CHAPTER – I

FOREST MANAGEMENT

1. Definition

Forest management is defined as the practical application of the scientific, technical and economic principles of forestry. Not a basic subject in itself, forest management is concerne with practical application of science, technology and economics to a forest estate for achievement of certain objectives. The subjects on which forest management is grounded are Silviculture, Ecology, Geology, Soil Science, Botany, Mensuration, Pathology, Economics, Finance etc.

1.1 Functions and scope

It follows from the definition that **forest management** aims to achieve three main functions, namely,

(1) Control of composition and structure of growing stock;
(2) Harvesting and marketing of forest produce;
(3) Administration of forest property and personnel.

It is the job of forest managers to constantly manage the growing stock to achieve given object of management. The scope of management encompasses a wide range of activities. Some major activities are described below.

- Site adaptation;
- Choice of species;
- Manipulation of stands;
- Harvesting the produce;
- Regeneration;
- Protection;
- Transportation and communication;
- Marketing data;
- Sale of produce;
- Value addition;
- Revenue;
- Distribution of benefits;
- Forest organization;
- Management of personnel;
- Monitoring and evaluation of works;
- Financial management and efficiency
- Integration in rural development.

2. Objectives

The forests in India, which are mostly state owned, are managed for various purposes, namely **productive, protective, recreational and bio-aesthetic**.

2.1 The productive purpose or production forestry - While working within scientific norms, the forests are primarily managed for direct material benefits. The management objective would be to maximize production of timber and other marketable forest produce on a sustained basis, and maximize economic return. In this type of management approach,

the focus will be on regeneration of commercially valuable species, establishment of a regular crop of fewer species being easy to manage, application of intense tending operation to maximize dia-volume increment, adoption of improved logging mechanism for intensive harvest and good marketing initiative.

2.2 The protective purpose or protection forestry - Forests are managed for indirect benefits. In this approach, the forests are not considered as mere growing stock but a complex ecological system which should be managed to obtain supporting and regulating services of forests.

For example, in wildlife reserves and national parks the objective is not to harvest forest produce and find ways to earn more revenue, but to maintain a good habitat to support the wildlife and biological diversity. Similarly, management of forests on hill slopes is not aimed at maximizing annual harvest and undertaking commercial plantations, but trying to conserve the vegetation for soil conservation and ecological development.

2.3 The recreational and bio-aesthetic purpose or recreational forestry - Forests are managed to enhance and enrich their bio-aesthetic value and recreational potential. The concept is rather new and the major beneficiaries are the people residing in urban areas. The recreational forests are therefore mostly located in and close to planned towns. The focus of management is to create and maintain wooded lands in natural landscapes, ecological parks of species of interest, wetlands as habitat of birds or other aquatic species, greeneries of aesthetic beauty etc. Sometimes, part of wildlife reserves is also dedicated for recreational purpose.

2.4 The Working plan - The various purposes or objectives are not mutually exclusive of each other. A scientifically managed forest can fulfill more than one objective, though one or the other objective receives priority. In case of extensive forests, it is possible to allocate separate forests to fulfill distinctly separate functions. **The Working plan** (a written scheme of management to achieve the objects of management) of a forest division, while specifying the general objects for the entire Working Plan area (i.e. Division), divides the area in several Working Circles. Each Working Circle, normally characterized by distinct vegetation and site factors, is considered more suited for certain purposes than others and is assigned some special objects of management and one set of Working Plan prescriptions. The Working Plan thus prioritizes objects of management for different Working Circles and such priorities of objects vary from Circle to Circle. In certain circumstances, Working Circles may overlap.

3 Forests on Concurrent List

In appreciation of the importance of forests for the well-being of the nation, the Parliament by the 42nd Amendment to the Constitution brought Forests and Wildlife on the Concurrent List of the Seventh Schedule. This has enabled the central government to promulgate legislation on Forests and Wildlife.

4. Principles of Forest Management – National Forest Policy

The objects of forest management in the regional and local level should be so formulated that they are in perfect harmony with and flow from the fundamental principles of forest management as embodied in National Forest Policy. In its resolution No. 3-1/86-FP dated 7th December, 1988, the Ministry of Environment of Forests, Govt of India, notified the National Forest Policy. While justifying the need to review and revise the Policy of 1952,

the National Forest Policy of 1988, in its preamble, defines the job of conservation as one which includes preservation, maintenance, sustainable utilisation, restoration, and enhancement of the natural environment. We describe herein below some salient features of National Forest Policy

4.1 ESSENTIALS OF FOREST MANAGEMENT

According to this Policy, the essentials will be –

• Existing forests and forest lands should be fully protected and their productivity improved. Forest and vegetal cover should be increased rapidly on hill slopes, incatchment areas of rivers, lakes and reservoirs and ocean shores and, on semi-arid, anddesert tracts.

• Diversion of good and productive agricultural lands to forestry should be discouraged in view of the need for increased food production.

• For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected areas should be strengthened and extended adequately.

• Provision of sufficient fodder, fuel and pasture, specially in areas adjoining forest, is necessary in order to prevent depletion of forests beyond the sustainable limit. Since fuelwood continues to be the predominant source of energy in rural areas, the programme of afforestation should be intensified with special emphasis on augmenting fuelwood production to meet the requirement of the rural people.

• Minor forest produce provides sustenance to tribal population and to other communities residing in and around the forests. Such produce should be protected, improved and their production enhanced with due regard to generation of employment and income.

4.2 STRATEGY

4.2.1 Area under Forests - The national goal should be to have a minimum of one-third of the total land area of the country under forest or tree cover. In the hills and in mountainous regions, the aim should be to maintain two-third of the area under such cover.

4.2.2 Afforestation, Social Forestry & Farm Forestry - A massive need-based and time bound programme of afforestation and tree planting, with particular emphasis on fuelwood and fodder development, on all degraded and denuded lands in the country, whether forest or non-forest land. To encourage the planting of trees alongside of roads, railway lines, rivers and streams and canals, and on other unutilised lands under State/corporate, institutional or private ownership.

• Village and community lands, not required for other productive uses, should be taken up for the development of tree crops and fodder resources. technical assistance and other inputs necessary for initiating such programmes should be provided by the Government. The revenues generated through such programmes should belong to the panchayats where the lands are vested in them; in all other cases, such revenues should be shared with the local communities. The vesting, in individuals, particularly from the weaker sections (such as landless labour, small and marginal farmers, scheduled castes, tribals, women) of certain ownership rights over trees, could be considered, subject to

appropriate regulations; beneficiaries would be entitled to usufruct and would in turn be responsible for their security and maintenance.

• Land laws should be so modified wherever necessary so as to facilitate and motivate individuals and institutions to undertake tree-farming and grow fodder plants, grasses and legumes on their own land. Appropriate regulations should govern the felling of trees on private holding.

4.2.3 Management of State Forests - Schemes and projects which interfere with forests that clothe steep slopes, catchments of rivers, lakes, and reservoirs, geologically unstable terrain and such other ecologically sensitive areas should be severely restricted.
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• No forest should be permitted to be worked without the Government having approved the management plan, which should be in a prescribed format and in keeping with the National Forest Policy.

• It is necessary to enhance forest cover and productivity of the forests through the application of scientific and technical inputs. No production forestry programmes should entail clear-felling of adequately stocked natural forests. Nor should exotic species be introduced, unless long-term scientific trials have established that they are suitable and have no adverse impact on native vegetation and environment.

4.2.3.1 Rights and Concessions - The rights and concessions, including grazing, should always remain related to the carrying capacity of forests.

• The rights and concessions from forests should primarily be for the bonafide use of the communities living within and around forest areas, specially the tribals.

• The rights and concessions enjoyed by tribals and other poor living within and near forests should be fully protected. Their domestic requirements of fuelwood, fodder, minor forest produce and construction timber should be the first charge on forest produce.

• To relieve the existing pressure on forests substitution of wood needs to be taken recourse to.

4.2.4 Diversion of Forest Lands for Non-forest purposes - Diversion of forest land for any non-forest purpose should be subject to the most careful examinations by specialists from the standpoint of social and environmental costs and benefits.

• Beneficiaries who are allowed mining and quarrying in forest land and in land covered by trees should' be required to repair and re-vegetate the area in accordance with established forestry practices.

4.2.5 Wildlife Conservation - Forest Management should take special care of the needs of wildlife conservation, and forest management plans should include prescriptions for this purpose. It is specially essential to provide for "corridors" linking the protected areas in order to maintain genetic continuity between artificially separated sub-sections of migrant wildlife.

4.2.6 Tribal People and Forests - A primary task of all agencies responsible for forest management should be to associate the tribal people closely in the protection, regeneration and development of forests as well as to provide gainful employment to people living in and around the forest. While safeguarding the customary rights and interests of such people, forestry programmes should pay special attention to the following:

• contractors should be replaced by institutions such as tribal cooperatives, labour cooperatives, government corporations, etc. as early as possible;

• Protection, regeneration and optimum collection of minor forest produce along with institutional arrangements for the marketing of such produce;

• Development of forest villages on par with revenue villages;

• Family oriented schemes for improving the status of the tribal beneficiaries;

4.2.7 Shifting Cultivation - Efforts should be made to contain such cultivation within the area already affected, by propagating improved agricultural practices. Area already damaged by such cultivation should be rehabilitated through social forestry and energy plantations.

4.2.8 Damage to Forests from Encroachments, Fires and Grazing

• Encroachment on forest lands has been on the increase. This trend has to be arrested and effective action taken to prevent its continuance. There, should be no regularisation of existing encroachments.

• The incidence of forest fires in the country is high. Special precautions should be taken during the fire season. Improved and modern management practices should be adopted to deal with forest fires.

• Grazing in forest areas should be regulated with the involvement of the community Special conservation areas, young plantations and regeneration areas should be fully protected.

4.2.9 Forest-based Industries - The main considerations governing the establishment of forest-based industries and supply of raw material to them should be as follows:

• As far as possible, a forest-based industry should raise the raw material needed for meeting its own requirements.

• No forest-based enterprise, except that at the village or cottage level, should be permitted n the future unless it has been first cleared after a careful scrutiny with regard to assured availability of raw material.

• Natural forests will not be made available to industries for undertaking plantation and for any other activities.

• The practice of supply of forest produce to industry at concessional prices should cease.

4.2.10 Forest Extension - It is essential to inculcate in the people, a direct interest in forests, their development and conservation, and to make them conscious of the value of trees, wildlife and nature in general.

4.2.11 Forestry Education - Agriculture universities and institutions, dedicated to the development of forestry education should formulate curricula and courses for imparting academic education and promotingpostgraduate research and professional excellence.

4.2.12 Forestry Research - Emphasis must be laid on scientific forestry research, necessitating adequate strengthening of the research base as well as new priorities for action. Some broad priority areas of research and development needing special attention are:

- Increasing the productivity of wood and other forest produce.
- Revegetation of barren/marginal/waste/mined lands and watershed areas.
- Effective conservation and management of existing forest resources (mainly natural forest eco-systems).
- Research related to social forestry for rural/ tribal development.
- Development of substitutes to replace wood and wood products.
- Research related to wildlife and management of national parks and sanctuaries.

4.2.13 Personnel Management- Government policies in personnel management for professional foresters and forest scientists should aim at enhancing their professional competence and status and attracting and retaining qualified - and motivated personnel, keeping in view particularly the arduous nature of duties they have to perform, often in remote and in hospitable places.

4.2.14 Forest Survey and Data Base - Priority needs to be accorded to completing the survey of forest resources in the country on scientific lines and to updating information.

4.2.15 Legal Support and Infrastructure Development - Appropriate legislation should be undertaken, supported by adequate infrastructure, at the Centre and State levels in order to implement the Policy effectively.

4.2.16 Financial Support for Forestry - The objectives of this revised Policy cannot be achieved without the investment of financial andother resources on a substantial scale. Such investment is indeed fully justified considering the contribution of forests in maintaining essential ecological processes and life support systems and in preserving genetic diversity.

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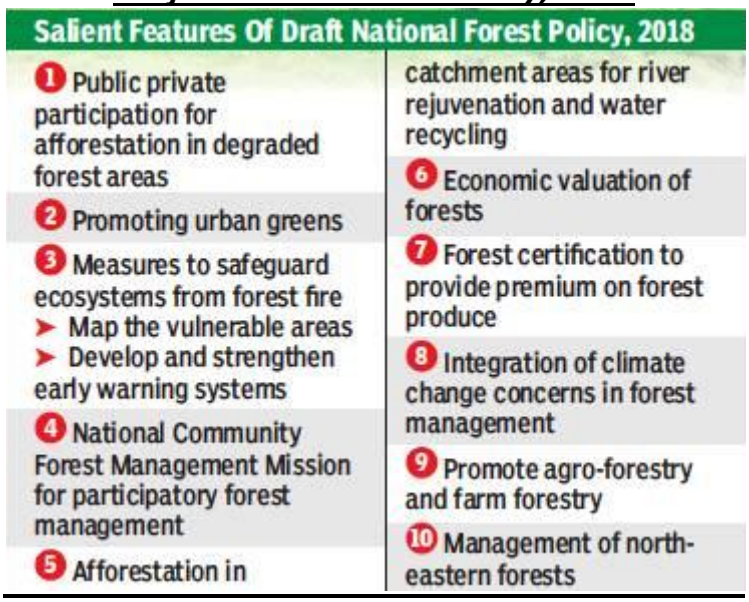


1. Preamble

1.1 Forests are a dynamic ecosystem consisting of plants, animals & microorganisms safeguarding the ecological security of the nation. Forests provide the carbon neutral timber, non timber products like medicines, grasses, & other ecosystem services essential for the very survival of the human beings.

1.2 The forest policies of 1894 & 1952 have stressed on the production& revenue generation aspects of the forests where as the principal aim of National Forest Policy, 1988 was to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all life forms, human, animals and plants. The 1988 Policy recognized that derivation of direct economic benefits must be subordinated to this principal aim. This policy has been instrumental in strengthening ecological security, sustainable forest management, and participatory forest management.

1.3 In the meantime India has been participating in several international summits and conventions on protection of forests, wildlife and environment and stands committed to the goals set in there. Several objectives have also emerged during debates and deliberations in seminars and workshops at National Level. In view of these it has become necessary to incorporate these goals and objectives in the National Forest Policy.

1.4 As a result of the implementation of the 1988 policy prescriptions, there has been an increase in forest and tree cover and reduction in the diversion of forest land for other land uses despite compelling demands from the increasing population, industrialization and rapid economic growth. However the , low quality and low productivity of our natural forests, impacts of climate change, human-wildlife conflict, intensifying water crisis, increasing air and water pollution and deteriorating environment have been the issues of serious concern.. The increased concerns for biodiversity conservation and the need to enhance forest ecosystem services, through new technological advancements and the continuously declining investments in the sector present new challenges for forest management in the country.

1.5 Hence there is a need to revise the National Forest Policy, 1988 in order to integrate the vision of sustainable forest management by incorporating elements of ecosystem security , climate change mitigation and adaptation, forest hydrology, participatory forest management, urban forestry, robust monitoring and evaluation

framework and establishment of mechanisms to oversee multi-stakeholder convergence in forest management, while building on our rich cultural heritage of co-existence and relying on our rich and diverse forest resources.

2. Goal and Objectives

The overall objective and goal of the present policy is to safeguard the ecological and livelihood security of people, of the present and future generations, based on sustainable management of the forests for the flow of ecosystem services In order. to achieve the national goal for eco-security, the country should have a minimum of one-third of the total land area under forest and tree cover. In the hills and mountainous regions, the aim will be to maintain two-third of the area under forest & tree cover in order to prevent soil erosion and land degradation and also to ensure the stability of the fragile eco-systems. 2 The following objectives shall be guiding the National Forest Policy.

2.1 Maintenance of environmental stability and conservation of biodiversity through preservation and conservation of natural forests.

2.2 Reverse the degradation of forest by taking up rehabilitation without compromising its natural profile.

2.3 Improvement in livelihoods for people based on sustainable use of ecosystem services.

2.4 Contribute towards achieving forestry related Nationally Determined Contribution Targets (NDC's) of the country.

2.5 Checking denudation and soil erosion in the catchments of rivers and the wetlands through integrated watershed management techniques and practices.

2.6 Maintenance of the health of forest vegetation and forest soils for augmenting water supplies through recharge of underground aquifers and regulation of surface water flows.

2.7 Safeguard forest land by exercising strict restraint on diversion for non-forestry purposes, and strict oversight on compliance of the conditions.

2.8 Increasing substantially the forest/tree cover in the country through Afforestation & reforestation programmes, especially on all denuded and degraded forest lands and area outside forests.

2.9 Manage protected areas and other wildlife rich areas with the primary objective of biodiversity conservation and for enriching other ecosystem services.

2.10 Conserve and sustainably manage mountain forests to ensure continuous flow of ecosystem services, including watershed, biodiversity, cultural and spiritual services to both upstream and downstream population.

2.11 Factor green accounting, valuation of ecosystem services and climate change concerns adequately into the planning and management of all forests, protected areas and other ecosystems.

2.12 Increase substantially the tree cover outside forests by incentivizing agro-forestry and farm forestry, facilitating assured returns, with enabling regulations and by promoting use of wood products.

2.13 Integrate climate change mitigation and adaptation measures in forest management through the mechanism of REDD+(Reducing Emissions from Deforestation and Forest Degradation plus) so that the impacts of the climate change is minimised.

2.14 Incentivize sustainability in community managed, community owned private forests and creating a sustained peoples' movement for achieving these objectives.

2.15 Managing and expanding green spaces in urban and peri-urban areas to enhance citizens' wellbeing.

2.16 Ensure effective translation of this policy into action by establishing credible measuring, monitoring and evaluation framework, ensuring good governance, providing commensurate financial support and developing an implementation framework with periodic review.

3. Essential Principles of Forest Management:

The following essential management principles will be pursued in this policy:-

3.1 Existing natural forests should be fully protected and their productivity improved. Adequate measures will be taken to increase rapidly the forest cover on hill slopes, in catchment areas of rivers, lakes and reservoirs and ocean shores and, on semi-arid, and desert tracts.

3.2 Productivity of the forest plantations will be increased through scientific and technological interventions so as to encourage usage of more timber so that the dependency on other high carbon footprint wood substitutes is reduced.

3.3 Management of the natural biodiversity rich forests for maximising the ecosystem services for ecological security of the nation.

3.4 For conservation of flora, fauna and total biodiversity, the network of national parks, sanctuaries, conservation reserves, community reserves, biosphere reserves and important wildlife corridors and biodiversity heritage sites will be strengthened and extended adequately.

3.5 Afforestation with suitable species will be intensified so as to cater to the needs of the rural population for fuel wood and small timber. Further alternative sources of energy like LPG etc will be promoted in rural areas to reduce dependency on forests.

3.6 Non-Timber Forest Produce (NTFP) such as medicinal and aromatic plants, oil seeds, resins, wild edibles, fibre, bamboo and grass etc. will be sustainably managed for improving the income of the tribals & other forest dependent populations.

3.7 Promotion of trees outside forests & urban greens will be taken up on a mission mode for attaining the national goal of bringing one third of the area under Forests & trees cover and also for achieving the Nationally Determined Contribution (NDC's) targets of the country.

4. Strategy:

The following strategies will be adopted to achieve the objectives of this policy

4.1.1 Sustainable Management of Forests (a) Reducing Threats to Forests The various threats to Forests due to encroachments, illegal tree fellings, forests fires, invasive weeds, grazing, etc. will be addressed within the framework of the approved Working Plan/ Management Plan and also by ensuring community participation in forest management. (b) Forest fire prevention With changes in climate and land use, fire is increasingly being viewed as a major threat to many forests and their biodiversity. Rising intensity and frequency of forest fires and their spread is resulting in substantial loss of forest functions and related ecosystem services every year. Adequate measures would be taken to safeguard ecosystems from forest fires, map the vulnerable areas and develop and strengthen early warning systems and methods to control fire, based on remote sensing technology and community participation. Also, awareness will be created about causes and impacts of fire on forests and local livelihoods. (c) Enhance Quality and Productivity of natural forests Many of our forest ecosystems have been significantly altered and degraded due to land conversion, pollution, over exploitation, deforestation and degradation etc. with adverse impacts on biological diversity and livelihoods of the local population. Protection and enrichment of dense forests will be a top priority. Degraded forests will be rehabilitated by promoting natural regeneration, by taking strict protection measures and also by planting locally suitable indigenous species for assisting the existing regeneration. (d) Increase the productivity of forest plantations Productivity of the forest plantations are poor in most of the States. This will be addressed by intensive scientific management of forest plantations of commercially important species like teak, sal, sisham, poplar, gmelina, eucalyptus, casuarina, bamboo etc. The lands available with the forest corporations which are degraded & underutilized will be managed to produce quality timber with scientific interventions. Public private participation models will be developed for undertaking Afforestation and reforestation activities in degraded forest areas and forest areas available with Forest Development Corporations and outside forests. (e) Protecting & enriching the Catchments Schemes and projects which interfere with forests that cover steep slopes, catchments of rivers, lakes, and reservoirs, geologically unstable terrain and such other ecologically sensitive areas shall be restricted. The 4 ecologically sensitive catchment areas shall be stabilized with suitable soil & water conservation measures and also by planting with suitable trees and grasses like bamboo etc. (f) Biodiversity Conservation Natural forests are rich repositories of biodiversity in the country. The following steps will be taken for the conservation of the biodiversity in the natural forests. (i) Biodiversity of the forest areas of the country will be surveyed and documented systematically, and sites having exceptional taxonomic and ecological value will be conserved. Legal and administrative measures for protection of biodiversity against bio-piracy will be taken, in sync with National Biodiversity Act. (ii) Modern techniques of ex-situ conservation will be promoted for the preservation of

Relic, Endangered and Threatened (RET) species. (g) Management of forests to be as per the approved Working Plan Management of forests & forest plantations will be done as per the Central Government approved Working/Management plans, and also in accordance with the guidelines issued by the Government of India, Ministry of Environment, Forests and Climate Change from time to time. Private forests/ forest plantations/ tree lots will be regulated as per the management plans. (h) Strengthen participatory forest management India has rich and varied experience in participatory forest management. There is a need to further strengthen this participatory approach, for which a National Community Forest Management (CFM) Mission will be launched. This mission will have a legal basis and an enabling operational framework.. The national, state and local level development programmes shall be converged in these villages. All efforts to ensure synergy between Gram Sabha & JFMC will be taken for ensuring successful community participation in forest management. (i) Management of Non Timber Forest Produce Non-Timber Forest Produce (NTFP) such as medicinal and aromatic plants, oil seeds, resins, wild edibles, fibre, bamboo, grass etc. provide sustenance to forest dependent communities by supplementing their food and livelihood security. Such produce should be managed sustainably ensuring increased employment and income opportunities for the local communities. Value Chain approach that is climate-smart and market oriented and embedded in sustainability would be made compulsory and part of the business plans related to NTFP.

4.1.2 Management of trees outside forests (a) Promote agro-forestry and farm forestry Agro-forestry and farm forestry have taken deep roots in the country and Trees Outside Forests (TOF) are contributing to the increase in tree cover and enhancing ecosystem services, while meeting a bulk of the country's wood demand and providing climate resilient incomes to the farmers.. Thus promotion of wood use obtained from sustainably managed forests and trees would play a significant role in mitigating climate change and ensuring sustainable living. In view of this the following measures will be taken: (i) Agro-forestry and farm forestry would be encouraged through commensurate incentives and operational support systems.. (ii) Systems for certification of improved planting material would be put in place. 5 (iii) Price assurance to the farmers would be facilitated by putting in place pre-production agreements between the farmers and the forest based industries. (iv) Suitable location specific Public Private Partnership models will be developed involving Forest Departments, Forest development Corporations, Communities, Public limited companies etc for achieving the target of increased forest & tree cover in the country. (v) Promotion of cultivation, harvesting, transportation and marketing of wood would be ensured by relaxing the existing felling and transit regime in the country. Inclusion of agro forestry & farm forestry in the Agricultural crop insurance scheme would be facilitated. Also, agro forestry and farm forestry crop will also be included in National crop insurance scheme. (vi) Massive awareness and extension services for promotion of agro forestry will also be launched. (b) Promoting urban greens Urban greens include woodlands, wetlands, parks, wood in institutional areas, gardens, avenue plantations, block plantations etc in such areas. These green patches bring many aesthetic, recreational, environmental and economic benefits to cities and their dwellers. They need to be managed as urban forest ecosystems to enhance optimal urban forest cover and to nurture and sustain urban health, clean air and related benefits. Management plans will be prepared and implemented in consonance with the development plan of cities.

4.2 New Thrust Areas in forest & tree cover Management

4.2.1 Production Forestry The demand for timber and other forest produce is showing an increasing trend and is likely to continue as the economy grows. The dependence on import has also been increasing drastically over the years. In order to ensure self sufficiency in timber, the States would be encouraged to further develop their plantation programmes with scientific inputs and genetically improved planting materials.

4.2.2 Economic valuation of the forests Forests provide a wide range of tangible benefits like timber, fuel wood, fodder and a wide range of NTFPs and intangible benefits like ecological services, hydrological benefits, soil conservation, flood control, carbon sequestration, biodiversity conservation, amelioration of the overall environment, etc. Contribution of the forest to the national economy is estimated generally on the basis of the recorded removals of industrial wood, fuel wood and NTFPs, which is abysmally low as compared to the actuals. Scientific methods will be evolved for appropriate valuation of forests and their services through institutions of repute.

4.2.3 Forest management for water recycling Water is critical for all life forms and is one of the most valuable outputs from the forests. Healthy forest ecosystems helps recharge of aquifers by increasing percolation and reducing surface runoff, thereby nourishing springs, streams, rivers and other aquatic systems. Forests and other ecosystems that function as key catchments need to be identified and conserved. Scientific catchment area treatment plans will be prepared and executed as part of the forest working/ management plans.

4.2.4 Forest Certification A Credible certification process can provide premium on the products, which can enhance value of forest product harvested sustainably. Adoption of appropriate certification regimes will be encouraged though phase wise adoption of compatible standards and institutional framework in forest management.

4.2.5 Integrate climate change concerns & REDD+ strategies in forest management: Forests acts as a natural sink of carbon dioxide thereby assisting in climate change mitigation. Use of wood products which have minimum carbon foot print will result in substitution of more emission-intensive 6 resources, by locking up carbon. Climate change impacts the structure, composition and functions of forest ecosystems, progressively affecting the embedded and dependent life forms. Strategic actions especially sustainable forest management as envisaged in REDD+ reference document for the country will be taken to strengthen forest-based climate change mitigation and adaptation as indicated below: (a) Afforestation and reforestation and assisting natural regeneration of the forests would be taken up to create an additional carbon sink while increasing the forest and tree cover and enhancing ecosystem services. All efforts for improving the quality of the degraded natural forests will be undertaken through appropriate interventions. (b) Agro-forestry and farm forestry sector will be encouraged to realise their full potential. (c) Sensitive ecosystems such as coastal and marine areas, mangroves, temperate and sub-alpine forests, alpine meadows, Western and Eastern Ghats etc. will be specially safeguarded. (d) Climate change concerns will be factored in all the forest and wildlife areas working/management plans and Community Ecosystem Management Plans. (e) Steps would be taken for promotion of wood technology innovations and enterprises. Intensive marketing and branding campaigns such as “Wood Is Good”, “Grow more wood- use more wood” will be taken up for promotion of growing trees and usage of wood products.

4.2.6 Develop a national forest ecosystems management information system Lack of adequate of pan country reliable and compatible datasets in the forestry sector is a matter of serious concern. Such comprehensive and reliable datasets are essential for scientific planning and management. Systems need to be designed and put in place to ensure a regular flow of reliable data from the states and other sources and making it available in the public domain. A national forest ecosystems management information system will be developed and made operational using the latest information and communication technology. Assessment of growing stock & carbon stock in Indian forests will be given more stress and importance.

4.3 Strengthen Wildlife Management India has rich diversity of wild flora and fauna housed in varied ecosystems. Despite serious conservation challenges, the wildlife management in the country has demonstrated gains in protection of flagship species, securing key habitats and re-establishing wildlife populations. However, our wildlife habitats and corridors are being constantly altered due to increasing anthropogenic pressures, rising human animal conflicts, illegal trade in wild species and climate change impacts. Hence, there is an urgent need to renew the efforts to safeguard wildlife and secure their habitats. Following actions will be undertaken in this regard:- (a) Management of Protected Areas would be strengthened for preservation of habitats for maintaining natural biodiversity profile and ensuring natural pace of productivity, and flow of reproductive surpluses in surrounding areas for strengthening the stressed habitats outside PA's. The wildlife rich areas and corridors outside PA's would be identified and maintained for ensuring ecological and genetic continuity. Such areas would be effectively secured by strengthening enforcement, restoring habitats and managing ecological corridors. (b) Assessment of species for survival and recovery measures based on population and habitat viability parameters would form an integral and regular part of management planning and practices. (c) Human wildlife conflicts have escalated over the years due to combination of factors related to habitats and population of certain wildlife species within and outside forests. Regular spatial and temporal dynamics of conflicts would be assessed for formulating and implementing state level strategy for management of Human Wildlife Conflicts. Quick response, dedicated teams of wellequipped and trained personnel, mobility, strong interface with health and veterinary services, rescue centres, objective and speedy assessment of damage and quick payment of relief to the victims would be at the core of the short term action. Monitoring and management of population of wildlife would be adopted on a long term basis within and outside forests for maintaining the balance. 7 (d) For tradable biodiversity a strong regime of inventory, assessment of status, and sustainability will be made part of the working/ management plans. (e) Import and trade of exotic species, their uses and upkeep shall be subjected to strict regulations to ensure that the native biodiversity does not face genetic contamination. (f) Wildlife crime and illegal trade pose grave challenge to conservation efforts. The existing central monitoring, sharing of information and on line updating of data on forest/ wildlife crime would be institutionalised and further strengthened. The detection, investigation and prosecution capacity shall be augmented by technical support in form of network of forensic laboratories. (g) Ecotourism models would be developed with a focus on conservation of the sites and nature education of the visitors while supplementing the livelihood needs of the local communities and without compromising the profile of habitats and behaviour of wildlife. (h) Zoological gardens, botanical gardens and biodiversity parks would be designed with modern and interactive methods for effective communication/interpretation about the value of flora and fauna as part of the awareness creation and nature education. Zoos and rescue centres would also be used for harbouring rescued species and conservation

breeding. (i) Trans boundary and regional cooperation will be strengthened to effectively manage wildlife across borders.

4.4 Facilitate forest industry interface There is a need to stimulate growth in the forest based industry sector. This sector being labour intensive can help in increasing green jobs. Forest corporations and industrial units need to step up growing of industrial plantations for meeting the demand of raw material. Forest based industries have already established captive plantations in partnership with the farmers. This partnership needs to be further expanded to ensure an assured supply of raw material to the industries with mutually beneficial arrangements. Further a forum for interaction and collaboration would be set up for Forest based industries with forestry institutions and concerned stakeholders so that a demand for trained professionals is created in the sector.

4.5 Research and Education Scientific research in forestry and wildlife is the back bone of forest management and contributes to understanding of the forest dynamics leading to pragmatic conservation planning. Forestry/ wildlife education has also been adopted by many institutions and the students graduating are finding several career opportunities within and outside government. In this context, to facilitate contemporary research and education following measures will be taken:-

4.5.1 Focus of forestry research will be on integrated and multidisciplinary research on forests and forest products for increasing livelihood support and economic growth.

4.5.2 Research on Forest inventory including growth yield assessment of forest products, ecosystem services etc will be taken up on priority.

4.5.3 Intensive and need-based research for biodiversity conservation, reclamation of degraded and mined areas for ecological security, integrated pest management, invasive alien species management, forest fires, forest hydrology and carrying capacity of ecosystems etc will be taken up on priority.

4.5.4 Research on enhancing the capacity of the forest ecosystems for carbon sequestration will be taken up on priority.

4.5.5 Increasing forest productivity through forest genetic resource management and tree improvement will be emphasised.

4.5.6 Policy research on various forests related issues will be undertaken in changing national scenario.

4.5.7 Promotion of forestry education and adoption of forestry curriculum addressing the contemporary priorities will be stressed.

4.5.8 Infrastructure and expertise available with the Indian Council of Forestry Research and Education (ICFRE), and other allied and state institutions, will be strengthened keeping in view the future trends in sustainable management and conservation of forests.

4.5.9 Collaboration with regional and international institutions of repute will be strengthened for multidisciplinary research to meet the policy goals and objectives.

4.6 Extension and awareness Conservation and development of forest and related ecosystems cannot be effective without the willing support, involvement and cooperation of the people. It is essential, therefore, to inculcate in the people, a direct interest in forests, in their development and conservation. There is a need to make them conscious of the values of trees, wildlife and nature in general. This can be achieved through active involvement and participation of local governments, schools, colleges, NGOs, community based organizations, Eco- clubs, PSUs, corporate houses, trade unions and other institutions. Extension of forests, trees and wildlife and creating awareness regarding their importance will be encouraged. National and state awards will be instituted to recognize and reward exemplary work, both in the individual and institutional categories.

4.7 Management of North-Eastern Forests The forests of North-East are endowed with rich biodiversity. These forests in North-East have vital impact on climate, agriculture production, and mitigation of floods in the plain areas of North-East. Most of the forests (about 85%-90%) are community owned. The following steps are suggested for the management of these forests:-

4.7.1 These forests will be treated as mosaic of community forest management landscapes and will be delineated and mapped having well defined digitized boundaries.

4.7.2 The capacity building of forest management by democratic institutions such as existing autonomous district councils and other authorities in North-East will be taken up by the State Forest Departments. Departments will also play proactive role in preparation of working plan and working schemes and management plans of protected areas in the North-East in totality.

4.7.3 The community ownership and participation for forest protection, conservation and increase in cover will be ensured.

4.8 Legal and institutional frameworks Appropriate laws, rules and regulations, as per requirement, will be put in place and existing ones suitably amended for effective implementation of this policy. Institutionalized legal support will form an integral part of the forest administration and management. A National Board of Forestry headed by the central minister in-charge of forests and State Boards of Forestry headed by state minister in-charge of forests will be established for ensuring inter-sectoral convergence, simplification of procedures, conflict resolution and periodic review.

4.9 Training and Skill development Stress will be given on training of frontline staff who are at the cutting edge of the forest department. The Directorate of Forest Education and various state training institutions will be strengthened for undertaking trainings for the field functionaries of the departments. Forest Skill Development Centres for skilling forest dependent population in forestry sector jobs will be instituted with the help of National Skill Development Corporation & State Skill Development Agencies. Further forum for interaction and collaboration would be set up for Forest based industries with forestry institutions so that a demand for trained professionals is created in the sector.

4.10 Financial support Forests and wildlife management and improvement in government forests for ecological security, is a cost intensive government mandate. Increasing the green cover and enhancing quality of forests area will be organised with appropriate dovetailing of various sectoral budgets. Therefore, innovative approaches are

needed for achieving the targets set for greening the country. Following actions will be pursued.

4.10.1 The budget of the forestry sector of the states will be enhanced proportionately to the allocation of central resources devolved, based on the finance commission weightage on forest resources of the States. Allocations for community development programmes especially those of agricultural and rural development in the states will also be utilised in forest areas in proportion of the population linked to the forests for life support.

4.10.2 Central assistance to the states will be enhanced for research, trainings/HRD, support for management of community rights in forests and wildlife management. National flagship programmes like forestry and wildlife research, management of protected areas, species recovery of identified species, management of human wildlife conflict, combating wildlife crime will be further strengthened with central funds.

4.10.3 The Compensatory Afforestation fund which is being transferred to the states would be a major source of funds for taking up Afforestation & rehabilitation works in degraded forest areas as well as for bringing new areas under forest & tree cover.

4.10.4 Efforts for tapping funds from other national sectors like Rural Development, Tribal Affairs, National Highways, Railways, Coal, Mines, Power, etc., will be taken for appropriate implementation of linking greening with infrastructure and other development activities.

4.11 Harmonization with other policies and laws Forests influence, and in-turn are influenced by activities and functions of different sectors such as Tribal affairs, mining, water, roads, tourism, agriculture, rural development, industry, irrigation and transmission lines etc. As far as community forest resources management under Forest rights Act is concerned, the new policy will address the same under participatory forest management and the same will be addressed through the proposed community forest management mission. It is also seen that the prescriptions under the farm forestry and urban greenings will ensure synergy with the existing agroforestry policy also. Necessary collaborative steps will also be undertaken to ensure that the policies, laws and programmes of various sectors, both at Centre and State level are in harmony with the objectives of this policy.

4.12 Assimilation of International Commitment and foster regional Cooperation India is party to a number of international conventions and instruments which have a direct bearing on Sustainable Forest Management, Biodiversity Conservation, Climate Change and Country's commitment to Sustainable Development Goals. Integration and assimilation of these multilateral agreements and commitments, as well as regional instruments and protocols into forestry program, strategies and plans will be ensured. Regional cooperation for forestry though trans-boundary landscape will need to be strengthened.

4.13 Good governance The public service delivery system will be strengthened by optimizing human resource availability at all levels, through massive capacity building efforts, reinforcing transparency and accountability measures, prompt grievance redressal and use of cutting edge technology. Institutional restructuring to enable effective implementation of this policy will be facilitated wherever needed. Human resource strategy for professional foresters and forest scientists will aim at attracting and retaining qualified

and motivated personnel, keeping in view, particularly the arduous nature of duties often in remote and inhospitable places. Opportunities for professional growth and specialization will be provided and proper utilization of such specialization will be ensured.

4.14 Implementation framework and way forward This policy envisages that a national implementation framework be put in place to deliver on these policy commitments. States will also prepare an implementation framework. Such national and state level implementation frameworks would specify measurable targets, objectively verifiable indicators, financial allocations, time schedules etc. using the logical framework approach. It will also reflect learning from past experience, identify administrative reforms required, public financing needed, institutional design, human resource strategies, re-structuring of institutions and forest management at all levels and measures for improving institutional capacity.

4.15 Periodic review The National and State Boards of Forestry will review implementation of this policy periodically. The achievements and progress made in implementing this policy will be monitored to ensure smooth and timebound translation of this policy into action.

CHAPTER II

FOREST ORGANISATION

1.Territorial Classification

Block – It is a main territorial division of a forest. It is normally bounded by natural features and bearing a local name. A forest block has clear-cut boundary which should carry boundary pillars.

Compartment – A block is divided into several compartments. A compartment is a permanent unit of forest for the purpose of administration and record. It is the smallest Working Plan unit of management. Its boundaries are carefully chosen on the ground and marked on the map. The boundaries are formed by natural features or permanent fire lines. The extent of area of a compartment depends on the intensity of management. A compartment is designates by numerals 1, 2, 3 etc.

2. Silvicultural Classification - From the point of view of silvicultural management, forests are classified into (1) Working Circle, (2) Felling Series, (3) Coupes, and (4) Periodic Blocks.

2.1 Working Circle – Working Plan (WP) is a written scheme of management aiming at continuity of policy and action and controlling the treatment of a forest. A WP is usually prepared for a forest division. That is, for each division there should be a corresponding WP. Since the area covered by a WP (area of a Division) is large and normally heterogeneous in composition, different silvicultural treatments and different working rules (prescriptions) should apply to different parts of the area. The different parts into which the WP area gets divided from the viewpoint of management prescription are called Working Circles (WC).

A W.C may be defined as a forest area (forming part or whole of the W.P area) organized with a particular object and subject to one and the same silvicultural system and the same set of Working Plan prescriptions).
In some cases, however, the Working Circles may overlap.

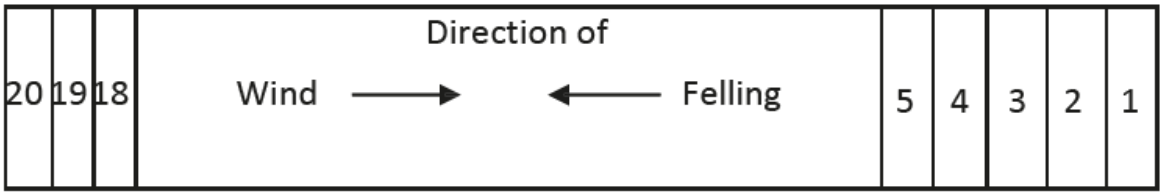
2.2 Felling Series - To avoid concentration of felling to a particular area and to distribute forestry works over a number of Ranges, a W.C is normally divided into **Felling Series (F.S.)**.

A F.S. is defined as a forest area forming the whole or part of a W.C. and delimited so as:
(1) to distribute felling and regeneration to suit local conditions and
(2) to maintain or create a normal distribution of age classes [Normal distribution of age class – A complete series of age classes in such proportion as will permit equal volumes from annual or periodic fellings.]

Each F.S. is assigned a self contained unit of management (say, annual or periodic felling area) with a separate calculation of yield and a separate series of silvicultural operations say tending operations. When a W.C. is not divided into several F.S, one F.S covers the entire W.C.

2.3 Coupe – In a clear-felling system, a F.S. is divided into a number of **Annual Coupes**. If the Rotation age is **R years**, and the area of a F.S. is **A ha, then the number of annual coupes is A/R ha.** Each F.S will have all the R age-gradations. The management unit of coupe is explained with reference to clear-felling system.

The following diagrams give an illustrative example for a felling series of 20 age gradations (R =20 years). Fig.2.1 shows diagrammatically in plan the F.S of 20 age gradations divided into 20 equal annual coupes.



Plan of a F.S with 20 annual coupes

It may be noted that felling should start against the prevailing direction of wind. The profile would then be as shown, that is, the smallest trees would be in the windward direction when the felling series has been established. The younger trees will break the wind speed and protect the older ones in the rear.

Forest Organisation – Silvicultural classification:

1. Periodic Blocks:

1.1 Please refer to management units with reference to Clear-felling system described in previous lesson. In Uniform system of natural regeneration, we have 'age class' in place of 'age gradation', and 'periodic blocks (PB)' in place of annual coupes. Each P.B has one age-class instead of one age-gradation.

1.2 A Periodic Block (PB) is defined as a part of 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 PB s are allotted and they retain their territorial identity at Working Plan revision, they are termed "fixed" or "permanent". (Ram Parkash 1986 Forest Management)

Arrangement of age classes is shown in **Fig.3.1**. The PB I contains trees in the age class 91-120 years, PB II trees in the age class 61-90 years, PB III trees in the age class 31-60 years, and P.B IV trees in the age class 1-30 years. Each P.B is regarded as approximately even aged (Even-aged stand is one which consists of trees of approximately the same age. Variation upto 25% of rotation age is allowed when the rotation is 100 years or more. Thus in the present case the PBs are even-aged stands). The first thirty annual coupes or age-radations are grouped together to form P.B I . The P.B I coupes will be felled, and regenerated gradually by seedling, secondary and final felling during the period of first thirty years. After the lapse of first thirty years, P.B I will automatically move to PB IV (age class 1-0 years), PBI to PB II (31-60 years), PB II to PB III (61-90 years) and PB II to PBI (91-120 years). At the end of 120 year rotation, the original P.B I area will again become P.B I, and the whole F.S or WC will be converted into four P.B s containing age classes as shown in

Suppose the rotation is 120 years and the regeneration period 30 years.
[Regeneration period is the period required to regenerate the whole area of a P.B.
The regeneration period depends on the species and the locality factors].

The number of PBs in the Felling Series

$$= \frac{Rotation}{Regeneration\ period} = \frac{120}{30} = 4$$

$$\text{The normal area of each PB} = \frac{\text{Area of F.S}}{\text{Number of P.B}}$$

Arrangement of age classes and P.B s in a F.S worked under Uniform System

2. Felling Cycle - Selection Forest

A Selection forest is one which is managed under Selection system. A selection forest is an uneven-aged crop containing many, theoretically all age-classes or gradations.

2.1 Ideally, the entire area of a selection forest should be gone over every year and the entire forest should represent a complete and undivided felling series. Since annual working of the entire area is not feasible, the forest area is divided into a number of coupes. Each of these coupes is worked at an interval of planned number of years, which is known as **felling cycle.**

2.2 Felling Cycle is defined as the time that elapses between successive main fellings on the same area. **The number of coupes will be equal to the number of years in the Felling Cycle.**

2.3 Let us take an example of a Selection Forest

Suppose -
Area of a Felling Series (or W.C if there is one F.S) = 200 ha.
Rotation = 50 years.
[In ideal selection system, the entire 200 ha will be worked annually on selection basis for 50 years, that is trees of rotation age (50 years) will be harvested from the whole forest every year]

However, in periodic felling system, the FS is divided into coupes to be worked in felling cycles. Suppose,
Felling cycle planned = 5 years,
Then number of felling coupes = 5, each of area 40 ha. Every coupe will be worked at an interval of 5 years, that is, 10 times during the rotation. In the year of harvest in a coupe, trees ranging from 45 to 50 years in age would be felled, and the coupe will be revisited after 5 years to do the same operation. **In each felling the intensity or quantity of harvest in a coupe will be 5 times of what would have been, had the entire felling series been worked every year as envisaged in ideal or true selection system.**
The Felling series with 5 felling coupes and the sequence of felling is illustrated in Fig.3.2.

I	II	III	IV	V
1,6,11,.....46	2,7,12,.....47	3,8,13,.....48	4,9,14,.....49	5,10,15,.....50

Fig.3.2 Felling Series worked on 5-year Felling Cycle.
(Numerical figures denote the year of working)

CHAPTER III

SUSTAINED YIELD

1. Concept and definition

The principle of maximum sustained yield forms the basic objective of good forest management. Sustained yield has been defined by many authors in various ways. Some of the definitions of sustained yield, which carry same meaning in different ways, are given below.

• The material that a forest can yield annually (or periodically) in perpetuity.
• The regular, continuous supply of the desired produce to the full capacity of forest.
• The yield of timber or other forest produce 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.

1.1 Yield from forest includes all forest products, both tangible and intangible. So, ideally the principle of sustained yield should ensure continuous supply, in equal amounts, of both material and intangible benefits.

1.2 Concept of sustained yield has emanated from the unavoidable obligation that the later generations may enjoy from the forest at least as much of the benefits as the present generation.

1.3 The management for sustained yield demands that the annual or periodic fellings do not exceed the annual or periodic growth, as the case may be. The sustained yield is thus expressed as the allowable cut, annually or periodically, which is approximately equal to the net increment of forest (i.e. gross increment minus the natural loss), annually or periodically.

1.4 The basic aim of forest management is to keep the forest land productive. It is obvious that sustained yield from the forest is not possible unless the productivity of forest land is kept intact. Sustained yield management therefore means continuity of harvest without impairment of productivity of forest soil.

2. Normal Forest

At the very outset it should be noted that 'Normal Forest' **does not mean usual, common or regular forest**, as the connotation of the word 'normal' may perhaps indicate. Normal Forest is a conception of forest management based on the principle of **sustained yield**.

2.1 Definition – Normal Forest is variously defined. A couple of definitions are described below.

i. A forest which, for a given site and given objects of management, is ideally 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.

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

3.2 Attributes/Characteristics of Normality

A Normal Forest being an ideal forest managed for sustained yields in perpetuity has the following **three main attributes**.

I. A normal series of age-gradations or age-classes.
II. A normal increment
III. A normal growing stock

3.2.1 Normal series of age-gradations or classes – It means trees of all ages from one yearold to rotation age are present in appropriate quantity. If the trees of each age occur on separate areas, they constitute a **series of age-gradations**. When the trees fallingwithin certain age limits occur mixed together on the same area, they form an **ageclass**. A very irregular forest which does not exhibit age-gradation or age-class may still be a normal forest, and the sign of normality in this case is the proper distribution of trees of all ages.

3.2.2 Normal Increment – it is the **best or maximum increment** attainable by a given species for a given rotation, per unit area on a given site.

3.2.3 Normal growing stock – It is the volume of stands in a forest with normal age – classes and normal increment.

3.2.4 If the forest has normal age-gradation or age-class and normal increment, obviously it will have normal growing stock. Thus the necessary and sufficient conditions for normality are (i) normal age-gradation or age-class, and (ii) normal increment. It should be remembered that normal forest represents an ideal condition which is rarely achieved in practice.

CHAPTER IV

1. Increment

Increment is the growth of a tree or a crop with age. By the term increment, one may indicate the physical increase of different parameters that increase with time or age. Thus increment may refer to increase of wood content, or any of the factors increasing with age, like, volume, diameter, height, basal area, price etc.

1.1 In Forest Management, the term increment refers normally to volume increment of crop.

1.2 Factors that influence increment

Increment of individual trees or crop is influenced by

- **Species** – fast growing species have larger increment than the slow ones in a given period.
- **Site Quality –** it is natural that superior site quality favours higher increment.
- **Silvicultural Treatment –** silvicultural treatment including tending operations have considerable influence on increment.
- **Nature of the crop –** nature of crop, that is whether even-aged or uneven-aged, influences the increment.

1.3 Increment is an important characteristic

Increment is an important characteristic of a forest crop. It is an indicator of the health of the crop, the site quality, and age or maturity of the crop. It is an index indicating suitability of a species at a given site or performance of a silviculture system.

1.3.1 A virgin forest, or a forest which has remained undisturbed for a long time, or a forest which has reached its climax, will not have any net increment. While individual trees may put on increment, other trees decay and die. In fact, the increment may also become negative for a period if there are adverse locality factors. Thus increment may be an indicator for maturity of a crop or impact of locality factors.

1.4 Current Annual Increment – Definition and concept

The growth that takes place in a particular year is called the Current Annual Increment (C.A.I) for that year. Thus CAI indicates the increase in girth, diameter, basal area, height, volume of individual trees or a crop in a specific year.

1.4.1 Annual Increment of individual tree or crop of a species is not constant. It is rather a function of age of the tree (crop). In other words, CAI depends on the age. So while mentioning the value of CAI, it is necessary to mention the age of the tree (crop) to which the CAI corresponds.

So, if
V_{n-1} = volume of wood produced in (n-1) years, i.e. volume at the age of (n-1) years;
V_n = volume of wood produced in n years, i.e. volume at the age of n years,
CAI at the age of n years = $V_n - V_{n-1}$

1.4.2 It would be apparent from above that to obtain accurate values of CAI, it is necessary to know the values of V_{n-1}, V_n , V_{n+1}, V_{n+2} etc. it is, however, not feasible to measure and record the volume (or other parameter) of tree (crop) every year. Measurement of a tree parameter is normally done at periodic intervals of 5 or 10 years, and increment over such

period is determined, which is called **periodic increment**. When the periodic increment is divided by the years of the period, one obtains **periodic annual increment**, which is taken as CAI for the period.

1.5 Mean Annual Increment – Definition and Concept

The volume of a tree is built up by the annual increments that the tree puts on in successive years. The CAIs vary from year to year. The mean or average of all CAIs is the **Mean Annual Increment (M.A.I)** which denotes average annual rate of growth upto any given age. M.A.I is thus defined as the total increment upto a given age divided by that age. In the context of volume increment,

If, V_n = volume of wood produced in n years, i.e. volume at the age of n years, V_n
M.A.I = V/n
It may be noted that MAI for a tree or crop varies with age.

1.6 Variation of CAI and MAI with age

Both for individual tree and crop, **CAI is small in the early stages** of growth (seedlings and saplings. However, soon **it increases rapidly to a maximum value**, after which CAI declines and finally ceases with the mortality of tree (crop). The sum of CAIs of volume put on during a period gives the total volume which when divided by the period (age) gives the MAI. Being a mathematically computed figure the MAI coincides with the actual values of CAI only on two occasions in the life of the crop – once at the end of the first year, and later when it culminates, that is, reaches its maximum value.

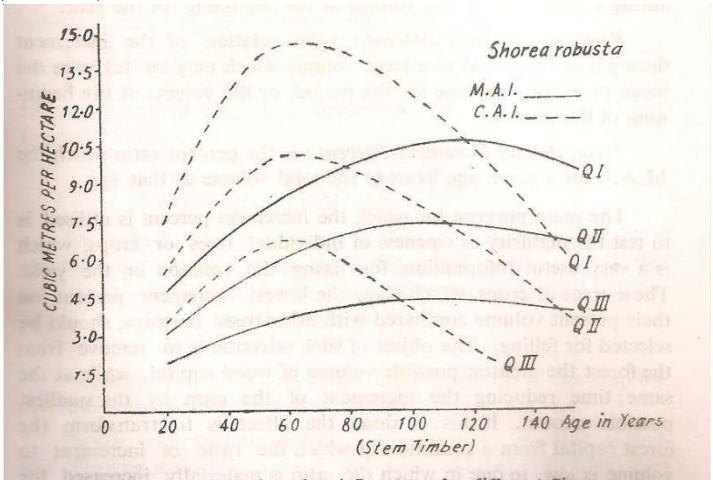


Fig. 5.1 MAI and CAI curves for different site qualities of Sal

• While the crop is young the CAI increases rapidly till it reaches the maximum value at the middle age.

• On account of rise in the value of CAI, MAI also rises but not so steeply as the CAI, as in the calculation of MAI the effect of increasing CAI gets distributed over all the previous years.

• Even after CAI begins to decline, the MAI still continues to rise for a period, as at this stage the declining CAI still remains greater than the average or mean increment.

• The MAI reaches the maximum value where the two curves intersect. In other words, at the age corresponding to the point of intersection, the CAI and MAI equal each other.

• Beyond the point of intersection, both CAI and MAI continue to decline. At this stage, CAI declines faster than the MAI, and CAI is less than the mean.

CHAPTER V

Rotation

1. Introduction

In the context of harvest, forest crops have some characteristic features.

• The main forest produce, that is, timber takes a long time to mature.

• In general, trees should be harvested when they mature, that is, at an age when the timber attains utilizable size and can fetch good price, and beyond which quality of timber starts deteriorating.

• The age of maturity of timber varies from species to species, and also depends on conditions of growth.

• The standard or yardstick of ripeness or maturity of forest crop, however, varies and is determined by forest policy, planning and object of management. Forest crops have utility at different ages. Talking about timber, price per unit volume rises sharply withsize, and therefore if yield of timber is the object of management, crop should be harvested at an age when it gives maximum volume of timber. However, for industrial timber of certain specifications, it may be necessary to harvest trees at a younger stage. For example, for mining timber, stems of pole size are required.

1.1 Rotation or Production period is the time that elapses between the formation and finalfelling of a forest crop. It is also **defined** in many ways by different authors.

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

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

(3) 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. (Knuchel)

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

2. Rotation in Regular and Irregular crop

The concept of rotation, as defined above, strictly speaking, applies to regular crops only. In regular forests, entire crops over a sizable area are felled at a time (as in clear felling system) or over a short period of time (regeneration period in regular shelterwood system). Thus there is a clear production period. This production period or rotation is planned in advance, and is uniquely fixed for a Working circle.

2.1 In unevenaged (irregular) selection forests, trees are selected for felling individually based on –

• Size, health and marketability;

• Adjustment of proportion of different sizes;

• Silvicultural requirements.

Thus in an irregular forest, size is a major criterion for felling and there is no final felling of a given area of a crop. It is thus more logical to say that rotation in irregular forest is equal to the average age of the exploitable size trees removed. 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 exploitable (or utilizable) size.

3. Types of Rotation

In forest management, various types of rotation are in vogue. They are –

- Physical Rotation
- Silvicultural Rotation
- Technical Rotation
- Rotation of Maximum Volume production
- Rotation of Highest Income
- Financial Rotation

3.1 Physical Rotation

Physical rotation is the rotation which coincides with the natural lease of life of a given species on a given site. rotation varies with species and site factors. The concept of physical rotation is to let the trees thrive till they die. It is adopted in protection and amenity forests, wildlife protected area, ecological park, avenue plantations etc. Physical rotation is also interpreted as the age upto which trees remain sound, or produce viable seeds in high forests, or generate coppice shoots in coppice forests.

3.2 Silvicultural Rotation

It is the rotation through which a species retains satisfactory vigour of growth and reproduction on a given site. From the definition it follows that silvicultural rotation is not less than the age at which trees start producing fertile seeds, and again not higher than the age when their reproductive capacity stops. It is quite long and has a wide range of limits. Silvicultural rotation is applicable in aesthetic and recreational forests. According to some foresters, there is no distinction between physical and silvicultural rotation.

3.3 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. The object of management under technical rotation is to produce maximum material of given specifications of dimensions and quality. Examples are railway sleepers, sawlogs, mining timber, transmission poles, match-wood, paper-wood etc. Since the same tree can produce assortment of material and trees of different species in a crop have varying rate of growth, it is difficult to fix a definite technical rotation for a crop. What is feasible is to adopt limits within which harvest can produce assortment of desired materials in better quantity and quality.

3.4 Rotation of Maximum Volume Production

It is the rotation that yields the maximum annual quantity of material, that is, the age at which the Mean Annual Increment (MAI) culminates.

3.4.1 The MAI referred to is that of the stand and not that of individual tree. The quantity referred to includes final volume obtained at the end of rotation, as well as material from all thinnings.

3.4.2 This rotation coincides with the age at which average rate of growth in volume per unit area reaches its maximum value. Please recollect from Lesson 5 that this is the age where CAI and MAI equal each other, that is, the age corresponding to the point where CAI and MAI curves intersect each other.

3.5. Rotation of Highest Income / Revenue

It is the rotation which gives 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.

3.6. Financial (or Economic) Rotation

It is the rotation which gives the highest net return on the invested capital. Financial rotation is different from the rotation of highest income/revenue, as calculation of all revenue and expenditure in this case is done with compound interest at an assumed rate.

4. Fixation of rotation

Rotation of a forest crop is determined upon consideration of many factors. In general, the factors to be considered are given below.

- The size of timber that is in local and national demand is considered.
- Keeping in view the growth rate, the prevailing site quality, and the thinning practice in vogue, the age corresponding to the desired size.
- The age of maximum volume production, and the silviculture of species to arrive at a tentative rotation.
- Determination of rotation of maximum net income;
- Silviculture practice to attain a rotation and feasibility for adoption of such practice.
- Judicious consideration of all relevant factors and to strike a compromise.

3. Definitions of some terms

Some of the terms related to yield are defined as follows.

- **Yield** – The volume or number of stems that can be removed annually or periodically, or the area over which felling may pass annually or periodically, consistent with the attainment of objects of management.

- **Final Yield** – All the material that counts against the prescribed yield and which is derived from the main fellings in a regular forest.

- **Intermediate Yield** – All material from thinnings or operations preceding the main felling in a regular forest.

- **Normal Yield** – Yield from a normal forest

- **Sustained Yield** – The material that a forest can yield annually (or periodically) in perpetuity.

- **Total Yield** – Sum of final and intermediate yields

CHAPTER VI

Working Plan

1. Introduction and Definition

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).

1.1 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.

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

2. 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.

2.1 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)

2.2 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)

3. 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.

3.1 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.

4. Organizational Structure

A. 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.

B. 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. 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.

5.1 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.

6. 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.

7. 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

7.1 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.

Draft 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.

8.1 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).

8.2 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.

9. 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**.

CHAPTER VII

Working Plan (continued)

1. 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.**

1.1 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.

1.2 Forest resource assessment

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

• **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;

• **Maintenance and Enhancement of Forest Health and Vitality:** Status of regeneration, area affected by forest fires, area damaged by natural calamities,M area protected from grazing, lopping practices, area infested by invasive weed species in forests, Incidences of pest and diseases, forest degradation and its drivers;

• **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;

• **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;

• **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;

• **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.

1.3 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.

1.4 Assessment of non-timber forest products

WPO may plan and undertake survey, sampling and assessment for estimation of few prioritised 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.

1.5 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.

1.5.1 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.

1.6 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:

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

b. Fair regeneration, if seedlings are more in numbers than the saplings but the saplings are equal or less than that of adults.
c. Poor regeneration, if a species survives in only sapling stage, but not as seedlings (though sapling may be less, more or equal to adults).
d. No regeneration, if a species is absent both in sapling and seedling stage, but present as adult.
e. New regeneration, if a species has no adults but only sapling and/or seedlings.

1.7 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.

1.8 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

1.9 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.

1.10 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.

1.10.1 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.

1.11 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.

1.12 2 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.

CHAPTER VIII

WORKING PLAN (CONTINUED)

1. 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.

1.1 Exclusive or Overlapping Working Circles

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.**

• **Overlapping working circle for sustainable management of bamboos /rattans** based on the availability and assessment of bamboos/rattans.

• **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.

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

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

• **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.

CHAPTER IX

CONTENTS OF THE PLAN

PART- I

Summary of facts on which proposals are made

1.The Tract Dealt with

2. Maintenance/ increase in the extent of forest and tree cover

2.1 Area of forests under different legal classes

2.3 Percentage of forest with secured boundaries Locations
2.4 Land use, land use change and forestry (LULUCF)
2.5 Threats to the forest
2.6 Distribution of different forest types.
2.7 Tree cover outside forest area
.

3. Maintenance, Conservation and Enhancement of Biodiversity

3.1 Forest composition anddistribution
3.2 Plant species diversity Biodiversity assessment in terms of density, frequency, total basal cover, dominance,
3.3 Status of biodiversity conservation in forests
3.4 Status of species prone to over exploitation
3.5 Conservation of genetic
Resources Preservation plots, sample plots, medicinal plants conservation areas, community conservation areas, etc.
3.6 Fauna and their habitats
3.7 Threats and challenges towildlife
3.8 Protection and management of fauna

4. Maintenance and Enhancement of Forest Health and Vitality

4.1 Status of regeneration
4.2 Area affected by forestfire
4.3 Area damaged bynaturalcalamities
4.4 Area protected fromgrazing
4.5 Lopping practices
4.6 Area infested byinvasiveweed species in forests
4.7 Incidences of pest anddiseases
.
4.8 Forest degradation and its drivers
4.9 Pollution control and protection of environment

5. Conservation and maintenance of soil and water resources

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

6. Maintenance and enhancement of forest resource productivity

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

7. Optimization of forest resource utilization

7.1 Recorded removal of timber

7.2 Recorded removal of fuel wood
7.3 Recorded removal of bamboo/ rattans
7.4 Recorded removal of locally important NTFPs
7.5 Demand and supply oftimber and important non-timber forest produce
7.6 Import and export of wood and wood products
7.7 Import and export of NTFPs
7.8 Removal of fodder & Description of cattle rearing community of forest dwellers
7.9 Valuation of the products

8. Maintenance and enhancement of social, economic, cultural and spiritual benefits

8.1 Number of JFM committees and area
8.2 Status of empowerment
8.3 Labour welfare
8.4 Use of indigenous knowledge
8.5 Extent of cultural/sacredgroves
8.6 Ecotourism areas and activities
8.7 Social customs Prevalent social customs relevant to forests.
8.8 Status of compliance of Forest Right Act (FRA)
8.9 Other Rights and Concessions
8.10 Dependency of local people on NTFPs

9. Adequacy of Policy, Legal and Institutional framework

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

10. 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.

11. Past systems of management

11.1 General history of the forests
11.2 Past system of management and their results
11.3 Special works of improvement undertaken
11.4 Past yield, revenue and expenditure
12. Statistics of growth and yield
12.1 Statistics of forest carbon stock

PART II

Future Management

1. Basis of proposals

1.1 Objectives of management

(i) Dynamics of Forests and Stands:
(ii) Forests and Soil:
(iii) Forests and Water:
(iv) Forest Biodiversity:
(v) Climate and Forests:
(vi) Socioeconomic considerations and generation of forest based employment opportunities and livelihood options:
(vii) Tool for integrated development:

1.2 Method of treatment to be adopted
1.3 Constitution of working circles
1.4 Period of working plan and necessity for intermediate revision

2. CHAPTER 2 to last CHAPTER (say N)

2.1 (Name of) working circle(Clearly marked on GIS based maps(1: 50,000)
There will be a separate chapter for each working circle including the overlapping ones. Last chapter identified with a working circle is presumed as N (last in row) which has a
2.2 General constitution of working circle
Mapping and summarization of working circle area statement by ranges, blocks, and compartments included in the circle indicating gross area and showing forest type and density classes (as adopted by FSI).
2.3 General characteristics of vegetation
2.4 Felling series, cutting sections and JFM areas
2.5 Blocks, compartmentsandJFM area (marked onGISbased maps).
2.6 Special objectives of management
2.6.1 Analysis of the crop Stock maps, range and mean of quality and age
2.6.2 Silvicultural system Define the system and give reasons for its adoption.
2.6.3 Rotation period The growth and other data on which the rotation is based are discussed.
2.6.4 Harvestable diameters These are prescribed species wise according to their site quality.
2.6.5 Reducing factors and reduced areas In general, reducing factors are used for quality and density for species for which yield tables are available.
2.6.6 Felling cycle Wherever applicable, it is fixed and reasons given.
2.6.7 Division into periods and allotment to periodic blocks (PB)
2.6.8 Calculation of the yield The yield calculation method adopted for sustainable harvesting should be indicated.
2.6.9 Table of felling Fellings are tabulated year-wise by ranges, blocks, compartmentsfor
2.6.10 Method of executing thefelling
2.6.11 Subsidiary silvicultural operations cleaning and thinning
2.6.12 Regeneration Methods of assisted natural regeneration based on status of natural regeneration may be prescribed.
2.6.13 Associated regulations and measures