UTTARAKHAND OPEN UNIVERSITY
Teenpani Bypass Road, Transport Nagar, Haldwani - 263 139
Phone No. : (05946) - 286002, 286022, 286001, 286000
Toll Free No. : 1800 180 4025
Fax No. : (05946) - 264232, email : <info@uou.ac.in>
http://www.uou.ac.in

FR 09

Forest Management,
Policy and Legislations

Forest Management, Policy and Legislations

Department of Forestry and Environmental Science
School of Earth and Environmental Science

Uttarakhand Open University
Haldwani, Nainital (U.K.)

FR 09

Forest Management, Policy and Legislations

Department of Forestry and Environmental Science
School of Earth and Environmental Science
Uttarakhand Open University

Board of Studies

Prof. Jeetram
Department of Forestry and Environmental Science,
Kumaun University, Nainital (U.K.)

Prof. P.C. Joshi
Department of Zoology and Environmental Science,
Gurukul Kangri, University, Haridwar (U.K.)

Dr. Sachi Sah
Department of Environmental Science
Indira Gandhi Open University, New Delhi

Prof. P.D. Pant
School of Earth and Environmental Science
Uttarakhand Open University, Haldwani (U.K.)

Dr. H.C. Joshi
Department of Forestry and Environmental Science (SoEES)
Haldwani, Nainital (U.K.)

Compilation by

Department of Forestry and Environmental Science, (SoEES),
Uttarakhand Open University

Disclosure: The entire compilation is extracted from different books and Open Educational Recourses (OERs), the sole purpose is to provide course pack to the learners as per curriculum. Restricted distribution only.

Cover page design

Krishna Kumar Tamta, Beena Tewari Fulara, H.C. Joshi

Printed at: Uttarayan Prakashan, Haldwani, Nainital (Uttarakhand)

Table of Contents

Unit 1:	**Introduction to Forest Management**	
	1.0 Learning objectives.	1
	1.1 Introduction	1
	1.2 Principles of forest management national forest policy	4
	1.3 Forests on concurrent list	7
	1.4 Some peculiar features of forest management or forestry	7
	1.5 Instruments of forest management	9
	1.6 Objects of management	9
	1.7 Choice of objects	12
	1.8 Social role of forestry: social forestry	14
	1.9 Forestry in relation to Agricultural	17
	Summary	18
Unit 2:	**Forest Organization**	
	2.0 Learning objectives.	19
	2.1 Introduction	19
	2.2 Administrative (Organizational) Classification	22
	2.3 Periodic Blocks: Felling Series in Uniform System:	25
	2.4 Felling Cycle – Felling Series in Selection Forest:	26
	2.5 Felling Series in Coppice-With-Standards (C.W.S.) System	26
	Summary	26
Unit 3:	**Concepts of Sustained Yield and Rotations**	
	3.0 Learning objectives.	27
	3.1 Introduction	27
	3.2 Concept of increasing and progressive yields	31
	3.3 Arguments for sustained yield principle	33
	3.4 Rotation or production period	35
	3.5 Types of rotation	38
	3.6 Soil expectation value (Se)	43
	3.7 Length of rotation	44
	3.8 Choice of the type/kind of rotation	46
	3.9 Rotation and conversion period	47
	Summary	48
Unit 4:	**Normal Forest and Growing Stock**	
	4.0 Learning objectives.	49
	4.1 Introduction	49
	4.2 Normality concept not absolute: related to treatment and rotation	53
	4.3 Normality in regular / even-aged forests	55
	4.4 Normality in irregular / uneven aged forests:	56
	4.5 De Liocourt's law:	58
	4.6 Distribution of trees in different diameter classes in uneven-aged sal forests	60
	4.7 Growing stock	61
	4.8 Determination of normal growing stock	62
	4.9 Comparison of real and theoretical NGS – Flury's constant	67
	4.10 Determination of actual GS with past data are not available	68
	4.11Comparison of G.S. in even-aged and selection forests	70

	4.12 Relationship between G.S. and yield	71
	Summary	74
Unit 5:	**Yield Regulation and Working Plan**	
	5.0 Learning objectives	76
	5.1 Introduction	76
	5.2 Method of yield regulation	77
	5.3 Working Plan	87
	5.4 Goal and Objectives of Working Plan	89
	5.5 Organizational Structure	89
	5.6 Working Plan Period	90
	5.7 Inputs to WPO	91
	5.8 Preliminary Working Plan Report (PWPR)	91
	5.9 Survey and assessment of forest resources	93
	5.10 Writing up of working plan	98
	5.11 Contents of the plan	99
	Summary	102
Unit 6:	**Policy and legislations**	
	6.0 Learning objectives.	103
	6.1 Introduction	103
	6.2 Historical Background	104
	6.3 Forest Legislations	105
	6.4 The Objectives of Forest Polices	106
	Summary	108
Unit 7:	**Forest and Environment Policies of India**	
	7.0 Learning objectives	109
	7.1 Introduction	109
	7.2 The concept of law	111
	7.3 Forest protection and law	111
	7.4 Necessity of a special forest law	112
	7.5 Functions performed by forest law	116
	7.6 Legal and Policy Frameworks related to Forest Conservation	117
	Summary	124
Unit 8:	**Protected Areas Management**	
	8.0 Learning objectives.	125
	8.1 Introduction	125
	8.2 Protected Area Network in India	130
	8.3 Regulations/ laws relating to Protected Areas (PAs)	133
	8.4 Conservation projects	134
	8.5 MAB	145
	8.6 Red Data Book	147
	8.7 CITES	149
	8.8 Central Zoo Authority of India	150
	Summary	152

Unit-1 Introduction to Forest Management

Unit Structure

1.0 Learning objectives.
1.1 Introduction
1.1.1 Scope of forest management
1.1.2 Management of private forests vis–a–vis public forests:
1.2 Principles of forest management national forest policy:
1.2.1 Forest policy of 1894
1.2.2 National Forest Policy 1952
1.2.3 Recommendations of national commission on agriculture (N.C.A) 1976
1.3 Forests on concurrent list
1.4 Some peculiar features of forest management or forestry
1.5 Instruments of forest management
1.6 Objects of management
1.6.1 Purpose and policy
1.6.2 General objects of management:
1.6.3 Special objects of management:
1.7 Choice of objects:
1.7.1 Attitude of the owner
1.8 Social role of forestry: social forestry
1.9 Forestry in relation to Agricultural
Summary

1.0 Learning objectives.

After studying this unit you will be able to understand:

- About introduction of forest management
- Definitions and its scope
- About the forest policies and laws
- Peculiarities of forest management
- Objectives of forest management

1.1 Introduction

Forest Management is defined in the Glossary of Technical Terms as the practical application of the scientific, technical and economic principles of forestry (BCFT). The term is variously defined by different authors, embodying, in essence, the same essential ingredients. Some of these are reproduced below:

(i) "**Forest Management** is that branch of forestry whose function is the organization of a forest property of management and maintenance, by ordering in time and places the various operations necessary for the conservation, protection and improvement of the forest on the one hand, and the controlled harvesting of the forest on the other."

(ii) "**Forest Management** is the application of business methods and technical forestry principles to the operation of a forest property" (SAF). The above definitions highlight the varied nature of the subject which is concerned with the task of "building up, putting in order and keeping in order a forest business". Forest management, by implication, is not a basic subject in itself; it is the practical application of science, technology and economics to a forest estate for the achievement of certain objectives – mainly production of wood – timber and industrial raw material, and other forest products such as resin, gum, tan bark, etc. It is based on the knowledge of a number of basic subjects / sciences, such as Siliviculture, Ecology, Geology, Pedology, Botony, Mensuration, Pathology, Economics, and Finance etc. In addition, a forester needs the practical experience gained from observations in the field, results of past treatments given to a forest and deductions there from. Management of forests broadly involves three main tasks viz, (i) Control of composition and structure of the growing stock, (ii) Harvesting and marketing of forest produce, and (iii) Administration of forest property and personnel.

It is, unlike any other commercial enterprise, complication; as forests, particularly the State-owned as most of the forests are in India (95.8%), are managed for a multiplicity of purpose – productive, protective, climatic, wildlife, recreational and bilaesthetic, with one use dominant, viz., most often the production of wood. Though the forest land can be managed simultaneously for several uses, however, in some cases, uses are incompatible with one another; e.g., grazing is not compatible with timber production, environmental conservation and recreational use. In each case, priorities are laid down by the owner - the State or the private owner as the case may be, and the management is oriented to achieve the prescribed objectives. In the forests dedicated primarily to recreational and bio-aesthetic use, and conservation of ecology and environment, grazing, fellings, timber extraction and even hunting may have to the suspended.

Productive and protective functions of the forests cannot be bifurcated. As a matter of fact, scientifically managed forests perform both these, simultaneously; productive forests do protect and protective forests do produce – the distinction between the two is of degree rather of kind - a matter of emphasis of the primary function of the forest that the management aims at. It is, therefore, essential that forest resources are maintained in a state of maximum production, consistent with their subsidiary or even the other main functions. Forests have to be managed in such a way so as to provide maximum benefits to maximum people and for all time, ensuring that the soil produces most and deteriorates least under their treatment.

1.1.1 Scope of forest management

Management of Forests, as that of any other enterprise, involves a process of making and implementing policy decisions to achieve the objectives of the owner. These decisions involve, in turn, a plan of action. Planning is the responsibility of the States and the Centre in case of State-owned forests, broad principles for which are embodied in the National and the State Forest Policies. Detailed plans are prepared by Forest Managers at the professional level, and executed by the technician level staff. Forest Manager has to constantly manage the growing stock to achieve given objects of management; in this process he has to decide: 'how much, when where and how to cut.' Scope of Forest Management is very extensive; it encompasses broadly, the following main activities:

A. Control of Growing Stock, its Structure and Composition:

i. Site adaptation

ii. Choice of species

iii. Manipulation of stands

iv. Harvesting the produce

v. Regeneration

vi. Protection.

B. Distribution and Marketing of produce:

i. Transportation and communication.

ii. Logging Plan

iii. Marketing data

iv. Sale of produce

v. Revenue

C. Administration of Forest Property:

i. Forest organization

ii. Management of Personnel

iii. Monitoring and control or works

iv. Labour management and welfare

v. Financial control and economy efficiency

vi. Fulfillment of social obligations

vii. Record for present and future reference.

1.1.2 Management of private forests vis–a–vis public forests:

A private owner of a small forest estate seldom looks beyond the immediate gains from sales of trees, as and when required to meet his financial obligations, or when the market rates are high. He is not much concerned with sustained production for the posterity or for the indirect benefits which the forest bestows. However, there are some exceptions; some of the princely States protected and conserved their forest estates zealously, though mainly for wild life and *shikar.* Now with the abolition of *Zamindari* and merger of the princely States, most of the Indian forests (95.8%) are under the State ownership which has to be managed not only for production of tangible or the material products alone, e.g., wood (timber and industrial raw material) and a host of minor forest products but also for the intangible services – protective, regulative and socio-cultural.

1.2 Principles of forest management national forest policy:

Fundamental principle of sound management of any enterprise is the fulfillment of the owner's objectives to the maximum extent possible. In case of the State forests, the objects are embodied in the National forest Policy and the concerned State Forest Policy.

1.2.1 Forest policy of 1894

India's first Forest Policy was enunciated in 1894, which laid down *public benefit* as the sole objective of management of public forests. The Policy suggested the maintenance of forests in hilly areas for preservation of climatic and physical conditions, and for protection of cultivated land below in the plains form the devastating action of hill torrents. Even though some safeguards were provided, demand for culturable land was proposed to be ordinarily met by clearing forest areas, thus giving preference to agriculture over forestry.

1.2.2 National Forest Policy 1952

After attaining Independence in 1947, it was felt that the revolutionary changes, which had taken place during the interval in the physical, economic and political fields, called for reorientation of the old Policy. Indian Republic formulated its first *National Forest Policy* in 1952. It retained the fundamental concepts underlying the old policy but considered the following paramount needs of the country in its formulation.

(i) Need for evolving a system of balanced and complimentary land – use, under which each type of land would produce most and deteriorate least.

(ii) Need for checking denudation of mountainous regions, erosion along treeless banks of rivers and vast stretches of undulating waste-lands, invasion of sea-sands along coastal tracts and shifting sand dunes.

(iii) Need for establishing tree- lands wherever possible for the amelioration of physical and climatic conditions promoting the well-being of the people.

(iv) Need for progressively increasing supplies of grazing small-wood for agricultural implements, and particularly of firewood to release cattle-dung for manuring agricultural fields.

(v) Need for sustained supply of timber and other forest produce required for Defence, Communications and Industry.

(vi) Need for realization of maximum amount of revenue in perpetuity, consistent with the fulfillment of the needs enumerated above.

The policy advocated a functional classification of India's forests, apart from legal classification, to focus attention on the specific object of management in each case into:

(a) Protection forests

(b) National forests

(c) Village forests

(d) Tree- lands.

The Policy also suggested keeping a minimum of one third of the country's total land areas under forests, with 60% in the Himalayas and other hilly tracts liable to erosion and 20% in the Plains. The Policy strongly deprecated the notion widely entertained that 'forestry as such had no intrinsic right to the land but may be permitted on sufferance on residual land not required for any other purpose.

1.2.3 Recommendations of national commission on agriculture (N.C.A) 1976

The N.C.A, constituted on 1970, suggested the need for a revised Forest Policy, in their Report of 1976. The N.C.A. concluded that National Forest Policy should rest on two important points, viz., (i) Meeting the requirements of goods, i.e., industrial wood for forest-based industries, Defence, Communications and other public purposes and small timber, fuel- wood and fodder for rural community. (ii) Satisfaction of the present and future demands for protective and recreational functions of the forests. To meet these requirements, N.C.A. suggested a revised Forest Policy. Revised National Forest Policy (draft) recognizes the following vital needs of Forest Management:

(i) For providing maximum goods and services for the public well-being and Economic progress of the country.

(ii) Need for checking denudation and erosion in the mountainous region, tree- less river bands and waste- lands.

(iii) Need for realizing maximum productivity of the forests to meet increasing requirement of industrial raw material, timber and other forest produce.

(iv) Providing small timber, firewood and grazing for rural population; however, indiscriminate and harmful grazing to be strictly controlled.

To fulfill these needs, the policy suggests that, on an average, 33% of the land areas should be dedicated to forest comprising of 60% in the hills and 20% in the plains. The fallacious notion that forests may be permitted on sufferance on residual land should be vigorously counteracted.

The policy clearly spells out the multiple purposes for which the forests will be managed, e.g.

(a) Environmental Conservation: to manage and provide for rehabilitation and improvement of forests for their protective influences specially soil and water conservation. Forests purify the air we breathe, temper climate, cushion the rain and storms, protect the soil from the ravages of floods and erosion and help in regulating stream flow.

(b) Production: to meet the demands of existing and developing industries and the national requirements of timber for Defence, Communication and domestic needs.

(c) Social: to meet social needs of the Community, consistent with other objects such as recreation, agricultural timber fuel-wood and regulated grazing for rural people.

States have been enjoined to regulate their policies on the lines of and in consonance with, the above principles.

1.3 Forests on concurrent list

Realizing the importance of forests for the well-being of the nation, the Parliament, by the 42nd Amendment to the Constitution in 1976, brought forests and wildlife on the concurrent list in 7th schedule. This has enabled the Central Govt. to play a more effective role, than a mere advisory one, in the management of forests. The President of India promulgated the Forest (Conservation) Ordinance, 1980, which put severe restrictions on de-reservation of forests, or use of forestland for non- forest purposes, without prior approval of the Central Govt.

1.4 Some peculiar features of forest management or forestry

Forestry presents some distinct features as compared with agriculture or any industrial enterprise. Firstly, forestry is a long term investment and there is a long interval between the formation and harvesting of forest crops. In agriculture, sowing and harvesting of forest crops are done every year, if not several times a year. Similarly, in industry the interval between the investment of capital and the date of first production is continuous. In forest plantations, the interval between the date of formation and date of harvesting may be several decades. This long production period involves delayed

returns on the invested capital, which is locked up in the form of maturing timber on the ground.

Second peculiarity is the identity of the product and the manufacturing plant, that is, the income or annual increment of the forest is not distinct from the capital or the growing stock. Trees themselves are the machinery which manufacture the raw material, wood, formed as thin annual rings round the stems and branches of trees. This circumferential growth is the result of absorption of water and nutrients (salts) from the soil, of oxygen from the air and assimilation of carbon from the atmosphere by photosynthetic process in the leaves in the presence of sunlight. Both the capital (trees) and the yield (increment) are just trees, and there is no natural line of distinction between the trees that may be felled as yield and the trees that must be retained as growing stock to form the capital. In agriculture, the land is the capital and the crop is the interest or income. In industry, the machinery, land and buildings are the capital and the manufactured product is the yield or income. In both these enterprises, there is little danger of capital being encroached upon as both the consumable product (the dividend or interest earned) and the capital are inseparable from each other, and it is not possible to harvest the product separately from the capital, only whole trees, when exploitable, can be felled. It is therefore, imperative to correlate the quantity of growth (increment/yield) to the whole trees that may be cut, ensuring, simultaneously, that the trees left are sufficient to provide the capital (growing stock) necessary for sustained yield. This identity in the form of capital and income, combined with the length of rotation, calls for a special approach to problems of forest management. The need for regulating the yield is thus very vital, even though it is not very easy to do so, especially in forests which are not normal.

Another peculiarity inherent in forestry is the multiple and varied uses of forests. Forests satisfy innumerable human needs varying from tangible material products to incomputable benefits they bestow; the latter create difficulty in deciding priorities when several benefits, not all assessable in terms of money, can be provided from the same piece of forest land. The difficulty is pronounced in case of public forests wherein claims and needs of multiple beneficiaries are not easy to decide.

To the foregoing peculiarities complicating forest management, may be added another, viz., forests, generally, occupy more remote, less accessible and less fertile lands as

compared to agricultural lands. This results in diffused working and resultant difficulties in supervision and protection as well.

1.5 Instruments of forest management

Since forestry is a long term enterprise, it is necessary to record the plan of forest management in the form of a written document, for guidance of the forest manager in charge of the forest estate. This will not only save the management from the whims and idiosyncrasies of individuals, provide summary of the results of past working and guidelines for future, but also serve as an instrument for execution of operations decided upon to achieve the desired objectives. A working plan of a forest is such an instrument which discusses and prescribes the management of a forest so as to realize the objects of management.

Working plans are invariably based on the principle of sustained yield. One of the objects of management is always to bring the forest to a condition as nearly normal as possible, and as early as practicable. A working plan gives full account of the physical factors of the locality, composition of the forest, describes the past history, reviews past management, furnishes statistical data and lays down silvicultural management of the various types of forest.

A working plan is not only a plan of operations for the management of the forest but also a document of reference on all matters connected with the forest.

1.6 Objects of management

1.6.1 Purpose and policy

"Primary object of good management is provision of the maximum benefit to the greatest number of people for all time" (Brasnett). This fundamental purpose is expressed in a similar way by Knuchel (1953) as: "The object of management under any circumstances is the most advantageous utilization possible of the soil allotted to forestry".

As already stated in the preceding Chapter, forests may be managed primarily for productive purposes, i.e. direct material benefits, or protective purposes, i.e., indirect benefits. As a matter of fact, a scientifically managed forest may fulfill both these purposes, simultaneously. However, it is expedient to determine priorities – i.e., the

primary (major) and the secondary (minor) objectives of the owner. In case of extensive national forests, it may be sometimes possible to allocate separate forests, in different locations, to fulfill distinctly separate functions, e.g., wildlife reserves, national parks, recreation and natural beauty spots may be clearly demarcated, as also soil conservation areas on the hill slopes, from the production forests. Forests fulfill more than one purpose, with usually one use dominant – the primary object, which is most often timber production. They have, however, to be so managed as to afford the highest possible direct and indirect benefits in perpetuity.

Objects of management broadly express the basic purpose of the forestry enterprise rather than the production of a specific product. In the State-owned forests, the management plans (Forest Working Plans), irrespective of the location and forest type, invariably stipulate the following (or more or less so) general objects of management as applicable to the entire forest estate under the specific plane, thereby providing a broad framework for management.

1.6.2 General objects of management:

(i) Maintaining and, as far as possible, raising the productive capacity of the soil and of the forest stands consistent with the maximum site potential.

(ii) Promoting the protective effect of the forest, against soil erosion, avalanches, floods and protection of the physical factors such as natural scenery, local flora and fauna.

(iii) Execution of silvicultural operations and regulation of fellings in such a way so as to bring the forest to a condition of as near normality as possible; in simple words, attainment of a *normal forest* is one of the principal objects.

(iv) Satisfaction or rights of the right holders in respect of timber, firewood, grazing, etc., in particular, and to meet the bonafide requirements of the local population in general.

(v) Subject to the above Silvicultural, Conservational and Social considerations, providing the maximum possible volume of valuable timber for constructional and industrial purposes, and other forest produce for meeting the market demands and securing the highest possible financial results.

1.6.3 Special objects of management:

Whereas the general objects of management provide the framework for the entire forest estate under a management plan, special rent site factors and forest types more suited for specific purposes. Accordingly, our Working Plans invariably specify general objects for the entire Working Plan area and in addition, special objects of management of each Working circle, which is characterized by a distinct vegetation type, more suited for certain purposes as compared to other. In short priorities of objects are re-arranged.

Some examples are given below:

(i) Badly eroded areas and steep hill slopes may be constituted into a Protection Working Circle, where the special object will be protection, afforestation, "Soil and Water Conservation; satisfaction of only the minimum social needs of the local population, ignoring considerations for market supplies and financial returns.

(ii) In the watershed of municipal water supplies, irrigation and hydro-electric generation dams, the special objective being the maintenance of an undisturbed protective vegetative cover, all other forms of use must be subordinated to it.

(iii) In forest areas of natural scenic beauty, wood- lands near urban habitation, recreation often being the dominant object, timber fellings, grazing and even hunting will have to be entirely stopped. Such forests serve as 'magnificent playgrounds for tired mankind seeking peace and spiritual strength.'

(iv) Mixed miscellaneous open forests, heavily grazed and felled in the past, with low proportion of valuable timber and industrially important species are clear felled and converted into plantations of desired species pure or simple compatible mixtures. Such areas have extensively been constituted into Plantation Working Circles and / or Industrial Timber Working Circle in plains and terai areas of U.P. and West Bengal, Bihar, Orissa, with a view to meeting increasing demand for industrial raw material for pulp, match and plywood industries.

(v) In Chir-pine forests, one of the special objects is invariably the production of resin for resin and turpentine industries.

In dry and moist mixed deciduous forests, containing quantities of *Khair and Semal,* one of the special objects will be to ensure their reproduction and increase their proportion to feed Cutch/Katha and Match industries.

1.7 Choice of objects:

Whereas the choice in case of private industrial enterprises, where profit alone is the main consideration, is comparatively easy, it is not so in case of State-owned properties, particularly such as forest lands which can provide a wide range of goods and services. Decisions regarding the extent of forest land to be dedicated for providing goods and services required for the local population, and the rate at which these should be provided at a profit or at cost or even free at the cost of general tax payer are quite difficult to take. Policy decisions regarding the course of action to be taken are even harder to take, as policy will change with the conditions and objects and has to be revised from time to time.

Difficulties in deciding the purpose and policy of forestry enterprise increase with the variety of its potential products and their importance to consumers' local population and the community as a whole. In additions, new inventions and discoveries, trends in development of resources and progress in standards of living, add new dimensions to the pattern of demand necessitating re-arrangement of priorities and objectives.

1.7.1 Attitude of the owner

Forest lands may be public-owned or privately-owned; in India, however, these are almost entirely State owned and / or managed. A forester is deeply concerned with the important, though sometimes perplexing, management problem of forest lands which are, as we know, capable of providing a variety immediate interest of the private owners is limited, which is mainly financial and, therefore, naturally focused on products which will bring direct monetary returns. Unlikely public ownership, their management is *marked-oriented* responsive to market demands and fluctuations in prices. Management objectives of private owners are usually specific, often narrow as compared with those of State forests, financial considerations being invariably dominant.

It frequently so happens that private interests in forest management do not adequately safeguard public interests, which in the long run must be paramount. The public has a stake in all forest lands, irrespective of ownership and hence a measure of control provided in forest enactment by the State on private forests against their wanton destruction.

In U.S.A., where there are extensive forest estates under private ownership as well, there is a large area of common interest. Forest Management, whether public or private, is a business requiring the same skill, technical knowledge and general managerial ability. Every owner is concerned with managing his forest lands in a thoroughly businesslike manner to obtain maximum benefits or returns that may be, or however measured. Fundamentally a forest business is very much akin to any other, the difference being primarily in application.

Approach of the owner to the intangible and incomputable services is different from that to material goods, while deciding his objects of management. He has to assess the importance and value of each service, both to the owner and the community the extent to which the service can be provided by forestry, or by some other activity and the cost of providing each service by forestry or by some other land use. This will enable him to determine whether forestry or some other land- use is best suited to supply the services, in whole or in part and, secondly, for areas allotted to forestry what priority is to be given to various services both among themselves and relative to material forest products. He should also be able to decide the degree to which the supply of services may be segregated to particular areas or combined with supply of other services or products in the same area. However, the crux of the matter, and its greatest difficulty, is the assessment of values and costs in comparable real terms, e.g., in money. Costs of providing services can often be judged more easily by estimating the value of what the land could produce in material goods were it not used for ensuring the service than by calculating the actual costs of a administering the service.

As regards material forest products or goods, there is a large variety, ranging from major products such as timber, industrial raw material, firewood, charcoal, to minor products such as gums, resins, oils, tans, drugs, fruits, medicinal plants, fodder, to name only a few. Choice of the type of products to grow depends mainly on the owner, his objects and limitations and constraints, if any. The tow paramount considerations will, however, be:

(i) What tree species are suited to the locality and what forest products can be raised.

(ii) To what use the products thus raised can be put to the best advantage.

The first is an obvious limiting influence. Even if a valuable species can grow in a locality but only slowly, it may be financially disadvantageous to grow. The second factor is more difficult to assess as it will involve fore-casting the trend of demand. The owner, in the first instance, should decide as to which of the following three alternative meanings he gives to works *best advantage* namely:-

(i) Production of a particular kind of product for a particular consumer (industrial raw material, etc.).

(ii) Securing most desirable financial results, irrespective of any particular type of product.

(iii) Production of the greatest quantity of products irrespective of the degree of financial gain.

Different owners may ascribe different meanings to the *most desirable financial results.* For example, a community owning a forest in a village may decide in favour of growing firewood because other forms of fuel may not be available, or be too expensive. A paper manufacturing company may, however, decide to grow only those species and sizes which are most suitable for a pulping plant, even if the profits are lower from forests, but more from its paper project, its primary activity, so that the combined profits are increased. It is obvious that the type of owner, or owning body, may substantially influence choice of objects of growing a particular product or products.

1.8 Social role of forestry: social forestry

In her thought provoking message to the Centenary Celebration of Forest Education at the F.R.I. and Colleges, Dehra Dun, in Decembter, 1981, (late) Smt. Indira Gandhi, the beloved Prime Minister of India, highlighted the Social role of forestry in the following words. “Forests have always occupied a special position in our culture folk- lore and religion. There has been emphasis on conservation and non-destruction of plant wealth. But greed and a growing population have led to progressive shrinkage of our forest cover, and to the inevitable consequences in the form of erosion, floods and drought. In a developing economy, there is bound to be conflict of interest in resource management. The challenge is to work out a balanced programme for forests, both for conservation and development. The forester has to serve the immediate needs of the villager, specially as regards fuel for the home needs. But he has also to think of the

future. A well thought out programme of training for foresters is a basic pre-requisite of good national developed.

As stated earlier, forests are one of the most valuable natural resources inexhaustible and self perpetuating if properly managed unlike oil, coal and minerals providing a wide range of goods and service and serving the mankind in multifarious ways.

The National Commission on Agriculture report high- lighted the importance of the socio-economic role of forms for the rural communities and in the management of the forest resources of the country. It has defined *Social Forestry* in include *Farm Forestry, Extension Forestry, Recreation Forestry and Reforestation* in degraded forests. Objectives of Social Forestry, taking into consideration the basic socio-economic needs of the community for betterment of their living conditions, include:-

(i) Fuelwood supply to villagers and replacement of cow-dung for cooking.

(ii) Supply of small timber

(iii) Supply of fodder.

(iv) Protection of agricultural fields against wind erosion

(v) Recreational needs of the community.

Social Forestry, a forestry programme for Community Development, (*also called Rural Forestry, Extension Forestry, Enrichment Forestry, Community Forestry, etc.),* has picked up momentum in India, as well as in many other under-developed countries of the world. It is essentially a people-oriented joint forestry management programme with the main objective of satisfying the needs and aspirations of both the people and the State.

Community forestry is the final expressions of the peoples involvement in tree plantation, conservation, development and harvesting of forests for the benefit of the local communities and the Nation.

In India, with a vast majority of population living in villages, subsisting and / or employed mainly on agriculture, forests play a significant role, particularly in rural economy, Trees meet the day to day vital requirements of rural and sub-urban communities in respect of fuel, fodder, grass, timber of small huts and agricultural implements, etc. in addition, forest products such as tan-bark, leaves, fruits and seeds

supply raw material for a number of cottage industries such as tassar and silk production (by rearing tassar and silk worm / cocoons on *arjun* (*Terminalia arjuna*) and mulberry leaves, respectively), oil extraction from seeds of *Kanji (Pongamia pinnata), Neem (Azadirachta indica)(and mahua (Madhuca longiforlia Var. latifolia),* paper pulp from Saijna (*Moringa oleifera), Sesbania* spp., *Ailanthus excelsa, Acacia nilotica, Albizia,* if planted on a sizable scale in suitable areas, can sustain schemes of rearing milch cattle as well, by the landless villagers.

Since our forests are not inadequate in extent, generally poorly stocked and not uniformly distributed, the problem of meeting multifarious needs of villagers becomes all the more serious. For cooking food alone an estimated quantity of 400 million tones of cattle-dung is burnt in the form of dung-cakes which deprives the village fields of valuable nitrogenous manure, equivalent to the production of chemical fertilizers by eight

Sindri Fertilizer Plants. In addition, it is estimated that about 4 million tones of fuel is required annually for cremation of the dead another important social requirement. Supply of fuelwood to divert cow-dung from village hearths to village fields, small timber of rural housing and agricultural implements, fodder for cattle or rural population living far a away from the forest areas, protection of agriculture by creation of diverse ecosystem and arresting wind and water erosion, and creation of recreational forests for the benefit of rural as well as urban population, are the basic economic and cultural needs of the community without which there can be no improvement in the standards of their living. Accordingly, the Govt. of India, on the recommendation of the National

Commission of Agriculture (1976) has embarked on a large scale Social Forestry Programme, through State organizations. Very impressive results have been obtained in Social Forestry Schemes / Projects launched in various States, particularly Gujarat, Uttar Pradesh, Haryana and Maharashtra. Large scale plantations of locally useful tree species are being raised in compact areas or scattered in waste-lands, village Panchayat lands, compounds, private and public degraded lands, etc. But for such Social Forestry programmes executed with the active co-operation of the villagers, Gram Panchayats and voluntary organizations, it would be very difficult to rehabilitate rural economy, which is mainly agricultural. All that is needed in this regard is the determination and effort, and not much of an investment.

1.9 Forestry in relation to Agricultural

A reading feature of the modern industrial civilization is the recognition of the importance of forests to our national economy. Our revised National Forest Policy has taken cognizance of the indispensability of forests, for both productive and protective purposes in our planning for national prosperity. Our forests are no longer to be considered as inexhaustible reserves for extension of agriculture. The right of forests to occupy land permanently has now been recognized and forestry is no longer to be viewed as a mere *hand maiden* of agriculture, but its promoter and protector as *forester-mother.* In a balanced national economy, both forestry and agriculture play supremely important roles for sustenance of human civilization. Another fact which deserves better recognition is that forests are also essential to maintain and increase the productivity of agricultural lands I various ways, e.g., by regulating water supply, maintenance of an equable climate, provision of leaf manure and fodder, timber for agricultural implements and fuel for the hearth so as to divert cow dung to its normal (and legitimate) use as manure in the fields. Shelter-belt plantations along coastal fringes (e.g., *Casuarina* plantations on shifting sands on the Orissa, West Bengal, Andhra Pradesh, Tamil Nadu, Maharashtra and Gujarat sea-coasts) control the ravages of violent winds, immobilize coastal sands and protect agricultural crops. In the arid regions, windbreak plantings protect the agricultural fields against desiccating winds.

Fertility and productivity of agricultural land is so intimately bound up with sound forestry practices, in and around the farms, that the wanton destruction of country's forest resources is invariably reflected in diminishing agricultural returns. Forestry is, thus, not a competitive but a complementary land use to agriculture; hence the urgent need for making *Social Forestry* a people's programme.

Concept of Social Forestry envisages the practice of forestry on lands outside the conventional forest areas for achieving social objectives for the benefit or rural and urban communities. This is a new dimension added to the concept of forestry and encompasses, with in its scope: (i) *Farm Forestry,* (ii) *Extension Forestry* including *mixed forestry,* shelterbelt and linear strip plantations, (iii) *Reforestation* of degraded forests (iv) *Recreational or Aesthetic Forestry.* A forester engaged in Social Forestry

projects is a veritable social worker, promoter or rural economy and a *de-facto* rural development officer as well.

Summary

Reference

http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forestry%20IInd%20year.pdf

Unit-2 Forest Organization

Unit Structure

2.0 Learning objectives.
2.1 Introduction
2.1.1 Geographical and Climatic (Ecological) Classification:
2.1.2 Functional Classification:
2.1.3 Legal Classification:
2.1.4 Territorial Classification
2.2 Administrative (Organizational) Classification:
2.2.1 Administrative Units Officer Incharge
2.2.2 Management (Silvicultural) Classification:
2.3 Periodic Blocks: Felling Series in Uniform System:
2.4 Felling Cycle – Felling Series in Selection Forest:
2.5 Felling Series in Coppice-With-Standards (C.W.S.) System:
Summary

2.0 Learning objectives.

After studying this unit you will be able to understand:

- Geographical And Ecological Classification of Forests
- Functional Classification of Forests
- ,Legal Classification of Forests
- Territorial Classification of Forests
- Administrative Classification of Forests

2.1 Introduction

FORESTS are classified into various categories for purposes of description, administration, management and record. These subdivisions are:

(i) Geographical & Climatic (or Ecological)

(ii) Functional

(iii) Legal (or Statutory)

(iv) Territorial

(v) Administrative (or Organizational) and

(vi) Management (or Silvicultural)

2.1.1 Geographical and Climatic (Ecological) Classification:

Under this, forests are divided into different forest types. Five major groups are recognized in India, viz, Tropical, Montane Sub-Tropical, Montance Temperate, Sub apline and Alpine Scrub. These major groups have been further divided into sixteen type groups, or simply groups or type-groups have been further differentiated into two subgroups, describing Southern and Northern forms. Each sub- group is further divided into forest type climax, edaphic, seral, etc.

2.1.2 Functional Classification:

National Forest Policy of 1952 suggested a functional classification of Indian Forests into Protection Forests, National Forests, Village Forests and Tree- lands. The National Commission on Agriculture (1976) has suggested a modified functional classification as Production Forest (sub-divided into valuable forests, mixed quality forests and inaccessible forests), Protection Forests and Social Forests (including minor forests on marginal lands).

2.1.3 Legal Classification:

Forests are broadly classified as Reserved, Protected, Village and Un-classes forests. *Reserved Forests* are constituted under the Indian Forest Act (I.F.A), or other forest laws (e.g., M.P. Forest Act). They are the exclusive property of the Govt. and subject to complete protection. Villagers have no rights what so ever in these forests; however, they may sometimes be granted certain concessions, such as watering their cattle, collection of dry and fallen firewood by head- loads for their bonafide domestic use, etc., in consideration of their co-operation and assistance in forest protection.

Protected Forest is a legal term for an area subject to limited degree of protection, and constituted as such under the provisions of the I.F.A. Rights of villagers are settled and recorded, and the Govt. exercises control on felling and transport of timber, and removal of forest produce in whatever form it may be.

Village Forests are State Forests assigned to a village community under the provisions of the I.F.A. or forests established and managed for supply of forest produce to a village.

Un-classed Forests are forest lands owned by Govt. but not constituted into Reserved, Protected or Village Forests. These are generally heavily burdened with rights and are excessively grazed and felled, and even burnt.

2.1.4 Territorial Classification

For executive and protective works, forests are divided into Blocks, Compartments and Sub-Compartments.

(i) Block: It is a main territorial division of the forest, generally bounded by natural features and bearing a local proper name. each block has a clear-cut boundary all round it with numbered pillars.

(ii) Compartment: A block is divided into several compartments which are territorial Units of a forest permanently defined for purposes of administration and record (preferably designated by Arabic numerals 1, 2, 3, etc.). It is the smallest permanent Working Plan unit of management, location of works and record; as such, its boundaries are carefully chosen on the ground and marked on the map. The boundaries are formed either by natural features such as ridges, valley bottoms, streams or artificial lines such as fire lines. The size of a compartment depends on the intensity of management. Smaller the compartment, easier it is to include areas homogeneous in site factors and forest types in each. In intensively worked forests, Compartments can be quite small, whatever the Silvicultural System adopted. As far as possible a compartment should be homogeneous throughout its extent as regards soil, aspect and composition of growing stock. In protection and Selection forests, working intensity is light and compartments are usually large in size.

(iii) Sub-Compartment: If a compartment does not carry one forest type uniformly, and is not suitable for a uniform descriptive inventory and treatment, it may be temporarily, or permanently, divided into *sub-compartments,* which then form the Silvicultural Units of management. A Sub-Compartment is defined as: *a sub-division of a compartment, generally (but not necessarily) of a temporary nature, differentiated for special description and silvicultural treatment (preferable designated by small letters, a, b, c, etc.).* The sub-division may be revoked when

the crops have been brought into a condition when they do not require different treatments.

2.2 Administrative (Organizational) Classification:

At the Central Government level, all Govt. owned forests in the Union Territories are under the control of the Govt. of India, and administrated on their behalf by the Inspector General of Forests, India (I.G.F), with head quarters at Delhi. He is assisted by an Additional Inspector General of Forests (Addl. I.G.F.), a number of Deputy Inspectors General (D.I.Gs.) And Assistant Inspectors General (A.I.Gs.) of Forests, incharge of various wings or special works, such as General Administration, Wild Life, Central

Forestry Commission, Forest Industries, Social Forestry, etc. He is currently, *ex-officio* Special Secretary to the Govt. of India in the Ministry of Environment & Forests, and is technical advisor on forestry matters to all the State Governments as well. The Govt. owned forests in the States are under the control of the respective State Governments. As the forests have now been included in the Concurrent List since 1976, central Government has also some say in their management and control. The Head of the State Forest Department is designated as the Chief Conservator of Forests (C.C.F.). In several major States, like Madhya Pradesh (M.P.), Uttar Pradesh (U.P.), Himachal Pradesh (H.P.), Maharashtra, Gujarat, Karnataka, Kerala, etc., there are at present more than one C.C.F. and the senior most amongst them is the administrative Head and designated as Conservator- in-Chief (as in M.P.), or Principal C.C.F. (as in U.P). The C.C.F. is assisted by Additional Chief conservators of Forest (Addl. C.C.F.) with supervisory and administrative jurisdiction over a number (usually 4 to 5) of Circles, each under a Conservator of Forest (C.F). Corresponding posts of Deputy Chief Conservator of Forests (Dy. C.F.) have since been abolished in almost all the States. With the expansion and stream- lining of forestry activities, and with a view to eliminating the middleman / contractors, State Forest Corporations have come up in most of the State.

These Corporations handle not only the timber trade, but also the extraction and marketing of other forest produce as well. A Forest Corporation is generally headed by a Managing Director (M.D.) usually of the rank of a C.C.F. (as in Himachal Pradesh,

Maharashtra, U.P., M.P.) and sometimes an addl. C.C.F. He is assisted by Directors and Deputy Managers and Assistant Managers for comparable positions in the administration of Corporations. The Forest Minister of the State is usually the chairman of such Corporations.

Similarly, in some States, as in U.P., H.P. and Gujarat, separate Directorates of Social Forestry has been created under the charge of a C.C.F. In West Bengal, the Director is of the rank of Addl. C.C.F. State forests, under the Head of State Forest Departments, are divided into a number of Circles, each under a Conservator of Forests (C.F.). There is Territorial as well as Functional Circles. A circle is divided into a number of Divisions, each under the charge of a divisional (or District) Forest Officer (D.F.O.) who is generally of the grade of a Deputy Conservator of Forests (D.C.F.). There is Territorial as well as Functional Divisions, such as Siliviculture, soil Conservation, Working Plans and Logging Divisions. A D.F.O. is the kingpin of forest administration in India.

In many States, Forest Divisions are sometimes divided into two or more Subdivisions, each under a Sub-Divisional Officer (S.D.O.), an officer of the rank of an Assistant Conservator of Forests (A.C.F.). In West Bengal, there are posts of Addl. D.F.Os. as well. In our Indian set-up, direct recruitment to the Gazetted ranks is made only at the level of an A.C.F. All other higher posts (of D.C.F., C.F., Addl. C.C.F., I.G.F.) are filled up by promotion from this rank. Thus, the post of an A.C.F. is of great importance. A certain proportion of these posts is filled up from the non-Gazetted ranks of Forest Rangers (F. Rs.) by promotion. Each Division or Sub-Division is divided into a number of subordinate units called *Ranges,* each under a Range Forest Officer, also designated simply as Range Officer (R.F.O. or R.O.) of the rank of a Forest Ranger (F.R.) or, sometimes, a senior Deputy Ranger (D.R.). A range is a very important unit in the management and administration of Forests. Ranges are further split up into a number of *Sub-Ranges, Blocks or Section*, each under the charge of a Forest Guard for protection and execution of field operations. *Beat* in the smallest functional territorial Units, and is the foundation of Indian forest administration. Summing up, hierarchy of the State Forest Department is, generally, of the following pattern.

2.2.1 Administrative Units Officer Incharge

(i) State Forest Department C.C.F.

(ii) Circle C.F.

(iii) Forest Division D.F.O. (D.C.F.)

(iv) Forest Sub-Division Sub-D.C.O. / S.D.P. (A.C.F.)

(v) Range R.F.O. / R.O. (F.R., or D.R)

(vi) Sub-Range, Section or Block Sub Range Officer; S.O. or B.O. (D.R or Forester)

(vii) Beat Beat Officer (Forest Guard)

2.2.2 Management (Silvicultural) Classification:

From the point of view of Silvicultural management, forests are classified into:

(i) Working Circles

(ii) Felling Series

(iii) (Cutting Section,

(iv) Coupes

(v) Periodic Blocks.

(i) Working Circle: The units of forest management are a Working Plan, usually covering an area of a Forest Division. As already defined, Working Plan is a written Scheme of management aiming at continuity of policy and action and controlling the treatment of the forest. Since the entire Working Plan area is usually large and heterogeneous in site conditions and crop composition, different silvicultural treatments may have to be given in different parts of the Working Plan area and different working rules, called prescriptions, drawn up for different parts. Such parts are known as Working Circles (W.C); a W.C. may be defined as: a forest area (forming the whole or part of a Working Plan area) organized with a particular object and subject to one and the same silvicultural system and the same set of Working Plan prescriptions. In certain circumstances Working Circles may overlap. (BCFT).

(ii) Felling Series: If is is considered undesirable for silvicultural, social or economic reasons to concentrate fellings in any one place, e.g., if it is desired to provide a sustained yield of forest produce to one or more markets, or to distribute works of all kings over one or more ranges, a W.C. may by divided into *Felling Series* (F.S.). A F.S 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 for each F.S. which should have an independent representation of age-classes (BCFT Modif.).* Each F.S. is a self- contained unit of management with a separate calculation of yield and a separate series of silvicultural operations. A division of a W.C. into several F.S. enables effective control and distribution of work in different ranges. When a W.C. is no divided it is, of course, one Felling Series.

(iii) Coupe: In clear- felling system, a F.S (or W.C., if undivided) is divided into a number of *Annual Coupes* (annual felling areas), equal to the number of years in the rotation, say R, size of each coupe being equal to the area of the F.S (or W.C., as the case may be), say A hectares divided by R, i.e. A/R hectares. Each F.S. will have all the R age gradation.

(iv) Cutting Section: Sometimes it may be desirable to avoid fellings in contiguous coupes in successive years for silvicultural considerations, such as danger from fire and / or insect attack. In such cases, a F.S. in sub-divided into a number of *Cutting Section;* a Cutting Section being defined as: a *sub-division of a F.S formed with the object of regulating cuttings in some special manner:* a planned separation of fellings in successive years.

2.3 Periodic Blocks: Felling Series in Uniform System:

Under the Regular Shelterwood (or Uniform) System of natural regeneration, ageclasses take the place of age-gradations and periodic blocks take the place of annual coupes, each containing one age-gradation. A ***Periodic Block*** **(P.B.)** is defined as "*the part or parts of forest set aside to be regenerated, or otherwise treated, during a specified period." The regeneration block is called "Floating" or "Single" when it is the only P.B. allotted at each Working Plan revision. When all P.Bs. are allotted and retain*

*their territorial identity at Working Plan revision they are termed "Fixed" or "Permanent". (*Glossary)

2.4 Felling Cycle – Felling Series in Selection Forest:

In an ideal Selection Forest the entire area will be worked every year and will represent a complete and undivided Felling Series. Such annual working of the entire area of the Working Circle is neither practicable nor desirable. The usual practice is to divide the area into a number of coupes (also sometimes known as Cutting Sections) each of which is worked at an interval of a planned number of years, known as *Felling Cycles* (F.C.), which is defined as: *the time that elapses between successive main fellings on the same area (*Glossary). It may vary from about 10 to 30 years (in some cases even 5 to 40 years) depending on the intensity of working. Larger the number of coupes, longer the felling cycle, heavier the intensity of felling in each coupe and, consequently, less irregular crop, and *vice-versa.* The number of coupes will obviously be equal to the number of year n the F.C and they may be made up of one or more compartments.

In practice, rotation means very little and is practically of no consequence in a selection forest; trees which are felled at each F.C. are those which are deemed to have completed their period of maximum growth, and are interfering with potentially more valuable trees, or require removal for Silvicultural reasons.

2.5 Felling Series in Coppice-With-Standards (C.W.S.) System:

In C.W.S., the arrangement of the age- gradation in over wood (Standards) is the same as in theory in Selection forests, regarding each coupe to be a Cutting Section, except that the age-class 0 to r (rotation of coppice) is missing; it being included in the under wood (Coppice). The age-gradations in the under wood are arranged as in clear felling high forest system. The rotation of the over wood (Standards), R, is a multiple of the rotation of the under wood (Coppice), r.

Summary

Reference

http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forestry%20IInd%20year.pdf

Unit-3 Concepts of Sustained Yield and Rotations

Unit Structure

3.0 Learning objectives.
3.1 Introduction
- **3.1.1 Concept and principle of sustained yield (even flow) management**
- **3.1.2 Pre-requisites for sustained yield management – its scope and limitations**

3.2 Concept of increasing and progressive yields
3.3 Arguments for sustained yield principle
3.4 Rotation or production period
- **3.4.1 Concept of rotation in regular and irregular crops**

3.5 Types of rotation
- **3.5.1 Physical rotation**
- **3.5.2 Silvicultural rotation**
- **3.5.3 Rotation of highest income / revenue (or forest rental)**
- **3.5.4 Financial (or economic) rotation**

3.6 Soil expectation value (Se)
3.7 Length of rotation
3.8 Choice of the type/kind of rotation
3.9 Rotation and conversion period
Summary

3.0 Learning objectives.

After studying this unit you will be able to understand:

- Rotation and it concepts
- Rotation period and types of rotation
- Length of rotation
- Choice of rotation and conservation period

3.1 Introduction

The principle of *Maximum Sustained Yield* has been the backbone of forest management ever since forests were brought under scientific management. Many foresters consider sustained yield synonymous with good management. It is one of the aims of National Forest Polices of all Progressive countries of the world.

Sustained Yield is defined and / or expressed variously as:-

(i) (a) "The material that a forest can yield annually (or periodically) in perpetuity. (b) As applied to policy, method or plan of management (*Sustained Yield Management),* it implies continuous production with the aim of achieving at the earliest practical time at the highest practical level an approximate balance between net growth and harvest by annual or somewhat longer periods" (BCFT).

(ii) "The regular, continuous supply of the desired produce to the full capacity of the forest" (Osmaston).

(iii) "The yield of timber or other forest produces from a forest which is managed in such a way as to permit the removal of approximately equal volume or quantity of timber or other forest produce annually or periodically in perpetuity.

Sustained Yield may be annual or periodic, depending on whether a complete series of age-gradations (or ages mixed together) is maintained or only an incomplete series. *Periodic Yield* is also considered as sustained, provided the period is short. A sustained yield is essential where large areas, specially state owned, are concerned this ensures continuous yield and safeguards against extinction of forest property, which is a trust with the present generation we have a right of use only but not to lead to its destruction. In case of private property, it is not practicable to maintain a complete series of age-gradations; in such eases the crop is worked for *intermittent Yield,* which is defined as: *the material or cash return obtained from time to time from a forest not organized for continuous production.*

3.1.1 Concept and principle of sustained yield (even flow) management

Yield signifies the flow of forest products, measured in terms of either volume or value units, harvested from a forest at a particular time. Forestry being a long term investment, forest yields, unlike agriculture, take a long time before utilizable produce is obtained.

The yield from the forest includes all the forest products, the tangible and the intangible, including protective, amenity, timber and non-timber products. The principle of sustained yield ensures stability and continuous supply of raw material to the industries and to meet the social and domestic needs of the people.

Concept of *Sustained Yield* (or Sustenance) has been evolved from the basic consideration that the later generations may derive from the forest at least as much of the benefits as the present generation. It is an accepted norm in forest management and forms the core of organized forestry.

The principle of *Sustained Yield* envisages that a forest should be so exploited that the annual or periodic fellings do not exceed the annual or periodic growth, as the case may be. *Sustained Yield* is, therefore, expressed as the allowable cut which may differ little from net increment (i.e., gross increment *minus* natural loss due to fire, wind, epidemics, etc.) depending on the growing stock and distribution of age-classes.

Much has been written about sustained yield as a major objective of forest management; it is, therefore, necessary to understand clearly the connotation of the term. Basic aim of management is to keep forest lands productive. Sustained productivity may be visualized in two respects viz., continuity of growth and continuity of yield or harvest. The two often do not mean the same thing, hence the confusion. The tow often do not mean the same thing, hence the confusion. The forest may be, currently, immature and un-merchantable though putting on excellent growth; in such cases, production is sustained but not the harvest or cut which will be available only later on. In contrast, there may be a forest area including the entire range of age or size classes which may be managed as a unit to yield a sustained flow of harvest, as well as maintained in a state of continuous productivity. *Sustained Yield* management, as the term is most accurately and commonly employed, mans continuity of harvest, indefinitely, without impairment of the productivity of the soil.

3.1.2 Pre-requisites for sustained yield management – its scope and limitations

Considering forestry from the economic point of view, investment in forestry should yield continuous return in terms of definite class of produce, and in greatest possible quantity within a reasonable time and to the best financial advantage. The simplest method of achieving this objective of sustained annual yield is to maintain a complete succession of equal areas of crops of all ages from one year old upto the age of maturity and remove the 10 year old wood annually, and plant up the area again. The mature wood would represent the increment on the whole forest and the difficulty of

removing the annual increment from each unit area, say one hectare, is overcome by removing accumulating production of 10 hectare on 1/10th part of the total area.

As the forest in the above example has equal area of every age in it, an equal area will be available for felling at maturity. The establishment of such a series of age gradations, as illustrated above, is one form of the crop necessary for *Sustained Yield Management* and for maintaining it in perpetuity. Such a forest provides a conceptual picture of a theoretical *Normal Forest,* which will be discussed in detail in a subsequent Chapter. The ideal of a normal forest is a logical corollary to the principle of *Sustained Yield* in perpetuity.

Arrangement of crop as described above is a simple form of management which would enable us to remove the old crop, 10 years old with 500 m ^{3} volume per hectare but this is by no means the only arrangement, nor is it necessarily the best. In several cases, it may be considered advisable from silvicultural point of view to grow several age gradations mixed together, forming an age-class, on a proportionately larger are instead of growing each year's crop on separate area as in areas worked under *Regular Shelterwood (Uniform) System* with natural regeneration. In such cases, sustained yield will be available if all the *Periodic Blocks* occupy equal / equi-productive areas. Similarly, sustained annual yields from irregular Selection forest will be available if all age-classes are present therein and in balanced proportion. These are the attributes of normality of a forest with different patterns of age gradation / class distribution; hence for a sustained yield management the forest must be normal, whether regular or irregular, though in the latter case management becomes rather complicated.

In the first rotation of scientific forest management, density and quality of crop are generally variable due to past management or due to mal-distribution of age-classes and, similarly, the composition of the main species in the mixture. In such cases, where forests generally comprise of old growth, it is not possible to apply sustained yield principle. Similarly, virgin forests, with a large percentage of deteriorating trees brought under management for the first time, cannot be suitably worked under sustained yield principle; instead, *accelerated-cut management* is indicated therein. Likewise, forests under afforestation schemes provide variable yield until after the end of first rotation,

starting from no yield to regular sustained yield in the second rotation. It will be appreciated that in the first rotation, sometimes even in the second rotation, due to unfavorable distribution of age-gradations, some sacrifice of younger age-classes or trees will be involved if sustained yield principle is rigidly followed.

However, as long as the present treatment is expected to result in equal sustained yields in future, it is considered to satisfy *Sustained Yield* principle: "*Variable yield to-day to ensure sustained yield tomorrow."*

On occasions, such as a national emergency, principle of sustained yield may have to be held in abeyance. Over exploitation for sometime may become unavoidable, which can be obviated by adopting a policy of retaining *Reserves.* For example, five trees of Deodar per hectare in Regular Working Circle of Kanagra division (H.P) are held over for full one period after the final felling in P.B.I. as *Emergency Reserves.* If this is not feasible, the situation must be retrieved by building up the depleted growing stock, as early as possible after the emergency is over.

The *Sustained Yield* principle is applicable to production forestry, but where protection and other accessory benefits far out-weight the other benefits, then they must be given precedence over material benefits, and the silvicultural treatment modified accordingly.

3.2 Concept of increasing and progressive yields

The concept of *Sustained Yield* has now been replaced by that of *progressive yield*, originally advocated by a German forester, Hartig. This takes into account both the gradual evolution of the economy as well as the progress in the silvicultural techniques, as a result of experience and research, which is considered as an important ingredient of scientific management. The concept of *Progressive Yield* envisages raising the productivity of soil, and of the crop, by silvicultural treatments, judicious tending, enrichment of the forest by changing the crop composition and by replacement of the original inferior forest by valuable forest species. It also stipulates avoidance of loss of increment by effective protection and tending and adoption of quick and efficient regeneration techniques. The new concept signifies a dynamic outlook in Man to build up and maximize productive enterprises through technological efficiency. It connotes a

synthesis of ecological and economic considerations, and a long range view of forest products requirement for economic self sufficiency.

The principle of *Progressive Yield* as against the *Sustained yield* principle was discussed at the VIth Indian Silvicultural Conference held in Dehra Dun in 1939 and the IIIrd World Forestry Conference held in Helsinki in 1948, an d adopted. Some foresters consider that the principle of *Progressive Yield* is embodies in the principle of *Sustained Yield.* Foresters, who advocate the principle of *Progressive Yield*, maintain that while the principle of progressive yield is a dynamic one, the one of *Sustained Yield*, aiming at the same yield in perpetuity is *static*. As Dr. J.C. Nautiyal put it; "Sustained Yield can be practiced in a stagnant economy, it has no justification in a growing or a developing economy." No individual or Organization, leave alone a nation, would accept a static economy.

A normal industrial concern will gear itself to producing that quantity which the market demands; not only this, it will take steps to stimulate the market and promote more sales. In case of forestry it is rather different. The forest goes on putting increment till the maximum is reached. Removing yield which is materially less than the annual increment is as bad management, and detrimental to the forest, as removing more than the annual increment. It was in view of this that subject was considered at the VIth Silvicultural Conference that in the first stages of developed the aim should be not a *Sustained Yield* but an *increasing yield*. This aim will necessitate steps towards further development of the forest, communications and the market. The principle was unanimously adopted.

The principle of *progressive yield* goes a step further than that of increasing yield, included i n the latest definition of *Sustained Yield.* While the idea of increasing yield primarily covers the case of forests in the earlier stages of development, that of

Progressive Yield is intended to cover the entire forest management. In a developing country like India, the demand of wood is progressively increasing and, with the economic development and higher standards of living, the demand is expected to rise at a much faster rate. We should, therefore, think in terms of expanding yields instead of sustaining the yield of our forests.

Protagonists of *Progressive Yield Principle* consider that the development of a forest is a continuing process; a natural progress of any forest towards higher and higher production as a result of scientific research and experience. As the research and experience are not static but dynamic and, if applied to the management of a forest, must result ingreater and greater yields, the aim of good management must be *Progressive yield* and not merely *Sustained yield.* Those who consider that the principle of *Sustained Yield* embodies the idea of *Progressive Yield* maintain that the correct term should be the

Maximum Sustained Yield in perpetuity, which term would include the principle of *Progressive Yield*. As already stated, the principle aims to cover the effect of experience and research in silvicultural techniques which even the principle of *Sustained Yield* does not convey the dynamic idea that the yield must go on progressing or progressively increasing, which would be the natural result of application of knowledge from experience and research. It is, therefore, considered that *Sustained yield principle* was all right so long as research was not an important factor research is given an important place in any forest policy, the dynamic principle of *Progressive Yield* should be the aim of all scientific managements. '*Sustained Yield Principle* is as out-dated as the cross-cut saw which has now been replaced by machines.' The new principle expresses the dynamic character of a wise forest administration, which must take into account both the increasing requirement of wood in a progressive country and the gradual improvement in the productive capacity of a forest under improved silvicultural techniques.

3.3 Arguments for sustained yield principle

In case of State Forests, some of the advantages are:

(i) It facilitates budgeting and regulation of taxation; ensures a steady income to the State. However, volume yield does not necessarily mean sustained revenue as well, due to fluctuation in price.

(ii) Local labour is always fully employed; by constant employment it is possible to establish permanent skilled labour force.

(iii) Staff employed is fully and permanently engaged. It affords scope for systematic work and equal employment continuously. Organization of current and future works is facilitated by sustained yield. The staff is not periodically over-or under-worked; use of mechanical equipment and other *infra-structure* is steady.

(iv) Contractors employed on felling, conversion and transport have an assured and steady permanent employment. It results in regular demand and a fair competition among the purchasers.

(v) Wood-using industries have an assured continuous supply of raw material, and the local people sustained supplies of wood for their domestic and agricultural needs.

(vi) Markets can be developed and their confidence gained with sustained supplies.

Some of the arguments *against the principle of Sustained Yield* may be summarized as followed.

(i) Sustained yield management treats timber production as only a biological function rather that a response to economic demand.

(ii) It ignores the costs involved in producing a fixed quality, i.e., production is carried on irrespective of price fluctuations resulting in inefficient resource management. Under this principle, the supply functions of timber would be completely in – elastic, i.e., unresponsive to price changes; price fluctuations would be more severe.

(iii) Fixed supply is not only economically inefficient but also ignores the possibility of changes taking place in the use of forest products, due to change in technology and social values.

(iv) It ignores the inter-relationship between forestry and other sections of national economy.

(v) Such a rigid (inflexible) policy is not suitable for a dynamic or growing economy.

(vi) A price-responsive supply will cause less severe fluctuation in price, and whatever changes in price do occur, will automatically regulate the demand.

(vii) In practice, sustained yield has merely been an ideal; wide fluctuations are yield are quite common.

(viii) The application of Sustained / Progressive Yield is beset with the serious difficulty of fore-seeing the future trend of timber and forest product requirement.

(ix) There are two economic objections also to the principle of sustained yield.

Firstly, regulated annual yield prevent an increase of felling and sales during time of high prices, or a reduction for low prices. There is no modification of fellings to suit demand; consequently not only does the owner suffer but high prices tend to rise still higher and low prices to fall still more.

Secondly, for sustained yield management the forest must conform to an ideal of a normal forest. To mould the forest into a normal one, it will involve the sacrifice of cutting the crop either before or after the financially more advantageous time. For example, stock of slow growing mature and over-mature trees may be held over longer by reduced fellings until immature stands grow to maturity, though financially it would be better to realize the mature stand quickly by heavy fellings and endure a gap in yield until the younger crops reach maturity. But the heavy felling now, and the proportionately larger regeneration following, will perpetuate misdistribution of ages and sizes of trees in the forest and yields will again fluctuate.

Summing up, the forests should be managed so as to give maximum sustained vegetative production, whether the material output or yield of the forest is sustained or not. Sustained or not. Sustained production must always be the aim; to achieve this, the soil must be kept in healthy and fertile condition as far as possible, preferably improved.

3.4 Rotation or production period

Agricultural crops are sown; they ripen and are harvested once or twice a year. As a rule, all plants ripen at the same time and are also harvest at the same time; their period of maturity is easily determined. However, it is not so in case of forest crops.

The main forest product, timber, takes a long time to mature for harvest; neither does it ripen the way agricultural crops do. Though trees are utilizable / saleable even at a younger age, there is a steep size / price gradient and the price per unit volume rises sharply with the size of trees. Ripeness of the trees can be estimated from the age beyond which quality of timber starts falling off; this age varies, not only from species to species but also from tree to tree. Trees should be harvested after they have reached utilizable size, and before their timber quality starts deteriorating. The maturity of timber depends on natural conditions of growth on the one hand and economic conditions on the other. In some cases, however, other considerations, such as protective, recreational and scenic value may also come into the picture. Unlike agriculture, trees have variable standards of ripeness or maturity as they satisfy different demands at different times and different sizes. What standard of ripeness we may then apply to trees size, age, vigour of growth or a combination of these? Such considerations complicate decisions on forest policy, finance and planning. Object of management will be an important consideration in this respect. The period which a forest crop takes between its formation and final felling is known as *Rotation or Production Period.* This term is also defined in various other ways by different authors; some of these definitions are given below:

(i) "The planned number of year between the formation or regeneration of a crop and its final felling. In the case of a selection forest, the average age at which a tree is considered mature for felling."

(ii) "The number of years fixed by the *Working Plan* between the formation or regeneration and the final felling of a crop."

(iii) "Rotation age is the age of trees or crops at which when they are felled, objects of management for the time being are best served."

(iv) "Rotation or Production Period is the interval of time between the formation of a young crop by seeding, planting or other means and its final harvesting."

(v) "Rotation is the period which elapses between the formation of a wood and the time when it is finally cut over."

3.4.1 Concept of rotation in regular and irregular crops

The term *Rotation,* strictly speaking, is correctly applicable to regular crops only. In *Clear-felling* System and plantations, rotation is a definite period of interval between the year of formation and final felling. In these, and regular forests in general, entire crops of trees of a sizeable area are felled at a time or during a comparatively short period (regeneration period in Regular Shelterwood System) when ready for felling. There is, more or less, a clear production period which can be planned in advance to give timber which satisfies the object of management. In the latter case, rotation is fixed for the whole working circle a unit, as the average length of time between the establishment of crops and their harvesting. Though this system facilitates better planning and organization of work, it does not take into consideration that:

(i) Rate of growth will vary with site variation, even for the same species.

(ii) It involves sacrifice of immature trees / crops, as some will not have reached exploitable size.

(iii) Accidents, such as fire, disease, and wind-throw may happen, necessitation gelling earlier than planned.

(iv) If profit is the main object of management, some difficulties may arise, as the degree of profit is affected by rotation, rate of growth, size / price gradients of timber and the cost of growing it. To obtain desired profits, stands will have to be finally at various times depending on their rate of growth.

From the fore- going, it is evident that whatever the object of management size of timber or profit *rotation* is associated with *final felling age or removal age* and, even with a planned *rotation, the removal age* may vary with rate of growth. On better sites rotation will be shorter; damage / mortality due to accidents may necessitate earlier removal of some parts thereby increasing the tendency to break up uniformity of original crops into smaller segments, until they start approaching the structure of uneven aged forest.

In uneven aged (irregular) selection forests, trees are selected individually on their merit for felling, depending on:

(i) Qualities of size, vigour and suitability for markets.

(ii) Adjustment of proportion of different sizes.

(iii) Silvicultural principles; e.g., removal of inferior stems in favour of better ones.

Such a system clearly has greater flexibility, and enables forester to adopt fellings to suit different rates of growth caused by variation in site or species. Moreover, forest is a perpetual entity and never suffers complete clearance of trees on any part of the area, except periodical thinning. Therefore:-

(i) Size being the criterion for felling, age is known, and

(ii) There being no final harvesting, there is no rotation as defined above. However, one could say that its rotation period is equal to that of the average age of the exploitable size trees removed the exploitable age, at which they attain the size required to fulfill the objects of management.

Therefore, in selection / irregular forests, concept of *Rotation* assumes, by and large, only an academic importance for accounting purposes. In these forests, there is no definite cor-relation between age and diameter; the latter depending on site and available light conditions and even individual characters also. The trees of all ages are mixed together and the crop as a whole, on any unit area, does not reach the age of final felling at a time. Consequently, the term *Rotation or Production Period,* is not correctly applicable to the age at which individual trees reach the age of maturity and are remove.

Maturity in selection forests is related to size, and exploitable size is fixed for removal of individual trees. Correct term expressive of maturity in selection forests is, as started above, exploitable age, or size. Size should therefore, be used as a standard of exploitability, and not age. Adherence to requirements of an out-of fixed rotation in such cases is more in conformity with date king of Adherence to a fixed *Rotation* in such cases is more in conformity with requirements of an out-of date king of *Yield Regulation* that with timber production.

3.5 Types of rotation

Rotation is an important factor in the regulation of yield and proper management of the forest as a whole. As stated earlier, it will depend on, mainly, the objects of management.

Various types of rotation recognized in forestry are:-

- Physical Rotation.
- Silvicultural Rotation.
- Technical Rotation
- Rotation of Maximum Volume Production
- Rotation of Highest Income
- Financial Rotation

3.5.1 Physical rotation

It is the *rotation which coincides with the natural lease* of life of a species on a given site. The natural life-span (longevity) of trees varies greatly with species and the site factors. This rotation is applicable only in case of protection and amenity forests, park lands, and in some case roadside avenues. It is very variable, fairly long and also indefinite. Another interpretation of Physical Rotation is the age upto which the trees remain sound, or produce viable seed in high forests and, in coppice crops, can put forth reliable coppice shoots. This rotation is not of any relevance to economic forestry.

3.5.2 Silvicultural rotation

It is the rotation *through which a species retains satisfactory vigour of growth and reproduction on a given site.* It can neither be lower than the age at which trees start producing fertile seed in sufficient quantity, nor beyond the age when they stop doing so. It is also necessary that soil conditions remain satisfactory for germination and establishment of seed. It is not only long but has also very wide range of limits hence somewhat vague and may be used in combination with other *rotations*, such as *Technical Rotation. Silvicultural Rotation* may be useful in forests managed primarily for aesthetic and recreational purposes, where large old trees with accompanying regeneration provide scenic beauty. Some foresters do not distinguish between *Physical and Silvicultural Rotations.*

3.5.3. Technical rotation

It is the *rotation under which a species yields the maximum material of a specified size or suitability* for economic conversion or for special use. It aims at producing the

maximum material of specific dimension / quality for specific purposes, such as railway sleepers, saw- logs, mine-props, transmission poles, match-wood, paper-wood, etc. Since one and the same tree any yield different assortments of material, and the trees in a crop may attain given size at different times, the technical exploitable age offers no reliable fixed point for fixing the rotation. It does, however, allow for fixation of limits within which a tree or stand is adopted for the production of assortments in greater number or better quality.

Technical rotation is adopted, particularly, by industrial firms which own forests / plantations for the purpose of supplying raw material for their plants (e.g., NEPA and West-Coast Paper Mills, WIMCO match factory).

3.5.4 Rotation of maximum volume production

It is the rotation that yields the maximum annual quantity of material; i.e., the *ge* at which the Mean Annual Increment (M.A.I) culminates. The M.A.I referred to is that of the stand and not that of individual trees. The quantity (usually the volume of wood above a minimum thickness) referred to naturally includes material from all thinning, as well as the final volume felled at the end of rotation.

The length of this rotation will coincide with the year when the average rate of growth, or volume increment per unit area, reaches the maximum, i.e., the age indicated by the point of intersection of C.A.I. (Current Annual Increment) and the M.A.I. curves (dealt with in greater detail in Chapter VII-INCREMENT). This rotation yields largest volume per unit area, per annum, and is an important rotation which is adopted frequently as such, or in combination with some other rotation (e.g., Technical Rotation).

If rotation is r, final yield Y*r* and volume of thinning at various age Va, Vb, Vc etc. then the age at which:

$$\mathrm{M.A.I.} = \frac{\mathrm{Yr}+\sum \mathrm{V}}{\mathrm{r}}$$ is the maximum, is the Rotation of Maximum Volume Production.

The following table shows the age of culmination of C.A.I. and M.A.I. for stem timber volumes for *Sal* and *teak* of different site qualities:

Species	. Quality	Age of max. C.A.I. (years)	Age of max M.A.I. (years)	Crop dia. at max. M.A.I. (cm)
Sal (High Forest)	I	75	128	57.40
	II	80	133	53.09
	III	85	142	45.98
	IV	90	148	37.50
Teak (Plantation)	I	42	70	68.58
	II	45	78	62.99
	III	48	Over 80	60.45
	IV	68	Over 80	-

These figures indicate that M.A.I. culminates later in the lower qualities and earlier in the higher qualities, and generally the crop diameter at the culmination point is lower in poorer qualities and higher in the better qualities.

This rotation is particularly suitable for adoption where the total quantity of woody material is important and not the size and specification, e.g. firewood, raw material for paper pulp fiberboard and industries based on disintegration processes of wood.

More often than not the objective in forestry is quality or value production, and Rotation for higher value production is usually longer than for highest volume production. In turn, maximum volume rotation is usually longer than Financial Rotation.

Common practice in forestry is to adopt a combination of *Rotation of Maximum Volume Production and Financial Rotation.*

3.5.3 Rotation of highest income / revenue (or forest rental)

It is the rotation which yields the highest average annual gross or net revenue irrespective of the capital value of the forest. It is calculated without interest and irrespective of the times when the items of income or expenditure occur. This rotation is important from the overall national point of view. With Forestry in the public sector, attainment of highest gross revenue is more important than that of net income because larger expenditure and investment generates several social benefits, and indirect advantages to the trade and industry. The private owner of a forest estate is interested in maximum net revenue (gross income minus expenditure, both discounted to date) by keeping the rotation period as short as possible.

The average net annual revenue or rental obtained from a stand of trees is expressed by the formula:

$$\text{Mean annual net revenue per unit area} = \frac{Yr + \sum Tr - C - \sum e}{R}$$

Where Yr = Value of final felling (final yield) per unit area

Tr = Value of all thinning during rotation period R, per unit area

C = Cost of formation of stand, per unit area

e = Annual cost of administration / maintenance

R = Rotation (years)

The rotation, at which the net revenue as calculated above is maximum, is the Rotation of highest Revenue / Income (Rental). Calculation of this rotation is similar to that of the highest volume production. Thus the mean annual net volume production (i.e., M.A.I.) is also = Yr + $\sum$Tr where Yr and $\sum$Tr are the values of final and thinning yields as used in the net income formula. To use the net income formula, it is, therefore necessary to multiply the volume yields expected by the net prices anticipated from timber; in other words to use a Money Yield Table instead of Volume Yield Table and in addition, subtract cost of formation and maintenance. The two rotations will be about the same unless there is an appreciable increase in price for larger-sized timber which is, in fact, usual. If the size / price gradient is marked, then the rotation of highest net income will be comparatively longer. Again, if there is a special size of timber which fetches a particularly high price, the rotation which provides that price may be the *rotation of highest income*, and possibly coincide with *Technical Rotation.*

3.5.4 Financial (or economic) rotation

It is rotation which yields the highest net return on the invested capital. It differs from the Rotation of Highest Net Income in that all items of revenue and expenditure are calculated with compound interest at an assumed rate, usually the rate at which the Govt. it able to borrow money. It is also defined as:

(i) "The rotation which gives the highest discounted profit, usually at its commencement."

(ii) "The rotation which is most profitable."

(iii) "The rotation which gives the highest net return on capital value, i.e., under which the *Soil Expectation Value* (Se) calculated with a given rate of interest is the maximum.

There are several methods of determining the *Financial Rotation* but as there are no agreed criteria for assessment of profit, they do not give the same result (for detailed account refers to books on *FOREST VALUATION*). The two prominent methods, however, may be summarized as:-

(a) Based on the Soil Expectation Value (Se) of the land, i.e., value based on the net income which it is expected to yield, and calculated at selected rate of interest, at different rotations Faustmann's Formula.

(b) Based on the financial yield, i.e., the rate of interest or Mean Annual Forest Percent (M.A.F. %), which the forest enterprise yields on investment. M.A.F. % is merely a financial equivalent of M.A.I. and used the same way as M.A.I. is used to determine rotation of maximum volume production.

The two last named *rotations* are concerned with money return from the forest and there has been considerable controversy as to which would be the correct rotation to adopt for Indian State forests. In cases when money has to be borrowed at compound interest for making new plantations the first *rotation* should be, as gives the maximum interest on the capital. Once, however, the original capital has been paid off, the rotation of highest net income may be adopted. For ordinary forests of Indian, the most paying rotation would probably be the rotation of highest sustained net income.

3.6 Soil expectation value (S_e)

"If a piece of land is expected to provide a continual net income of X rupees yearly, then that land can be valued at a sum, which at an acceptable rate of interest gives the same yearly income of Rs. X; that value is known as *Soil Expectation Value* (Se).

Expressed by formula, $Se = \frac{X}{0.0p}$; where p – rate of interest, percent

$$\left(\text{Because } X = S_e \, X \, \frac{P}{100} \text{ or } Se = \frac{X}{0.0p} \right)$$

But if the land produces income periodically, instead of yearly, such as coppice forest the present discounted value of that return = $Y_r / (1.0p^{\,r} - 1)$ where Y_r is the net

periodic income every r^{th} year for every. Consequently a formula can be derived to calculate the expectation value of land by discounting to the present all fore-casted future net incomes whether collected yearly or at regular intervals, and subtracting from the sum the discounted fore-casted future expenses calculated in the same way. Such a formula, known as *Faustmann's Formula,* is as:

$$Se = \frac{Yr + Ta\ 1.0p^{r-a} + \cdots Tq\ 1.0p^{r-q} - C.1.0p^{r}}{1.0p^{r}-1} - E$$

Where Y_r is the net value of final felling made in the year r at the end of rotation; Ta …. Tq are the net value of the several thinning made in the years r-a ….r - q; C is the cost of raising the plantation at the beginning of the rotation, p is the selected rate of interest and E = e / 0.0p, where e = the sum of all annual expenses. The formula depends on the assumption that each item of income or cost recurs at definite and constant intervals forever, and is the same constant figure at each recurrence. Each item of the formula thus becomes the sum of an infinite series of discounted costs. Thus, the same final net yield, Yr, is received at the end of r, 2r, 3r years etc., forever and the sum of the infinite series of discounted values of Yr / 1.0pr – 1.

3.7 Length of rotation

The choice of the type of rotation will depend on the object of management, but the length of rotation of whatever, type, will depend on the interaction of several physical and economic factors given below. While commonly expressed as an average age, the rotation is in practice the age range within which the major crop will be harvested a new crop started.

(i) **Rate of growth:** This will vary with species, site fertility (soil, climate, topography, etc.) and intensity of thinnings, etc.

(ii) **Silvicultural characteristics of the species:** For example, natural span of life, age of fertile seed production, age at which rate of growth culminates, age at which the quality of its timber is most desirable or begins to fall, etc.

(iii) **Response of the soil:** That is, deterioration or exhaustion of soil due to exposure (short coppice rotation) biotic influence etc.

(iv) **Economic considerations:** Depending on a combination of factors of cost, prices of different sizes, time required to reach those sizes, etc. a factor tending to lengthen the rotation is the increase in value of large-size timber – though not economically sound to grow large-size timber over a long rotation.

(v) **Soil conditions:** Socio-economic and employment policy of the State. Climate and topography may necessitate long, protective rotation or the adoption of uneven aged forestry, whatever the economics may be.

Some of the above factors may affect the management policy. The inevitable combination of factors may require different rotations in different parts of a forest and thereby complicate management.

Summing up, the following points may be kept in view while fixing the rotation period:-

(i) The size of timber to be produced is first determined with reference to market and national requirements. A tentative rotation is fixed with reference to *Yield Tables* for the prevailing site quality and thinnings practice. The *Stand Table* should also be consulted to find out the percentage of trees above or below the average diameter at the rotation age.

(ii) Shorter rotations are financially attractive for private owners, but in State owned forests longer rotations are generally suggested for following reasons:

(a) Forests are meant to fulfill large national interests, especially those of Defence, communications and wood-based industries which demand larger assortments. These must have priority in production from public owned forests. With rapid industrialization and potentialities of cheap electric power from river valley projects, the general tendency is the steadily increasing demand for quality timber, which must be met even though less profitable than the production of smaller assortments giving higher rate of interest on the forest capital.

(b) Silvicultural, biological and protective principles definitely favour the choice of longer rotations with increased volume of growing stock.

(c) Forests with large growing stock have an insurance value in times of emergency, financial crises or unforeseen abnormal demands.

Thus, fixation of rotation is a compromise between several considerations and cannot be just computed mathematically. In case of State forests, it would be desirable to follow the following procedure in determining the length of rotation:-

(i) Determine the size of timber to be produced (specify object of management) with regard to market and national demand.

(ii) Consult the yield table for the prevailing site quality and thinning practice in vogue, to determine the age corresponding to the desired size.

(iii) Examine the age of maximum volume production and silvicultural of species to arrive at a tentative rotation.

(iv) Prepare *Money Yield Table* to see the rotation of Maximum net income.

(v) Then strike a compromise.

3.8 Choice of the type/kind of rotation

For considering the choice of most suitable rotations under different social, silvicultural and economic conditions, the above mentioned types may be sub-divided into three main groups which satisfy three different broad objectives, viz., :-

(i) Rotations controlling the supply of certain services i.e., the Silvicultural and Physical Rotation.

(ii) Rotations controlling the output of material forest products in form or quantity i.e., the Technical and maximum volume rotations.

(iii) Rotations controlling the financial returns, i.e., the Rotations of maximum Gross or net Income and the Financial Rotation.

Choice of rotation, as already pointed out, is one of the most important decisions in forest management. Different arguments have been advanced in favour of one or the other type. Two controversial views expressed in forestry literature are:

(i) Forest means capital and, as such, it should yield the maximum revenue or interest, i.e., it should satisfy economic and financial aspects of investment.

(ii) The second view is that more important than the financial aspects is the general usefulness of products specially incase of state-owned forests.

Before making a choice of a suitable rotation, the forester has to carefully consider the following:

(i) Objects of management.

(ii) Silvicultural requirements of the species.

(iii) Productivity of the site.

(iv) The market demands and / or national requirements.

(v) Socio economic policy of the State (labour conditions, employments, etc.)

(vi) Financial and economic aspects.

Where the objects are commercial, the rotation adopted is a compromise between *Silvicultural and Technical Rotation,* tempered by some economic considerations and financial test. The mistake is often made of working timber forests on the rotation of maximum volume productions, as it is readily ascertained by the point of intersection of C.A.I. and M.A.I. curves. In actual practice, as has already been started, there is invariably a price increment for larger sizes of timber and, in order to find the most paying rotation, it is necessary to collect data for the average net value per $m^3$of timber obtained from trees of various sizes and applying these net values to the *Yield Tables* figures, a *Money Yield Table* can be prepared. Care should be taken to use appropriate data for the yield from thinning which have a lower mean diameter than the main crop.

The total money yield for each age divided by the age gives the mean annual net value increment per unit area. These values when plotted against each age give a curve, the culmination point of which is the *rotation of maximum net income.* Experience in Europe has shown that economic and financial considerations should not dictate the choice of Rotation as it often endangers the productivity of the soil, which is the basic capital of the forest.

3.9 Rotation and conversion period

The term conversion is defined as: “a change from one silvicultural system or one (set of) species to another” and *conversion period* as; “The period during which a change from one Silvicultural system to another is affected.” *Rotation and conversion period* as defined above are basically the two entirely different terms. *Conversion Period* is indicated where a change in silvicultural system is contemplated, or where a forest is

brought under scientific management for the first time, and no rotation can be calculated or applied straight away for various reasons.

While it is necessary to fix a Rotation in case of regular forests, it is not so with *conversion period*; the latter is fixed where it is considered necessary to minimize sacrifice. For the purpose of management and yield control it takes the place of rotation, usually in the first rotation. *Conversion period* is usually less than *Rotation*; may be sometimes even more than rotation, but when equal, it is not distinguished.

Conversion Period is usually kept less than *Rotation* when it is desirable to remove the mature crop earlier that the rotation period due to:-

(a) Crop not likely to survive the full rotation period.

(b) Crop has suffered from some injury.

(c) Crop is very openly or irregularly stocked.

(d) Crop is putting on small increment.

(e) Advance growth is already present on the ground and, therefore, time required for replacement of mature crop by new one can be shortened.

The shortening of the conversion period, or the extent to which it can be shortened would be limited by:-

(i) Size of the material produced and its marketability, as compared to the size produced in the contemplated rotation.

(ii) The extent of sacrifice involved.

The greater the difference between the conversion period and *rotation* greater is the sacrifice and more difficult it is to bring the forest on to the contemplated *Rotation* at the end of *Conversion Period*.

Summary

Reference

http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forestry%20IInd%20year.pdf

Unit-4 Normal Forest and Growing Stock

Unit Structure

4.0 Learning objectives.
4.1 Introduction
- **4.1.1 Basic factors (attributes/characteristics) of normality:**
- **4.1.2 Need for an ideal standard**

4.2 Normality concept not absolute: related to treatment and rotation
- **4.2.1 Kinds of abnormality**
- **4.2.2 Effect of silvicultural system on normality:**

4.3 Normality in regular / even-aged forests
4.4 Normality in irregular / uneven aged forests:
4.5 De Liocourt's law:
4.6 Distribution of trees in different diameter classes in uneven- aged sal forests
4.7 Growing stock
- **4.7.1 Determination of actual growing stock**

4.8 Determination of normal growing stock
- **4.8.1 NGS in clear felling system**
- **4.8.2 Calculation of N.G.S. form yield table:**
- **4.8.3 Graphical illustration of the above formula**

4.9 Comparison of real and theoretical NGS – Flury's constant
4.10 Determination of actual GS with past data are not available
- **4.10.1 NGS in uniform regular shelterwood system**
- **4.10.2 N.G.S. in selection system:**

4.11Comparison of G.S. in even-aged and selection forests
4.12 Relationship between G.S. and yield
- **4.12.1 Utilization Percent**
- **4.12.2 Reducing (or reduction) factors – reduced (or modified) areas**
- **4.12.3 Reduction (or modification) for quality**

Summary

4.0 Learning objectives.

After studying this unit you will be able to understand:

- About Normal Forest
- About the normality concept not absolute: related to treatment and rotation
- About Growing Stock and its concepts
- How to determine growing stock

4.1 Introduction

A *Normal Forest* is an ideal state of forest condition which serves as standard for comparison of an actual forest estate, so that the deficiencies of the latter are brought out for purposes of sustained yield management. On a given site and for a given object

of management, it is forest which has an ideal growing stock, an ideal distribution of age- classes of the component crop and is putting on an ideal increment. From such a forest, annual or periodic yields equal to the increment can be realized indefinitely, without endangering future yields and without detriment to the site. In forestry, concept of *Normal Forest* envisages an ideal state of perfection, serving the purpose of good scientific management.

Normal series of age-gradations, normal growing stock and normal increment form the 'Trinity of Norms' in forestry, as Osmaston calls it. The word *normal* does not mean *usual, common, or regular* as one ordinarily understands it; it means an *ideal condition* in the context of forestry.

Normal forest is, thus, a conception of forest management based on the principle of *Sustained Yield.* It was evolved in early 19th century by German Foresters. The term is variously described or defined as:-

(i) "A forest which, for a given site and given objects of management, is ideally

(ii) constituted as regards growing stock, age class distribution and increment, and from which the annual or periodic removal of produce equal to the increment can be continued indefinitely without endangering future yields. A forest which by reason of its normalcy in these respects serves as a standard of comparison for sustained yield management."

(iii) "A forest which, corresponds in every way to the objects of management is called a *Normal Forest.* It serves as an ideal to be aimed at, though it may never be altogether reached or, if established, not permanently maintained. Normal state of a forest, under given set of conditions, depends chiefly on the presence in it of:-

(a) A normal increment.

(b) A normal distribution of age-classes, and

(c) A normal growing stock."

(iv) "That forest which has reached and maintains a practically attainable degree of perfection in all its parts for the full satisfaction of the purpose of management".

(v) "A forest which has (a) a normal series of age-gradations or age-classes, (b) a normal increment, and consequently, (c) a normal growing stock, it termed a

normal forest. It follows that there is nothing absolute in the term. A forest normal under one method of treatment or rotation, would be abnormal under any other treatment or rotation."

(vi) "A forest which contains a regular and complete succession of age- gradations or classes (several age-gradations thrown together) in correct proportion so that an annual or periodic felling of the ripe woods results in an equalization of the annual or periodic yields."

(vii) "Normality is that practically attainable degree of perfection in a forest which we strive to secure in all parts of the forest and to maintain it in perpetuity."

4.1.1 Basic factors (attributes/characteristics) of normality:

The above definitions stipulated the presence of three main attributes of an ideal forest managed for sustained yields in perpetuity (called *normal forest):-*

(i) A normal series of age-gradations or age-classes.

(ii) A normal increment.

(iii) A normal growing stock.

By *normal series of age-gradations or classes* is meant the presence in the forest, in appropriate quantity, trees of all ages from one year old to rotation age. When the trees of each age occur on separate areas, they constitute a series of age- gradations. When trees falling within certain ago limits occur mixed together on the same area, they form an age-class. In very irregular forests there may neither be age-gradations nor age-classes; in such cases is the sign of normality the proper distribution of trees of all ages.

Normal Increment is the best or maximum increment attainable by a given species and for a given rotation, per unit area on a given site. An abnormal increment may be caused by faulty formation, faulty treatment injurious external influences and also unequal distribution of age-classes.

Normal Growing Stock is the volume of stands in a forest with normal age-classes and a normal increment. In practice, this is taken to be the volume indicated in Yield Tables for each age-class. It must, however, be remembered that a *normal forest* represent an ideal condition rarely, if ever, attained in practice; while the Yield Tables are the averages of actual *Sample Plots,* which were varying degrees short of the normal. It will be seen that the conditions determining the normality of a forest are, in fact, only

two, viz., normal age-classes and normal increment; normal growing stock follows as a matter of course, if these two conditions are satisfied. On the other hand, the presence of a normal growing stock does not necessarily imply a normal forest. A natural sal forest of low density may consist entirely of mature and over-mature trees and may carry a volume of timber equal to, or even greater than that indicated in the Yield Table but such a forest is definitely abnormal because of the absence of younger age-classes, and cannot produce sustained yield.

The easiest way to visualize the conception of a *Normal Forest* is to consider is as a series of even-aged plantations of equal area, each of one age- gradation, worked under Clear-felling or coppice system. A plantation of one hectare was planted every year for ten years. These are, therefore ten age-gradations of equal size, constituting a *normal series of age-gradations,* of which one is assumed to be ripe for harvesting every year. At the end of tenth year, the plantation planted first of all is cut and regenerated by *Coppice,* natural seeding, sowing or planting. At the end of next year, this regenerated coupe becomes one- year old age-gradation; the series is complete again and the oldest plantation is now ten year old and due for felling.

An area operated on such a basis, with all age-classes represented and with uniform conditions of increment and stocking is a *fully-regulated forest or a Normal Forest.* It is not at all necessary that each gradation / class may be distinctly separated into separate crops, as in forests worked under Clear- felling and Uniform Systems; they may as well be thoroughly mixed up on the ground as in the case of irregular all-aged Selection forests, without altering the basic concept. It is the balanced proportion of all age and size classes that is essential, rather than their actual distribution on the ground.

4.1.2 Need for an ideal standard

As started already, a normal forest is an ideal model after which we aim to mould our forest. Attaining that ideal is within practicable possibilities but the requirements are such that some of these may not be found over the whole of the series, or they may get disturbed quickly and cannot be maintained in that condition for long. This is, however not to suggest that the ideal condition of normality should not be the aim under the apprehension of its likely failure at some stage. Such an attitude would not only be defeatist but will also leave us without a goal. W shall have neither any criterion

to compare the existing conditions of the forest, nor any idea of the direction we should proceed to get the maximum benefit from out forests. To be able to improve his forests, the Forester must know its deficiencies, hence the conception of an ideal forest as standard fro comparison is essential. This is also necessary for proper appreciation of the principles of Yield Regulation.

4.2 Normality concept not absolute: related to treatment and rotation

As a result of growth of trees, harvesting and other unforeseen influences the condition of forest changes. Even if normality ideal condition is achieved in a forest, it is seldom possible to preserve it for long. There is no absolute normality, remaining unaltered everywhere in the forest, and for all time, but only a relative one which corresponds best to the circumstances for the time being.

The normal forest is purely an artificial conception developed to meet the needs of forest management. No virgin forest is normal. The nearest approach to theoretical normality is made in plantations which are entirely artificial. There is no such thing as *absolute normality,* independent of treatment. The concept of normality is related to both rotation, and the system of management. What is normal increment, normal age-classes and normal growing stock for a forest on a sixty year rotation is obviously not normal for a hundred year rotation. Similarly the data for normality may vary for a coppice forest, an even-aged high forest and a selection forest, although the species, the site and the rotation may be the same in all cases. The normal forest is created not by nature, but by progressive scientific treatment. It is a mathematical abstraction, on which all methods of yield regulation are based.

4.2.1 Kinds of abnormality

Forest may be abnormal usually in the following ways:

(i) They may be over-stocked. A forest past the age of maturity, or having excessive distribution of older age-classes, will have more volume per unit area that the normal.

(ii) They may be under stocked. This condition may be caused due to preponderance of younger age-classes, poor density or extension in rotation. In such cases conservative treatment, i.e., felling less than the permissible

amount in order to build up a proper reserve of growing stock is indicated. The accumulation of growing stock to remedy a deficit is often secured by adopting a rotation longer than that necessary, or by cutting less then the possibility.

(iii) They may have normal growing stock volume but abnormal distribution of age-classes or age-gradations; i.e., they may be disproportionate, some of them may be even missing. This is the worst form of abnormality because the entire forest may be practically of one age-class. The conversion of such a forest to normality is a very difficult problem, and involves either an interruption in sustained yield or sacrifice of material by decay or unsoundness.

(iv) The increment may be sub-normal. This condition may be caused by defective density, fire disease, etc., or it may be due to preponderance of over-mature trees.

(v) Normal increment volume in an abnormal forest: Annual increment of a forest may be the correct volume for normal increment, but unless it is laid on to trees of the right size-class in the right proportion it is not a normal increment.

4.2.2 Effect of silvicultural system on normality:

Silvicultural systems can be broadly classified into two main groups:

(i) Even-aged system - e.g., Clear felling, Coppice and Uniform.

(ii) Uneven-aged system – e.g., True or Single Tree selection and group selection.

The basic difference between the two groups is that in an even-aged system any small unit of area, even half an hectare, contains trees of only one age, although the forest as a whole contains all ages upto maturity. In the uneven-aged forest, however, each small unit or area contains trees of all ages; in the single tree selection system the unit of area is very small, say only half an hectare or even less, but in group selection system it will be larger perhaps two hectares or even more.

In very intensive even-aged forestry, in order to take full advantage of differences in site individual stands of one age may also be small, perhaps 0.2 or even 0.1 hectare. The forest then approaches and begins to merge into an uneven-aged one.

The basic difference between the two groups is whether separate ages and areas can be distinguished, and delineated on the ground and on the map or not. In even aged forestry they can be distinguished so that management can be based on area and age.

If they cannot be distinguished, as in true selection forests, then management must be based on individual trees and their size and not on age and area.

Therefore, there must be two main types of *Normal Forest,* viz.,

(i) The Normal Even-aged Forest and

(ii) The Normal Uneven-aged Forest.

4.3 Normality in regular / even-aged forests

The clear- felling system in which all age-gradations from one year to rotation age (R years) are present, each occupying equi-extensive / equi-productive areas, in which the rotation age coupe is felled and regenerated every year, offers the simplest example of a conventional *Normal Forest,* capable of giving annual sustained yield. If *A* hectares is the area of the F.S., the normal annual coupe would be A/R hectares the area occupied by each age gradation. In addition, each gradation must be fully and ideally stocked and putting on normal increment.

Thus, there is 'trinity of norms' in the Normal Forest in respect of distribution of age-gradations / classes, growing stock and increment. It is, however, not at all necessary, though desirable, that each age-gradation be in one compact area; it may be scattered among other age-gradations throughout the forest, provided their total area is correct. A fifteen year old gradation may be found in several stands in several places and may be occurring next to twenty, thirty or other aged stand.

Except when the rotations are very short, as in Coppice System and / or plantations of some fast growing species, it is seldom practical to distinguish between age differences of only one year. This is definitely so where regeneration is mainly natural. In such cases five, ten or even more age- gradations may be grouped together to form an age-class. A forest worked on a hundred year rotation might then have for example ten age-classes each having crops 1 – 10, 10 – 20 …… 80 – 90, 90 – 100 and occupying one tenth of the equi-productive area of the F.S., as already explained in an earlier paragraph. The oldest age-class will be felled and regenerated in ten years, preferable but not necessarily in equal yearly quantities. A degree of flexibility is thus introduces which is consistent with the definition that a normal forest has that perfection which is practically attainable.

This conception may be extended to the division of forest area into periodic blocks. In the above example we might allot them to five P.Bs., each containing two ten- years. Each P.B. would be felled and regenerated, in turn during twenty years regeneration period in as regular a manner as possible. This kind of organization is not only simple but provided some flexibility which is both useful to meet market fluctuation and essential to vary fellings designed for natural regeneration.

It will be readily appreciated that shorter the regeneration period, narrower will be the age-class range and more even-aged the stand; conversely, longer the regeneration period, wider will be the age class range and less even aged the stand therefore, whereas the short rotation plantations of *Eucalyptus,* worked under annual coupes and with one year age class are absolutely even aged the Chir converted crops, worked under Uniform System on 120 year rotation with 30 year regeneration period and 30 year age classes are only more or less even aged.

In each case of the forest worked under clear felling coppice, coppice-with- standards or Uniform Systems, the stands are even-aged and the test of normality is the presence of all age- gradation / classes, occupying equi-extensive / productive areas, fully stocked and putting on normal increment. Strictly speaking, occupation of equal areas by each class is not essential, but the proportion of different ages should be correct; in other words, in theory each of the age-gradations must occupy in series areas of equal productiveness. Such a proportion between various age-gradations is known as normal proportion. These may occupy compact, self-contained areas or be scattered.

4.4 Normality in irregular / uneven aged forests:

In an entirely uneven-aged forest worked under selection system, trees of all ages are found mixed together on every unit of area, even as small as half an hectare. Younger and smaller trees occur in groups partly under older and larger trees and partly in gaps or openings of the upper canopy. The oldest and the largest trees are scattered everywhere singly or in pairs. In such circumstances neither the age of trees can be known nor the areas occupied by each class.

Fellings, therefore, cannot be distinguished by either area or age; nor can thinnings be separated from final fellings and yields. Consequently, definite areas cannot be set

aside ever year either for final felling or intermediate yields. All fellings are, in fact, a continuous process of thinning a perpetual forest by selection of individual trees for felling every year but for practical considerations, the fellings are confined to one section each year in turn, i.e., the F.S. is divided into a number of sections, equal to the number of years in the felling cycle, and gone over during the felling cycle, which may be 5, 10 or 15 years.

Larger, mature trees are felled when they reach *exploitable size* or their increment falls below the acceptable level. Other trees are removed on principles of thinnings to give proper growing space to the better stems. All fellings are so made as to maintain or, if necessary, increase the irregularity of the stand and maintain or acquire the ideal proportion of large, medium and small trees.

Age and rotation are meaningless concepts in selection forests; the only scheme in the arrangement of growing stock is the proper intermingling of different sized trees in their ideal proportion so that a regular sequence of maturing trees is obtained, on the general assumption that, on an average, size indicated the age.

Therefore, normality of an uneven aged selection forest can be ascertained by the number of trees in each *size class*; it must have a normal series of *size gradations* instead of *age-gradations* of the normal even-aged forest. In addition, it must have the normal volume and normal increment, as well as the amount of irregularity per unit area that is deemed to be most satisfactory.

Although it is obvious that a normal uneven aged forest contains larger number of smaller trees than bigger ones per hectare, it is not possible to devise a simple model such as the triangle of normality for even aged forests to represent the numbers or volumes of trees in the various size-classes. We do not have Yield Tables either for irregular forests, to show what the normal numbers of trees should be in each size class.

About irregular selection forests, some people even think that there can be no normal selection forest; this of course is incorrect. It is true that it is easy to visualize a normal forest of pure even aged, densely stocked stand, each age occupying separate areas arranged in a sequence. We have also yield Tables applicable to even-aged regular crops for reference, but none for selection forests. However, it is not only possible but

even necessary to have some conception of a normal selection forest for an ideal to aim at.

The uncertainty of what the constitution of a normal uneven-aged forest should be, led some foresters on the continent and elsewhere, like, M. Biolley, consider the ideal redundant and are of the opinion that the forest should be brought on to maximum production by frequent checks. This is possible by keeping exact comparable records, frequently and periodically complied of the standing growing stock, its distribution in each size-class and of similar for what is felled; the progress of increment and yields can thus be watched. With that knowledge and long experience of working such forests, the growing stock can be moulded to that which is most productive of valuable increment.

Bulk of our Indian forests is irregular; they are thoroughly irregular in density and diameter distribution, etc., and such deviations take place over relatively small areas. As the ultimate aim is to bring them to a normally productive state, the fellings, thinnings and regeneration operations have to be regulated that all undesirable irregularity is smoothened out and the forest is brought to correspond to a properly balanced irregular forest. This cannot be done till we know what a normal irregular forest should be; very little work has been done in India in this regard.

4.5 De Liocourt's law

A very important fact was discovered by F. De. Liocourt that in a fully stocked selection forest, the number of stems falls off from one diameter class to the next in geometrical progression, which means that the percentage reduction in the stem number from one diameter class to the next is constant. This is referred to as *De Liocourt's Law*. If the quotient of the series is known and the number of stems in any class is given, the whole series can be worked out and this should give the *proportionate distribution* in an Ideal Selection forest or its *balanced composition*. This series is represented by the geometrical progression:

$$a,\ aq\text{-}1,\ aq\text{-}2,\ aq\text{-}3 \qquad aq\text{-}(n\text{-}1)$$

Where, a = number of stems in the lowest dia class.
q = Co-efficient of reduction in the number of stems; the quotient.

By itself, it is a very important discovery, but it does not readily lead us to the ideal selection forest. Firstly, it is not known what the ideal number in known class should be and, secondly, what the quotient should be. Later researchers found that the normal stem number distribution for different site qualities varies. It was still in geometrical progression but the quotient was different for different qualities. For example, this quotient q for silver fir Q.I is reported as 1.30, 1.35 for Q.II, and 1.40 for Q.III and 1.50 for Q.IV.

In India, it was only in 1952 that some studies were made in this regard, in the plots laid out in 1939. Some of the conclusions reported by S.K. Seth and G.S. Mathauda at the Ninth Silvicultural Conference at the F.R.I., Dehra Dun, in 1956 are:

(i) The number of stems in successive diameter classes of true selection forest of tropical wet ever-green, southern moist deciduous or hill sal type follows De liocourt's law, which was hitherto known to hold well for temperate forest.

(ii) A set of 'empirical yield Tables' for selection Sal forest in one locality, and 'empirical stand Tables' f o r true selection sal forest for various qualities have been prepared. It is felt that there is urgent need for a study of the rate of growth and the composition in a selection forest and for the preparation of stand tables for different types of forest.

The problem of a normal forest, for the irregular and / or mixed forest, continues to be a complex one: management of Indian irregular forest would remain unscientific till the problems of composition and growth solved. Meyer (1933) simplified De Liocourt's law in the form of an exponential function:

$$y = Ke\text{-}ax$$

Where y = number of stems in the dia, interval; x = diameter at breast height. A = percentage reduction in number of stems for each dia. K = relative stand density which is dependent on site conditions. *e* = 2.71828, the base of Napierian logarithms.

By plotting the log, mumbers of stems against their mid-diameter values on an ordinary graph paper, if the resulting points are in a straight line, it would indicate a balanced crop. The abnormality in number in any dia-class can be readily detected and silvicultural treatment can be given to obtain ideal distribution in course of time. For example, if there is preponderance of smaller trees, mid-sized or larger-sized tree, the

position can be rectified by thinnings, heavy thinnings or regeneration fellings, respectively.

4.6 Distribution of trees in different diameter classes in uneven-aged sal forests

Theoretical selection forest is supposed to have all diameter classes intermingled in balanced proportion. Uneven-aged crops are continuous in nature and have no point of termination; when mature trees are removed a new crop of the next order is started. Growth data of unevernaged forests cannot be presented in the form of yield tables. Age of the crop is usually difficult to determine. Mathauda studied the distribution of number of stems in different dia. classes in uneven-aged sal forests in Ram Nagar forest division (U.P.).

Application of De Liocourt's law to enumeration results of spruce and silver fir forests of Mandi and Nachan forests of Himachal Pradesh yields the ideal stocking of fir forests as given in the following table (source: article "Ideal stocking and normal growing stock of selection forests of fir and spruce", by R.V.Singh, Indian Forester, January, 1975).

Dia. Class (cm)	No. of trees (per ha)	Standing Vol. (m /ha)	Total growing Stock (%)
20-30	108.7	30.78	8.7
30-40	65.0	55.20	15.6
40-50	39.5	67.17	19.0
50-60	22.7	65.49	18.5
60-70	12.3	52.47	14.8
70-80	7.4	44.08	12.5
80-90	4.4	34.00	9.6
Over 90	0.5	4.61	1.3
Total	260.5	353.80	100.0

Concepts of an ideal forest – a normal forest – and that of standard yield management, the aims of good management, form the basis of scientific management of forests all over the world. Trinity of norms, viz., the normal distribution of age gradations/classes,

normal volume of the growing stock and normal increment, determine the normality or otherwise, of a given forest – whether regular or irregular; in the former case it can be easily assessed but not so in the latter case. In a selection forest, the test of normality is the presence of various age/size-classes in balanced proportion. This calls for enumeration data and the stand tables applicable to the site and component species.

4.7 Growing stock

Growing stock (GS) in a forest is the forest capital; the other basic factor of this capital being the forest soil. It is, however, ultimately the G.S. which gives the return (yield), which is the aim of every enterprise. It represents the investment of the owner (in case of Indian forests, generally the state) from which he receives the income. Ordinarily, any increase or decrease in the capital (GS), is immediately reflected in the income (increment/yield). Just as in a business enterprise, the investment may be over-capitalized, normally-capitalized or under-capitalized, in forestry enterprise also the G.S. (capital) may be over-stocked, normally- stocked or under-stocked. An over-mature and/or very densely stocked crop may have an excess GS to the extent that it is over- crowded, and not only the increment is retarded but even the excess GS may also gradually be lost by decay.

Besides the volume of the GS as such, its composition as regards age-classes is also important, so that it may continue to provide mature trees for regular sustained fellings (annual yields). Therefore, regularization of the GS, as also its composition, are very important factors in the practice of forestry. Both these variables can be accurately determined by regular and frequent inventories or enumerations by age-gradations/ classes. These inventories indicate the trend of the progress of the G.S. (forest capital) and increment (interest) thereon.

Growing stock (GS) is defined as “The sum (by numbers or volume) of all the trees growing in the forest, or a specified part of it” (glossary).

Normal growing stock (NGS) is defined as “The total volume of trees in a fully stocked forest with normal distribution of age-classes for a given rotation” (glossary).

4.7.1 Determination of actual growing stock

Measurement of volumes of single trees and crops forms a part of the subject of forest menstruation. These may be determined with the help of volume tables and by any of the following methods.

(i) By total or complete enumeration: Seldom practicable over large forest areas; practiced only in very valuable forests of limited extent.

(ii) By partial or sample enumeration: Statistically acceptable methods are adopted for the purpose. This gives results which are reasonably accurate for the purpose.

(iii) By sample plot measurement: In selected representative areas of the crop.

For preparation of inventories of large forest areas, of late, aerial photography is being increasingly used. These methods have been exclusively adopted by the Directorate of Forest Resources of India for estimation of GS in various regions of the country.

The importance of determination of the actual GS and its composition by age-gradations/classes cannot be over-emphasized. However, it will not in itself indicate whether the GS volume is at its optimum and putting on optimum increment. Even frequent enumerations will only indicate the direction in which the GS is moving, but we will not know how far behind we are from the optimum, or whether the age-class distribution is shaping towards an ideal (normal), capable of giving mature crops in equal quantities, un- interruptedly (sustained yields).

4.8 Determination of normal growing stock

Normal growing stock (NGS) of forests worked under various representative silvicultural systems may be determined as follows:

4.8.1 NGS in clear felling system

(a) Based on final MAI: The simplest example may be taken of a firewood Eucalyptus plantation of ten hectares, one hectare of which has been planted annually for ten years – the proposed rotation period. There are, therefore, ten age-gradations of equal/equiproductive areas, consisting of a normal series of age-gradations, of which one 10 year old is felled and allowed to coppice to form future crop supplemented with planting, if an when necessary). So, at the end of next year, this regenerated area becomes one- year old age-gradation and the series is complete again, and the oldest plantation now 10 year old is harvested and regenerated. Age- gradation areas are shown along the baseline AB, with the theoretical volumes standing on each, which are represented by a number of equal rectangles, each equivalent to one year's

growth, assuming that each hectare of plantation puts on equal volume of wood every year of its life. Thus, if each year's growth in each plantation is represented by *i*, the volume of each age-gradation starting from one year old, will be i, 2i, 3i …. 9i and 10i, as illustrated in the diagram. The volume of 10-year old gradation on one hectare area has grown 500m3 , so the final MAI at this rotation age 500/10 = 50m3 , and this is shown as the volume on one-year old hectare as *i*.

The volume r x i standing on the oldest age-gradation at the end of *r* years (in this case, 10x50 = 500 m^3) is also the sum of the MAIs of all the r (10) age-gradations, and may be termed as I to represent the increment of the whole series. Therefore, by felling the rotation-age ha each year, the normal increment for the rotation of this normal series is being harvested.

Careful study and interpretation of this diagram brings out that the volume of the oldest or rotation (r) age-gradation is equal to

(i) r x i = I (or)

(ii) Final Mai of anyone age-gradation i multiplied by rotation r (or)

(iii) The sum of CAIs, i, of all the r age- gradations

(iv) The total MAI of the series

The annual yield of the normal forest is the volume of the oldest or rotation (r) age-gradation; it is equal to the increment of the forest and may be based on any of the above four items.

Total GS on *r* age gradations, one to *r* year old, is the sum of the series i, 2i, 3i … (r-1) i, ri, in arithmetical progression, at the end of the growing season and before the oldest, r-year old, plantation is felled.

This sum is= $(r + ri)\frac{r}{2} = \frac{ri}{2} + \frac{r}{2}(r \times i)$ Sub-Stituting I for *r i*, it is = $\left(I \times \frac{r}{2}\right) + \frac{I}{2}$.

Similarly, with the removal of oldest (volume = r x I = I), the increment I of the whole series is removed and the volume at the beginning of the next growing season will be $\left(I \times \frac{r}{2}\right) - \frac{I}{2}$.

Therefore, the volume of N.G.S. in the middle of the growing season is the average of the two values $I \times \frac{r}{2}$ Where in *r* id taken as 10 years. Assuming that half the increment is laid by the middle of the growing season, the total volume of the G.S. will be *r* represented by the area of triangle ABC = $I \times \frac{r}{2}$; whereas at the end of the growing season, it will be = Triangle ABC + *r* small triangles above the triangle.

Similarly, at the beginning of the growing season, after the old plantation (I) is felled but no further growth has taken place, the volume of the

$$\text{G.S. will be} = I \times \frac{r}{2} - \frac{I}{2}.$$

For all practical purpose, the mid-season formula is generally used.

Applying the above reductions to the particular case of *Eucalyptus* plantations, worked on 10 year rotation, on 10 ha area, one ha under each gradation, the volume of 10 year gradation being 500 m^3 , the N.G.S. will be:

(i) $I \times \frac{r}{2} = 500 \times \frac{10}{2} = 2500 m^3$ at the middle of growing season.

(ii) $\left(I \times \frac{r}{2} - \frac{I}{2}\right) = 2500 \times \frac{500}{2} = 2700 m^3$ at the end of growing season.

(iii) $\left(I \times \frac{r}{2} - \frac{I}{2}\right) = 2500 \times \frac{500}{2} = 2250 m^3$ at the beginning of growing season.

This N.G.S. at the mid season, i.e. 2500 m^3, is standing on r ha area; so the 2500 average N.G.S. per ha in this case is = $\frac{2500}{10}$ = 250 m^3. We substitute age-class of 10 Years for the age- gradations, it will represent a normal series of age-classes of, say, *chir* pine crop, 1 – 10, 11 – 20, 21 – 30 …… 91 – 100 years old for a 100 year rotations.

The sum of age-gradations / classes in a forest is then the G.S. of the forest; the sum of the normal such series is the N.G.S.

4.8.2 Calculation of N.G.S. form yield table:

If a yield table gives data for intervals of one year, that is, it gives the volume of each age-gradation, the G.S volume can be readily calculated by adding up the volumes

of successive years. But the yield tables usually give data for intervals of five or ten years. In such cases, the volume of N.G.S. can be accurately determine by plotting the yield table data on a graph paper, drawing a smooth curve and computing the area below the curve either by a *plani-meter*, area-square or by counting the squares. This is however, a cumbersome procedure.

If we assume that during each Yield Table interval, say five years, the rate of increment is uniform (although it may vary from interval to interval), the trend of the growth curve from one measurement to the next is smooth either rising or falling, and the increment put on by the crop changes in equal quantities annually, or in an arithmetical progressing. Though this assumption is not quite correct, but as the period between two successive measurements is usually mathematically by regarding the two successive entire in the yield table as the first and the last terms of an arithmetical progression.

Let n be the Yield Table interval, and A, B, C, and D the volumes given in the yield table at ages n, 2 n, 3 n and 4 n, respectively. Then:- Sum of volumes of age-gradations from *Zero* to n years (inclusive) = (0 + A) × $\left(\frac{n+1}{2}\right)$ similarly, sums of volumes of age- gradations from n to 2n, 3n and 3n to 4n years *inclusive,* are respectively.

$$A+B \times \frac{n+1}{2},\ B+C \times \frac{n+1}{2} \text{ and } C+D \times \frac{n+1}{2}$$

Addition of these gives twice the volumes of age-gradations n, 2 n and 3 n plus that of 4 n gradations; in general terms, in the summation all the yield table entire, except the last one are included twice. Hence their values, i.e., A, B, and C, the volumes of n, 2 n and 3 n age- gradations, must be deducted. Summing up, the N.G.S. volume will be:

$$= \frac{n+1}{2} \times (A+A+B+B+C+C+D) - (A+B+C)$$

$$= (n+1)\left(A + B + C + \frac{D}{2}\right) - (A + B + C) = n \left(A + B + C + \frac{D}{2} + \frac{D}{2}\right)$$

This is the calculation for the end of the growing season, before the felling of the oldest age- gradations is felled after the growing season, the G.S. must be reduced by D to obtain its value for the beginning of the growing season. Thus, the G.S. at this stage

will be = $n\left(A + B + C + \frac{D}{2}\right) - \frac{D}{2}$. The N.G.S. at the mid-season is the average of these two value, i.e., N.G.S. = = $n\left(A + B + C + \frac{D}{2}\right)$. In practice, this mid season formula is generally used. It must however, be clearly understood that this result applies to an area of as many units of area (acres/hectares, on which Yield Tables are based) as the age of the oldest (rotation-year old) age- gradation (4n in the above case). For other areas, the results will have to be worked out by rule of proportion.

4.8.3 Graphical illustration of the above formula

Assume a yield table showing only four entries at intervals of *n* years (as in the above case); the volumes in the years n, 2n, 3n and 4n being A, B, C and D. The volumes are plotted against age and a smooth curve ELMNP drawn through the plotted points. Total volume of mid season or summer NGS for the rotation r = 4n or r hectares, will be the area below the curve, i.e., area EKPNMLE = Triangle ELF + Trapeziums (FGML + GHNM + HKPN).

(Note: Segments EL, LM, MN and NP of the curve may assumed to be straight lines).

$$NGS = \frac{n}{2}(A) + n\left(\frac{A+B}{2}\right) + n\left(\frac{B+C}{2}\right) + n\left(\frac{C+D}{2}\right)$$

$$= \frac{n}{2}(2A + 2B + 2C + D) = n(A + B + C + D/2)$$

For the sake of convenience only four values have been taken in the above example; if the rotation is *r* years, n the yield table interval, and V_n, V_{2n}, V_{3n}, …. V_{r-n} and V_r the volumes at ages n, 2n, 3n, ……. r – n and r years, then the general formula can be written as:

$$NGS = n(V_n + V_{2n} + V_{3n} + ... V_{r-n} + V_r)$$

Over r units of area (acres/hectares)

NGS at the end of growing season (autumn NGS) and at the beginning of the growing season (spring GS) will, similarly, be:

$n\left(A+B+C+\frac{D}{2}\right) + \frac{D}{2}$, and $n\left(A+B+C+\frac{D}{2}\right) - \frac{D}{2}$ respectively,

4.9 Comparison of real and theoretical NGS – Flury's constant

If the MAI and CAI curves are plotted against age, the age at which they intersect is the one at which the MAI culminates. The real NGS, for any rotation is represented by the area below the curve to a point on the curve vertically above rotation age. On the diagram are also shown the theoretical NGS triangles, according to equal annual increment conception for rotations of 10, 16 and 20 years. At 16 years, which is several years after the MAI has culminated, the triangle AHD and the area under the curve AHDEFA are about the same; that is, volume indicated by the final MAI and the actual yield table figures are nearly equal. Later on, say, at 20 years, true NGS indicated by the curve ABCDEFA is greater than the theoretical NGS (I x r/2) as indicated by the triangle ABC. The data is tabulated below:

Age (Years)	Theoretical NGS by MAI triangle (m3)	Real NGS under the YT curve (m^3)	On area (ha)
10	500	366	10
16	1118	1105	16
20	1486	1615	20

Note that the yield table volume curve does not change its course but remains unaltered; it is the MAI formula curve which changes with each change of rotation, which changes the Mai as well. At some particular rotation, the excess as shown by formula curve during the earlier part of rotation is exactly made good by the deficit during the rest of the rotation, it is about 16 years. At this rotation age, the formula will also give the correct volume of the NGS just as the yield table does. It is easy to see that the nearer the rotation is to the time at which the growth of the wood is most active, that is to the time at which the CAI culminates, the greater will be the volume of the oldest age-class and more exaggerated will be the volume of the GS as calculated by the formula.

The volume of the true NGS will not attain equality with that obtained from the formula GS = I x r/2, until some considerable time after the CAI has fallen below the final MAI, i.e., until after the MAI has reached its maximum – the rotation of maximum volume

production. Since it is seldom economical to work with rotations longer than this, and the modern tendency is to work on still shorter ones, this means that formula will, generally (not always, as illustrated above) given higher values for the NGS.

As the GS obtained from the yield table (real NGS) is more accurate than that obtained from the MAI formula (theoretical NGS), the former is ordinarily the method employed for its determination. Since the yield tables are not always available, it has led many foresters to find some modification to the more convenient MAI formula, which would allow for varying conditions under different systems of management. Amongst them, flurry (Swiss Forest Service) is the more prominent. He suggested that in the mid-season formula, GS = I x r x 1/2, a variable constant C (different for each rotation) should be substituted for ½, to obtain more correct results and the formula would read, GS = I x r x C, wherein C is known as Flury's constant. Flury actually calculated values of G at various ages to substitute for ½ in the formula, for various species, various rotations and varying sets of growing conditions.

4.10 Determination of actual GS with past data are not available

Wherever yield tables are available, these figures may be applied to actual forest, by applying reduction factors for density. In case the yield tables are not available, as also the past data of the forest, the forester proceeds to enumerate the oldest age-class (on which the fellings will impinge) assuming that the volume of this age-class represents the increment of the forest and calculate the GS from it.

4.10.1 NGS in uniform regular shelterwood system

Under this system, theoretically, regeneration of a crop, compartment or a block (PB) extends over a period of time during which the old crop is removed progressively, and is replaced by the young crop. There is always an area under regeneration during the period; in the regeneration block (PBI) there will be found both old trees and young regeneration. The period over which the regeneration of the area goes on the regeneration period is the combined period required for recruitment of new seedlings and their establishment.

It is considered that for uniform crops to result from the uniform system, the regeneration period should not be more than a quarter of the rotation, in actual practice it varies from 15 to 30 years. Sometimes, when full reliance is placed on advance

growth for regeneration, a period equal to the estimated age of the advance growth is deducted from the regeneration period.

Generally, regeneration in the regeneration block comes up in the first few years of the regeneration period and the rest of the period is for gradual removal of the old crop and establishment of the new. However, sometimes, recruitment may continue throughout the regeneration period; in such cases there is a great difference between the ages in the new crop (= the regeneration period).

Generally, regeneration in the regeneration block comes up in the first few years of the regeneration period and the rest of the period is for gradual removal of the old crop and establishment of the new. However, sometimes, recruitment may continue throughout the regeneration period, in such cases there is a great different between the ages in the new crops (= the regeneration period).

Whatever the regeneration interval for a coupe or a compartment, it is necessary that the whole PB should be regenerated within the regeneration period, so that regeneration PB has one age-class in it, corresponding to the length of the regeneration period. When all the overwood has been removed from a PB., and no advance growth has been retained to form part of the future crop (or if retained, has been cut back as in case of teak and sal), the G.S. may be considered as normal as in the case of Clear- felling System, the age-classes replacing the age-gradations.

The N.G.S. is usually determined from the suitable yield table in the same way as for Clear- felling system. However, it does not give a correct picture due to the difficulty in defining the duration of regeneration correctly.

Fischer evolved a formula for a condition when part of the G.S. has been removed under regeneration fellings. The N.G.S under such working would be = $(V+V1) \times \frac{P}{2} \times D$

Where: V is the initial G.S; V1 is the G.S at the end of regeneration period; P is the regeneration period and D is the crown density.

4.10.2 N.G.S. in selection system:

As we already know, yield tables prepared from even-aged crops are not applicable to the selection forests and, in the present state of our applicable to the selection forests and, in the present state of our knowledge, we cannot precisely describe the constitution of an ideal / normal selection forest, as regards age-class

distribution, etc. Very little work has been done in India on this subject, though some empirical yield tables have been constructed but their use is very restricted. In the meantime N.G.S. in selection forest will continue to be determined by the old methods. Due to the assumed similarity between the G.S. in a normal even aged forest and a selection forest, the N.G.S has often been determined by the use of the M.A.I.; this is also easier to apply. A formula evolved by Munger (U.S.A) is based on C.A.I.; be considers that the N.G.S. in a selection forest can be better found on the basis of C.A.I. rather than the M.A.I. His normal G.S. (C_n) = $\frac{i \times fc}{2}$ + reserved timber per felling area x the number of areas. In this *i* is the C.A.I. over the whole reserved timber and F.C. is the felling cycle suppose, total area = 100 ha, I = 500 m^3; f.c. = 10 years ; Reserved Timber = 25000 m^3 over the whole area (or 250 m^3 / ha).

$$\text{Then G.S.} = \frac{500 \times 10}{2} + 25000 \text{ m3 for 100 ha; or 275 m3 per hectare.}$$

4.11Comparison of G.S. in even-aged and selection forests

Comparative data for G.S (total volume) in even-aged and selection forests are not available, to the extent and precision necessary for drawing any general conclusions. However, on theoretical considerations it is quite understandable that an uneven-aged stand with maximum utilization of soil and air space should carry a larger volume of G.S per ha as compared to an even-aged crop on the same site.

Result obtained in respect of uneven-aged sal forests of Ram Nagar Forest Division, U.P. (as reported by Mathauda in his article; "The uneven-aged Sal forest of Ram Nagar Division, U.P.", in Indian Forester, May 1958), substance the above. These are as follows.

Site quality	Even-aged Sal forest: Rot 125 years (cft / acre)	Forest Selection (cft / acre)
(1)	(2)	(3)
I	2969	2880
II	2095	2180
III	1216	1480
IV	590	800

(**NOTE:** Divided figures in col. 2 and 3 by 14 to obtain approximate corresponding figures in m^3/ha)

4.12 Relationship between G.S. and yield

A complete picture of the N.G.S. at the end of the first rotation is given in figure. The 10 year old crop will be felled at the beginning of the next rotation and will be immediately regenerated by planting or coppice. Similarly, even plantation will reach maturity and, in its turn, felled to give annual yield. Thus the G.S. remove during a rotation period of *r* years will be:

I (annual coupe / yield) x (rotation) = I x *r,* as represented by rectangle ABCD, which is twice the triangle ABC, the N.G.S. triangle. Thus, during a rotation the yield is twice the existing G.S the other half coming from the increment put on by the G.S during the interval (rotation); in other words, during a rotation, half the yield is provided by the exciting G.S and the other half by increment. Only half the increment occurring during the rotation is used in this way. The other half goes to form the G.S. of the next rotation. In this way, although the volume equal to the increment only is felled during the rotation (i x r) and this is what it should be, it is composed of the G.S received from the previous rotation and this loan is repaid to the next rotation.

4.12.1 Utilization Percent

It is the percent ratio of normal yield to the N.G.S. It is expressed as $\frac{\text{Yn}}{\text{N.G.S.}}$ x 100, where Yn is the normal yield. The term is also applied to the percentage ratio between volume as estimated from the standing tree, or the log, and the actual merchantable out-turn.

4.12.2 Reducing (or reduction) factors – reduced (or modified) areas

Over large areas of forest crops, the soils and sites are seldom uniform, and the consequent variation in fertility results in variation of growth rates. Consequently, even equal annual coupes will yield different volumes of wood and not *sustained yield*. This variation can be offset by adopting *equi-productive* or reduced areas instead of *equi-extensive* areas.

By *reduced or modified* area is meant that area which would produce the same yield with uniform quality and / or density, as it produced by the existing areas with their various qualities and / or densities; and the factors, by which each class must be

multiplied to reduce it to the standard quality and / or density, are known as *Reducing Factors.*

Yields tables are prepared from data collected on normally stocked forest, which are seldom found in our forests. Two most important factors in which conditions from measurements in *Sample plots* with normal stocking, i.e. fully stocked, expressed as Unity (1.00). In practice we may find density varying within a very wide range from a virtual blank to full stocking; it would, therefore, be incorrect to apply yield rable figures directly.

As regards quality, separate yield table are usually constructed for each recognized quality, but the quality of the locality may vary frequently within the same compartment with the result that it may not be practicable to correctly apply yield table figures for any particular quality. Since the potential volume production of different site qualities varies considerably, it is essential for sustained yield management that various age-gradation/classes, where occupying separate areas in even-aged crops, occupy equip-productive areas. For this reason both density of stocking and quality of the locality have to be brought on to a common basis before allotment to the annual coupes or periods is made.

Reduction (of modification) for density: In order that yield table be correctly applied to determine of volume of any crop, it is necessary to assess its density as compared to that of a fully stocked forest, which is represented by the numeral 1.0 – the normal density. Density of a stand which is not normally/fully stocked is expressed by decimal, e.g. 0.6, etc. It is usually assessed by comparison of actual basal area with that of yield table basal area, per hectare. The area occupied by the crop is multiplied by its density of stocking to get equivalent area in terms of crop with normal density (1.0) (Assessment of crop density is dealt with in detail in forest mensuration).

The density of 40- year old teak plantation is 0.8; the volume per hectare would be 114.75 x 0.8 = 91.80 m^3. Thus 0.8 is a reducing (or modifying) factor for density; it should not be confused with that for quality. The former may relate to a variable and temporary condition of the crop; e.g. if a crop has a density of 0.7 it may, in course of time, become 0.9, or normally stocked as a result of regeneration operations. Thus, the stocking factor is not a permanent one; it will also vary from age to age and rotation to rotation. In such cases, there is no need for applying the reducing factor for density,

though in the first rotation annual yields will be unequal, but with prospects of normal equalized yields in the next. However if, theoretically, the causes for variation in density are inherent – i.e., permanent, reducing factor for density will also have to be applied, to bring all areas to a common basis of normal density. Correct assessment of density in our usually irregular forests may involve complete enumeration of the G.S., in that case reduction for density may not be practicable.

4.12.3 Reduction (or modification) for quality

Variation in GS due to yield capacities of different site qualities is, more or less, a permanent factor of the locality and has to be taken into account. For all important species, yield tables are usually available separate for different site qualities. Indication of different qualities is given by the MAI. For e.g., in case of plantation teak, the yield capacity (MAI) for total wood for a rotation of 60 years is (from yield tables):

Quality I	-	9.30 m^3/ha
Quality II	-	6.79 m^3/ha
Quality III	-	4.20 m^3/ha

In order to determine the areas under different qualities which will produce the same yield, a reduction or modification of the area will have to be made on the basis of their production capacity, i.e. Mai. Reduction may be made in any of the three ways:

(i) Reduction to the most prevalent quality

(ii) Reduction to the mean quality of the whole area

(iii) Reduction to any suitable quality – whether present in the area or not

In Chakrata Forest Division, U.P., the most prevalent quality of forest included in Deodar Working Circle is II. Taking this as the standard quality, reduction factors of other site qualities based on their MAI at rotation, are worked out as 1.37, 1.20, 1.00 (standard), 0.83 and 0.63 for qualities I, I/II, II, II/III and III respectively.

The quality most represented is called the standard quality, in which the reduction of other qualities is usually made. This is done by applying the inverse proportion of their MAI.

Reduced area: actual area = MAI of the quality: MAI of the standard quality.

The factor: $\frac{\text{MAI of the quality to be reduced}}{\text{MAI of the standard quality}}$ is known as the reducing factor for quality

Summary

References

http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forestry%20IInd%20year.pdf

Unit 5: Yield Regulation and Working Plan

Unit Structure

5.0 Learning objectives.
5.1 Introduction
5.2 Method of yield regulation
- **5.2.1 Annual coupe method**
- **5.2.2 Method base on area and volume controls permanent or fixed periodic block method**
- **5.2.3 Methods based on volume or volume and increment of growing stock**
- **5.2.4 Von Mantel's Formula**
- **5.2.5 Austrian Method**
- **5.2.6 Heyer's Modification**
- **5.2.7 Methods of successive enumeration or continuous inventory based on Biolleys method of control**
- **5.2.8 Number and Sizes of Trees**
- **5.2.9 French Method of 1883 Or Melard Method**
- **5.2.10 Brandis/Indian Method**

5.3 Working Plan
- **5.3.1 Working Plan, Working Scheme, Micro-plan**

5.4 Goal and Objectives of Working Plan
5.5 Organizational Structure
- **5.5.1 At national level**
- **5.5.2 At the State Level**

5.6 Working Plan Period
5.7 Inputs to WPO
5.8 Preliminary Working Plan Report (PWPR)
- **5.8.1 Preparation and Finalization of PWPR**
- **5.8.2Draft Working Plan**
- **5.8.3 Sanction of the Plan**

5.9 Survey and assessment of forest resources
- **5.9.1 Examination of territorial units**
- **5.9.2 Forest resource assessment**
- **5.9.3 Growing stock estimation**
- **5.9.4 Assessment of non-timber forest products**
- **5.9.5 Biodiversity assessment**
- **5.9.6 Assessment of regeneration status**
- **5.9.7 Plantation survey and assessment**
- **5.9.8 Assessment of bamboo/rattan**
- **5.9.9 Soil survey and assessment**
- **5.9.10 Socio-economic survey and assessment**
- **5.9.10 Assessment of wildlife habitats and species**
- **5.9.11 Assessment of trees outside forest (tof)**

5.10 Writing up of working plan
5.11 Contents of the plan
Summary

5.0 Learning objectives.

After studying this unit you will be able to understand:

- About the yield and yield regulation
- About the various methods of yield regulation
- About the working plan, its goal and objectives
- About the preliminary work of working plan
- How to prepare a working plan

5.1 Introduction

Once the structure of a normal or ideal forest has been decided upon, it is necessary to plan the management of the given working cycle so as to develop it towards this standard. The management procedure leading to this result is called yield regulation (YR).

It is consists of:

(a) Estimating productive capacity of the area in its present condition i.e. production possibility.

(b) Deciding how much of this should be retained to built up the grows stock or how much of the excess growth stock should be removed to minimize loss and balance the yield.

(c) Deciding in what localities, time, proportion and total volume of timer to cut (i.e. where, when and how much to cut).

(d) Deciding on the kind of timber species and size that should compose the volume cut.

The very essence of Y.R. is in determining the cut. There is no single formula for the solution of cut-determination. This depends on state and trends of market, intensity of management and silvicultural systems adopted. Thus Y.R. necessarily involves a compromise between economic and silvicultural consideration in management.

Generally the main objectives why timber production and telling of trees should be regulated can be broadly discussed under 4 headings namely:

(i) Silvicultural
(ii) Labour
(iii) Industries Object of Yield Regulation
(iv) Economic Reasons.

(i) Silviculture

(a) Over Cutting (i.e. Cutting more than required or cutting more than can be replaced). This may cause determination of the soil, introduction of unwanted species. (example Musanga cescropioides) and dieing out of wanted species due to lack of regeneration.

(b) Under-Cutting: May lead to over matured trees which deteriorate in wood quality and the seeds and fruits of which loose viability rapidly. The dense shade of an over-matured tree will make it difficult for young plant on forest floor to survive due to lack of light.

(ii) Labour

The employer needs skilled labour to carry out his work and this can only be got by regular employment intermittent employment leads to forced employment of casual labour with consequent lack of skill and responsibility. Similarly an employee will not stay in a job or trade hthat offers only intermittent employment. It means then that both parties employer and employee suffer when the work is intermittent.

(iii) Timber Industry

Both the industries themselves and the workmen they employed cannot continue to operate it the out turn of wood raw material is only intermittent. They must have a continuous and steady supply of timber to function adequately and profitably.

(iv) Economic Reasons

We can liken forestry to a business operating within biological limits. These capital investments are made up of two things – the trees themselves and the money expended in operations in that forest. Although the owner of the forest may make a profit by waiting 60 years or more for the trees to mature before selling them, yet he has nothing to line on in the meantime. Whereas, the can get better returns on this money by merely putting it in a saving bank. We must consider the capital tied up in the forest to be an investment upon it every sensible petran expects a return or profit. Not as a final profit but as a steady interest on the money invested. This can only be got by regular periodic (Preferably Annual) yield from the forest.

5.2 Method of yield regulation

The objects of management are firstly to obtain sustained yield and secondly to aim at a normal forest. Several methods have been tried particularly in Europe to regulate

yield and attain those objectives. Some methods have been move successful than others.

The type of method to be adapted depends on the type of forest and the degree of accuracy required.

The methods used so far can be divided into 4 major groups:

(A) Methods based on area only.

(i) Annual Coupe Method.

(B) Methods based on area and volume control

(i) Control by rotation and age classes or periodic blocks methods.

(C) Methods based on volume or volume and increment of growing stock

(i) Von Mantel's method and Smythies modification.

(ii) The Austrians formula and Heyers modification.

(iii) Methods of successive enumeration or continuous inventory base on Biolleys method of control.

(D) Methods based on number and size of trees.

(i) Brandis or Indian methods.

(ii) Melands or French methods of 1883

5.2.1 Annual coupe method

This is the oldest method of regulating the cut (14^{th} – 16^{th}) century ago- based on an area and rotation methods. The methods consist of dividing the whole forest into equal areas, equal in number to the rotation. Each part is cut and regenerated sequentially every year.

$$\text{Size of Annual Coupe} = \frac{\text{Area of Forest}}{\text{Rotation}}$$

It should be noted that only one rotation is used throughout. The annual coupe then consist of a series of "R" stands differing in age by one year (R= Rotation)

Assumptions:

(i) Since there will be site difference or micro site variation; each area will produce at different yield. It follows therefore that the longer the Rotation the

greater the differences will be. Hence this method is assumed to be best suited for short rotation crops.

(ii) The method also assumes evenness in ages of crop.

In general this method is best suited for plantations grown on short rotation e.g. fuel wood, poles, pulpwood plantation etc.

Advantages

(i) The method is direct and simple and aims directly at establishing a normal series of age gradation in the first Rotation.

(ii) It is this the quickest way of attaining a sustain yield from the forest.

Disadvantages

This method is rigid and tends to ignore economic and silvicultural conditions for example it may entail some heavy sacrifices of immature stands. The method tries to decide ahead the allowable cut and its location for the whole rotation. Due to the fact that the tropical high forest is compared of many different species, it means that the yield from each annual coupe is likely to be vastly different in the first rotation. This difference is further aggravated by the facts that some species are economic while some are not. And it is only the economic ones that are exploited several attempts have been made to overcome these vast difference in annual yield. This includes the reservation of some rotation of the forest. A part of the forest is set aside as a reserved area and is not considered as part o the yield. This reserve is intended to be used as a BUFFER against large fluctuations in yield and will be used to replace or supplement any areas of very low yield. In this case area of annual coupe is equal to the area of the whole forest misuse area of reserve divided by the rotation.

$$\text{i.e. Area of Annual Coupe} = \text{Area of whole far} - \frac{\text{Area of Res.}}{\text{Rotation}}$$

(i) Free choice of coupe by contractors

In this case, the contractor is allowed to choose the order in which he takes the annual coupes. Normally the contractor enumerates the forest and from his data he can nominate which coupe he wants to take next. He can then select his yield to sait the market demand.

For instance if the contractor wants obese, he will nominate or choose the coupe with a large proportion of obeche while on the other hand if he wants mahogany, he will opt

for a coupe with a large proportion of mahogany. By so doing it is hoped that by the time he eventually gets to the coupe with a lower yield, it is likely the number of economic species taken to the market should have increased considerably so that they are which was thought to be of low yield earlier on will now be considered as high yielding area.

(ii) Fixing of minimum felling girth

The third method for adjusting the yield of a coupe is also practiced in high forest. By this method a minimum fell girth is set for each species below which the contractor is not allowed to fell.

This method acts as a guide against over cutting and also ensures that there is something left behind for the next rotation (this method however prevents the quick achiever of uneven aged forest).

5.2.2 Method base on area and volume controls permanent or fixed periodic block method

The method of annual coupe is more suitable for the crop that is clear felled at rotation age and for system of direct planfix or artificial regeneration. In this method however it can be applied suitably to a high forest system i.e. shelter wood system.

The shelter wood system demands a gradual removal of the trees in the area to encourage natural regeneration. i.e., fellings are made on the same area over a period of time until the whole area is felled and completely regenerated.

The periodic block is therefore that part of the forest allocated fir regeneration or other treatment during a specific period.

When all the periodic blocks are allocated and maintain their territorial identity or a working plan they are termed fixed or permanent periodic blocks.

To avoid the vigidity and reduce the sacrifices of the permanent periodic block method, the obvious remedy is to abandon fixed periodic blocks and realot then according to circumstances at each revision of the work plan namely at the end of each period. Such blocks that di bit retain their territorial identities at a W. P. is termed a Revocable periodic block.

Generally we call the period over which the fellings are completed as the regeneration period (P). The whole forest has to be divided into a number of equal areas known as periodic blocks equal in number to rotation over regeneration period. i.e.

$$\text{Number of periodic block} = \frac{\text{Rotation}}{\text{Regeneration Period}} = \frac{r}{P}$$

.

For example if r = 100 and p = 20

$$\text{Then number of periodic block} = \frac{100}{20} = 5$$

If the total area of the forest is equal to 2,000 hectares, then area of periodic block $= \frac{2000}{5}$ = 400 hectares. These periodic blocks are then marked on the ground and hence the system is known as the Permanent Periodic block method. Within each P.B., fellings are done over a wide area accord to silvicultural regts. Hence it is impossible to calculate yield by area but it has to be calculated by volume. If the trees were not growing, then the yearly volume yield would be their present volume (v) divided by the period (P). But they do grow. Now the trees cut at the beginning of the period have no time to grow but those cut at the end of the period can grow for the whole period. So on average the trees put on half the increment (I) they would have put on if they have been left untouched. So the volume available for cutting annually in the regeneration block is the present volume (v) plus half the increment (I) that the untouched stands would have put on in the period. This can be expressed in symbols known as COTTA's formula.

Total volume available for few during the period = V + ½ I

$$\therefore \text{Annual yield} = \frac{V + \frac{1}{2} I}{P} \text{ or } \frac{V}{P} + \frac{\frac{1}{2} I}{P} \cdots\cdots\cdots (n)$$

$$\text{Annual increment (i)} \frac{I}{P}$$

Substituting i for I in equation i, we have $A.Y = \frac{V + \frac{1}{2} i}{P}$ (cotta's formula)

Generally the convenience of this method is its flexibility since felling can be varied in intensity and position to suit progress of regeneration.

5.2.3 Methods based on volume or volume and increment of growing stock

All methods of Y.A. own at determine how much timber should be cut from a working cycle. The volume of cut can be determined indirectly through area control methods or directly through volume control method. The majority of methods of Y.R. had been based on direct approach which is the only one available for irregular forest where age-class cannot be recognized by area.

There are a number of methods based on this direct approach which have been derived on the basis of relationship between growing stock and increment under certain assumed conditions and expressed in formulae. It is always necessary to check up whether the presumed conditions have been fulfilled otherwise these formulae would be misleading.

Advantages:

(i) Applicable to all types of silvicultural system.

(ii) Useful as an overall guide to appropriate cut.

(iii) Useful in bringing an unmanaged forest under some degree regulation.

(iv) Being derived from a mathematical model of the grow stock, it allows for the quick estimation of the allowable cut often from a limited amount of data.

Disadvantages:

(i) Even though more accurate than area method, it could be more expensive in the sence that regular or constant enumeration will be required and this is time and money consuming and labour demanding.

(ii) Increment which is regard in most volume formulae tend to be a weak figure. If volume or increment data are incurrect, there is no assurance that the forest is constituted as desired. Therefore for safe application of V.C.M. a reasonably high degree of accuracy of volume and increment data is regard.

5.2.4 Von Mantel's Formula

Some volume methods are certainly more successful than the others. The simplest method is von Mantel's formula.

Von Mantel assumed the concept of a normal forest i.e. that the N.G.S is equal to the annual yield multiplied by R^{n} all upon 2.

$$\text{i.e. N.G.S} = \frac{I \times r}{2} \quad \text{Where I = Annual Yield, and r = Rotation}$$

$$I = \frac{2NGS}{r}$$

$$\text{A.Y.} = \frac{2NGS}{r} \text{ (Von Mantel's Formula)}$$

(i) If the G.S. is completely measured include the small and big trees then the annual yield can be calculated quite simply.

(ii) However in practice, trees are not enumerated or mmed below a certain girth limit.

(iii) Another disadvantage is that the formula is wrongly applied to all forest irrespective of their normality. If there is no normal distribution of trees of all age classes then the annual yield will be very wrong. Therefore there is a modification to this called SMYTHIES MTD OR MODIFICATION.

In many countries especially in the tropics, it is usual to measure the volume over a certain minimum girth. Let us call the volume 'V' and the age at which the trees reach the minimum girth as 'X' and rn as "r" Smithies submission is that:

$$\text{A.Y.} = \frac{2V}{r-x}$$

The disadvantage of these methods (i.e. Von Mantel & Smithies) is that the forest is assumed to be normal. Anything contrary to this assumption that, forest in normal will lead to great errors in calculation.

5.2.5 Austrian Method

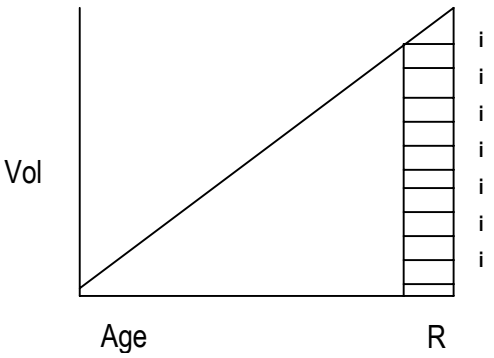
The Austrian method is a means of calculate the yield by comparison of actual growing stock and normal growing stock. (AGs & NGs).

The AGs is mmed and it is assumed that the stock on $R^{\underline{n}}$ age plot is equal to the annual yield and is equal to (I) sum of increment of all the age classes of the growing stock.

That is:

$$AY = I = Ri$$

Where AY = Annual Yield ; R = Rotation, i = annual increment; $I = \varepsilon i = R$ = sum of increment of all the age class of the G.S.



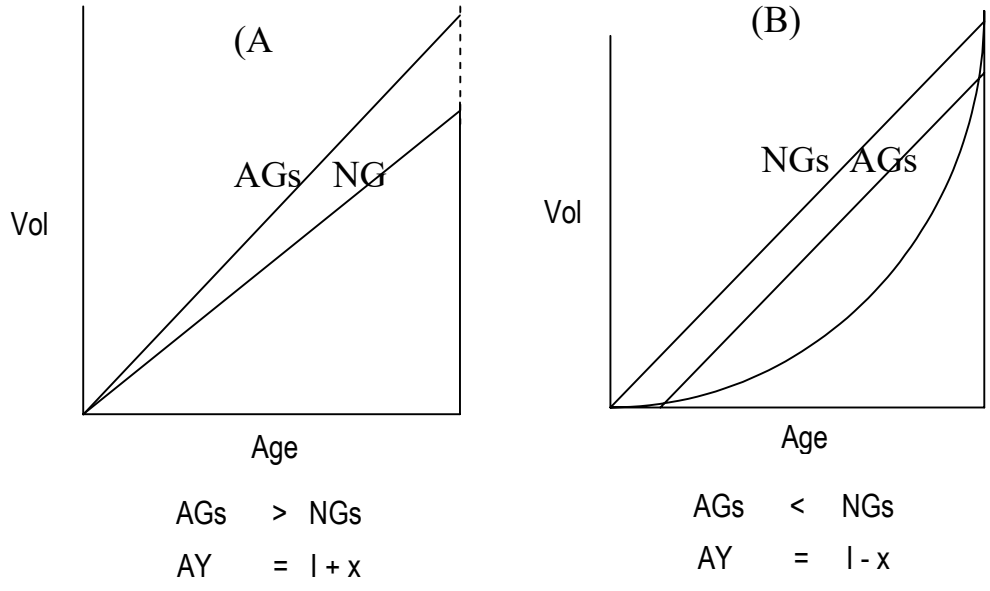
i earlier assumption on the NGs it was found that NGs = $\frac{I \times r}{2}$ (Von Mantel formula)

However when the AGs was mmed it was found out that the total volume is either greater than or less than the volume of the normal growth stock. The Austrian tax collector mmed the Volume of the AGs and the volume of the R$\underline{n}$ age stand. This was assumed to be equal to I = AY.

He postulated that AY ought to be the volume of R$\underline{n}$ (I) age plus the AGs minus the NGS all upon R$\underline{n}$.

$$AY = I + \frac{(AGs - NGs)}{R}$$

And if the AGs is greater than NGs the little excess will be positive and if the AGs is less than the NGs, the little deficit will be negative.



AGs > NGs
AY = I + x

AGs < NGs
AY = I - x

It means that AY will be greater than I if AGs is greater than NGs see sketch 'A', But AY would be less than I if AGs is less than NGs.

5.2.6 Heyer's Modification

The disadvantage of Austrian's method is that too much emphasis have been placed on the stand of the R$\underline{n}$ age. However he thought that it would be better to measure the actual increment of each stand after a certain period says 10 years i.e.

$$AY = PMAI + \frac{(AGs - NGs)}{R}$$

5.2.7 Methods of successive enumeration or continuous inventory based on Biolleys method of control

This is infact the most detailed and probably accurate method but it depends on successive enumeration or short interval so that it is practicable where forestry is intensive.

It is also suitable for forest under selection system and clear fell into. Depends on complete enumeration at regular intervals and works as follows:

P = Period between enumeration

V1 = Volume enumerated in the 1st enumeration

V2 = Volume enumerated in the 2nd enumeration

N = Volume felled between enumerator

Note:- These Vols ("N") are got from things . The annual yield for the succeeding period is equal to PMA = $\frac{V2 + N - V1}{P}$

$$AY = PMAI = \frac{V2 + N - V1}{P}$$

Since the AY in the preceding period is $\frac{N}{P}$ the aim is to get the calculated

Yield exactly equal to this so that the volume remains constant.

Other Methods of Volume Control

- **(i)** Hundeshagen method
- **(ii)** Hufuagels Method
- **(iii)** Kuusela Nyyssonen method (finish formular)
- **(iv)** Armorlization formula
- **(v)** Grosenhangl's allowable cur formula

5.2.8 Number and Sizes of Trees

Up till now we've been discussing methods it take into consideration the age of the trees.

This is possible where we are considering approximately over-aged forest as is obt'ed in clear felling, or in temperate countries. In the tropical high forest trees of different

ages are all mixed together. It therefore becomes meaningless to use age class distribution as a yard stick or measure of yield regulation.

Hence we apply size class distribution to uneven-aged forests. Furthermore it is difficult to know ages of trees in tropical high forest since there are no clear-cut relationships between age and size classes. Also growth rings are not equivalent to annual rings and so it is difficult to assess the ages of these trees.

Methods of yield regulation of un even-aged forest based on size classes includes:

(i) French method of 1883 or Meland method

(ii) Brandis method or Indian Method

(iii) Meyers method

(iv) The Recruitment method

(v) The chapmans Horizontal cut method.

5.2.9 French Method of 1883 Or Melard Method

In this method we divide the growth stock into three parts according to the sizes and these are equated to the rotation as follows:

Let size at R^n (r) be equal to x i.e.

Rotation	Size girth in fees
R = 75	x = 6
1/3r = 25	1/3x = 2
2/3r = 50	2/3x = 4

The G.S is divided into three.

(i) The large Trees (L.W) = 2/3x and above.

(ii) The Medium Trees (M.W.) 1/3x to 2/3x

(iii) The small trees (S.W) – below 1/3x

The vol. of the large tree is then measured and the annual yield is then calculated by Cotta's formula.

$$AY = \frac{V+½i}{P}$$

$$A.Y. = \frac{\text{Vol of L.W}}{1/3r} + ½ \text{ annual increment of L.W.}$$

Above is of course the figure representing trees in the final yield.

During this period thinnings have been done especially among the medium trees and it is assumed that in a well stocked forest 1/3 of the annual increment of the medium trees can be removed as thinnings. In some cases however it is less than 1/3 of annual increment i.e. about ¼ only. The total AY therefore becomes Total AY = $\frac{\text{Vol of L.W}}{1/3\text{r}}$ + 1/3 annual increment of L.W.

5.2.10 Brandis/Indian Method

This method was developed to regulate the cutting of teak in Burma. The regulation is by size classes based on number of trees that can be removed with respect to rate of replacement or recruitment.

Method:

(i) Classification of growth stock to three girth classes namely:

I = > 6ft

II = 4½ - 6ft

III = 3 – 4½ feet

Fixing of class I as the minimum felling girth.

(ii) Calculation of TIME it will take all trees in girth class II to go into girth class I.

Note:- This can be done by ring count or observation of trees of known ages.

(iii) Brandis determine the recruitment period to be 24 years.

(iv) Therefore allowable cut = 1/24 of the present number of class I trees.

5.3 Working Plan

Working Plan is the main instrument of forest planning and working for scientific management of forests. It is a very useful document for evaluating the status of forests and biodiversity resources of a forest division, assessing the impact of past management practices and deciding about suitable management interventions for future. (Source: National Working Plan Code 2014).

A Working Plan (W.P) document is a means of enforcing systematic, obligatory and mandatory regulations for continuous management of a given forest property. The WP does not deal only with silvicultural and management aspects but also covers general administration, watershed management, conservation of biodiversity, soil and water

conservation, wildlife etc. In short, a WP is a complete forest plan for the Working Plan period.

Glossary **defines** Working Plan as a written scheme of management aiming at continuity of policy and action and controlling the treatment of a forest.

5.3.1 Working Plan, Working Scheme, Micro-plan

Every working plan includes the specific scientific prescriptions for proper management of forests of a particular forest division. However, working schemes are prepared for smaller areas for a specific purpose or for forest areas under the control/ ownership of such bodies as private, village, municipal, cantonment, autonomous district council etc. These prescriptions should aim at developing forest resources, while meeting the requirements of the objectives of the National Forest Policy and other international conventions/agreements, and satisfying the provisions of the relevant statutes.

The National Forest Policy clearly states “No forest should be permitted to be worked without an approved working plan by the competent authority”. It is the duty of the manager or owner of the forest area to ensure the preparation of the working plan / scheme. The authority as designated by the MoEF, will approve the working plan and ensure its implementation. Even working schemes have all major elements of a working plan and these schemes also need the sanction of the competent authority. (National Working Plan Code – 2014)

For involvement and benefit of local stakeholders, micro plans are to be prepared within the ambit of working plan prescriptions for Joint Forest Management (JFM) areas, and eco development plans are to be prepared for eco-sensitive forest areas adjoining the notified protected areas. The micro-plan of jointly managed forests is prepared by the members of the Joint Forest Management Committee (JFMC), through Participatory Rural Appraisal (PRA), with the technical assistance of forest staff of the territorial division as per MoU, for sharing the responsibilities of implementation and equitable sharing of usufructs among the stakeholders within the broad prescriptions of working plan. Micro plan is approved by concerned Working Plan Officer (WPO)/Divisional Forest Officer (DFO)/Forest Development Agency (FDA) as per prevailing conditions in the state/UT. Proper implementation of the micro plan by each JFMC should be reviewed at least once in two years by the Forest Development Agency (FDA). (National Working Plan Code – 2014)

5.4 Goal and Objectives of Working Plan

The goal of Forest Management Planning is that the Plan must provide for sustainable management of forests and its biodiversity as laid down in the National Forest Policy. The Plan should encompass the ecological (environmental), economic (production) and social (including cultural) dimensions of management.

The objectives for attaining this goal include -

- conservation of forests and reducing forest degradation
- maintenance and enhancement of ecosystem services including ecotourism
- enhancement of forest productivity together with establishment of regeneration to improve forest health and vitality as per ecological andsilvicultural requirements of the species
- progressively increasing the growing stock and carbon sequestration potential
- maintenance of biological diversity, sustainable yield of forest produce
- prevention of soil erosion and stabilization of the terrain
- improvement and regulation of hydrological regime
- people's involvement in planning and management of forests
- fulfilling socio-economic and livelihood needs of the people, while ensuring simultaneous implementation of the relevant Acts and Rules

5.5 Organizational Structure

5.5.1 At national level

In order to efficiently monitor the whole process of working plan preparation and adherence to the prescriptions of working plans in all workings/management of forests, the administrative structure operative at the national level includes Director General of Forests & Special Secretary (DGF&SS) to the Government of India, Additional Director General of Forests, Inspector General of Forests, Deputy Inspector General of Forests, and Assistant Inspector General of Forests in the MoEF, New Delhi. This structure is supported by the Regional Offices headed by Additional Principal Chief Conservator of Forests (APCCF)/Chief Conservator of Forests.

5.5.2 At the State Level

The organizational structure at the state level varies fro state to state. In general, the structure is as follows.

Head (Policy level) **–** PCCF/APCCF (Working Plan)

Field Supervisory unit – APCCF/ CCF (Working Plan)

Field Functional unit – WPO

According to the National Working Plan Code 2014, a working plan unit (WPU) at the field level should be headed by a working plan officer (WPO) of the rank of Conservator of Forests. However, in West Bengal, the WPOs are officers of the rank of Divisional Forest Officer, and the Field Supervisory unit is headed by an Officer of the rank of Conservator of Forests. There are three WPUs, or Working Plan Divisions in the State.

5.6 Working Plan Period

Working Plan period is the period for which detailed prescriptions are laid down in a Working Plan. A forest management plan has to deal with long term development and scenarios that cover a long period, e.g. rotation, size of produce intended to grow, intermittent yield etc. However, all such parameters relating to forests depend on many locality factors whose behavior over a long time cannot be mapped with certainty. For example, poor seed years, periods of drought, floods and resulting damage, fluctuations of market may make it necessary to adjust and revise long term plan. On the other hand, frequent revision of plan expends too much of time, labour and money that cannot be afforded. A period of 10 years is generally found to be convenient. According to the National Working Plan Code 2014, generally the working plan is to be revised every 10 years and the preparation of working plan of a territorial forest division should normally take two years which may vary depending upon the volume of work and technical facilities available. If the planning/prescriptions are given for a period of more than 10 years (for e.g., in a working circle if the conversion period of the crop is fixed for 30 years) then review will be done at the end of 10 years and the 11thyear coupe will become the 1st year coupe, 12th year coupe will become the 2nd year coupe and so on after review.

5.7 Inputs to WPO

GIS Cell of the Forest Department should provide WPO withdigital maps of the division based on latest, cloud free, good quality satellite imagery along with the several copies of print outs of the map on 1:25,000 scale. Relevant and latest satellite data with spatial resolution of 5.8m or higher which can be used for generating maps up to the scale 1:12,500. Spatial database of a forest division with spatial layers which include Division- Range-Beat boundaries, National parks-wildlife sanctuaries, road network, stream network, rest houses, forest cover etc. updated compartment / village/ management unit history, deviation forms, control forms, JFM areas etc.

5.8 Preliminary Working Plan Report (PWPR)

PWPR forms the basis of the WPO's fieldwork and should contain necessary details of the working plan area; details of management practices adopted during the working plan period; aspects of forest management which are considered important for assessing the sustainability, and a set of related quantitative, qualitative *or* descriptive attributes; comments on Part I of the working plan regarding such sections which are required to be updated. The field work including vegetation survey or other survey or enumeration the WPO has to undertake

5.8.1 Preparation and Finalization of PWPR

In the working season immediately preceding the one, in which the working plan revision is due to commence (at least two and half years before the expiry of current working plan period), the concerned DFO territorial shall be directed by Head, territorial forest circle to initiate preparation of the preliminary working plan notes. These notes briefly review the results of management during the past years and suggest any necessary change for improvement. DFO must complete the notes within two months and submit the note to the Head, territorial forest circle, who in turn inspects the forests concerned and writes the PWPR during or soon after completing the tour within two months and submits the draft to concerned CCF/APCCF/PCCF for consideration of the standing consultative committee. The Head, territorial forest circle during the PWPR preparation will hold consultation with local people's forum, JFM committees, village Panchayats and forest development agency (FDA) about the expectations of people dependent on forests and try to accommodate the same as far as possible. There shall be a standing consultative committee of the state under the chairmanship

of PCCF (HoFF) having representation from the state (including Chief Wildlife Warden) and MoEF (RAPCCF) for preparation of working plans. The experts from FSI and its regional centres and ICFRE institutes may be included in the committee. The draft PWPR is deliberated upon in the standing consultative committee meeting chaired by the PCCF (HoFF), which then finalizes the report with changes as deemed necessary. The approval of PWPR by PCCF (HoFF) should be granted at least two years prior to the expiry of the current working plan, so that the preparation of working plan by the WPO, approval by the designated authority and delivery of approved working plan to the DFO territorial concerned for implementation can be completed prior to expiry of the current plan.

5.8.2Draft Working Plan

WPO writes the Draft Plan as per approved PWPR. It consists of two parts. Part I of the working plan provides the information generated from various sources including forest inventory and assessment. The chapter "Past Systems of Management" and "Statistics of growth and yield" should be written as comprehensively as possible and should be completed soon after the data has been compiled and analysed. Part II will be written chapter by chapter using more or less standardized paragraph headings in their proper order. The write up of Part II shall be based on information provided in Part I.

The complete plan along with required maps is first vetted by the CCF/APCCF (WP). Copies are circulated to the members of standing consultative committee especially the RAPCCF (MoEF). The members especially RAPCCF (MoEF) should get the copies for examination and comments at least 45 days prior to the final meeting of the standing consultative committee. The draft working plan is deliberated upon, in the meeting and commonly acceptable suggestions/alterations/ modifications are incorporated in the final draft working plan for submission to RAPCCF (MoEF). Draft WP as deliberated in the standing consultative committee and as revised after incorporating the suggestions of the committee, is sent to the RAPCCF (MoEF) by the PCCF (HoFF) under intimation to the state government.

5.8.3 Sanction of the Plan

After examining the plan, RAPCCF (MoEF) accords the approval on behalf of MoEF as such or with necessary suggestions, directions and modifications within three months.

5.9 Survey and assessment of forest resources

Prerequisite for writing a working plan is to undertake survey and make an assessment of forest resources. Guidelines, in this respect, laid down in the National Working Plan Code 2014 are briefly mentioned below.

5.9.1 Examination of territorial units

- States should digitize the forest boundary and generate geo-referenced version of map of scale 1:50,000 or higher after complete verification.
- WPO will also inspect and examine the forest area (including range, beat), village, block, compartment and ascertain that the extent of forest cover is properly maintained.

5.9.2 Forest resource assessment

Following the methodology prescribed in the Code, forest data are to be collected to cover the following aspects.

(i) **Maintenance, conservation and enhancement of biodiversity:** Forest composition and distribution, plant species diversity, status of biodiversity conservation of forests, status of species prone to over exploitation, conservation of genetic resources, fauna and their habitats, threats and challenges to wildlife, protection and management of fauna;

(ii) **Maintenance and enhancement of forest health and vitality:** Status of regeneration, area affected by forest fires, area damaged by natural calamities area protected from grazing, lopping practices, area infested by invasive weed species in forests, Incidences of pest and diseases, forest degradation and its drivers;

(iii) **Conservation and maintenance of soil and water resources:** Assessment of excess runoff from discharge zone and conservation measures for soil, groundwater, and soil moisture. Area treated under soil and water conservation measures, duration of water flow in the selected seasonal streams, wetlands in forest areas, water level in the wells in the vicinity (up to 5km) of forest area, status of aquifers;

(iv) **Maintenance and enhancement of forest resource productivity:** Growing stock of wood / bamboo, increment in volume of identified timber species, efforts towards enhancement of forest productivity through quality plantation activities, carbon stock, carbon sequestration and mitigation;

(v) **Optimization of forest resource utilization:** Recorded removal of timber, fuel wood, bamboo/ rattans, and locally important NTFPs including MAPs, demand and supply of timber and important non-timber forest produce, removal of fodder, valuation of the products;

(vi) **Maintenance and enhancement of social, economic, cultural and spiritual benefits:** Number of JFM committees and area protected by them, status of empowerment of JFMCs, labour welfare, use of indigenous knowledge, extent of cultural/sacred groves, social customs, status of compliance of Forest Right Act (FRA), other rights and concessions, ecotourism areas and activities, etc.

5.9.3 Growing stock estimation

From the enumeration/field data, species wise distribution of trees in each diameter class will be generated for compartment/village/any other management unit. This data would be used for population structure and to identify the old group forests. Adding the growing stock of all compartments, the growing stock of the block will be estimated, which will be again integrated up to range level and further at divisional level.

5.9.4 Assessment of non-timber forest products

WPO may plan and undertake survey, sampling and assessment for estimation of few prioritized species of NTFPs to start within the selected grids. In general, WPO does the assessment of potential NTFPs through available old records, local enquiry, and plot enumeration data. Data collected under different studies and/or maintained in the JFM areas may be used. Summarized estimated quantities may be recorded for every compartment /village/any other management unit in terms of their scientific name, local name, type of plants, their part and its utility, area(ha), quantity per hectare, estimated harvest/hectare, etc. for species of trees, shrubs, climbers, grasses, herbs, lichens, fungi, etc. A separate estimation may be done for MAPs.

5.9.5 Biodiversity assessment

The data collected during enumeration such as the number of individuals of each species and the DBH of each tree are utilized to derive secondary attributes like basal

area (BA, m2/ha), density (D, trees per ha) and frequency (F, number of quadrates where trees are present in relation to total plots observed). Further, relative values of BA, D and F are calculated, and The Importance Value Index (IVI) is calculated by adding up relative dominance (RBAF), relative density (RD) and relative frequency (RF). However, in case of shrubs, herbs, saplings and for regeneration, the IVI is calculated on the basis of relative values, i.e. relative frequency and relative density.

Species diversity is an expression of community structure and is unique to the community. The number of species in a community is referred to as species richness. The relative abundance of all species is called evenness. Species diversity includes both species richness and evenness. Species diversity indices like Shannon-Wiener Index (H`) and Simpson's Index (λ) are calculated separately for trees, shrubs and herbs as their individuals differ in size and are sampled differently. Similarity index (community coefficient) is calculated for determining the number of species which are shared among the sites to assess the extent of variation in the species composition.

5.9.6 Assessment of regeneration status

Young plants of tree species up to 10 cm diameter are taken into consideration for assessment of regeneration status of a particular species as practiced in National Forest Inventory by FSI. Data collected from the square plots of 3x3m for saplings (2cm to 10 cm collar diameter) and from the square plots of 1x1m for seedlings will be generally used to assess the regeneration status of species in the management unit (compartment, village or any other unit). The regeneration status of the sampled species may be assessed in the following categories:

(i) Good regeneration, if seedlings are more in numbers than the saplings and likewise saplings are more than that of adults.

(ii) Fair regeneration, if seedlings are more in numbers than the saplings but the saplings are equal or less than that of adults.

(iii) Poor regeneration, if a species survives in only sapling stage, but not as seedlings (though sapling may be less, more or equal to adults).

(iv) No regeneration, if a species is absent both in sapling and seedling stage, but present as adult.

(v) New regeneration, if a species has no adults but only sapling and/or seedlings.

5.9.7 Plantation survey and assessment

The assessment of growing stock of old plantations, which attains a minimum size of 10 cm DBH or age of 10 years can be done based on plot enumeration data for such plantation areas. But assessing the status of young plantations having less than 10 cm DBH or age of 10 years is also important. Plantation journals offer the best option for assessing such young plantations. Results of survey should be recorded in the journals which should be made available to WPO by the DFO.

5.9.8 Assessment of bamboo/rattan

All culms occurring in the clump would be enumerated as per different classes of National Forest Inventory and these data would be used to assess the availability of bamboo/rattan. Data from plot enumeration will be used to estimate the number of clumps per management unit (compartment, village or any other unit) and classify them as:

(i) Luxuriant – All healthy, un-congested, undamaged and in good condition

(ii) Degraded – Not capable of being rehabilitated and of attaining normal productivity

(iii) Culturable – Not included in (i) or (ii)

(iv) Non-clump forming bamboos

5.9.9 Soil survey and assessment

Soil properties along with site features like slope, aspect, erosion, climate, etc. brings out information about the land capability class, land suitability, etc. For survey, soil samples may be collected in the selected grids from different horizons i.e. from soil surface upto 2m depth. The soil samples may also be collected from pre-determined depths like 0- 15cm, 16- 30cm, 30-60cm, 60-100cm, etc. The sampling may be carried out by excavating a soil profile or by auger method. The soil samples are collected, labelled and carried to laboratory for the analysis of physical properties such as texture, bulk density, moisture, water holding capacity, field capacity, depth and colour and chemical properties such as pH, organic matter and nutrients. The nutrients mainly include nitrogen, phosphorus, potassium, calcium, and magnesium. However, the detailed soil survey is not required during the revision of working plan. WPO may take help from the secondary sources for the assessment of the forest soil.

5.9.10 Socio-economic survey and assessment

Available information on socio-economic status of the people living in forest fringe villages should be collected and assessed to bring forth the role of forest products and ecosystem services in their lifestyle. Socio economic survey shall include dependency on timber, fuel wood, fodder, grazing, other NTFPs and livelihood aspects. The detailed survey is not required to be undertaken by WPO during the revision of working plan. The villages situated within the limit of 3Km from the forests will be considered as forest fringe villages for the assessment. Stratified multistage random sampling will be deployed for the socio-economic survey. The first stage sampling units will be the fringe villages and the second stage sampling units will be the households.

5.9.10 Assessment of wildlife habitats and species

The WPO is not required to undertake an estimation of faunal populations. Advantage may be taken of study being carried out by the National Tiger Conservation Authority (NTCA) in collaboration with the Wildlife Institute of India and the state forest department. The WPO should identify flagship species including mammals, birds, reptiles, amphibians, plants etc. which may be significant for the area. The WPO should identify suitable habitats and micro habitats for such key wildlife species and appropriate measures needed to conserve and improve the same. The maintenance and restoration of grasslands, wetlands, wildlife corridors and water points must be identified. Threats, such as habitat loss and/or fragmentation; illegal trade; road and rail networks; etc. should be identified and appropriate corrective measures should be suggested for implementation. Similarly, areas of man animal conflict deserve special attention for amelioration.

5.9.11 Assessment of trees outside forest (tof)

For assessing tof, geometrically rectified IRS P-6 LISS IV (5.8m) or any higher version imageries may be procured from NRSC, Hyderabad. Forest area of the division is masked out from them and classified map is generated having different strata namely, block plantation, linear trees, scattered trees, area with no trees, cropland etc. Stratified random sampling may be undertaken to assess the growing stock and the potential area for extension of forestry outside forests and sustainable land use management within the forest division. This requires inter-sectoral synergy and

convergence. WPO may therefore prepare a separate strategy as new chapter, not being part of general prescriptions of a working circle for forests.

5.10 Writing up of working plan

The Working Plan should be written in a standard format, dwelling on contents under standard title/sub-title. The format and guidelines have been prescribed in the National Working Plan Code 2014. According to the National Working Plan Code 2014, besides the working circles related to maintenance and enhancement of forest resource productivity, suitable prescriptions should be made for the following exclusive or overlapping working circle**.**

(i) Overlapping working circle for sustainable management of bamboos/rattans based on the availability and assessment of bamboos/rattans.

(ii) Exclusive or overlapping plantation working circle to cover existing plantations, blanks and under stocked areas not suitable for ANR, clear felled areas, road side, river side, canal side, rail side and sea side areas and lands under CAMPA etc. which are suitable for plantations. Such areas should be identified and allocated to different years of plan period along with prescription of sustainable management.

(iii) Exclusive or overlapping working circle for important NTFPs like gums and resin, tendu leaves, medicinal and aromatic plants (MAPs), fruits and seeds, etc.

(iv) Exclusive or overlapping working circles namely Fringe Forest Management, JFM and Community Forest Management in the working plan for sustainable management of forests.

(v) Exclusive or overlapping mandatory working circles related to maintenance, conservation and enhancement of biodiversity, maintenance and enhancement of forest health and vitality, conservation and maintenance of soil and water resource, maintenance and enhancement of social, economic, cultural and spiritual benefits and institutional (infrastructural and capacity building) support subject to their applicability for a given forest division.

5.11 Contents of the plan

(i) Summary of facts on which proposals are made

- The tract dealt with maintenance/ increase in the extent of forest and tree cover
- Area of forests under different legal classes
- Percentage of forest with secured boundaries Locations
- Land use, land use change and forestry (LULUCF)
- Threats to the forest
- Distribution of different forest types.
- Tree cover outside forest area

(ii) .Maintenance, Conservation and Enhancement ofBiodiversity

- Forest composition and distribution
- Plant species diversity Biodiversity assessment in terms of density, frequency, total basal cover, dominance,
- Status of biodiversity conservation in forests
- Status of species prone to over exploitation
- Conservation of genetic
- Resources Preservation plots, sample plots, medicinal plants conservation areas, community conservation areas, etc.
- Fauna and their habitats
- Threats and challenges to wildlife
- Protection and management of fauna

(iii) Maintenance and Enhancement of Forest Health andVitality

- Status of regeneration
- Area affected by forest fire
- Area damaged by natural calamities
- Area protected from grazing

- Lopping practices
- Area infested by invasive weed species in forests
- Incidences of pest and diseases
- Forest degradation and its drivers
- Pollution control and protection of environment

(iv) Conservation and maintenance of soiland water resources

- Area treated under soil and water conservation measures
- Duration of water flow in the selected seasonal streams
- Wetlands in forest areas
- Water level in the wells in the vicinity (up to 5km) of forest area
- Status of aquifers Details of aquifers to monitor their sustainability.

(v) Maintenance and enhancement of forest resource productivity

- Growing stock of wood
- Growing stock of bamboo
- Increment in volume of identified timber species.
- Efforts towards enhancement of forest productivity through quality plantation activities
- Carbon Stock Details of biomass for carbon stock assessment
- Carbon sequestration and mitigation

(vi) Optimization of forest resource utilization

- Recorded removal of timber
- Recorded removal of fuel wood
- Recorded removal of bamboo/ rattans
- Recorded removal of locally important NTFPs
- Demand and supply oftimber and important non-timber forest produce
- Import and export of wood and wood products
- Import and export of NTFPs

- Removal of fodder & Description of cattle rearing community of forest dwellers
- Valuation of the products

(vii) Maintenance and enhancement of social, economic, cultural and spiritual benefits

- Number of JFM committees and area
- Status of empowerment
- Labour welfare
- Use of indigenous knowledge
- Extent of cultural/sacred groves
- Ecotourism areas and activities
- Social customs prevalent social customs relevant to forests.
- Status of compliance of Forest Right Act (FRA)
- Other Rights and Concessions
- Dependency of local people on NTFPs

(viii) Adequacy of Policy, Legal and Institutional framework

- Existing policy and legal framework and their compliance
- Status of approved working plan and compliance
- Number of forest offences
- Status of research and development
- Human resource capacity building efforts
- Forest Resource Accounting
- All tangible benefits should be reported.
- Budgetary allocations to the forestry sector
- Existence of monitoring, assessment and reporting mechanism
- Public awareness and education
- Adequate manpower in forest division

(ix) Five Year Plans

- WPO has to describe the activities taken up under preceding Five year plan, (plan wise and scheme wise) and make summary suggestions for future.

(x) Past systems of management

- General history of the forests
- Past system of management and their results
- Special works of improvement undertaken
- Past yield, revenue and expenditure
- Statistics of growth and yield
- Statistics of forest carbon stock

Summary

Reference:

Adekunle, M.F, Momoh, S.and Agbaje, B.M .(2008). Valuing urban forests: The application of Contingent Valuation Methods. Ethiopian Journal of Environmental Studies and Management (published by ;Department of Geography, Bahir Dar university ,Bahir Dar ,Ethiopia) 1 (2) 61- *67. www.ajol.info/index.php.*

Adeyoju, S. K., (1975). Forestry and The Nigerian Economy, Ibadan University Press.

Etukudo, I. G. et al (1994): Elements of Forestry

Gbile, Z. O. (1979): Exploitation of Nigeria's economic non-timber plant species in the wild – progress and prospects. An invited paper for the 9th Annual conference of the Forestry Association of Nigeria, November 1979.

Hill, Albert F. (1951): Economic Botany. McGraw – Hill Book Company, Inc.

M. B. Shrivastava 2004. Department of Forestry The Papua New Guinea University of Technology Lae. Vikas Publishing House PVT Ltd 576, Masjid Road, Jangpura, New Delhi – 110 014.

Unit-6 Policy and legislations

Unit Structure

6.0 Learning objectives.
6.1 Introduction
6.2 Historical Background
6.3 Forest Legislations
6.4 The Objectives of Forest Polices
Summary

6.0 Learning objectives.

After studying this unit you will be able to understand:

- About the policy and legislations
- About historical background of policy and legislations
- About the forest legislations
- About the objectives of forest polices
- About the legal and policy frameworks related to forest conservation

6.1 Introduction

Forests are the major natural resources and are also recognized as a colorful expression of nature. They are also recognized as guardians and protectors of the wildlife of the country. Forests are valuable not only due to his botanical use but also for its recreational and scenic beauty that gives glory and attraction to many places in North-east of India as well as in other countries. Forests always add to the agriculture of the place it was situated whether it is in the terms of fertility of the soil, prevention of soil erosion, and promote perennial stream flow in rain-fed rivers. They shelter wild animals, preserve gene pools, and protect the tribal population. Thus, forests help in maintaining the ecological balance.

Besides these environmental and ecological benefits, forest bring revenue to the state, supply raw material to industries, and act as a source of fuel and fodder. Forest management always gives rise to conflicting viewpoints. Claims of development would raise problems of ecological security. During the last century, forest has been cut at

rates unequalled in world and they are disappearing at an alarming rate. In India, it has been claimed that we have got vegetation cover over 19% of the total land area as against the accepted ideal of 33% in India and over 40% internationally. Thus, vegetation cover is much less than required. The forests are home to some of the world's signature fauna, including the Bengal tiger and Asian elephant, as well as a diverse tropical flora unique to the subcontinent. The forests also contain vast reserves of natural resources, like timber products and minerals. With its population growing, demanding more resources, and consuming more, Indian forests face possible degradation. Forest helps in keeping air and water fresh and climate good. The Indian Forest Act 1927 and State legislation relating to forest impose Governmental control over forests by classifying them into reserved forests, protected forests and village forests.

Every law carries with it the hopes and aspirations of the social and political forces at work at a given time. The Indian Forest Act, 1927 is a comprehensive legislation relating to forests management that consolidates the pre-existing laws. The Forest Act, being a product of the British colonial period, reflects the exploitative intentions of colonial and feudal society of that time, rather than the environmental and ecological interests of the society. Based on a revenue-oriented policy, its main object was to regulate dealing in forest produce and augment the public exchequer by levy of duties on timber.

When India gained independence, forests were placed on the state list of the constitution. Forest departments of individual states continued to regulate forests in accord with the Indian Forest Act of 1927, as implemented by state regulations. The Indian Forest Act gives the state jurisdiction over both public and private forests and facilitates the extraction of timber for profit. Public forests are those in which state governments have a proprietary interest, are divided into three categories: Reserve forests, village forests, and protected forests.

6.2 Historical Background

India has a very old culture and civilization of our country have developed on the river banks and amidst the dense forest. Different Vedas make it clear that often people saw the image of god in nature (trees, plants etc,) and treated them as divine objects with great devotion and love. Plants were regarded as possessing divine qualities with

reference to their healing powers. Moreover, plants were deified of God Varuna, one of the most popular deities of Vedic times1. Emperor Ashoka is also known for his work to protect forests and for planting trees along public roads. The edicts issued by him include “Forest must not be burned” and “trees shall be planted on both the sides of the roads2”. India had a culture of protecting and guarding the forests and it was a social responsibility of the individuals as well as the rulers to maintain and protect them. And, that India had a culture of worshipping glory.

Till the inception of the British colonial period the forest were protected by the tribal people but during the British period the forest were used as the matter of revenue extraction and not as natural resources. Many forests were destroyed in the name of agriculture and the need for more land for cultivation. Later on, forests were extensively cut to meet the needs of timber for ship building, iron smelting and tanning. Oak forests were cut and shipped to England for the use of English Royal navy as the “safety of the empire depended on its wooden walls3”. British Rule in India was virtually a period in which forests were vastly damaged and destroyed and the vegetation cover started shrinking. To, serve the imperial cause, the forest act was enacted in 1865 and the forest department was established. The main purpose of this act was to facilitate the acquisition of the Indian forest areas to supply timber for railways and to establish the claim of the state on the forest land. But, the Act did not have provisions to protect the existing rights of the people living in the forests. Basically this Act was meant to regulate forest exploitation, and the management and preservation of forest resources. Soon, it was found that the provisions of the Act were not effective as it lacked deterrent punishment and gave only meager powers to the forest officers. Therefore, after a great debate, a new forest act was passed in 1878 which claimed absolute control and ownership rights of the state on forests. It also recognized the rights of the nomads of the forests and of other nearby dwellers in various areas. Such rights included the rights of the villagers in Himalayan region, tribals in Chhattisgarh, Santhals in midnapore, Bhil in Rajasthan and other north-eastern Areas.

6.3 Forest Legislations

The first effort to regulate the Indian forests began in South India. In 1880, a commission was appointed to enquire into the availability of teak in the Malabar

forests. Following the commission's report, felling of teak below twenty one inches in girth was prohibited. Subsequently, in 1805, a Forest Committee was constituted to access the capacity of forests. It found that the more accessible forests had been over-worked4. So a proclamation was made declaring 'royalty rights' over teak trees in the south and prohibiting unauthorized felling of teak.

As soon as Brandis was appointed as Inspector General of Forests, Cleghorn was deputed to assist him. They were responsible for the development of methodological system of forest management in the early stages. They realized the necessity for separate forest enactment not only for affording protection to the forests but also for bringing them under proper management with adequate authority vested in the officers of the forest department for the purpose. In 1865 the first Indian Forest Act was passed. It came into effect on 1 May 1865. The Act empowered the Government to declare any land covered with trees as Government forests and to issue rules for conserving them. This was the first attempt at forest legislation by the British in India. Butthe Indian Forest Act was not extended to Madras presidency mainly on account of the attitude of the Board of Revenue. It held that the villagers had the rights over the forests and forests could not be established as the absolute property of the State5.

A revised Indian Forest Act was passed in 1878 and was extended to all provinces of British India with the exception of Madras and some other areas. This Act aimed at improving on the inadequacies of the Indian Forest Act of 1865. This Act classified the forests into reserved forests, protected forests and village forests. The rights of the people over forest lands and produce in the reserved and protected forests were restricted and regulated by this Act. It empowered the Government to exercise control over the forests.

6.4 The Objectives of Forest Polices

The purpose of a society in establishing policies about what its members do is to try to assure that their actions will contribute as much as possible toward some ends which the society deems desirable. A policy is this means to some end and its effectiveness on only budged in forms of those ends. However many of the ends towards which policies are aimed are desirable only because they in turn become means towards the achievement of other ends.

For example a society may have on objective of adequate wood supplies for all consumer needs. It is therefore establishes a policy of increasing the growth of timber in its forest. One way and doing this is to reduce the occurrence and severity of wild forest fire. A second objective thus arises of keeping forest fire damage to a minimum.

There will be a hierarchy of policies as a result of the chair ends and means. In order to measure the value or effectiveness of any given policy, it may be necessary to look beyond its own immediate ends. The objectives of forest policies are often not clearly stated and probably in many cases are not even clearly known. Confusion about objectives leads to many difficulties, and it is desirable that the objectives of forest policies and of other policies which affect or conflict with them may be made as explicit as possible.

The most obvious objective of any society with forest resources is to obtain the benefits that it might from them. These potential benefits cover a wide range including wood products, other vegetative products, animal products, water, recreation sites, flood reduction, soil stabilization, modification of climatic conditions, and environmental amenity. Not all forests are potentially capable of producing all the benefits.

Eg: A river – bottom swamp forest cannot do anything to reduce floods. A forest cannot be preserved indefinitely in the same condition, even it is protected well. Some of the potential benefits of the forest cannot be obtained without disturbing the natural conditions.

Eg: In order to obtain the benefits of wood products, one must at the trees and remove usable portion from the forest. in this process one will make drastic changes in the vegetative cover on the area and perhaps also in soil conditions.

The magnitude of the adverse effects may be controlled of some extent, and this is me function of forest management. Manipulating the condition of the vegetation and site, man con change the output of most benefits in the direction that he desires. Although a forest may simultaneously produce various benefits such as water, game and wood, an attempt to increase the yield of all these products will usually lead to series conflicts.

Foresters usually have conceived of multiple use as a process applied to forest properties. Multiple is not a system of management but is concept of management. Multiple use is not a rational objective for forest policy unless it is accompanied by some recognition of the impossibility of obtaining a maximum of yield of everyone of

the potential forest benefits. Since it is not possible to obtain the maximum amount of every one of the potential forest benefits, society is forced to assign some sort of priorities to them.

The positive efforts of the late 19th century to conserve the remaining forest and to augment them through tree planting were largely motivated. Even though the forests were producing or were capable of producing other benefits, the primary objective in setting aside the forest reserves and in developing public forestry programs was to ensure a future supply of wood, fodder, fuel.

Animal products were also recognized early as an important benefit of the forests grazing was one of the principal uses of the public domain. The concepts of Biodiversity, ecological balance, environmental stability have been receiving much more attention in recent years with growing concentration of population in urban areas. The most fundamental objective of my society is probably survival.

A very basic goal of our society is "security and national welfare. Another fundamental objective of our society is the "health and welfare of the people. Outdoor recreation activities are generally considered as conducive to health. They also are assumed to add to the participants' welfare through the measure obtained and favourable environment in which they are practiced. Thus recreation becomes a means to the end of health and welfare.

Economic development is an objective which has received a great attention in recent years. Forests may occupy an important place in the development of countries. The conflicts between society's multitudinous objectives are inevitable and part of the problem in policy formation is to resolve them satisfactorily.

Unit-7 Forest and Environment Policies of India

Unit Structure

7.0 Learning objectives
7.1 Introduction
7.1.1 Purpose of law
7.1.2 Bill – Type
7.2 The concept of law
7.2.1 The characteristics of law
7.3 Forest protection and law
7.3.1 The value of forest
7.3.2 The scope of forest law
7.4 Necessity of a special forest law
7.4.1 Special law due to peculiar nature
7.4.2 Objects and Reasons for enactment of special law relating of forests and its produce the object of forest law
7.4.3 Objects and reasons for enactment of special law relating to forests and its produce
7.5 Functions performed by forest law
7.6 Legal and Policy Frameworks related to Forest Conservation
7.6.1 Forest Conservation Laws and Policies
7.6.2 Other Constitutional and Central Legal Provisions for Forest Conservation
7.6.3 An Overview of the Range of State Forest Laws
Summary

7.0 Learning objectives

After studying this unit you will be able to understand:

- About the Law, its definition and concept.
- About the forest protection and law and its scope
- About the necessity of a special forest law
- About the functions performed by forest law
- About the Legal and Policy Frameworks related to Forest Conservation

7.1 Introduction

❖ **Hooker Austin**

Every society has a system of rules promulgated by the ruling groups for regulating the behavior of its member.

- The right way of doing things are termed as "Norms" by sociologists.

- Individuals was conform to norms are reworded and those who deviate are punished.
- Social norms become legal norms through enactment and enforcement.
- To define law is more difficult task due to various reasons. Various schools of law have defines law from different angles on the basis of nature source and some on the effect on society.
- Law is kind of rule or cannon wave by actions are framed.

❖ **Maciver & Page**

Law is the body of rules which are recognized, interpreted, and applied to particular situations by the courts of the state. It is clear that law is a rule of conduct. Law clay detains rights, obligation (or) duties, as well as punishment for violations.

7.1.1 Purpose of law

- To mountain law and order
- To maintain status in society
- To facilitate individual to lave maximum freedom
- To give maximum satisfaction of the needs of the people

7.1.2 Bill – Type

Act

Act is a land made by legislative body.

- It originals from the form of prills
- Passed by both of percent
- sent for president assent, when assental
- It because act.

Ordinance

Legislative power of governance/president

- Can be issued when state/ /counsel anemby, impoliment is not in session
- To meet urgent matter
- Cease to operate at the expiry of six weeks from the date of rearembly of parliament/state legislative.

Order

Relater to executive or enforcement of rule previously made.

- Specific and limited operation
- Legislative
- Executive
- Judicial

Basis of law

Whatever relationship that is envisaged by the sovereign authority between person and things on the hand and persons and persons on the other hand forms the basis of law.

7.2 The concept of law

Dr. Sethna defines law as follows: "Civil law may be defined as all that body of statutes or ordinances, rules made by the Government by virtue of powers given to it by the legislature and judicial decisions based on positive morality, public opinions, customs and conventions, enforced through the machinery of judicial process and meant for regulating the rights and duties of citizens interse and the state and citizens – so as to secure the greatest good of the greatest number". Law is evolved from precedent, custom, statute and these the courts apply to the exclusion of their private judgments.

7.2.1 The characteristics of law

(a) Law is a command set by a sovereign authority, backed by requisite force so as to claim habitual obedience from the bulk of the community.
(b) Law is not justice in itself but is an instrument for achieving justice
(c) Law is uniform and is applicable to all without any distinction
(d) Law is administered by courts functioning as a limb of the state

7.3 Forest protection and law

The legal concept of a forest does not take the nature of Vegetational growth into account. Even an area devoid of any vegetation can be a forest in a legal sense, if such an area has been decaled as one or the other category of forests according to prescribed procedure. In case of dispute, courts rely on dictionary for enlightenment.

7.3.1 The value of forest

There are three important roles played by forests; they are protective, productive and accessory. Protective means the conservation of soil and water, the production of wood and other forest produce refer to productive function, recreation, improvement of environment contribute towards aesthetic role.

7.3.2 The scope of forest law

In order to secure effective protection of the forests, the law has to

(a) Define the limits of forest property

(b) Classify them into different categories, requiring different degrees of protection

(c) Provide for the regulation and settlement of rights of regular users

(d) Incorporate suitable provisions for preventing the commission of forest offences and punishing the offenders when they are actually committed

(e) Invest public authorities with necessary powers to enforce the above provisions

(f) To prescribe such other measures as would be necessary for the protection of forest generally

7.4 Necessity of a special forest law

Necessity of a special forest law inadequacy of the existing law of the land as applied to forests peculiarities of forest property warranting a separate treatment. The general laws of the country are applicable to forests as well as to any kind of property. But provisions in general laware inadequate to deal with special problems of forest protection, because forest as a piece of property has certain peculiarities which are listed below and which need to be taken not of and dealt with in a special manner in a separate enactment.

(a) Popular misconception about forests due to their natural origin. It becomes necessary to make it clear to one and all in set terms what all acts are prohibited in a forest and what the penalty will be if these prohibitions are violated. Special law is necessary for doing this.

(b) Forests are burdened with rights of user. As the rights in question are legal rights, settlement and regulation have to be done according to prescribed legal procedure which can only form part of special law.

❖ **Forests occur over vast areas**

(a) Even trespass is made an offence in the case of reserved forest. It is difficult to include all these provisions in general law and hence they have to become the subject matter of special law only.

(b) Forests subject to variety of injuries. It will be much simpler to specify such offences in special forest legislation rather than allow them to be brought

under the general terms of the ordinary law by long explanation and highly technical arguments.

(c) **Control in transit**: This is done by controlling the forest produce in transit by suitable legal provisions which have to form part of special law only.

(d) Potty nature of offences and the need for simple procedure for their disposal. We do not need a steam hammer to crack a nut.

(e) Vulnerability to damage due to natural factors. Measures to prevent fire, extinguish them when they break out. Prohibition of lighting fire in fire season and the requisition for help of right users and losses call for a separate to forest law. Forbidding the import of infected seeds also require special measures. The need for regulation of the working of private forests. Soil erosion, floods, landslips, drying up of springs due to mismanagement of private forests, have to be stopped. Hence special law.

(f) **Empowering of forest officers**: To deal with offenders, forest produce under theft and demand help from certain categories of individuals special provision is required and hence special law

(g) **Machinery for collection of revenue**: The aid of special law is necessary to enable prompt realization of dues to Government without resource to civil suit with all the delay it entails.

(h) **Protection of wildlife**: Suitable legal measures have to be devised to protect them from the usual dangers and hence special legislation.

(i) **Consensus of opinion based on past experience**: Practical experiences of all civilized countries towards and separate forest law.

7.4.1 Special law due to peculiar nature

(i) Estates placed under forest management – burdened with rights adverse to larger public interest. Special provisions are needed for determining claims for compensating rights.

(ii) Great variety of produce soil-U growth minerals trees injuries caused are varied. Petty theft mischief trees pass should be best treated.

(iii) Ignorant of people to consider forest inexhaustible resource roman's (or) everyman's property. Essential to make it clear what acts may be done prohibited.

(iv) Liable to accident - natural causes insect pest, carelessness of man eg. fire.

(v) Fire incidence will rain the entire forest permanently. Hence some provision in necessary to deal it strictly.

(vi) Special law for mountainous region preventing private owners flanging the forest. Flange to landscape land slide, drying of spring, soil erosion etc.

7.4.2 Objects and Reasons for enactment of special law relating of forests and its produce the object of forest law

The protection of certain estates or properties called forests and also include protection of timber, forest trees, and natural produce generally, in lands outside the forests property. In India all tracts of land are under the ordinary law by which all ordinary offenses can be punished. The Indian penal code is therefore applicable to forest cases throughout India. It has been found better to place forests under special land due to the peculiar nature on the following grounds.

1. Estates placed under forest management are often burdened with rights adverse to larger public interest as represented by the government which make it necessary to deal with them in a special way. Special provision are required for determining claims, for compensating rights in case they are incompatible with the existence of the forest, for regulation of the existing rights to prevent their further extensions or accrual.
2. Forest contains a great variety of produce soil under growth, gram minerals, the trees and all ports of the tree each liable to its own special injuries. Thus the acts of petty theft, tress pen, mischief etc. which constitute forest offences are very varied and as the best treated by a special land. The forest which is vast extent cannot be protected without special land.
3. It is the habit of innocent people to consider forest on an inexhaustible resource and as no man's or rather every man's property, owing to its natural mission. Hence it is essential to made it class to the public what acts may be done in a forest and to prohibit in set forms such acts which strictly speeding may be considered as damage or theft.
4. A Forest is peculiarly liable to accidents some of which are due to natural causes i.e., Pest and insect attack. Others are due to carelessness of man i.e., Fire incidence. As these incidents may rain the forest even permanently. It is

necessary to have some provisions to prevent these accidents or to punish the responsible portion in case of negligence.

5. A special law is wanted in certain cases especially in mountainous districts, to prevent even private owners from wasting and clearance their forests owner such clearance would be followed by land slip/slides drying up springs, soil erosion, or denudation of the country.

7.4.3 Objects and reasons for enactment of special law relating to forests and its produce

Protection of forests includes protection of timber forest trees, and natural produce generally.

In India all tracts of land are under the ordinary law by which all ordinary offences can be punished. The I.P.C is ∴ applicable to forest cases throughout India. It has been found to place forests under a special land due to its peculiar nature on the following:

(a) Estates placed under forest management are offer burdened with right adverse to larger public interest as represented by the government, which make it necessary to deal with them in a special way. Special provisions are required for determining claims for compensating rights in case they are incompatible with the existence of the forest, for regulation of existing rights and to prevent their future extension (or) accrual.

(b) Forest certain a great variety of produce soil, undergrowth, grass, minerals, the trees each liable to its own special injuries. The acts of petty theft, trespass, mischief etc which constitutes "Forest offence" are very varied and are best treated by a special land. The offences against the properties in the field and garden etc are very simple and few and easily be brought under the heads of mischief and trespass in I.P.C. Moreover these properties are usually of small extent and easily protected. Whereas the reverse is often the case with forests.

(c) It is the habit of ignorant people to consider forest as on inexhaustible resource and as no man's or every man does property owe to its natural origin. Hence it is essential to make it clear to the public what acts may be done in a forest and to prohibit in set terms such acts.

(d) Forest is liable for accident. Some of which are due to natural causes; others to the carelessness (or) malice of man. Eg. Invasion of caterpillars, leaf eating insects usually fire place in latter case, the fire accident will rain the forest even permanently. It is necessary to have some provisions to prevent these accidents or to punish the person responsible.

(e) In mountainous districts, to prevent even private owners from clearing their forests entirely or party which will lead to erosion, denudation, land slips, drying of springs.

(f) There also need a special law to protect the produce in transit. The protections afford to produce while inside the forest most be continued when it is outside.

(g) Also needed for the sake of private owners or dealers, whose marks are registered to prevent for instance the steeling of floating logs under pretence that they were drift wood which had been stranded on their ground? The government has reserved for itself the ownership of waif timber.

(h) To have special service vested with certain powers.

(i) Forest officers are needed not by for the sake of improving the forests, but to acts as police for their protection. Such service must be vested with certain powers, laying in view the vastness and inaccessibility of forest tracts and the conditions in which they work. Such powers include the power of arresting offender and obtaining help in case of need. Power to inter upon any land, to survey, demarcate and maliry map, the power of a civil court power under criminal procedure code for issue of search comments and power to head enquiry into forest offers, receive and record evidence.

7.5 Functions performed by forest law

The purpose served by the forest law includes the fulfilling of the following six categories of legal requirement, vital to effective forest administration.

(a) Separation of forest estates from the general area, by constituting them into reserve, protected and village forests.

(b) Separation of rights or private persons from that of the state on forest estates and making rules for regulating their exercise or for buying them out or preventing growth of new rights

(c) Protection of forests including their wildlife content by preventing the commission of the offence and punishing of the offenders if and when the offenders are committed

(d) Extending protection to the timber and other forest produce in transit

(e) Investing forest officers with powers to carry out the purposes of the Act and also impose certain duties

(f) It provides for the controlling the management of privately owned forests and wastelands when such an action is justified

7.6 Legal and Policy Frameworks related to Forest Conservation

7.6.1 Forest Conservation Laws and Policies

There have been three forest policy announcements in independent India; the Forest Policy of 1952, The National Commission on Agriculture, 1976 (NCA) and the 1988 Forest Policy.

(i) The National Policy 1952: The National Policy 1952 was formulated out of the need for a reorientation of forest policy in light of the changes that had taken place since the enunciation of the 1894 policy on forests. Forestry in India, whether state or privately owned, was classified into four categories of Protection Forests, National Forests, Village Forests and Tree Lands. The Policy laid down "that India, as whole, should aim at maintaining one third of its total land area under forests." village communities should under no circumstances be permitted to use forests at the expense of the "national interest", which was identified with defense, communications and vital industries. The policy emphasized scientific conservation. Emphasis was laid on the conversion of low value mixed forests to high value plantation of commercial species.

(ii) The National Commission on Agriculture: The National Commission on Agriculture also stated "there should be a change over from the conservation oriented forestry to (a) more dynamic programme of production forestry." The NCA recommended that the national forest policy should be based on optimizing forest resources for goods and services, preventing erosion and denudation, maximizing forest productivity and augmenting employment potential for national prosperity.

(iii) **Forest Policy of 1988 (NFP):** Forest Policy of 1988 (NFP) represented a major paradigm shift from the earlier policies and this shift began to take some shape through the introduction of *Joint Forest Management* in India in 1990 both of which are discussed in detail in a subsequent section of these notes. In addition to the policies, mentioned above, there are some key central legislations, that regulate the forestry sector in India and these are discussed next.

(iv) **Forest Conservation Act, 1980:** The Forest Conservation Act of 1980 (FCA) can be seen as a single biggest legislative initiative in Indian history to slow deforestation caused by the conversion of forestlands to non-forest purposes. Under this Act, no State Government can authorize such conversion without securing Central Government's approval. Note that the FCA does not itself ban any non-forest activity or the de-reservation of forest land. What the law says id that any such non-forest activity requires that the permission of the Central Government be secured for such actions. The Act has been given credit by some for slowing the rate of deforestation in India, in part by providing a defense against political pressures –where the State Governments may be particularly vulnerable - for converting forest areas to other uses.

(v) **The Biological Diversity Act 2002:** The Biodiversity Act 2002 has been enacted in pursuance of the United Nations Convention on Biological Diversity 1992. The preamble to the Act borrows the objectives as laid down in the Convention and says that the Act is to "provide for conservation of biological diversity, sustainable use of its components and equitable sharing of the benefits" arising there from.

(vi) **Indian Forest Act, 1927:** The Indian Forest Act of 1927 (IFA) and its progeny in the various states provide the overarching framework for forest management in India. The preamble to the Act states that the Act seeks to consolidate the law relating to forests, the transit of forest produce and the duty livable on timber and other forest produce. The Indian Forest Act establishes three categories of forests. The most restricted category is "reserved forest." In reserved forests, most uses by local people are prohibited unless specifically allowed by a forest officer in the course of "settlement."1 In "protected forests," the government retains the power to issue rules regarding the use of such forests, but in the absence of such rules, most practices are allowed.2. Among other powers, the state retains the power to reserve specific tree species in protected forests which

has been used to establish state control over trees whose timber, fruit or other non-wood products have revenue-raising potential3. A third classification is "village forests" in which the state government may assign to "any village-community the rights of Government to or over any land which has been constituted a reserved forest." Little use has been made of this provision. The Act creates a three-tier structure of authorities to manage the biodiversity of the country. This includes the National Biodiversity Authority (NBA), the State Biodiversity Boards at the state level and the Biodiversity Management Committees at the local level.

(vii) **The Forest Policy of 1988 and Joint Forest Management (JFM):** It has been pointed out above that Forest Policy of 1988 (NFP) represented a major paradigm shift from the earlier policies and this shift began to take some shape through the introduction of Joint Forest Management in India in 1990 and these are discussed here. Unlike, the use oriented policy of 1952, the Forest Policy of 1988 (NFP) gives major emphasis on the ecological roles of forests, and envisages that the rights and concessions from forests are to be primarily for bona-fide use of communities living within and around the forest areas, especially tribals. Such communities are required to be motivated to protect and develop such forests from which they derive their benefits 5. The NFP also stipulates that the rights and concessions relating to forest produce of tribal community and other poor living within and near forests must be fully protected. The domestic requirements of fuel-wood, fodder, minor forest produce and construction timber should be the first charge on forest produce. It is envisaged under the Policy that these and substitute materials shall be made available through appropriate means6. In the field of domestic energy, fuel wood needs to be substituted as far as practicable with alternative sources like biogas, solar energy, LPG, etc[7]. The NFP further stipulates that any diversion of forest land should be subject to most careful scrutiny by specialists and must take into consideration the social and environmental costs. Some of the laudable objectives of the NFP began to take root through the introduction of Joint Forest Management in India in 1990. The Ministry of Environment and Forest issued a circular in June 1990 to various State Departments of Forest (vide no.6-21/89-F.P) encouraging the involvement of village communities and voluntary agencies for regeneration of forest land and

this circular officially launched JFM in India. Almost all the States have now issued notifications pertaining to Joint Forest Management (hereinafter JFM) in line with the Central Government circular. However the legal bases of these notifications and its place in legal hierarchy have been a major concern to ensure real benefits to the people along with sustainability of forest products. The numerous legal issues on JFM relate to institutional arrangements, impacts of other legislations, tenurial security and benefit sharing mechanisms. The JFM specifically needs to address these issues if it has to sustain itself legally as well as administratively and these are of crucial significance if the forests are to be jointly managed by the people and the agencies of the State.

(viii) **Panchayats and Forests: The Case of PESA:** The Parliament extended the 73rd Amendment Act to the Scheduled Areas in ten states by legislating the Provisions of Panchayats (Extension to the Scheduled Areas) Act, 1996 (here in after PESA). The PESA along with its State Adaptations has to be seen as one more definitive indicator of increasing attempts at carving out the role of the PRIs in Natural Resource Management. The PESA endows special powers and authority to the Panchayat at appropriate level and the Gram Sabha in order that they function as institution of self government. It has been mandated that State Legislature shall ensure these powers to the Panchayat at appropriate level as well as to the Gram Sabha. The PESA is especially remarkable for the vast and wide-ranging powers that it vests with the Gram Sabhas in Scheduled Areas. These include, interalia, approval of the Gram Sabha of the plans, programmes and projects for social and economic development before such plans, programmes and projects are taken up .for implementation by the Panchayat at the village level; Gram Sabha would be responsible for the identification or selection of persons as beneficiaries under the poverty alleviation and other programmes. Further, State-Legislature shall ensure that the Panchayats at the appropriate level and the Gram Sabha are endowed specially with the ownership of minor forest produce. This has direct implications for the extent of empowerment of the Gram Sabha vis-a–vis its right relating to forest and forest produces. Although the PESA is restricted in its application to the Scheduled Areas alone, its logic of conferring “ownership of Minor Forest Produce” to the Panchayat Raj Institutions cannot be missed. Generally speaking, in most of the

states this power seems to be restricted to the local areas of the Panchayat of the respective Gram Sabhas.

7.6.2 Other Constitutional and Central Legal Provisions for Forest Conservation

(i) **Constitution of India:** The Constitution of India has significant provisions for environmental protection and environmental rights and duties of the people. Under the Directive Principle of State Policy, Article 48-A of the Constitution, enjoins that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country, and Article 51-A (g) which proclaims it to be the fundamental duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures. Thus, by raising environmental concerns to the constitutional level, India has provided its citizens with a powerful legal tool to protect wildlife, maintain health standards and curtail government and private sectors including trans-nationals corporations, from degradation of natural resources. The constitutional mandate can certainly be invoked in case of threats to ecosystems or any rich biodiversity region.

(ii) **The Environment Protection Act, 1986:** Another important general framework of environment protection is provided under the umbrella legislation of the Environment Protection Act, 1986 and this law can be of a great value in sustaining legal action for forest conservation. The Environment Protection Act, 1986 was the response to a widely felt need for a general legislation for environment protection. Under the Act, the Central Government is vested with power to take all such measures, as it deems necessary or expedient for the purpose of protecting and improving the quality of environment and preventing, controlling and abating environmental pollution. (Section 3) The Central Government has been empowered to issue directions including the power to direct closure, prohibition and regulation of any industry, operation or process or stoppage or regulation of the supply of electricity or water or any service. (Section 5) Subsequent to the enactment of the Environment Protection Act, the Water and Air Acts were Acts were also amended and the Pollution Control Boards were clothed with powers to direct closure, prohibition or restraining of any industry operation or process. (Section 33 Water Act 1974 and Section 31-A Air Act 1981) Though these Acts do not have specific action points on biodiversity, their liberal

interpretation and use can have wide implications for biodiversity conservation. This is specifically true in case of areas of biodiversity importance that are not protected under the existing legal regime. For example the corridors of protected areas that are vital to genetic continuity in PAs are not covered under any law may be protected zones under the Environment Protection Act.

(iii) **Wildlife Protection Act, 1972:** The Wildlife Protection Act, 1972 (WLPA) is the single most significant statute on wildlife conservation in India. Under it, over five hundred National Parks and Sanctuaries termed protected areas (PAs) in common parlance (though this is not a legal term), have been created or given legal protection. Though there were several laws relating to wildlife prior to 1972, as discussed above, the WLPA was India's first comprehensive legislation, covering the whole country. This law has been explained in detail in another module of the Course.

7.6.3 An Overview of the Range of State Forest Laws

Forest is a 'Concurrent' subject under the legislative lists of the Constitution of India which means that both the Centre and States are competent to enact laws for forest conservation and use in India. The States therefore have introduced a range of legal instruments that regulates Forestry in the respective states. This section gives an overview of the range of such laws at the State level.

(i) **Indian Forest Act, 1927:** The Indian Forest Act as applicable to the States and the rules made there-under is the most significant statute that governs the use and management of forests in any State. Typically several rules are enacted at the State level under the above Act. These ranges from rules regarding protected forests, transit of timber and other forest produce, collection and disposal of drift and stranded wood and timber to regulation and establishment of saw mills and grazing rules. Each of these rules is discussed briefly below.

(ii) **The State Transit of Timber & Other Forest Produce Rules:** Such rules regulate the transit of timber and other forest produce within the state by means of passes. An official of the forest department or any person duly authorised under such rules may issue a transit pass (TP) for the movement of forest produce to any rule and in accordance with any conditions that may be imposed. However, any forest produce that is removed for bonafide consumption in

exercise of a privilege granted by the state or through a right recognized under this Act does not require a transit pass.

(iii) **The State Establishment & Regulation of Saw Mills Rules:** These rules typically provide that no person would establish or operate any saw mill or machinery for converting or cutting timber and wood without a license from the concerned Divisional Forest Officer at the state level.

(iv) **State Protected Forest Rules*:*** In areas that are declared as protected forest the *Protected Forest Rules* is applicable whereby no person is allowed to cut, saw any tree or forest produce in protected forests. Further, the clearing and breaking of land for cultivation for creating any temporary or permanent structure, cutting of grass pasturing of cattle or burning of any fire near such protected forests is prohibited unless the Forest Officer permits to do so.

(v) **The Rules Regulating the Grazing of Cattle:** Most of the States have also formulated rules regulating the grazing of cattle in the reserved forest and to other forests or lands that Conservator of Forest of the state may direct. Under the said Grazing rules areas that are open to grazing are earmarked. Further, grazing is prohibited in certain blocks in accordance with the working plans of the said area. The rules also provide for grant of permit for grass cutting and the conditions on felling or lopping of any tree.

(vi) **The State Forest Corporation Act:** The Act provides of the establishment of a corporation for better preservation, supervision and development of forest including better exploitation of forest produce within the State. The Act empowers the Corporation to undertake removal and disposal of trees and exploitation of forest resources entrusted to it by the State Government. The Corporation is also required to prepare projects and undertake research programs in forestry within the State. Every local body is mandated by the Act to extend full support to the Corporation furnishing all the requisite information including examination of records, maps, plans and other documents relevant to the local area

(vii) **The State Tendu Patta (Vyapar Viniyaman) Adhiniyam:** These Acts restrict the sale, purchase and transport of Tendu leaves to the state government or an authorized officer of the state government or an agent in respect of the unit in which the leaves have grown. The Act also defines the grower of Tendu leaves

and includes the state government in respect of the RF and the PF, the Gaon Sabha and tenure holder on whose land such leaves are grown. The State Government is empowered to fix the price of the Tendu leaves and also register growers and manufacturers of bidis and exporter of Tendu leaves. The rules under the above Act prescribes the manner in which agents are appointed, the manner in which Tendu leaves would be collected, the authority who would issue transport permit etc.

(viii) **State Private Forests Act and Rules:** The State Private Forests Act was enacted immediately after independence in most states to check the denudation of tree growth in 'private forests' due to extensive over felling as a consequence of high prices of fuel.[8] The objectives of the Act include conservation of forest for providing fuel and fodder resources, prevention of erosion, and the interest of future generations and also develop Private Forests as national assets. It is provided under these Acts that the owner of Private Forests has the option to manage such forest in accordance with a working plan approved by a Forest Officer and in case the owner fails or refuses to manage the forest in accordance with the working plan the management of forest would be done by the Forest Officer in lieu of profits for such management. The State Private Forest Rules, enacted under the State Private Forest Act, prescribes a manner in which notified area of private forest may be managed.

Unit-8 Protected Areas Management

Unit Structure

8.0 Learning objectives.
8.1 Introduction
8.2 Protected Area Network in India
- **8.2.1 Sanctuary**
- **8.2.3 Conservation Reserves:**
- **8.2.4 Community Reserves:**
- **8.2.5 Biosphere reserves:**

8.3 Regulations/ laws relating to Protected Areas (PAs)
8.4 Conservation projects
- **8.4.1 Need for conservation projects**

8.5 MAB
8.6 Red Data Book
- **8.6.1 Brief History of the Red Data Book**
- **8.6.2 Advantages of the Red Data Book**
- **8.6.3 Disadvantages of the Red Data Book**
- **8.6.4 Red Data Book of India**

8.7 CITES
- **8.7.1 The need for CITES**

8.8 Central Zoo Authority of India
- **8.8.1 Vision**

Summary

8.0 Learning objectives.

After studying this unit you will be able to understand:

- About Protected areas and its management
- About types of protected areas Sanctuary, National Park and Biosphere Reserves etc
- About special projects for wildlife conservation; Project
- About Red Data Book and Central Zoo Authority of India

8.1 Introduction

Protected areas or conservation areas are locations which receive protection because of their recognized natural, ecological and/or cultural values. Generally, in protected areas human occupation or the exploitation of resources is limited and is regulated through National Legislation. The International Union for Conservation of Nature (IUCN) defined protected areas as: “a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (Dudley, 2008). Protected areas will usually encompass several zones, such as important and endemic bird areas, centers of plant

diversity, indigenous and community conserved areas, alliance for zero extinction sites and key biodiversity areas.

Protected areas are essential for biodiversity conservation. They are the cornerstones of virtually all national and international conservation strategies, set aside to maintain functioning natural ecosystems, to act as refuges for species and to maintain ecological processes that cannot survive in most intensely managed landscapes and seascapes. Protected areas act as benchmarks against which we understand human interactions with the natural world. Today they are often the only hope we have of stopping many threatened or endemic species from becoming extinct (Dudley, 2008). Most protected areas exist in natural or near-natural ecosystems, or are being restored to such a state, although there are exceptions. Many contain major features of earth history and earth processes while others document the subtle interplay between human activity and nature in cultural landscapes. Larger and more natural protected areas also provide space for evolution and future ecological adaptation and restoration, both increasingly important under conditions of rapid climate change.

The term "protected area" is therefore shorthand for a sometimes bewildering array of land and water designations, of which some of the best known are national park, nature reserve, wilderness area, wildlife management area and landscape protected area but can also include such approaches as community conserved areas. More importantly, the term embraces a wide range of different management approaches, from highly protected sites where few if any people are allowed to enter, through parks where the emphasis is on conservation but visitors are welcome, to much less restrictive approaches where conservation is integrated into the traditional (and sometimes not so traditional) human lifestyles or even takes place alongside limited sustainable resource extraction. Some protected areas ban activities like food collecting, hunting or extraction of natural resources while for others it is an accepted and even a necessary part of management. The approaches taken in terrestrial, inland water and marine protected areas may also differ significantly and these differences are spelled out later in the guidelines (Dudley, 2008). Today roughly a tenth of the world's land surface is under some form of protected area. Over the last 40 years the global protected area estate has increased from an area the size of the United Kingdom to an area the size of South America. However, significant challenges remain. Many

protected areas are not yet fully implemented or managed. Protected areas continue to be established, and received a boost in 2004 when the Convention on Biological Diversity (CBD) agreed an ambitious Programme of Work on Protected Areas, based on the key outcomes from the Vth IUCN World Parks Congress,1 which aims to complete ecologically-representative protected area systems around the world and has almost a hundred time limited targets.

The IUCN protected area management categories are a global framework, recognized by the Convention on Biological Diversity, for categorizing the variety of protected area management types. Squeezing the almost infinite array of approaches into six categories can never be more than an approximation. But the depth of interest and the passion of the debate surrounding the revision of these categories show that for many conservationists, and others, they represent a critical overarching framework that helps to shape the management and the priorities of protected areas around the world. The first effort to clarify terminology was made in 1933, at the International Conference for the Protection of Fauna and Flora, in London. This set out four protected area categories: national park; strict nature reserve; fauna and flora reserve; and reserve with prohibition for hunting and collecting. In 1942, the Western Hemisphere Convention on Nature Protection and Wildlife Preservation also incorporated four types: national park; national reserve; nature monument; and strict wilderness reserve (Holdgate 1999). In 1978, Ten categories were proposed, defined mainly by management objective, all of which were considered important, with no category inherently more valuable than another: scientific reserve, national park, natural monument/national landmark, nature conservation reserve, protected landscape, resource reserve, anthropological reserve, multiple-use management area, biosphere reserve and world heritage site (natural). In 1994, IUCN and the World Conservation Monitoring Centre are definition new protected area categories: strict protection/strict nature reserve and wilderness area, ecosystem conservation and protection, conservation of natural features, conservation through active management, landscape/seascape conservation and recreation, sustainable use of natural resources. This is the most important changes in the definitions that the biosphere reserves and world heritage sites. These categories are not

discrete management categories but international designations generally overlain on other categories.

The concept of biosphere reserves as originated by a task force of UNESCO's Man and the Biosphere (MAB) Programme in 1974, The biosphere reserve network was launched in 1976 and, as of June 2011, has grown to include 580 reserves in 114 countries. The network is a key component in MAB's objective of achieving a sustainable balance between the sometimes-conflicting goals of conserving biological diversity, promoting economic development, and maintaining associated cultural values. Biosphere reserves are sites where this objective is tested, refined, demonstrated and implemented. In this chapter, which is one of the most important protected areas in the approach to the information given in relation to the biosphere reserve.

The original intent of the IUCN Protected Area Management Categories system was to create a common understanding of protected areas, both within and between countries. This is set out in the introduction to the Guidelines by the then Chair of CNPPA (Commission on National Parks and Protected Areas, now known as the World Commission on Protected Areas), P.H.C. (Bing) Lucas who wrote: "These guidelines have a special significance as they are intended for everyone involved in protected areas, providing a common language by which managers, planners, researchers, politicians and citizens groups in all countries can exchange information and views" (The International Union For Conservation of Nature [IUCN], 1994).

Though its Commission on National Parks and Protected Areas (CNPPA), IUCN has given international guidance on the categorization of protected areas for nearly a quarter of a century. The purposes of this advice have been (The International Union For Conservation of Nature [IUCN], 1994):

- To alert governments to the importance to the importance of protected areas;
- To encourage governments to develop systems of protected areas with management aims tailored to national and local circumstances
- To reduce the confusion this has arisen from the adoption of many different terms to describe different kinds of protected areas;
- To provide international standards to help global and regional accounting and comparisons between countries;

- To provide a framework for the collection, handling and dissemination of data about protected areas; and
- generally to improve communication and understanding between all those engaged in conservation.

As a first step, the General Assembly of IUCN defined the term "national park" in 1969. Much pioneer work was done by Dr Ray Dasmann from which emerged a preliminary categories system published by IUCN in 1973. In 1978, IUCN published the CNPPA report on Categories, Objectives and Criteria for Protected Areas, which was prepared by the CNPPA Committee on Criteria and Nomenclature chaired by Dr Kenton Miller. This proposed these ten categories. Ten categories were proposed, defined mainly by management objective, all of which were considered important, with no category inherently more valuable than another (Dudley, 2008):

Group A: Categories for which CNNPA will take special responsibility

- Scientific Reserve/Strict Nature Reserve
- National Park
- Natural Monument/Natural Landmark
- Nature Conservation Reserve/Managed Nature Reserve/Wildlife Sanctuary
- Protected Landscape

Group B: Other categories of importance to IUCN, but not exclusively in the scope of CNNPA

- Resource Reserve
- Natural Biotic Area/Anthropological Reserve
- Multiple Use Management Area/Managed Resource Area

Group C: Categories that are part of international programmes.

- Biosphere reserve
- World Heritage Site (natural)

This system of categories has been widely used. It has been incorporated in some national legislation, used in dialogue between the world's protected area mangers, and has formed the organizational structure of the UN List of National Parks and Protected Areas.

8.2 Protected Area Network in India

India is one of the 17 mega diverse countries of the world. With only 2.4% of the world's land area, 16.7% of the world's human population and 18% livestock, it contributes about 8% of the known global biodiversity, however, putting enormous demands on our natural resources. India is home to world's largest wild tigers population and has got unique assemblage of globally important endangered species like Asiatic lion, Asian Elephant, One-horned Rhinoceros, Gangetic River Dolphin, Snow Leopard, Kashmir Stag, Dugong, Gharial, Great Indian Bustard, Lion Tailed Macaque etc.

A National Board for Wildlife (NBWL), chaired by the Prime Minister of India provides for policy framework for wildlife conservation in the country. The National Wildlife Action Plan (2002-2016) was adopted in 2002, emphasizing the people's participation and their support for wildlife conservation.

India's conservation planning is based on the philosophy of identifying and protecting representative wild habitats across all the ecosystems. The Indian Constitution entails the subject of forests and wildlife in the Concurrent list. The Federal Ministry acts as a guiding torch dealing with the policies and planning on wildlife conservation, while the provincial Forest Departments are vested with the responsibility of implementation of national policies and plans.

A network of 668 Protected Areas (PAs) has been established, extending over 1,61,221.57 sq. kms. (4.90% of total geographic area), comprising 102 National Parks, 515 Wildlife Sanctuaries, 47 Conservation Reserves and 4 Community Reserves. The State/Union Territory wise details of PAs in the country with year of notification and area is given at Annexure-I. 39 Tiger Reserves (Annexure-II) and 28 Elephant Reserves (Annexure-III) have been designated for species specific management of tiger and elephant habitats.

UNESCO has designated 5 Protected Areas as World Heritage Sites. As the ecosystems and species do not recognize political borders, the concept of Transboundary Protected Areas has been initiated for coordinated conservation of ecological units and corridors with bilateral and/or multilateral cooperation of the neighboring nations. There are 4 categories of the Protected Areas viz, National Parks, Sanctuaries, Conservation Reserves and Community Reserves.

8.2.1 Sanctuary

Sanctuary is an area which is of adequate ecological, faunal, floral, geomorphologic, natural or zoological significance. The Sanctuary is declared for the purpose of protecting, propagating or developing wildlife or its environment. Certain rights of people living inside the Sanctuary could be permitted. Further, during the settlement of claims, before finally notifying the Sanctuary, the Collector may, in consultation with the Chief Wildlife Warden, allow the continuation of any right of any person in or over any land within the limits of the Sanctuary.

8.2.2 National Park:

National Park is an area having adequate ecological, faunal, floral, geomorphologic, natural or zoological significance. The National Park is declared for the purpose of protecting, propagating or developing wildlife or its environment, like that of a Sanctuary. The difference between a Sanctuary and a National Park mainly lies in the vesting of rights of people living inside. Unlike a Sanctuary, where certain rights can be allowed, in a National Park, no rights are allowed. No grazing of any livestock shall also be permitted inside a National Park while in a Sanctuary; the Chief Wildlife Warden may regulate, control or prohibit it. In addition, while any removal or exploitation of wildlife or forest produce from a Sanctuary requires the recommendation of the State Board for Wildlife, removal etc., from a National Park requires recommendation of the National Board for Wildlife (However, as per orders of Hon'ble Supreme Court dated 9th May 2002 in Writ Petition (Civil) No. 337 of 1995, such removal/ exploitation from a Sanctuary also requires recommendation of the Standing Committee of National Board for Wildlife).

8.2.3 Conservation Reserves:

Conservation Reserves can be declared by the State Governments in any area owned by the Government, particularly the areas adjacent to National Parks and Sanctuaries and those areas which link one Protected Area with another. Such declaration should be made after having consultations with the local communities. Conservation Reserves are declared for the purpose of protecting landscapes, seascapes, flora and fauna and their habitat. The rights of people living inside a Conservation Reserve are not affected. Community Reserves can be declared by the State Government in any private or community land, not comprised within a National Park, Sanctuary or a

Conservation Reserve, where an individual or a community has volunteered to conserve wildlife and its habitat.

8.2.4 Community Reserves:

Community Reserves are declared for the purpose of protecting fauna, flora and traditional or cultural conservation values and practices. As in the case of a Conservation Reserve, the rights of people living inside a Community Reserve are not affected.

8.2.5 Biosphere reserves:

Biosphere reserves are designed to deal with one of the most important questions the World faces today: How can we reconcile conservation of biodiversity and biological resources with their sustainable use? An effective Biosphere reserve involves natural and social scientists; conservation and development groups; management authorities and local communities, all working together on this complex issue. The concept of biosphere reserves as originated by a Task Force of UNESCO's Man and the Biosphere (MAB) Programme in 1974, The biosphere reserve network was launched in 1976 and, as of June 2011, had grown to include 580 reserves in 114 countries. The network is a key component in MAB's objective of achieving a sustainable balance between the sometimes-conflicting goals of conserving biological diversity, promoting economic development, and maintaining associated cultural values. Biosphere reserves are sites where this objective is tested, refined, demonstrated and implemented (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1996). Landmarks in the history of the Man and Biosphere Programme are given below Table 1 (Pocono Environmental Education Center and The Center for Russian Nature Conservation/Tides Center, 2001)

- **Characteristics of Biosphere Reserves**

(i) The characteristic features of Biosphere reserves are (Government of India Ministry of Environment and Forests, 2007):

(ii) Each Biosphere Reserves are protected areas of land and/or coastal environments wherein people are an integral component of the system. Together, they constitute a worldwide network linked by International understanding for exchange of scientific information.

(iii) The network of BRs includes significant examples of biomes throughout the world.

Each BR includes one or more of the following categories

(a) BRs are representative examples of natural biomes.

(b) BRs conserve unique communities of biodiversity or areas with unusual natural features of exceptional interest. It is recognized that these representative areas may also contain unique features of landscapes, ecosystems and genetic variations e.g. one population of a globally rare species; their representativeness and uniqueness may both be characteristics of an area.

(c) BRs have examples of harmonious landscapes resulting from traditional patterns of land-use.

(d) BRs have examples of modified or degraded ecosystems capable of being restored to more natural conditions.

(e) BRs generally have a non-manipulative core area, in combination with areas in which baseline measurements, experimental and manipulative research, education and training is carried out. Where these areas are not contiguous, they can be associated in a cluster.

8.3 Regulations/ laws relating to Protected Areas (PAs)

The PAs are constituted and governed under the provisions of the Wild Life (Protection) Act, 1972, which has been amended from time to time, with the changing ground realities concerning wildlife crime control and PAs management. Implementation of this Act is further complemented by other Acts viz. Indian Forest Act, 1927, Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 and Biological Diversity Act, 2002 and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. The Wildlife Crime Control Bureau of the Central Government supplements the efforts of provincial governments in wildlife crime control through enforcement of CITES and control of wildlife crimes having cross-border, interstate and international ramifications. In order to strengthen and synergies global wildlife conservation efforts, India is a party to major international conventions viz. Convention on International Trade in Endangered Species of wild fauna and flora (CITES), International Union for Conservation of Nature (IUCN),

International Convention for the Regulation of Whaling, UNESCO-World Heritage Committee and Convention on Migratory Species (CMS).

Main issues concerning the management of Protected Areas:

Wildlife conservation and management in India is currently facing a myriad of complex challenges that are both ecological and social in nature. Issues such as habitat loss/fragmentation, overuse of biomass resources in the context of biotic pressures, increasing human-wildlife conflicts, livelihood dependence on forests and wildlife resources, poaching and illegal trade in wildlife parts and products, need for maintaining a broad base of public support for wildlife conservation exemplify and characterize the contemporary wildlife conservation scenario in India. The government and the civil society are taking several measures to address these issues. Improved synergies and better coordination amongst the wide array of stakeholders are needed to meet the challenges of conserving India's diverse wilderness resources.

8.4 Conservation projects

Conservation has not been defined in Indian statutes per se, but in a general sense means 'preservation, protection, or restoration of the natural environment and of wildlife'. In this era of the climate crisis, the destruction of nature, environment, and wildlife is highly evident. There is an irreversible depletion of natural resources due to industrialization and globalization. Conservation projects are an effort to maintain and use natural resources in a sustainable manner. This is to ensure that future generations have access to these resources. Wildlife is a part of nature and therefore there is a need to protect them. Conservation projects are established to integrate evolutionary theory with environmental reality. This helps in predicting how wildlife will react to current and future environmental changes. It is established for their survival since global warming, farming, population growth, pollution and hunting pose a great danger to them.

8.4.1 Need for conservation projects

In historical times, wildlife was traditionally hunted which led to a decrease in the population of various species.

In the case of State of Bihar vs. Murad Ali Khan (1989), it was held that hunting is an offence under the Wildlife Protection Act, 1972. The term hunting has been comprehensively defined under Section 2(16) of the Wildlife Protection Act, 1972. In this case, the accused were alleged for shooting and killing an elephant in the

Kundurugutu Range Forest. They also removed the ivory tusks of the elephant. Subsequently, the Forest Range Officer lodged a complaint under Section 51 of the Wildlife Act.

The aforementioned instance shows that people still continued with harmful practices in spite of legislation. Therefore, the need for conservation projects arose and as a result, India established several projects.

We need conservation projects:

- ✓ To conserve wildlife;
- ✓ To conserve habitats;
- ✓ To work for the welfare of individual wild animals;
- ✓ To protect biodiversity;
- ✓ To sustain agricultural activities;
- ✓ To assist eco-tourism;
- ✓ To benefit from the medicinal value of plants;
- ✓ To promote pollination;
- ✓ To preserve heritage and culture; and
- ✓ To protect livelihood and knowledge of indigenous tribes.

It is extremely crucial that these creatures are protected from poaching and hunting. This is because every species has a pivotal role to play in the health and the diversity of the environment. If stringent measures are not taken, then wildlife will dwindle at an alarming rate. This will eventually lead to their extinction. The ecosystem is entirely about the symbiotic relationships between different species. There is a need for conservation because the extinction of a single species can pose disastrous consequences on the entire food-chain and food-web.

1. **Project Snow Leopard:** The species of Snow Leopard inhabits the Himalayan landscape as well as states such as Jammu and Kashmir, Uttarakhand, Arunachal Pradesh, Sikkim, and Himachal Pradesh. Schedule I of the Wildlife Protection Act, 1972 and IUCN declare the species as a 'vulnerable' category. Additionally, the species is listed in CITES and CMS which reveals that the highest conservation status has been accorded to them, both nationally and internationally.

   The International Snow Leopard Day is celebrated on 23rd October each year. The Government of India launched the 'First National Protocol on Snow Leopard Population Assessment' in 2019. This involves the use of technology such as

camera traps and scientific surveys. This initiative was developed under the global protocol of Global Snow Leopard and Ecosystem Protection Program. This program is an intergovernmental alliance of 12 snow leopard range countries, India, Pakistan, Nepal, Russia, China, Bhutan, Afghanistan, Tajikistan, Uzbekistan, Kazakhstan, Kyrgyzstan, and Mongolia. The Population Assessment of World's Snow Leopard (PAWS) is a collaborative effort of these countries. The primary threats to snow leopards were loss of habitat, poaching, and man-animal conflict. In Sansar Chand vs State of Rajasthan (2010), the organized nature of wildlife crime has been highlighted. In this case, it was mentioned that an FIR was filed against his younger brother who was also involved in illicit trade of wild animals. One snow leopard skin was seized from the younger brother, Narayan Chand. He was also named as an accused under Section 55 of the Wildlife Act, 1972 in this case. There are several other cases pending against him.

Project Snow Leopard launched in 2009, aims to promote inclusivity and participatory approach for the conservation of the species. To add to this project, SECURE Himalaya (Securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems) is another initiative taken to conserve high altitude biodiversity. This is operational in Sikkim, Himachal Pradesh, Uttarakhand, and Jammu & Kashmir. The key component of the project is the protection of snow leopards and other endangered species. The six-year-long project also focuses on securing livelihoods of the local public and enhancing enforcement to reduce wildlife crime. The government has allocated 130 crores for the project, to protect around 200 snow leopards in the Trans and Greater Himalayan Region. In addition, SOS or Save Our Snow Leopards is an initiative launched by WWF India in collaboration with Tata Housing Development Company in 2014. The project aims at assessing the status and distribution of snow leopards through setting up camera traps. It also aims to promote conservation strategies.

The Protected Areas include:

(a) The Sacred Himalayan Landscape
(b) Kibber Wildlife Sanctuary
(c) Great Himalayan National Park
(d) Hemis National Park
(e) Dibang Wildlife Sanctuary

(f) Pin Valley National Park

The Ladakh region is setting a prime example for the other states through its conservatory practices to protect the Snow Leopards. Efficient collaboration among the NGOs, local public and Wildlife Department has helped in the prevention of man-animal conflict. WWF-India installed around 13 Predator Proof Corral Pens which positively impacted the families living in 13 villages of Ladakh. Corrals are enclosures for capturing or confining livestock. It was established through a study that if people were compensated for the loss of their livestock, they would not resort to 'revenge-killing.' This has led to less killing of the snow leopards. The Jammu and Kashmir forest officials, in 2018, began working on estimation of the population of snow leopards in Ladakh. This estimation is based on the protocols of All India Tiger Estimation. This initiative requires a combined effort of the State Forest Department, Ministry of Environment and Forest at the Centre and Wildlife Institute of India.

2. **Project Tiger:** The population of Indian Tigers was drastically declining towards the end of the 20th century. Resultantly, a nation-wide Tiger Census was conducted in 1972 to estimate the population of tigers. Large scale development activities including dams, mines, railway projects and establishment of industries led to deforestation and further loss of habitat. Since the body parts of the tigers are used for traditional Chinese medicine, they were killed in high numbers. All these factors collectively led to a decline in the population of tigers. In the case of Sansar Chand vs. State of Rajasthan (2010), the appellant was arrested in 1974 for poaching tigers and smuggling their body parts to various countries, particularly China. He was allegedly involved in 57 wildlife cases between 1974 and 2005. He was convicted in all the offences registered against him. The Supreme Court also requested the Central and the State Government to take stringent actions against such offenders. The acts of poaching, killing, maiming, etc. of any animal are offences under Section 428 and Section 429 of the Indian Penal Code, 1860. The punishment under S.428 is imprisonment for two years and under S.429, imprisonment for five years. In 1973, Project Tiger was launched in the Palamau Tiger Reserve, Jim Corbett National Park, Uttarakhand. This is a centrally sponsored scheme of the Ministry of Environment and Forests. It is primarily governed under the Wildlife Act, 1972 itself.The project is administered by the

National Tiger Conservation Authority, which was established in December 2005. The aim of the project is the protection of tigers from extinction, by ensuring that there is a viable population of the species in their natural habitats. The Project began from nine reserves in 1973-74 and has substantially grown to fifty reserves. The Project has seen significant success in the recovery of the habitat and the population of the tigers in the reserved areas. In 2019, the Tiger Census has shown that there are 2967 Bengal Tigers in India.

(i) Measures Taken For Conservation of Tigers under the Wildlife Act, 1972
Legal Measures

(a) The Project has been converted into a statutory authority by providing enabling provisions in the Wildlife Protection Act, 1972. A National Tiger Conservation Authority has been constituted under Section 38L of the Act. The Tiger and Other Endangered Species Crime Control Bureau has also been established under Section 38Z of the Act.

(b) The punishment for offences related to tiger reserves and its core areas has been enhanced.

(c) Several treaties have been signed with neighboring countries such as Nepal, China, and Bangladesh for controlling trans-boundary illegal wildlife trade and for tiger conservation.

(ii) Administrative Measures

(a) Anti-poaching activities have been strengthened, especially monsoon patrolling. This involves deploying anti-poaching squads.

(b) A National Tiger Conservation Authority has been constituted.

(c) A Special Tiger Protection Force has been established.

(d) Tiger Conservation Foundation has been created.

(iii) Financial Measures

Pecuniary measures include the provision of financial and technical help via Centrally Sponsored Schemes through the Project itself and Integrated Development of Wildlife Habitats.

(iv) Tiger Task Force

It is essential that for proper implementation of the Project, a statutory authority having sufficient legal backing is established. The National Board for Wildlife recommended the set-up of a Task Force to look into the issues

arising in the implementation of tiger conservation initiatives across the country. This led to the creation of the Tiger Task Force. The TTF recommended the establishment of the National Tiger Conservation Authority (NTCA).

(v) Core and Buffer Zones

The Wildlife Protection Act, 1972 under Section 38V lays down the tiger conservation plan. Under sub-section (4), it is laid down that the State Government shall ensure the overall development of the people living in tiger bearing forests or a tiger reserve. For this purpose, under Section 38V(4)(i), the core or critical tiger habitat areas are established in national parks and sanctuaries. Under Section 38V(4)(ii), the buffer or peripheral area is identified and established.

(a) Core Zones

- The areas included in the core zones are notified by the State Government after its consultation with an Expert Committee which is constituted for the purpose.
- It is a requirement that these areas are solely used for tiger conservation but should not infringe upon the rights of the Scheduled Tribes or other forest dwellers.
- Further, this area must be kept free from biotic disturbances and forestry operations. The collection of minor forest produce, grazing and other human disturbances are not allowed within this zone.

(b) Buffer Zones

- The buffer zone is the area that stands peripheral to the core tiger habitat. It acts as a supplementary habitat and also offers scope for the co-existence of human activities.
- The area is determined by the concerned Gram Sabha after its consultation with an Expert Committee which is constituted for the purpose.

3. Project Elephant

Project Elephant was launched in 1992 and is a centrally sponsored scheme. Elephants face the threat of attrition, as opposed to extinction faced by Tigers. The

project aims at assisting the management and protection of elephants in the States which have free-ranging populations of wild elephants.

The Elephants' Preservation Act, 1879 has also been formulated for the protection of elephants across the country. India has over 27,000 elephants spread over 26 elephant reserves but only 65% of the elephant corridors are in protected areas.

The protection of elephants is also important because it has been declared as a national heritage of the country. This was done by the Government of India in 2010 after the Standing Committee on the National Board of Wildlife gave its recommendations. This step was taken to create awareness about the dwindling population of the elephants so that people would actively participate in its conservation. The objectives of the project are:

(i) Protection of Elephants, Elephant Corridors and their Habitats;

(ii) Prevention of Man-Animal Conflicts; and

(iii) Ensuring the welfare of domesticated elephants.

This project is crucial because it protects the elephants from hunters and poachers and thereby curb illegal trading of ivory.

In Balram Kumawat vs. Union of India & Ors. (2003), the appellants had imported mammoth fossils, which is said to be an extinct species. They indulged in trading mammoth ivory, citing that it was not banned under the Wildlife Act or CITES.

The Court cited the case of State of West Bengal vs. Union of India (1962) wherein it was said that the legislative intent should be derived by taking the entire statute into consideration, not just some provisions. The Court held that the ban on ivory trading extended to ivory of every description, so that elephant poaching could be curbed.

In M/s Ivory Traders and Ors. vs Union of India and Ors. (1997), the petitioners were ivory traders. They imported mammoth ivory from Russia and Hong Kong. They pleaded that they were affected by the Wildlife Amendment Act, 1991.

The Court held that the use of ivory for commercial purposes is explicitly banned. The Court interpreted that the words 'ivory imported into India' as defined under Section 49B(1)(a)(i) includes all descriptions of ivory, whether elephant or mammoth. It dismissed the writ petition. In Indian Handicrafts Emporium and Ors. vs. Union of India & Ors. (2003), the Supreme Court upheld the constitutional validity of the clause 'ivory

imported into India' as defined under Section 49B(1)(a)(i). It said that the restrictions imposed were reasonable as the legislative intent was to plug the loopholes in the Act.

In this case, the appellants imported ivory from African countries and manufactured several articles out of them. They filed a writ petition questioning the constitutional validity of the 1991 Wildlife (Protection) Amendment Act as the Act prohibited trade of imported ivory, which affected their rights under Article 19(1)(g) of the Indian Constitution.

The famous case of Veerappan also highlights the extent of wildlife crime. He killed 138 people and 1000 elephants for the purposes of poaching and smuggling. He was later killed in October 2004 in Operation Cocoon.

Ecological restoration of the natural habitats and migratory routes is another important feature of this project. An elephant task force was also established by the Ministry of Environment and Forests to spread the idea of friendship between elephants and people (Take Gajah to the Prajah).

4. Elephant Corridors

Elephant Corridors are narrow strips of forested lands which act as a bridge to larger elephant habitats. This conduit is essential for the movement of the elephants and to enhance the survival rate of the species in the wild. The National Green Tribunal in the case of Rohit Chaudhary vs. Union of India & Ors. (2016) has ruled that elephants have the first right on the forests. It ordered the demolition of a boundary wall in the middle of an elephant corridor in Assam's Deopahar Reserve Forest. The elephants also have a right to passage.

In this case, some elephants died after the wall was built. It was determined that there was a destruction of the environment through the establishment of the wall. Hence, Numaligarh Refinery Limited was held liable to pay the environmental compensation based on the 'polluters pay principle' and the 'precautionary principle'. It was held in the case of Vellore Citizens Forum vs. Union of India (1996), that these aforementioned principles are essential features of sustainable development. Further, it was ruled that no power fencing could be erected on the elephant corridors. This judgment was upheld by the Supreme Court.

There are approximately 88 elephant corridors in India and are distributed in the following manner.

Location	Number of Corridors
South India	20
North-Western India	12
North West Bengal	14
Central India	20
North-Eastern India	22

The corridors are categorized into high ecological priority and medium priority. The categorization is on the basis of the regularity of elephant movement, the size of the population, the area of habitats connected and the presence of other routes nearby. The corridors are also graded on the basis of conservation feasibility. Further, only about 77.3% of these corridors are regularly being used by the species.

The major threat to these corridors is the loss of habitat due to fragmentation of forests and other protected areas. The fragmentation is due to an increase in human activities and industrialization, which includes mining activities.

The Supreme Court ordered restraining all kinds of mining and related activities along the Kaziranga National Park area, in the case of In Re: T.N. Godavarman Thirumulpad vs. Union of India & Ors. (2019)., It is crucial that there should be a fusion of elephant corridors with nearby protected areas and reserved forests. In other areas, ecologically sensitive areas or conservation reserves can be declared. This is because the elephants have a habit of constantly foraging for food and water, and they are threatened due to habitat loss, degradation or shrinkage. These paths allow them to move freely and uninterrupted. It is important that awareness is spread and sensitization takes place.

The Supreme Court in the case of A. Rangarajan vs. Union of India (2018), passed an order in 2018 to shut down 27 resorts and hotels that were built illegally on the Nilgiris Elephant Corridors without prior approval. This endangered the safe passage, which is the basic purpose of an elephant corridor.

(i) Measures for Protection of Elephants

Apart from the project, there are other programs which have been implemented for the protection of elephants.

(a) Monitoring of Illegal Killing of Elephants Program (MIKE)

This program began in 2003 in South Asia. MIKE was established under CITES by resolution 10.10. There are approximately 45 countries across the worlds which are included in the program. The aim is to provide information which the elephant range countries require for making proper arrangements and enforcement decisions. It is also for the promotion of institutional capacity in these States for long term conservation and management of the elephants.

The objectives of the program are to measure the rate of illegal poaching of elephants, to determine factors responsible for changes in the elephant population, and collection of data on a monthly basis from all MIKE sites.

(b) Haathi Mere Saathi

This campaign was launched by the Ministry of Environment and Forest in collaboration with Wildlife Trust of India. The aim is to improve the protection, conservation and welfare of elephants in India. The campaign was launched at the Elephant-8 ministerial meeting held in Delhi, in 2011.

The objective of the campaign is to spread public awareness and for developing friendship and companionship between the local public and elephants. The campaign also envisions setting up of Gajah Centres in elephant landscapes across the country, to spread awareness about their plights and invoke public participation. The mascot of the campaign is Gaju.

5. Project Hangul

In the 1970s, the Jammu and Kashmir Government in association with the International Union for Conservation of Nature (IUCN) and World Wildlife Fund (WWF) designed a project for the protection and conservation of the Kashmir Red Stag and its habitat. This project came to be known as Project Hangul.

Hangul or Kashmir Red Stag is a subspecies of the Central Asian Red Deer, which is native to northern India. It is mostly found in the dense riverine forests of Kashmir Valley, some parts of Himachal Pradesh, Sindh Valley, Dachigam National Park and in the forests of Kishtwar. It is also the state animal of Jammu and Kashmir. The project was started since Hanguls were enlisted in the critically endangered species list prepared by IUCN. The species is scattered through an area of 141 square kilometres in the Dachigam National Park.

The population of these deers was once approximately 5,000 in number. Problems such as overgrazing of domestic livestock in the habitat of Hanguls and criminal activities like poaching, illicit trading lead to the decline in the population of Hangul. Then, their population dwindled to as low as 150 by the end of 1970. The aim of the project was to create enclosures for artificial breeding of the species.

After the implementation of the project, the numbers rose to 340 by 1980. But over a course of time, the project however failed due to several factors. As per the census of 2008, their population was approximately 160.

(i) **Fallacies in Project Hangul:** The project faced a major setback because the State Government allowed sheep breeding and research farms to be set up in the park. This covered almost 100 hectares of the park area. Over a period of time, this proved to be a major disturbance. It is believed that several infectious zoonotic diseases could have been transmitted through the sheep to the stags. Due to habitat fragmentation and biotic interference, it posed a threat to their population. It took the government 12 years to arrive at the decision of relocation of sheep from Dachigam National Park. This has led to a tussle between the wildlife department and the sheep husbandry department. Although the state government passed an order in 2005 to relocate the sheep, it continued to exist because the successive regimes failed to find a place for relocation. Further, there was no local participation of the people in the project. The Gujjars, Bakerwals, Nambardars, Chowkidars and Patwaris were not actively involved in it. The Government also allowed the establishment of cement factories around the Park. Lastly, the onset of militant activities in the area was the final straw in the failure of the conservation project.

In 2009, the project was reintroduced as 'Save Kashmir's Red Deer Hangul'. Plans were made to breed them in captivity so as to increase their chances of survival. Funds were released for their captive breeding. Conservation breeding centres were opened in Pulwama, Sikargah Tral and Kangan. As per the latest census of 2017, there is an increase in the population of Hanguls. There are now 182 Hanguls in the Dachigam National Park.

6. Crocodile Conservation Project

The species of crocodilians was threatened in India due to the increasing number of indiscriminate killings. They were poached for commercial purposes, which led to a

drastic decline in their population. Apart from this, there was a loss of habitat due to the increasing development projects and industrialization.

In light of this situation, Project Crocodile was introduced in 1975. The primary focus was on breeding and rearing in captivity. The initiative was taken by the Government of India in association with the Food and Agriculture Organization and United Nations Development Fund. Due to the implementation of this project, there is an increase in the population of crocodiles, which has saved them from extinction. The protected areas include National Chambal Sanctuary and Katerniaghat Wildlife Sanctuary.

There are mainly three species of crocodilians:

(i) Gharial or Gavialis Gangeticus

(ii) Mugger or Crocodylus Palustris

(iii) Saltwater Crocodile or Crocodylus Porosus

The strategy adopted for rehabilitation of these species was to offer them protection in their own habitats. The practice of captive rearing was followed and subsequently, they were released. The methods of 'grow and release' and 'rear and release' were used. The objective of this project is to protect the remaining population of the species, to promote research which would help in improving management, to promote the rebuilding of their habitat and to encourage local public participation.

The project has saved the species from the verge of extinction, as they were enlisted as critically endangered in the IUCN Red List. It has also been helpful in the creation of wetland sanctuaries which has led to active management of other species as well. These species include turtles, Gangetic dolphins, lizards and others.

8.5 MAB

The MAB Programme develops the basis within the natural and social sciences for the rational and sustainable use and conservation of the resources of the biosphere and for the improvement of the overall relationship between people and their environment. It predicts the consequences of today's actions on tomorrow's world and thereby increases people's ability to efficiently manage natural resources for the well-being of both human populations and the environment. By focusing on sites internationally

recognized within the World Network of Biosphere Reserves, the MAB Programme strives to:

(i) identify and assess the changes in the biosphere resulting from human and natural activities and the effects of these changes on humans and the environment, in particular in the context of climate change;

(ii) study and compare the dynamic interrelationships between natural/near-natural ecosystems and socio-economic processes, in particular in the context of accelerated loss of biological and cultural diversity with unexpected consequences that impact the ability of ecosystems to continue to provide services critical for human well-being;

(iii) ensure basic human welfare and a liveable environment in the context of rapid urbanization and energy consumption as drivers of environmental change;

(iv) promote the exchange and transfer of knowledge on environmental problems and solutions, and to foster environmental education for sustainable development.

Man and the Biosphere reserves are areas of terrestrial and coastal marine ecosystems, internationally recognized under UNESCO's Man and the Biosphere Programme, which innovate and demonstrate approaches to conservation and sustainable development. Biosphere Reserves are intended to promote a balanced relationship between people and nature. They are nominated by national governments, and are recognized under UNESCO's Man and the Biosphere Programme, and remain under the sovereign jurisdiction of the States where they are situated. The Man and the Biosphere programme was formally launched in 1971 as an intergovernmental scientific initiative to improve the relationship between people and their environment, by proposing interdisciplinary research and training in natural resources management. The concept of MAB reserves originated in 1974 by a task force of UNESCO's Man and the Biosphere Programme, and the first MAB reserves were designated two years later. Today, all MAB reserves form the World Network of Biosphere Reserves (WNBR) which serves three different functions:

(i) Conservation - to contribute to the conservation of landscapes, ecosystems, species and genetic variation;

(ii) Development - to foster economic and human development which is socially, culturally and ecologically sustainable; and

(iii) Logistic - to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development.

Fundamentally, the network of MAB Reserves aims to be an international tool to develop and implement sustainable development and to contribute towards the Millennium Development Goals. Physically, each MAB reserve should contain three zones: one or more core zones which are legally protected; and clearly identified buffer and transition zones. The transition zone may be referred to as an area of co-operation.

8.6 Red Data Book

The Red Data Book is a public document that is created for recording endangered and rare species of plants, animals, fungi as well as some local subspecies that are present in a particular region.The Red Data Book helps us in providing complete information for research, studies and also for monitoring the programs on rare and endangered species and their habitats. This book is mainly created to identify and protect those species which are on the verge of extinction.

8.6.1 Brief History of the Red Data Book

The name of this book has its origins in Russia, it was originally known as the Red Data Book of the Russian Federation or the RDBRF. The book was based on research conducted between 1961 and 1964 by biologists in Russia. Hence, it is also called the Russian Red Data Book. Currently, the International Union for Conservation of Nature maintains the Red Data Book. IUCN is the world's most detailed inventory centre of the global conservation status of biological species. The **International Union for Conservation of Nature** (**IUCN**) was founded in 1948 with an aim to maintain a complete record of every species that ever lived. The Red Data Book contains the complete list of threatened species. The main aim behind this documentation is to provide complete information for research and analysis of different species. The Red Data Book contains colour-coded information sheets, which are arranged according to the extinction risk of many species and subspecies.

(i) Black represents species that are confirmed to be extinct.

(ii) Red represents species that are endangered

(iii) Amber for those species whose status is considered to be vulnerable

(iv) White is assigned for species that are rare

(v) Green for species that were formerly endangered, but their numbers have started to recover

(vi) Grey colored for the species that are classified as vulnerable, endangered, or rare but sufficient information is not available to be properly classified.

In a nutshell, the Red Data Book indexes species as:

- Threatened
- Not threatened
- Unknown

Furthermore, The Red Data Book also has information as to why a species has become extinct along with the population trends and the extent of its range (distribution).

8.6.2 Advantages of the Red Data Book

(i) It helps in identifying all animals, birds and other species about their conservation status.

(ii) It is used to evaluate the population of a particular species.

(iii) The data available in this book can be used to evaluate the taxa at the global level.

(iv) With the help of this book, we can estimate the risk of taxa becoming globally extinct.

(v) Provides a framework or guidelines for implementing protective measures for endangered species.

8.6.3 Disadvantages of the Red Data Book

(i) The information available in the Red Data Book is incomplete. Many species, both extinct and extant are not updated in this book.

(ii) The source of the book's data has been speculated and has been mired in controversy.

(iii) This book maintains the complete record of all animals, plants, other species but it has no information about the microbes.

8.6.4 Red Data Book of India

Red Data Book of India includes the conservation status of animals and **plants** which are endemic to the Indian subcontinent. The data for this book is provided through surveys which are conducted by the Zoological Survey of India and the Botanical

Survey of India under the guidance of the Ministry of Environment, Forest and Climate Change.

Critically endangered mammals as per the Red Data List of India include:

- Kondana Rat
- Malabar Civet
- Kashmir Stag
- River Dolphins

Critically endangered arthropods include:

- Rameshwaram Parachute spider
- Peacock Tarantula

Critically endangered fish include:

- Pookode Lake barb
- Ganges River shark
- Pondicherry shark

Critically endangered amphibians and reptiles include:

- Gharial
- White-spotted bush frog
- Toad-skinned frog

8.7 CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species. CITES was drafted as a result of a resolution adopted in 1963 at a meeting of members of IUCN (The World Conservation Union). The text of the Convention was finally agreed at a meeting of representatives of 80 countries in Washington, D.C., United States of America, on 3 March 1973, and on 1 July 1975 CITES entered in force. The original of the Convention was deposited with the Depositary Government in the English, French and Spanish languages, each version being equally authentic. The Convention is also available in Chinese and Russian.

8.7.1 The need for CITES

Widespread information about the endangered status of many prominent species, such as the tiger and elephants, might make the need for such a convention seem obvious.

But at the time when the ideas for CITES were first formed, in the 1960s, international discussion of the regulation of wildlife trade for conservation purposes was something relatively new. With hindsight, the need for CITES is clear. Annually, international wildlife trade is estimated to be worth billions of dollars and to include hundreds of millions of plant and animal specimens. The trade is diverse, ranging from live animals and plants to a vast array of wildlife products derived from them, including food products, exotic leather goods, wooden musical instruments, timber, tourist curios and medicines. Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors, such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction. Many wildlife species in trade are not endangered, but the existence of an agreement to ensure the sustainability of the trade is important in order to safeguard these resources for the future.

Because the trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation. CITES was conceived in the spirit of such cooperation. Today, it accords varying degrees of protection to more than 37,000 species of animals and plants, whether they are traded as live specimens, fur coats or dried herbs.

CITES is an international agreement to which States and regional economic integration organizations adhere voluntarily. States that have agreed to be bound by the Convention ('joined' CITES) are known as Parties. Although CITES is legally binding on the Parties – in other words they have to implement the Convention – it does not take the place of national laws. Rather it provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES is implemented at the national level. For many years CITES has been among the conservation agreements with the largest membership, with now 184 Parties.

8.8 Central Zoo Authority of India

The Indian Board for Wildlife re-constituted its Zoo Wing as 'the Expert Group on Zoos' at its 9thsession held on 18th November, 1972 at New Delhi to make detailed study for setting up and maintenance of zoos in the country. The Expert Group on Zoos submitted its report in June, 1973 which was accepted by the Board in its meeting in November, 1973. The report recommended setting up of a central agency (Zoo Grants

Commission), and to give effect to this recommendation, the Wildlife (Protection) Act, 1972 was amended through an amendment Act inthe year 1991.

A separate chapter, Chapter IVA contains Section 38 A to 38 J was added to the Wildlife (Protection) Act, 1972 for establishment of the Central Zoo Authority in India. Accordingly, the Central Zoo Authority was established as a statutory body under the Ministry of Environment &Forests by the Government of India in the year 1992. The Authority consists of a Chairman, ten members and a Member Secretary.

The main objective of this Authority is to complement and strengthen the national effort in conservation of the rich biodiversity of the country, particularly the fauna as per the National Zoo Policy, 1998. Other objectives of this Authority include- enforcing minimum standards and norms for upkeep and healthcare of animals in Indian zoos and to control mushrooming of unplanned and ill-conceived zoos.

For the overall management of the animals housed in the Indian zoos, standards and norms for appropriate housing, upkeep, health care, diet etc. has been laid down under the Recognition of Zoo Rules, 1992 which was further amended in the year 2009 and 2013.

Every zoo in the country is required to obtain recognition from the Authority for its operation. The Authority evaluates the zoos with reference to the parameters prescribed under the Rules and grants recognition, accordingly. The Authority's role is more of a facilitator than a regulator. It therefore, provides technical and financial assistance to such zoos which have the potential to attain the desired standard in animal management.

Apart from the primary function of grant of recognition, the Central Zoo Authority also regulates the exchange of animals of endangered category listed under Schedule- I and II of the Wildlife (Protection) Act, 1972 among zoos.

Exchange of animals between Indian and foreign zoos is also approved by the Authority before the requisite clearances under EXIM Policy and the CITES permits are issued by the competent authority.

The Authority also coordinates and implements programmes on capacity building of zoo personnel, planned conservation breeding programmes and ex-situ research including biotechnological intervention for conservation of species for complementing in-situ conservation efforts in the country.

8.8.1 Vision

The zoo will have healthy animals in eco-system based naturalistic enclosure, be supportive to in-situ conservation with competent and content staff, good educational and interpretative facilities, have the support of people and be self-sufficient.

8.8.2 Mission

The Central Zoo Authority's mission is to provide better upkeep and veterinary care to the wild animals housed in zoos in India to ensure their conservation through best practices of management and bringing education & awareness among the people.

8.8.3 Functions

The Authority has been assigned following functions under Section 38 (C) of the Wildlife (Protection) Act, 1972:

(a) Specify the minimum standards for housing, upkeep and veterinary care of the animals kept in zoos;

(b) Evaluate and assess the functioning of the zoos with respect to the prescribed standards or norms;

(c) To recognize or derecognize zoos;

(d) To identify endangered species of wild animals for purposes of captive breeding and assigning responsibility in this regard to a zoo;

(e) To coordinate the acquisition, exchange and loaning of animals for breeding purpose;

(f) To ensure maintenance of studbooks of endangered species of wild animals bred in captivity;

(g) To identify priorities and themes with regard to display of captive animals in zoos;

(h) To coordinate training of zoo personnel in India and outside India;

(i) To coordinate research in captive breeding and educational programmes for the purposes of zoos;

(j) To provide technical and other assistance to zoos for their proper management and development on scientific lines;

(k) To perform such other functions as may be necessary to carry out the purposes of this Act with regard to zoos.

Summary

References

1. http://nja.nic.in/Concluded_Programmes/2018-19/P-1102_PPTs/3.The%20Wildlife%20(Protection)%20Act,%201972.pdf
2. http://www.asiannature.org/sites/default/files/2005%20Menon%20Sukumar%20Right-of-Passage.pdf
3. https://www.symlaw.edu.in/files/Empirical-Study-on-Implementation-of-Wildlife-Protection-Laws-FinalReport_Oct16.pdf
4. https://www.wti.org.in/wp-content/uploads/2017/08/pub_right_of_passage-1.pdf
5. https://www.forests.tn.gov.in/tnforest/app/webroot/img/document/news/news/Expert_Committee_Report.pdf