aspect. A compartment is separated with other compartments with the help of artificial cut lines, paths, streams, ridges etc. compartments are identified by numbers in Arabic numerals, 1,2,3,4 and so on and are indicated in the map sheet.

During the preparation of a working plan, a compartment is inspected, stock mapped and all information needed for writing the working plan is collected compartment-wise.

Silvicultural Division of the Forest

In Gujarat State, silviculturally the forests are classified into:

i. Working circle
ii. Felling series
iii. Annual coupes

i. Working Circle

Working circle is defined as a forest area (forming the part or whole of the working plan area) organised with a particular object and worked under one silvicultural system and one set of working plan prescriptions. In certain circumstances working circles may overlap.
Forest area is classified into working circles depending upon the object of the management and the silviculture system to be followed. A working plan area may be divided into one or more working circles. The most commonly adopted working circles are Teak Working Circle, plantation working circle, selection working circle, protection working circle, coppice working circle etc. Certain species need special treatment and their area overlap with other working circles, usually kept under overlapping working circle e.g. Bamboo overlapping working circle, khair over-lapping working circle etc.

ii. Felling Series

Felling series is defined as a forest area forming the whole or part of a working circle and delimited so as (i) to distribute felling and regeneration to suit local conditions and (ii) to maintain or create a normal distribution of age classes. The yield is calculated separately for each felling series which should have an independent representation of age classes.

The felling series is usually a part of working circle, comprising of its own age classes. If a working circle is spread over a large area, more than one felling series are usually recognised. The felling series form the unit of yield calculation and for carrying out various
silvicultural operation. But these follow the same general principal of silviculture system.

Division of the Working circle into felling series often leads to the effective and equal distribution of work in different ranges.

iii. Coupes

Coupes are defined as a felling area usually one of a felling series. The term is usually applied to the area where fellings or thinnings etc. are carried out and are called felling coupes or thinning coupes. The area of the coupe depends upon the number of factors. The area may usually vary between 20-200 hectares but larger and smaller coupes may also be found. Clear felling coupes are usually smaller than selection felling coupes. Similarly thinning coupes are generally larger than felling coupes. The coupes are generally demarcated on the ground in order to enable clear the area selected for felling.

1.3 ADMINISTRATIVE ORGANISATION

The forests occurring in a particular state are divided into various administrative units for maintaining effective control and supervision of the forests. The most common system adopted in various states is indicated below:
Administrative unit | Incharge officer
---|---
1. Head of the forest of the state | Chief Conservator of Forests of the state
2. Circle | Conservator of Forests
3. Forest division | Dy. Conservator of Forests or Divisional forest officer
4. Range | Range Officer
5. Block | Block Officer or Forester
6. Beat | Beat officer

In nutshell, working plans forms the basis for a proper scientific management of forests. For preparing the working plans, forest maps at different levels are required apart from other information as mentioned above.

Forest stock maps, which are prepared at compartment level are the first step for preparing the management maps. Stock maps are mostly prepared at 1:15,840 scale in India and these are prepared by Occular estimate by traversing the area by a qualified forest officer. Preparation of stock maps by Occular methods leads to serious mistakes in delineating various forest classes on the basis of density, composition, soil types, presence of natural regeneration etc. However, if such delineation is done through remote sensing techniques i.e. using aerial photographs, the mistakes are reduced to minimum. In West Germany stock maps are prepared on orthophoto maps prepared
every five years for an area. Aerial photography being a restricted document in India, this technique could not become popular in Indian forestry. Similarly use of satellite data for preparing the stock maps has also not picked up due to poor resolution of the satellite data and its availability on a very small scale i.e. 1:1 million. But with the availability of better resolution data, frequency of availability of data and equipment which can enlarge the satellite imagery to 1:15,840 scale without splitting the grains of the imagery, an attempt has been made to determine the potential and limitations of satellite data for preparing the stock maps.

This study hopes to bring out the methodology, utility, limitations of satellite data for preparing the stock maps for working plan preparations.