Training of Trainer in Forest Management

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Our Cover: Women from the local community gather firewood in the Tilaurakot Collaborative Forest of Kapilvastu. By Pawan Karki

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Acronyms

AEFM	Active and Equitable Forest Management
ANR	Assisted Natural Regeneration
BFMP	Block Forest Management Plan
BS	Bikram Sambat
CAI	Current Annual Increment
CBFM	Community Based Forest Management
CF	Community Forests
CFD	Community Forestry Directives
CFUG	Community Forest Users Group
CFUC	Community Forest Users Committee
CP	Cooperative Policy
D	Diameter
DBH	Diameter at Breast Height
DFO	Divisional Forest Officer
DFPSC	District Forest Product Supply Committee
ECM	Executive Committee Meeting
FAO	United Nations for Food and Agriculture Organization
FC	Forest Conditions
FECOFUN	Federation of Community Forest Users Nepal
FMP	Forest Management Plan
FOP	Forest Operational Plan
FR	Forest Regulation
FSC	Forest Stewards Council
FUG	Forest Users' Group
GA	General Assembly
GESI	Gender Equality and Social Inclusion
GoN	Government of Nepal
GPS	Global Positioning System
GS	Growing Stock
GSS	Group Selection System
IPLC	Indigenous People and Local Communities

Kg	Kilogram
KI	Key Informant
LG	Local Government
LL	Local Level
m^3	Cubic meter
MAI	Mean Annual Increment
MoFE	Ministry of Forests and Environments
NTFPs	Non-Timber Forest Products
NRM	Natural Resources Management
OP	Operational Plan
PAI	Periodic Annual Increment
PFC	Program for Forest Certification
PPE	Personal Protective Equipment
REDD+	Reduce Emission from Deforestation and Forest Degradation Plus
RFA	Rapid Forest Assessment
RFRA	Rapid Forest Resources Assessment
SFM	Sustainable Forest Management
SOAR	Strengthen
Sqm	Square Meter
SS	Silvicultural System
UG	User's Group
UNDP	United Nations Development Program
UTM	Universal Transverse Mercator
WB	World Bank
WGS	World Geodetic System
WRB	World Reference Base

Definition of Key Terminologies

Afforestation: Establishment of a forest in a previously unforested area.

Annual allowable cut: Volume of trees biomass that can be harvested annually from a forest without affecting its growth and health.

Artificial regeneration: Artificial regeneration is defined as the renewal of forest crops by sowing, planting, or other artificial methods.

Biodiversity: The variety of life forms in each area can be categorized in terms of number of species, variety of plant and animal communities, genetic variability, or some combination of these categories.

Biomass: Any organic matter, including forest and mill residues. Forest biomass is usually obtained through in-woods chipping of all or some portion of trees, to include tops and limbs, for energy production.

Block: An area of land or timber that has been defined for management purposes. One block may be composed of stands of different species or ages.

Breast height: A fixed height of 1.3 meters above the ground level.

Canopy: A layer or multiple layers of branches and foliage at the top or crown of a forest's trees.

Clinometer: An instrument that is held at eye level to read stump height and merchantable or total height when standing 50 and 66 feet from the base of the tree. The difference between the two readings yields the height.

Competition: The struggle between trees to obtain sunlight, nutrients, water, and growing space. Every part of the tree, from the roots to the crown, competes for space and food.

Conifer: A class of trees that are evergreen, have needle or scalelike foliage and conelike fruit; often called softwood. Examples include pine, hemlock, cedar, and cypress.

Conservation: Planned management and wise use of natural resources for present and future generations.

Cover: (a) Any plant that intercepts rain drops before they reach the soil or that holds soil in place; (b) a hiding place or vegetative shelter for wildlife from predators or inclement weather.

Crown: The branches and foliage at the top of a tree.

Crown-class: A tree classification system based on the tree's relative height, foliage density, and ability to intercept light. Crown-class measures past growth performance and calls attention to crop trees that could benefit from future thinning and harvest operations. There are four classifications: a) **Dominant trees:** Larger-than-average trees with broad, well-developed crowns. These trees receive direct sunlight from all sides and above. b) **Codominant Trees:** Average-to-large trees with medium-sized crowns that form the forest canopy. These trees

receive full light from above but are crowded on the sides. c) **Intermediate Trees:** Medium-sized trees with small crowns below the general level of the canopy. Intermediate trees receive little direct light, are poor crop trees, and should be removed during thinning operations, and d) **Suppressed or Overtopped Trees:** Small trees that grow below the tree canopy and receive no direct sunlight from any direction.

Current annual increment: Increment of trees or stands in each year. Increment can be height, diameter or biomass.

Deforestation: The permanent conversion of land from forest to non-forest. FAO defines deforestation as "the conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10% threshold."

Degradation: Degradation refers to changes within the forest that negatively affect the structure or function of the forest stand or site, and thereby lower its capacity to supply products and services.

Diameter of tree: Diameter measured at 1.3 meters above ground level.

Diameter tape: A steel measuring tape that has a scale calibrated to read a tree's diameter when wrapped around the tree's circumference.

Ecosystem: A loosely defined area consisting of numerous habitats.

Ecosystem services: Benefits people obtain from the goods and services produced by an ecosystem e.g., water and air purification, nutrient recycling, recreation, biomass for fuel.

Erosion: The wearing a way of land or soil by the action of wind, water, or ice.

Even-aged Forest: Forest composed of trees at almost the same age. A natural forest with 25% variation in age is also considered an even aged forest.

Felling diameter: A threshold diameter set to harvest trees from a forest. Also known as exploitable diameter.

Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%

Forestry: The art and science of managing forests to produce various products and benefits including timber, wildlife habitat, clean water, biodiversity, and recreation.

Forest management plan: Written guidelines for current and future management practices recommended to meet management objectives.

Forest operational plan: Approved plan to manage a forest for a certain period.

Forest type: Groups of tree species commonly grow in the same stand because their environmental requirements are similar.

Group selection: (a) The removal of small groups of trees to regenerate shade-intolerant trees in the opening (usually at least 0.101 hectare). (b) A specific type of selective felling.

Growing stock: Sum of trees/plants growing in a forest by number or by volume.

Improvement felling: An intermediate cut made to improve the form, quality, health, or wildlife potential of the remaining stand.

Increment: Growth of a tree or a forest in terms of height, diameter or biomass in a certain period

Mature tree: A tree that has reached a desired size or age for its intended use. Size, age, or economic maturity varies depending on the species and intended use.

Mixed forest: Forest composed of two or more species of trees/plants.

Mother tree: Tree retained in a forest to produce seeds and provide shelter.

Natural regeneration: The growth of new trees in one of the following ways without human intervention: (a) from seeds carried by wind or animals, (b) from seeds stored on the forest floor, or (c) from stumps that sprout.

Non-timber forest products: Any product derived from the forest that is not used as timber — e.g., medicinal herbs, resins, mushrooms, berries, ferns, cones.

Periodic annual increment: The average annual increment of crop within certain period

Pest: Any organism that is out of place or causes stress to a desired organism.

Pole: A plant with a diameter between 10 and 29.9 centimeters

Prescribed or controlled burning: The use of fire under specific environmental conditions to achieve forest management objectives. Used to reduce hazardous fuel levels, control unwanted vegetation, favor desired vegetation, and improve visibility and wildlife habitat.

Pruning: Removal of live or dead branches and twigs from a plant

Pure forest: Forest composed of at least 80% trees of a single species.

Pure stand: A timber stand in which at least 75 percent of the trees in the main crown canopy are of a single species.

Reforestation: Reestablishing a forest in a deforested land or degraded forest

Regeneration felling: A cutting strategy in which old trees are removed while favorable environmental conditions are maintained for the establishment of a new stand of seedlings.

Regeneration period: Time period between regeneration and forest establishment

Reproduction: (a) The process by which young trees grow to become the older trees of the future forest. (b) The process of forest replacement or renewal through natural sprouting or seeding or by the planting of seedlings or direct seeding.

Rotation age: Time period between regeneration and final felling of a forest crop

Rotation: The number of years required to establish and grow trees to a specified size, product, or condition of maturity.

Sample plot: It's a representative area used to collect information about a forest's composition and structure.

Sapling: Sapling is a tall perennial woody plant having a main trunk and branches forming a distinct elevated crown; includes both gymnosperms and angiosperms. Saplings generally have greater than 1.3 m height and have a diameter at breast height less than 5 cm.

Seed tree felling: A harvesting method in which a few scattered trees are left in the area to provide seeds for a new forest stand. Selection of seed trees is based on growth rate, form, seeding ability, wind firmness and future marketability. This harvesting method produces an even-aged forest.

Seed year: A year in which a given species produces a large seed crop over a sizable area. Some species of trees produce seeds irregularly.

Seedling: Seedling is a young plant sporophyte developing out of a plant embryo from a seed. Seedling development starts with germination of the seed having a height less than 1.3 m. It can be considered as regeneration materials.

Selective felling: The periodic removal of individual trees or groups of trees to improve or regenerate a stand.

Shelterwood felling: Removing trees in the harvest area in a series of two or more cuttings so that new seedlings can grow from the seeds of older trees. This method produces an even-aged forest.

Shrub: Shrubs are woody perennial plants, generally of more than 0.5 m and (usually) less than 5 m in height on maturity and without a definite stem, i.e., they produce several shoots or trunks from the base.

Silviculture: Science of cultivating and growing forest crops.

Silvicultural operation: Silvicultural treatment applied to cultivate and grow a tree or a forest crop.

Silvicultural system: Planned program of silvicultural treatments during the entire life of a forest crop.

Site preparation: Preparing an area of land for planting, direct seeding, or natural reproduction by burning, chemical vegetation control, or by mechanical operations such as disking, bedding, scarifying, windrowing, or raking.

Slash: (a) Tree tops, branches, bark, or other residue left on the ground after logging or other forestry operations. (b) Tree debris left after a natural catastrophe.

Slashing: (a) A harvesting function of cutting felled trees into shorter lengths; also known as bucking. (b) a cleaning practice used in plantations to cut back less tough competing vegetation with a light cutting tool or machine.

Species: A group of related organisms having common characteristics and capable of interbreeding. Loblolly and Virginia pine are common species that can be interbred.

Stand: A group of trees that are sufficiently the same in species composition and arrangement of age classes and condition so that they can be managed as a unit.

Stocking: A description of the number of trees, basal area, or volume per acre in a forest stand compared with a desired level for balanced health and growth. Most often used in comparative expressions, such as well-stocked, poorly stocked, or overstocked.

Stump height: stump height is measuring 15 cm above the ground level. Stump: Remaining part of cut tree usually height is less than 1.3 m.

Sustained yield: Management of forestland to produce a relatively constant amount of wood products, biomass, revenue, or wildlife.

Thinning: A tree removal practice that reduces tree density and competition between trees in a stand. Thinning concentrates growth on fewer, high-quality trees, provides periodic income and generally enhances tree vigor. Heavy thinning can benefit wildlife through the increased growth of ground vegetation.

Tree: A perennial woody plant that has many secondary branches clearly above the ground on a single main stem or trunk with clear apical dominance. Plant with a diameter of at least 30 centimeters

Understory: The area below the forest canopy that comprises shrubs, snags, and a small tree. Because the understory receives little light, many of the plants at this level tolerate shade and will remain part of the understory. Others will grow and replace older trees that fall.

Uneven-aged Forest: Forest composed of trees/plants with various ages or ages classes

Volume table: Table showing the estimated average volume of trees based on diameter, or diameter and height.

Wildlife: A broad term that includes non-domesticated vertebrates, especially mammals, birds, and fish.

Wood: The solid interior of a tree.

Yield: Number or volume of trees that can be harvested annually or periodically, from a forest

Yield regulation: Yield regulation means to estimate the amount of yield, i.e., how much should be harvested (cut), where to harvest, when to harvest and 'in which form', i.e., either main felling, intermediate felling, etc.

Introduction

Training approach

The training design has been created on principles of participatory learning, bottom-up idea's consolidation, more field-based exercise rather than class theory, encouraging contributions from all so that participants can construct on their own experiences. A participatory approach encourages mutual respect, confidence, cooperation, learning exchange, value each other and shared decision-making during the training.

The aim is for participants to replicate these methods in their own training. Some of the core values are:

- All sessions will be active and practical.
- The emphasis will be on peer support, positive feedback, and excitement.
- Experienced trainers in facilitation will support interactive learning processes.
- The series of learning sessions will allow participants to practice their skills.
- At regular intervals, participants will be given the chance to extract their own lessons learned.

How to strengthen the learning process

This training manual is proposed to guide a learning process that pulls on ideas based on adult experiential learning (Kolb 1984, Kolb et al 2000) and social learning theory (Buck et al 2001, Cundill et al 2014). The training methodology is based on the following essential features:

- Participants are plentiful sources of information, and their individual experiences offer a considerable resource for problem-solving and learning.
- Participants should be actively employed in the process of their own learning, especially in any pretraining assignments and exercises during the training period.
- Learning is activated by inspiring participants in training to pursue new knowledge, skills, and behavior and to utilize the newly learned knowledge and skills in their work and personal environments. Facilitation of such learning appears only by fully engaging participants in new practices and by having them follow, reflect, and take out upon these experiences to progress.
- Learning prospers in a setting that nurtures, partnership and the exchange of ideas and perspectives. People learn by modelling, observing and imitating others. Establishing

learning conditions in which participants can work and learn together is thus essential in this regard.

In line with this training approach, and to reach the learning objectives, the training sessions in this manual have been organized around the following basic steps:

■ An activity that helps participants understand concepts through facilitated and structured experience, both through indirect (such as observation or field exercise) and direct (such as group exercise) exposure.

■ An analysis that allows participants to examine and reflect on the completed activity.

■ Assimilation to help participants synthesize their ideas and perspectives.

■ Application, carried out by means of assignments or action plans, in order that participants learn how to practically use their new knowledge and skills. These four steps help both participants and trainers evaluate the learning achievements in relation to the expected results.

Need for manual.

In the past Nepal used to get trained forester from Deharadun India and currently they are graduated within the country. Forest management in Nepal has been practiced over hundred years. Selective felling in the thick forest blocks were practiced during the Rana regimes to supply timber to India for railway league construction. However, science-based forest management began during 1970^{s}. Forest management objectives mostly driven by socio-economic of the user and hence the management interventions are not static. In addition, several new technologies are immersed in this sector and once of learning process may not be sufficient for forestry technicians to meet the requirement of present day. Hence, they need to update and refresh forest management skills and knowledge.

Target group of the manual

This training manual has been prepared for the forest technicians/officers/facilitators who are involved in the planning and implementation of the forest management and the delivery of this information to various stakeholders such as community based natural resource management group, forest technicians and students. This manual is specifically aimed at facilitators/trainers who play an implementation and supporting role in sustainable forest management, implement policies and programs. It is expected that its users are familiar with subject matter in addition to

experiential co-learning process including participant-centered learning method and adult learning process. The target group of this manual primarily are government officers. However, those people beyond government service who have graduated with a bachelor's in forestry would be eligible to participant the ToT on SFM.

Structure of the manual

This training manual primarily covere forest management, forest rotation, silvicultural system, and operations, growing stock, yield regulation, forest governance, harvesting and logging operations, post management operations, inclusive forest management planning. The training contents have divided into 7 modules that harmonized principle of "translating from more general to specific". Training facilitators will be able to use this training manual in many ways. It has been designed for 7 days as per fulfilling inter/national standards, and criteria of the training objectives, target participant. However, training institutions can develop a tailormade package in 3 to 5 days depending on the time, cost, location, target participants and availability and capacity of facilitators. This manual incorporates knowledge, skills and topic related information that helps to be used in simple way for training facilitator/resource person. The detailed session plan is given in Annex: 1. The manual is not static; this must be revised time and again to cater to the cutting age demand and technologies.

How to use the manual

Instructions to Users

As the lead facilitator or master trainer, keep in mind the main objective of the training. What do you want the participants to have gained by the end of the training course? What change in knowledge should they demonstrate? Also keep in mind these points:

- Be ready to spend more time than initially planned on main topics though needed assessment if it is clear the group needs additional time to work through ideas or practical tasks. It is better to do a few things well rather than to speed through the entire curriculum and risk losing the group's concentration.
- Be flexible and spend time discussing issues important to the group, even if not initially planned. You should, however, not lose sight of the final goal.
- And finally, enjoy the training and the participants, and embrace the opportunity to learn from the experience.

Guiding Principles for Facilitators

It is up to the course trainers and facilitators to make use of those guidelines and materials in the handbook that best suit the proposed course.

- Easily understood tasks should be addressed at the beginning of the training course.
- Broad concepts and technical terms applicable throughout the course should be introduced at an early stage and complemented by supplementary materials where necessary.
- Concepts or skills likely to be frequently used should be addressed in the course content.
- Difficult tasks that involve complex elements and concepts should be introduced in an incremental fashion.

Teaching Learning Methods

Brainstorming: is generally a first step to generate interest and involvement. The trainer facilitates sharing ideas and asks learners to suspend evaluation or judgement. Ideas can be discussed later for practical consideration.

Interactive talks: Encourage participants to be active and analytical in their learning approach.

Illustrative talks: These are lectures supplemented by illustration and audio-visual aids. Presentation of success stories and case studies is also a useful method.

Group exercise: This method is an effective instrument for participatory learning, whereby the trainer acts as a group adviser, facilitator, and mentor.

Panel discussions: This is one way to promote participatory learning. Here the role of the trainer is limited to coordinating and moderating the discussion, while the participants are the panelists and act as catalyst agents of the learning process.

Fishbowl: Fishbowl Exercise is a group discussion or activity that involves creating an inner and outer circle of participants. The inner circle actively participates in the discussion, while the outer circle observes and takes notes. After a set period, the roles can switch. This exercise encourages active listening, reflection, and diverse perspectives.

Snow Bolling: Snowballing Exercise is a group activity that encourages participants to share their thoughts, ideas, or responses in a structured and interactive manner and come on with common ideas.

Gallery presentation: A gallery presentation is a visual and interactive way to showcase information, ideas, or projects in a gallery-like setting. This format is often used for exhibitions, conferences, or training sessions where visual impact is crucial.

Role play: This is one of the most effective training methods of participatory learning where participants put into action their new skills. A scenario is created whereby individual participants are assigned roles which they enact to demonstrate the skills learnt.

Classroom exercises: These supplement the knowledge input provided through lectures and topics presented during the training session. Examples include developing a plan of action for a training program.

Field exercises: Participants go to the field and interact and learn from community members and other concerned stakeholders.

Module 1:
Learning environment setting

Module 1: Learning environment setting

Session-1.1: Participant's introduction

Background information

Introducing participants, each other with their name, residence, experiences, hobby, etc. helps to know each other and make them open during the interaction. This training aims to involve participants in an interactive and participatory learning situation. The learning process becomes effective if the learning expectations of the participants are met during the training period. In addition, during the training participants need to play certain roles and take responsibilities as well as maintain certain norms that help for a conducive learning environment.

Learning objectives

At the end of the session, Participants will be able to

- Feel at ease in the group and acquaint themselves.
- Describe the objectives of the training.
- Raise their expectations and agree on training itinerary; and
- Set norms "Do and don't" during the training period.

Time 1:00 hour

Equipment and materials requirements

- Power-point or flip chart presentation on training objectives and itinerary
- Training materials: Flip chart pater, markers, masking tape, meta-card, thumb pins, writing pad and pen, attendance sheets, and a list of Nepali Proverbs.
- Training pre-test sheets
- Multimedia projector

Session facilitation process

1. Registration and welcome
    1. Register and welcome the participants, distribute stationery, collect letters if provided by institution.

2. Participant's introduction
    1. Explain the background and objectives of the session.
    2. Arrange the participants sitting in a circle. Distribute paired-proverbs and ask them to find their pair.
    3. Ask each participant to find and introduce their pair. Introduce: name, education, address, institutions, current role, and experience in forest management.
3. Training objective and itinerary
    1. Provide 2 meta-cards to each participant and ask them to write one expectation on each card.
    2. Collect Meta –cards and read them all loudly. Pest that in board in different group.
    3. Present the objective of the training and itinerary of the training. Clarify the scope of training if all the expectations are not covered in the training explain the scope of the training. If addition things within the scope of the training, include them in the training itinerary.
    4. Distribute objectives and itinerary of the training is given in handout 0.2.

4. Understand the knowledge.
    1. Distribute Pre-test sheet (please see handout 0.3 below). Explain briefly how to fill the sheets and ask one participant to collect the sheets.
       Explain that based on the pretest results, facilitators adjust their sessions.
5. Norms development and committee formation
        1. Through plenary discussion, develop a norm related to do and don't during the training period. Write them down on a chart paper and pest them on a wall so that all can read it at any time.
        2. Ask the participants to form different committees such as review and reporting for every day, entertainment, logistic support etc.
6. Conclusion
    1. Conclude the session with a summary of session activities against objectives.

Handout 0.1: List of Nepali proverbs

Akkhoro roti	pakdaina
Nachna jandaina	aagan tedo
Kam garne kalu	makai khane bhalu
Kam kuro akatira	kumlo boki thimi tira
Nau dinma naulo	bis dinma birshiyo
Jun goruko sing chhaina	usko nam tikhe
Aaphu takchha mudho	bancharo takchha ghudo
Nadi ne bajai	budhabaar barchhin
Sarpa pani marne	lathee pani na bhachhine
Yek hatle	taali bajdaina
Yekle thuki suki	sai thuki nadi
Aghayeko bhanchha danda pari khau	bhoko banchha danda wari khau
Kholo taryo	lauro birsiyo
Aghi pachhi anta	chaitama janta
Sojho aulale	gheu audaina
Aakshko phal	aakha tari mar
Sawanma aakha phuteko goru	sadhai hariyo dekhchha
Aakashka rahu, patalko ketu	yek palta napari kasari chetu
Tai rani mai rani	kasle bharchha kuwako pani
Rat bhari kuryo	budhi jimdai
Gheu na tel	paka budhi sel
Bat garne swar chhaina	rag gaune shokh
Kam sache aaphulai	thau sache arulai.

Handout 0.2 Training objectives:

The overall objective of the training is to equip participants with tools and techniques on sustainable management of forests. The specific objectives include, at the completion of all modules, participants will be.

1. Able to explain important theoretical aspects of Silviculture and Forest Management,
2. Able to conduct forest resource assessment,
3. Able to analyze demand and supply of ecosystem goods and services,
4. Develop vision, objectives, and strategy for sustainable management of a forests,
5. Design silviculture and management prescriptions for different types and forest,
6. Able to explain safeguards mechanism and use of safety gears,
7. Demonstrate on how to use power chain saws and other transportation means,
8. List out the process and techniques post operations protection and management of forest and
9. Explain the key readiness steps for community to take responsibility of forest management.

Handout 0.3 Pre-test sheet:

Some Fundamental Questions of Forest Management

1. List down at least two types of rotations normally practiced in Nepal.
2. In a fragile gentle slope, which silvicultural system you prefer for managing Sal dominated broadleaved forests?
3. List two reasons how transect walk with rapid forest assessment is helpful in forest management planning.
4. List out modern equipment used for forest inventory process.
5. List down the criteria for selecting a mother tree.
6. Under Safety and Safeguards, list out the key areas we need to consider.
7. List down the three key activities of post harvesting operations.

Module 2: Overview of silviculture and forest management

Module 2: Overview of silviculture and forest management

Module 2 is designed to recap the overview of Silviculture and Forest Management to make common understanding among the participants. In the end of this module, participants will be able to

- Explain the relationship among growing stock, increment and forest management prescriptions,
- List down the importance and method of application of forest rotation in management of even aged forests,
- Explain the role of yield regulation concept in sustainable forest management; and
- List out application of various silviculture systems and operations based on forest types and management objectives.

Session-2.1: Concept of forest rotation

Background information

The forest rotation normally applies in management of plantation or even aged forests. The forest rotation is the time elapse between establishment and final harvesting of forests. Trees or stands are harvested after their maturity means when the stand can meet the objective or purpose. For objectively managing forests, the concept and application of different types of rotation age (age of final harvesting) is very important to understand.

Learning objectives

At the end of the session, participants will be able to

- Define the rotation period and age,
- Describe different types of forest rotation, and
- Develop a matrix of rotation for various species based on the objective of forest management.

Time 1:50 Hours

Materials and equipment requirements

- Power-point presentation on definition, types, and application of forest rotation.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins.
- Multimedia projector

Session facilitation process

1. Define rotation.
    1. Explain the objective of the session.
    2. Distribute meta-cards to each participant to write the definition of forest rotation, rotation period/age and establishment period.
    3. Collect and loudly read the answer.
    4. Agree on a common definition.
2. Types and application of forest rotation
    1. Through plenary discussion, list down the types of forest rotations,
    2. Divide the participants into three groups and assign them at least two rotation types. Ask the group to discuss, define and write down application with examples (15 minutes),
    3. Ask each group to present their group work (5 minutes each group),

4. Allow participants for constructive feedback, and
5. Present the summary PP slides to recap the whole session.

3. Conclusion

1. Allow participants to raise questions and address them. Give priority from peer to answer.
2. Ask a few questions to participants to gauge their understanding.
3. Conclude the session with summary.

Handout 2.1: Concept and application of forest rotation

Concept

Agricultural crops are sown, they ripen and are harvested once or twice a year. In this case their maturity period is easily observed. However, in the case of forest crops the maturity age is generally longer i.e., 10 years to 80 years depends on the objective of the forest management, species, and site quality. Maturity in a forest crop/tree is generally estimated by the age, size, and growth vigor. Beyond age/size, quality of timber starts falling off or the volume added may be ineffective. Maturity of timber depends on the natural condition of growth and economic condition.

Definition

Forest Rotation is the period in which a forest crop takes between its formation and final felling. It is also called the production period. According to Osmaston, it is the interval of time between the formation of a young crop by seedling, planting or other means and its final harvesting. Jerram defines rotation as the period which elapses between the formation of a wood and the time when it is finally cut over.

Application

Table 1 Application in regular forest

Applications	Limitation
▪ Rotation is easily applicable to mostly regular crops. ▪ In clear- feeling system and plantation, rotation is definite period of interval between the year of formation and final felling. ▪ In regular forests in general, entire crops of trees of a sizeable area are felled at a time (regeneration period	▪ Rate of growth will vary with site quality for the same species. ▪ It involves sacrifice of immature trees/crops, as some will not have reached exploitable size.

in Regular Shelterwood System) when ready for feeling. ▪ There is a bit of a clear production period which can be planned at beginning time to give timber, which satisfies the object of management. ▪ In Shelter wood system, rotation is fixed for the whole working circle as a unit, as the average length of time between the establishment of crops and their harvesting.	▪ Accidents, such as fire, disease, and wind-throw may happen, necessitating felling earlier than planned. ▪ To obtain desired profits, stand will have to be felled finally at various times depending on their rate of growth.

ii. Application in irregular forests

In uneven aged (irregular) selection forest, trees are selected individually on their merit for felling. Felling depends on:

- Qualities of size, vigor, and suitability for markets.
- Silvicultural principles, e.g., removals of inferior stems in favor of better ones.

In irregular systems, it has greater flexibility, and enables forester to adopt feelings to suit different rates of growth caused by variation in site or species. Moreover, forest is a perpetual entity and shouldn't suffer complete clearance of trees on any part of the area, except periodical thinning. Generally, rotation period is equal to that of the average age of the exploitable size trees, at which they attain the size required to fulfill the objective of management. Normally, maturity in selection forests is related to size, and exploitable size is fixed for removal of individual trees. Size is used as a standard for exploitability, and not age.

Importance and types of rotations

Rotation is an important factor in regulating yield and a tool for proper management of the forest.

- It is a part of planning and hence easy in management.
- It fixes the time of harvest for specific purposes.
- It guides us to provide maximum benefits from a limited resource.
- Regulation of Yield
- It fixes the size/quality of trees for specific purposes.

Its type depends mainly on the objective of management as described in the section below.

i. Physical rotation

It is the rotation, which coincides with the natural lease of life of a species on given site. The natural life span of trees varies greatly with species and site factors. This rotation is applicable only in the case of protection and amenity forest, park lands and roadside avenues. It is long and indefinite. It is also interpreted as the rotation in which the age up to which the trees remain,

sound, or produce viable seed in high forest and in coppice crops, can put forth reliable coppice shoots. This rotation is not of any relevance to economic forestry.

ii. Silvicultural rotation

It is the rotation through which a species retains satisfactory vigor of growth and reproduction on a given site. It is useful in forests managed primarily for aesthetic and recreational purposes, where large old trees with accompanying regeneration provide scenic beauty. It is like physical rotation.

iii. Technical rotation

It is the rotation under which a species yields the maximum material of a specified size or suitability for economic conversions or for special use. It aims at producing the maximum material of specific dimension/quality for specific purposes, such as railway slippers, saw logs etc. Since trees in a crop may yield different assortments of material, and the trees may attain a given size at different times, it provides no point for fixing the rotation.

iv. Rotation of maximum volume production

It is the rotation that yields the maximum annual quantity of material. The length of the rotation will coincide with the year when the average or volume increment per unit area reaches the maximum i.e., the age indicated by the point of intersection of CAI and MAI. MAI refers to the stand but not that of individual trees. This rotation is particularly suitable for adoption where the total quantity of wood material is important and not the size specifications, e.g., firewood, raw material for paper industries.

If rotation is r, final yield (Yr) and volumes of thinning at various ages Va, Vb, Vc etc. then the age at which is the maximum, is the rotation of maximum of volume production.

$$M.A.I. = \frac{Yr + \sum v}{r}$$

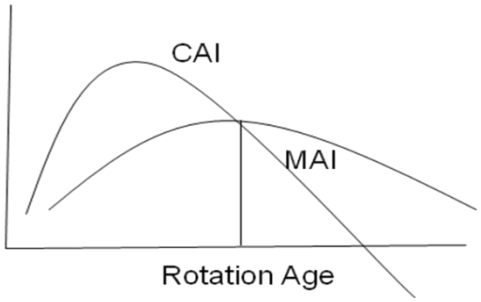


Figure 1 Relation between CAI and MAI

v. Rotation of highest income/revenue

It is the rotation which yields the highest average annual gross or net income irrespective of the capital values of the forests. It is calculated without interest and irrespective of the time when the items of income or expenditure occur.

$$= \frac{Yr + \sum Tr - C - \sum e}{R}$$

Mean annual net income/unit area.

Where, Yr. = value of final felling (final yield) per unit area
Tr = Value of thinning during rotation period R, per unit area
C = Cost of formation of stand, per unit area.
e= annual cost of annual administration/ maintenance, per unit area
r = rotation (year)

The rotation at which the net revenue as calculated is maximum, is the rotation of highest revenue/income. This rotation is important from the overall national point of view.

vi. Financial rotation

It is the rotation which yields the highest net return on the invested capital. It differs from the rotation of highest net income in that all items of revenue and expenditure are calculated with compound interest at an assumed rate, usually the rate at which the government can borrow money. It is the rotation which gives the highest discounted profit, usually at its commencement. This rotation provides the most profitable net return on capital value.

Choice and length of rotation

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

- Rotations controlling the supply of certain services- i.e., the silvicultural and physical rotations.
- Rotation controlling the output of material forest products in form or quality- i.e., the technical and maximum volume production rotations.
- Rotation controlling the financial returns, i.e., the rotation of maximum gross or net income and financial rotation.

Length of rotation

Within a specific type of rotation, the length of rotation depends on

i. Growth rate- Species, Fertility, Thinning
ii. Silvicultural characteristics of the species- Life span, Seed production age etc.
iii. Response of the soil- Exposure, biotic influence etc.
iv. Economic considerations- Cost, price, time
v. Social condition- Socioeconomic, employment, policy

Rotation determination criteria

There are broadly three criteria to determine rotation.

i. **Biological criteria:** Insects, disease, fire, mean annual increment.
ii. **Financial / economic criteria**: Money yield table, forest rent, land expectation value, present net worth, internal rate of return, financial maturity
iii. **Social /environmental criteria**: Weather, labor available, user's need

Current rotation practices in Nepal:

In the context of Nepal, all the natural forests in different management regime (such as government managed, community forest, protected, lease hold forest) are found uneven age type and distributed in different region of country.

- The existing practice of harvesting or removal of forest trees is selective.
- Exploitable diameter limit- 40 Centimeter (cm) Diameter at Breast Height (DBH) for Sal and 30 cm for mixed broad leaves species).
- In the context of community forestry, if the forest is managed for productive function, either technical or maximum volume production combined with rotation of highest income can be applied.

Table 2: Rotation age of plantation species that are being practiced in Nepal.

S.N.	Species	Rotation (year)
1	*Cassia siamea*	4
2	*Dalbergia Sissoo*	35
3	*Eucalyptus Camaldulensis*	7-10
4	*Leucana lecocephala*	7
5	*Tectona grandis*	60
6	*Pinus Patula*	40-45
7	*Pinus roxburghii*	60
8	*Shorea robusta*	80

(S.M. Amyta, 2000)

Session-2.2: Concept of yield regulation

Background information

Yield regulation is very important for sustainable forest management. Products from a forest can't be fully harvested once. The harvest limit is estimated in various ways. For example, if the forest is fully stocked, all the volume obtained from mean annual increment can be harvested called annual allowable harvest which then estimated as yield for that particular year. There are various types of yield and methods to estimate and regulate yield in a forest.

Learning objectives

At the end of the session, participants will be able to

- Define yield and yield regulation,
- List out the types of yield; and
- Explain various methods of yield regulation.

Time 1:50 Hours

Equipment and materials requirements

- Power-point presentation on definition, types, and key methods of regulating yield.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins.
- Multimedia projector

Session facilitation process

1. Define yield

    1. Explain the objective of the session.
    2. Brainstorm to recall the definition of yield and agree on.
    3. In plenary, list down the types of yield and discuss the meaning of each and application in the plenary.

4. Method of estimating yield

    1. Through plenary discussion, write down the methods of yield regulation in even aged and uneven aged forests.
    2. Divide the participants into four groups and assign them at least one important method to discuss in a group (such as technical method/formula, example, and applications) (15 minutes).

3. Facilitate fishbowl exercise (4 fish and rest members are around the bowl to discuss) for each group to present each other (5 minutes each).
4. Once the fishbowl exercise is finished, discuss the confusion in plenary.

5. Conclusion

1. Present power point presentation (slide 1.3). Allow participants to raise questions and address them. Give priority from peer to answer.
2. Ask a few questions to participants to gauge their understanding.
3. Conclude the session with summary.

Handout 2.2: Yield regulation

Background information

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

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

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

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

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

The very essence of YR is in determining the cut. There is no single formula for the solution of cut-determination. This depends on the state and trends of the market, intensity of management and silvicultural systems adopted. Thus, YR necessarily involves a compromise between economic and silvicultural consideration in management. Generally, the main objectives why timber production and telling of trees should be regulated can be broadly discussed under 4 headings namely:

i. Silviculture

(a) Over cutting (i.e., Cutting more than required or cutting more than can be replaced). This may cause determination of the soil, introduction of unwanted species.

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

ii. Labor

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

iii. Timber industry

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

iv. Economic reasons

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

2. Method of YR

The objectives of management are firstly to obtain sustained yield and secondly to aim at a normal forest. Several methods have been tried particularly in Europe to regulate yield and attain those objectives. Some methods have been more successful than others. The type of method to be adapted depends on the type of forest and the degree of accuracy required. The methods used so far can be divided into 4 major groups:

A. Area only method (direct method)

Annual Coupe Method is the oldest method of regulating the cut (14^{th}–16^{th}) century ago based on an area and rotation methods. The methods consist of dividing the whole forest into equal areas, equal in number to the rotation. Each part is cut and regenerated sequentially every year. The Size of coupe is calculated as area of forest divided by Rotation of the crop. It should be noted that only one rotation is used throughout. The annual coupe then consists of a series of "R" stands differing in age by one year (R= Rotation).

Assumptions under this method: -

1. Since there will be site difference or microsite variation; each area will produce a different yield. It follows therefore that the longer the Rotation the greater the differences will be. Hence this method is assumed to be best suited for short rotation crops.

2. The method also assumes an evenness in ages of crop. In general, this method is best suited for plantations grown on short rotation e.g., fuel wood, poles, pulpwood plantation etc.,

Advantage: The method is direct and simple and aims directly at establishing a normal series of age gradation in the first Rotation. This is the quickest way of attaining a sustained yield from the forest.

Disadvantage: This method is rigid and tends to ignore economic and silvicultural conditions, for example it may entail some heavy sacrifices of immature stands. The method tries to decide ahead the allowable cut and its location for the whole rotation. Since the tropical high forest is compared of many different species, it means that the yield from each annual coupe is likely to be vastly different in the first rotation. This difference is further aggravated by the facts that some species are economic while some are not. And it is only the economic ones that are exploited several attempts have been made to overcome this vast difference in annual yield. This includes:

1. Reservation of some rotation of the forest: A part of the forest is set aside as a reserved area and is not considered as part of the yield. This reserve is intended to be used as a buffer against large fluctuations in yield and will be used to replace or supplement any areas of very low yield. In this case the area of annual coupe is equal to the area of the whole forest misuse area of reserve divided by the rotation. i.e., Area of Annual Coupe = Area of whole far - Area of Res. Rotation

2. Free choice of coupes by contractors: In this case, the contractor is allowed to choose the order in which he takes the annual coupes. Normally the contractor enumerates the forest and from his data he can nominate which coupe s/he wants to take next. He can then select yield to suit the market demand.

3. Fixing of minimum felling girth: The third method for adjusting the yield of a coupe is also practiced in high forest. By this method a minimum fell girth is set for each species below which the contractor is not allowed to fell. This method acts as a guide against overcutting and ensures that there is something left behind for the next rotation.

B. Method based on area and volume control.

Permanent fixed periodic block method:

The method of annual coupe is more suitable for the crop that is clear felled at rotation age and for system of direct plan fix or artificial regeneration. In this method, however, it can be applied suitably to a high forest system i.e., shelter wood system. The shelter wood system demands a gradual removal of the trees in the area to encourage natural regeneration. i.e., felling is made on the same area over a period until the whole area is felled and completely regenerated. The periodic block is therefore that part of the forest allocated for regeneration or other treatment during a specific period.

When all the periodic blocks are allocated and maintain their territorial identity or a working plan, they are termed fixed or permanent periodic blocks. To avoid the vigidity and reduce the sacrifices

of the permanent periodic block method, the obvious remedy is to abandon fixed periodic blocks and reallot then according to circumstances at each revision of the work plan namely at the end of each period. Such blocks that did bit retain their territorial identities at a W. P. is termed a Revocable periodic block. Generally, we call the period over which the felling is completed as the regeneration period (P). The whole forest must be divided into several equal areas known as periodic blocks equal in number to rotation over regeneration period. i.e.

Number of periodic blocks = Rotation = r

Regeneration Period p

For example, if r = 100 and p = 20

Then number of periodic blocks = 100 = 5= 20

If the total area of the forest is equal to 2,000 hectares, then area of periodic block = 2,000 = 400 hectares.

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

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

Annual Yield (AY) = V + ½ I or v + ½ I ..... (n P p p

Annual increment (i) I P

Substituting i for I in equation i we have AY = V + ½ i (cotta's formula) P

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

C. Methods based on volume or Volume and Increment of Growing Stock

All methods of YR own at determine how much timber should be cut from a working cycle. The volume of cut can be determined indirectly through area control methods or directly through volume control method. Most methods of YR had been based on direct approach which is the only one available for irregular forest where age-class cannot be recognized by area. There are several methods based on this direct approach which have been derived based on the relationship between growing stock and increment under certain assumed conditions and expressed in formulae. It is always necessary to check whether the presumed conditions have been fulfilled otherwise these formulae would be misleading.

Advantages:

1. Applicable to all types of silvicultural system.

2. Useful as an overall guide to appropriate cut.

3. Useful in bringing an unmanaged forest under some degree regulation.

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

Disadvantages:

1. Even though more accurate than area method, it could be more expensive in the sense that regular or constant enumeration will be required and this is time and money consuming and labor demanding.

2. Increment which is regarded in most volume formulae tends to be a weak figure. If volume or increment data are incorrect, there is no assurance that the forest is constituted as desired. Therefore, for safe application of Volume Control Method (VCM) a reasonably high degree of accuracy of volume and increment data are regarded.

a) Von Mantel's Formula

Some volume methods are certainly more successful than the others. The simplest method is Von Mantel's formula. Von Mantel assumed the concept of a normal forest i.e., that the Normal Growing Stock (NGS) is equal to the annual yield multiplied by Rn all upon 2.

NGS = I x r; where I = Annual Yield; 2 r = Rotation

I = 2 NGS/ r

Annual Yield = 2 NGS (Von Mantel's Formula)/r

b) *Austrian Method*

The Austrian method is a means of calculate the yield by comparison of Actual Growing Stock (AGS) and Normal Growing Stock (AGS & NGS). The AGs is assumed that the stock on Rn age plot is equal to the annual yield and is equal to (I) sum of increment of all the age classes of the growing stock.

That is: AY = I = Ri

Where AY = Annual Yield; R = Rotation; i = annual increment; I = εi = R = sum of increment of all the age class of the G.S. i i i Vol. I i I I Age Ri earlier assumption on the NGS it was found that NGS = I x r (Von Mantel 2 formula)

However, when the AGS was measured it was found out that the total volume is either greater than or less than the volume of the normal growth stock. The Austrian tax collector measured the Volume of the AGs and the volume of the Rn age stand. This was assumed to be equal to I = AY. He postulated that AY ought to be the volume of Rn (I) age plus the AGs minus the NGS all upon Rn

AY = I + (AGs - NGS) R, and if the AGs is greater than NGS the little excess will be positive and if the AGS is less than the NGS, the little deficit will be negative.

D) Number and Size of the Tree

Up till now we've been discussing methods it takes into consideration the age of the trees. This is possible where we consider approximately over-aged forest as is obted in clear felling, or in temperate countries.

In the tropical high forest trees of different ages are all mixed. It therefore becomes meaningless to use age class distribution as a yard stick or measure of yield regulation. Hence, we apply size class distribution to uneven-aged forests. Furthermore, it is difficult to know the ages of trees in tropical high forest since there are no clear-cut relationship between age and size classes.

Also, growth rings are not equivalent to annual rings and so it is difficult to assess the ages of these trees. Methods of yield regulation of uneven-aged forest based on size classes includes:

a) French Method of 1883 or Meland Method

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

Let size at Rn (r) be equal to x, i.e., Rotation Size girth in feet.

R = 75 x = 6

1/3r = 25 1/3x = 2

2/3r = 50 2/3x = 4

The GS is divided into three.

1. The Large Trees (LT) = 2/3x and above.
2. The Medium Trees (MT) 1/3x to 2/3x
3. The Small Trees (ST) – below 1/3x

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

AY = V + ½ i P

AY Vol of LT + ½ annual increment of LT 1/3r

Above is of course the figure representing trees in the final yield. During this period thinning has been done especially among the medium trees and it is assumed that in a well-stocked forest 1/3 of the annual increment of the medium trees can be removed as thinning. In some cases, however it is less than 1/3 of annual increment i.e., about ¼ only. The total AY therefore becomes Total AY = Vol of LT + 1/3 annual 1/3r increment of LT

b. Brandis/Indian method

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

Method: -

i. Classification of growth stock to three girth classes namely:

I = > 6ft

II = 4½ - 6ft

III = 3 – 4½ feet

Fixing class, I as the minimum felling girth.

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

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

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

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

Session-2.3: Major silvicultural system and operations

Sub-session- 2.3.1: Introduction and application of silviculture systems

Background information

Silviculture is the backbone of forestry science. It deals with tools and techniques beginning from seed production to final harvesting of a forest crop. Silviculture systems are ways to establish a forest crop. Silviculture systems are applied based on forest conditions, demand of products and capacity of forest management entity to implement the defined system. Since these are important for a forester, their in-depth and common understanding would make them confident in choosing or advising the right system.

Learning objectives

At the end of the session, Participants will be able to

- Define the silviculture system and operation,
- List and explain different types of silviculture systems, and
- Develop a matrix for application of silviculture system based on forest types, conditions, and objectives.

Time 2:00 Hours

Equipment and materials requirements

- Power-point presentation on definition, types, and application of silviculture system.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins.
- Multimedia projector

Session facilitation process

1. Define silviculture

    1. Explain the objective of the session.
    2. Ask participants (randomly) in plenary to define the meaning and differences between silviculture system and operation.
    3. Receive feedback from peers and finalize the definition and differences.

4. Types of silviculture system

    1. Through plenary discussion, list downs the types of forest (based on regeneration mode).
    2. From plenary discussion, finalize the main silviculture systems.

3. Divide the participants into four groups and assign them one system each. Ask the group to discuss and define and write down application with examples (15 minutes).
4. Facilitate gallery presentation of four groups (5 minutes each group).
5. Allow participants for constructive feedback.

6. Conclusion

1. Present the summary PP slides to recap the whole session.
2. Allow participants to raise questions and address them. Give priority from peer to answer.
3. Ask a few questions to participants to gauge their understanding.
4. Conclude the session with summary.

Handout 2.3.1: Concept and application of silvicultural system

Silvicultural systems are broadly classified based on age of resultant crops or mode of regeneration. Two types of crops are developed based on the mode of regeneration, i.e., by seed or by coppice. They could be either even aged or uneven aged. If a silvicultural system follows the process of regeneration from seed, it is known as a coppice forest. In this document, the mode of regeneration has been taken as the basis for classification. With some modifications from Prakash et al., 1991 and USAID, 2015, a brief description of each system is presented below.

High forest system

A. Clear felling system

The clear-felling system is defined as a silvicultural system in which equal or equi-productive areas of matured crops are successively clear-felled in one operation and a new crop is established mostly artificially (plantation) or sometimes naturally. Under this system, the entire forest area is divided into annual coupes which are normally equal to the number of years in the rotation of targeted species. For example, if the rotation of the targeted crop is 30 years, the number of coupes will be 30. This will ensure alignment with sustainable forest management principles. Artificial regeneration is obtained through planting seedlings or broadcasting seeds in the area. If the matured crops being harvested are of desired species, then natural regeneration can be obtained from existing seeds disbursed before clear felling or advance growth or seed blown from nearby forests. This system produces even aged crops. Applications of this system are presented in Table 1 below.

Table 3: Application and main activities of clear-felling system

Applicable when	Main activities
• Adequate financial and human resources are available. • Local factors are suitable: soil, sufficient and timely rainfall relatively flat area, suitable temperature for regeneration and growth. • There are limited negative environmental impacts on soil erosion and wildlife. • The principal species are light demander. • There is need for change in Species composition.	• Divide the area into small coupes for planting. Its natural regeneration is reliable, clear-felling is done after sufficient seeds have fallen and disbursed on the ground. If advanced growth of desired species is sufficiently available, they may need some tending operations, i.e., ANR. Surface tillage may be required after tree felling to create environment for regeneration. • When natural regeneration is not possible, artificial regeneration can be achieved through planting seedlings or broadcasting seeds of desired species. Surface tillage is required for seed broadcasting. • Area can be cleared in strips to protect against strong winds to minimize damage to natural regeneration from seed blown from nearby forests.

B. Selection System

The selection system is defined as a Silvicultural System (SS) in which felling, and regenerations are distributed over the whole area or coupe and the resultant crop is uneven-aged. Trees of all ages are found over every part of the area or coupe. This type of forest is also called selection forest or all-aged forest. Regeneration in this system is obtained artificially from existing seed trees. This system is widely accepted and can be applicable to any forest types where the existing stock is relatively good and sufficient seed trees are available. The system is further classified into two types as:

B.1) Single tree selection system

Individual trees and small clumps of trees of all size classes which are uniformly distributed throughout the stands are removed to maintain a balanced, regulated, and uneven-aged stand structure. This system created or perpetuated the multi-layered uneven-aged nature of the standby creating very small canopy gaps. Applications of this system are presented in Table 2:

Table 4: Applications and main activities of single tree selection system

Applicable when	Main activities
• There is a need for various age and size class trees. • Most of the trees are vigorous, healthy and of good quality for desired species. • The principal species are a mixture of light and shade demanders. • Where terrain and slope are variable. This system can be used on sloped or flat land. • The presence of various ages and size class trees are available may not be in appropriate ecological proportion. • Limited skilled human resources available; and • Sufficient financial resources are available.	• This system follows nature in respect to its pattern of felling. Scattered single mature trees are selected all over the area and felled to enable regeneration. As the process continues every year, an uneven aged forest is established. • Felling can also be done in coupes. The number of coupes is equal to the felling cycle. The shorter the felling cycle, the larger the size of coupe and lesser the felling intensity. For example, if the felling cycle is 10 years, MAI is 2 percent of the growing stock; the removal will be approximately 20 percent of the growing stock. • Under the selection system, categories of tree to be removed include dead, dying, diseased, deformed, trees of undesirable species, immature congesting trees as well as others to balance the number of different age/size classes and mature trees of exploitable diameter. An exploit-able diameter is determined for matured trees based on the growth rate/rotation age or principal species and market demand.

B.2) Group selection system

The Group Selection System (GSS) is defined as a selection system in which trees are felled in small groups in various patches. Scattered single trees throughout the forest or felling coupe are not felled. The felling may be distributed over the whole area if it is small; otherwise, these are carried out only in a part of the forest each year under a felling cycle. In a small patch, the resultant crop is even aged but it will be uneven aged pattern when considered across the entire forest. This system relies on natural regeneration. Applications of this system are presented in Table 3.

Table 5: Application and main activities of group selection system

Applicable when:	Main activities
• Principle species are light demanding, and they need large gaps for natural regeneration. • Most of the crops are vigorous, healthy and of good quality of desired species. • Forest is not too sloped. • Skilled labor and sufficient financial resources available. • There is market access for all products received from harvest. All types of products may not have market demand. So, if there is no market for such products, the implementation cost will be higher than the net benefits.	• All the trees are clear felled in small patches in a group. Felling area or coupes are divided into small patches to conduct felling. The number and size of group/ small patches depends on the desired dominant species and the total size of forest or a coupe. In addition, the size of the group/patch depends on the light requirements, which, in turn, would vary with aspect, slope, total height of the surrounding trees and condition of the soil. For instance, in one coupe, operations can be conducted for five years in five small patches which will create five layers canopy and age gradation. • Regeneration is obtained from advanced growth or seed fallen before felling or from adjoining unfelled areas. • No tillage or other additional activity is carried out to promote natural regeneration.

B.3) Shelterwood system

It is a silvicultural system in which mature trees are removed in a series of felling operations to achieve a new even-aged stand under the shelter of remaining trees. The trees which remain uncut are known as shelter trees and are retained for the purpose of protection and providing shelter to the understory from climatic extremities. These trees also act as mother trees as they can disperse seeds for natural regeneration as well.

In this system, there are three different stages; Preparatory cut, establishment cut, and removal cut.

- Preparatory cut is the first stage in shelterwood system and is also known as preparation for regeneration stage. In this stage, the main objective is to increase the healthy state of trees by removing fewer desirable species and low-quality products to be

harvested later. The process is quite like thinning and in case thinning has been completed recently, the operations in this stage can be skipped.

- Establishment cut is often referred to as regeneration cut or seedling cut. Applying this step helps in providing enough growing space in canopy for regeneration establishment in one operation. Only the stands which can provide good return and can withstand wind pressure are retained for further operation.
- Removal cut is made after 20-30 years of establishment cut. The trees retained in the previous steps are removed, partially or wholly as per the requirement.

The Shelterwood system is further classified into different categories. Some of them are described below.

B.3.1) Uniform shelterwood system:

Artificial regeneration requires large sums of money, and its success depends upon the correct choice of species, use of correct techniques and favorable climatic conditions. When financial resources are limited or artificial regeneration is not possible due to other factors, regeneration is obtained under the shelter of the over wood (retained tree). Such systems are known as the shelterwood System. The over wood is removed in two or more operations; these are known as system of successive regeneration felling. In other words, the shelterwood system involves gradual removal of the entire stand in two or more successive felling, which extends over a part of rotation.

The uniform shelterwood system aims for concentrated regeneration, in which the canopy is uniformly opened over the whole area of coupe to obtain uniform regeneration. This method is different from the seed tree method. Under the seed tree method, the area to be regenerated is clear cut retaining some seed trees (less than 10%), either singly or in groups aiming to supply seed for natural regeneration in the area. But under the uniform system, up to 100 seed bearer tees/ha. are retained not only for seed supply but also to provide shelter against adverse climatic factors. The crop produced is even aged. Application and main activities of this system are presented in table 4 below:

Table 6: Application and main activities of the uniform system

Applicable when	Main activities
• Enough financial and human resources are not available. • Suitable local factors (soil, rainfall, temperature).	• Seeding/preparatory felling is done to open the canopy of a mature stand to provide conditions for regeneration. Middle-aged trees with long cylindrical boles and well-developed crowns and seed bearer trees are selected. The

• Adequate supply of seeds from seed trees for natural regeneration of desired species. • Possibility of control or absence of invasive species. • Species are not strong light demanders. • Regeneration requires protection against adverse climatic factors. • Area prone to soil erosion and invasion by weeds.	number of trees per unit area depends on light and temperature reaching the forest floor, silvicultural requirement of the species, topography, and climatic factors. For example, heavy seed requires less opening but light demander and light winged seeds need more opening. • Secondary/regeneration felling is done to gradually remove the shelter to provide lighter. When the regeneration from seedling felling progresses, it requires lighter. The opening of trees in secondary felling as well as the number of secondary felling is governed by the progress of regeneration and its light requirements. • Final felling of over wood is carried out when the coupe is completely stocked with established regeneration and shelter from adverse conditions is no longer required.

B.3.2) Group shelterwood system

Under this system, regeneration felling is carried out in a scattered group and the regeneration of the coupe does not take place uniformly all over the compartment as in the uniform system. But starts from natural groups of advanced growth and spreads centrifugally to finally cover the entire area, thus creating an uneven aged crop. Regeneration is obtained naturally. Below table 5 summarizes the main applications of this system:

Table 7: Application and main activities of the group shelterwood system

Applicable when	Main activities
• Light demanding species are to be promoted. • Forest area is not sloppy. • Protection against grazing and fire is possible. • Adequate human resources and capacity is available.	• Existing patches of advanced growth, where secondary felling is done. • At the time of secondary in 1, seeding felling in 2. • Final in 1, secondary in 2 and seeding felling in 3. • Final felling 2, secondary in 3 and seeding felling in 4. • Final in 3, secondary in 4 and seeding felling in 5. After this, final in 4 and secondary in 5 and again final felling in 5.

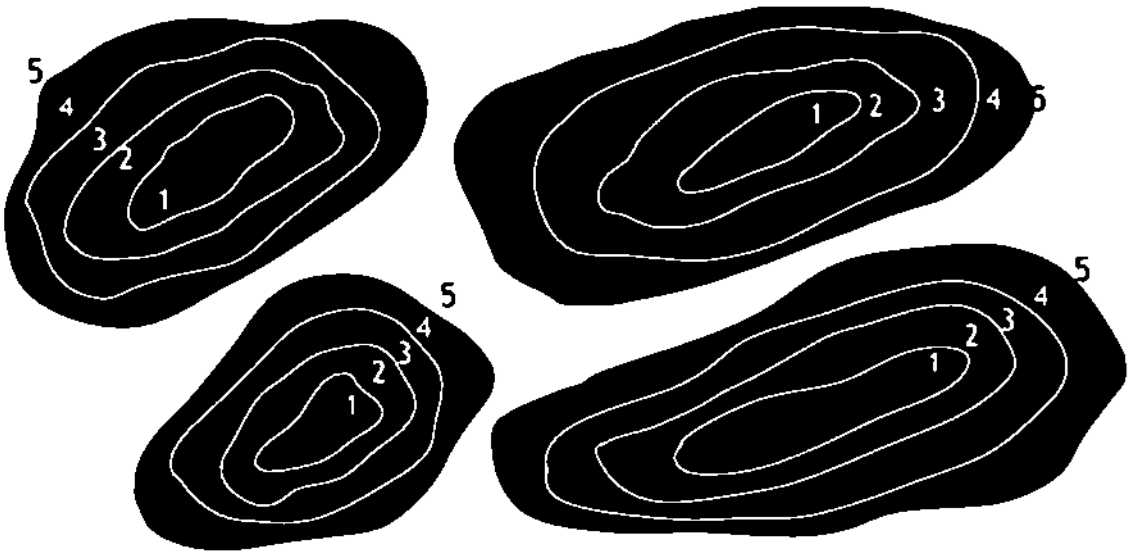


Figure 2: Pattern of felling in group shelterwood system

B.3.3) Strip shelterwood system:

In this system, regeneration felling is done in the form of strips successively from one side of the compartment, progressing against the direction of wind, resulting in an uneven aged crop. Regeneration is obtained naturally from seed. The felling compartment or coupe is divided into several cluster strips. One cluster may include 3-4 strips. No felling is carried out in a strip/area opposite to wind direction. The summary of this system can be seen in table 6 below:

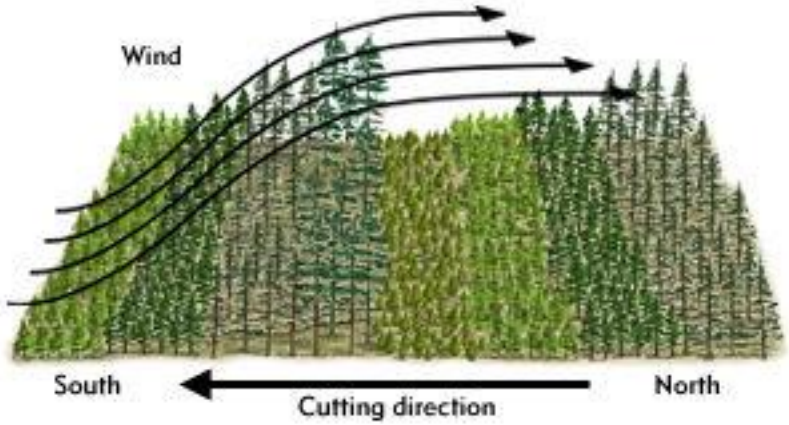


Figure 3: Felling strips in shelterwood strip system

Table 8: Application and main activities of strip shelterwood system

Applicable when	Main activities
• The area encounters strong wind. • Forest is flat or gently sloped. • Primary species are light demanding.	• Width of strips varies from 20-30 meters at right angles of the wind direction. In sloppy areas, strips can be along the contour lines. • Seeding felling is carried out in the first strip. When regeneration needs lighter, a secondary felling is done, and a seeding felling is done in the next strip. When regeneration needs lighter in the second strip, secondary felling is carried out and seeding felling is conducted in the first strip. • In this way, the process is continuous.

B.3.4) Irregular shelterwood system:

The regeneration felling under this system is done irregularly but follow the pattern of the group system. Under this system, regeneration period is long, and the crop is uneven aged or irregular. As a hybrid of the selection and group shelterwood system, the felling pattern unsystematically follows group system based on local site conditions.

A. Coppice system

A coppice system depends on the regeneration of coppice shoots from the adventitious buds on the stumps of felled trees. The coppicing power varies depending on the species and age of tree stump. This system is applicable to those species which give coppice and grow vigorously in their early age. Under this system, new crops mainly originate from stool coppice and rotation age is short. The best timing for coppice is the dormant season (November to March) and the best time is just before the dry season as huge amounts of food is stored during this time in the root system which can be utilized by new shoots. The stems are cut as low as possible (5cm), however, in very dry areas; stump; stump is left up to 10 cm to prevent the stump drying out. The Coppice systems are further classified according to the pattern of felling. The main types are described below:

C.1) Simple coppice system:

This involves clear felling of a fixed area annually and regeneration is obtained by coppice shoots. A forest area is divided into felling series or coupe equal to the number of years in rotation period and each coupe is treated annually. The resultant crop from this system is even aged. Table 7 below summarize the application and main activities of the system:

Table 9: Application and main activities of simple coppice system

Applicable when:	Main activities
• Low investment, faster and high returns are required. • Sites are incapable of producing large sized timber. • High demand of fuelwood, poles, and small-sized timber.	• The entire forest is divided into annual felling series/coupes and each coupe is clear-felled annually. • As stumps loose coppicing power over time, the gaps are filled by artificial regeneration. • In the following years, cleaning to remove climbers and weeds is done and similarly, two-three best shoots from each stump are kept and the remaining shoots are removed. • It the objective is to produce small size timber; thinning will be essential in 5th year (Singling).

C.2) Coppice of two rotation system:

This is the modification of a simple coppice system where the best poles or saplings are left throughout the felling coupe during operation, which produces larger-seized timber at the end of the second rotation. This can be applicable in community forestry.

C.3) Shelterwood coppice system:

This is also a modification of simple coppice system where some or the most promising trees/poles (125-150 / ha.) are retained as shelter. These shelter trees could be reduced by half after five years and fully removed after 10 years, thereby fulfilling the requirements for production of medium-sized timber. The coppices are managed as in the simple coppice system.

C.4) Coppice with standard system:

The coppice with standard system produces a crop with distinct characteristics and provides multiple forest products. Under this system, over wood of standards, usually of seeding origin and composed of trees of various ages, are kept over coppice for a period which may be greater than the rotation age and a permanent feature of the crop throughout its life.

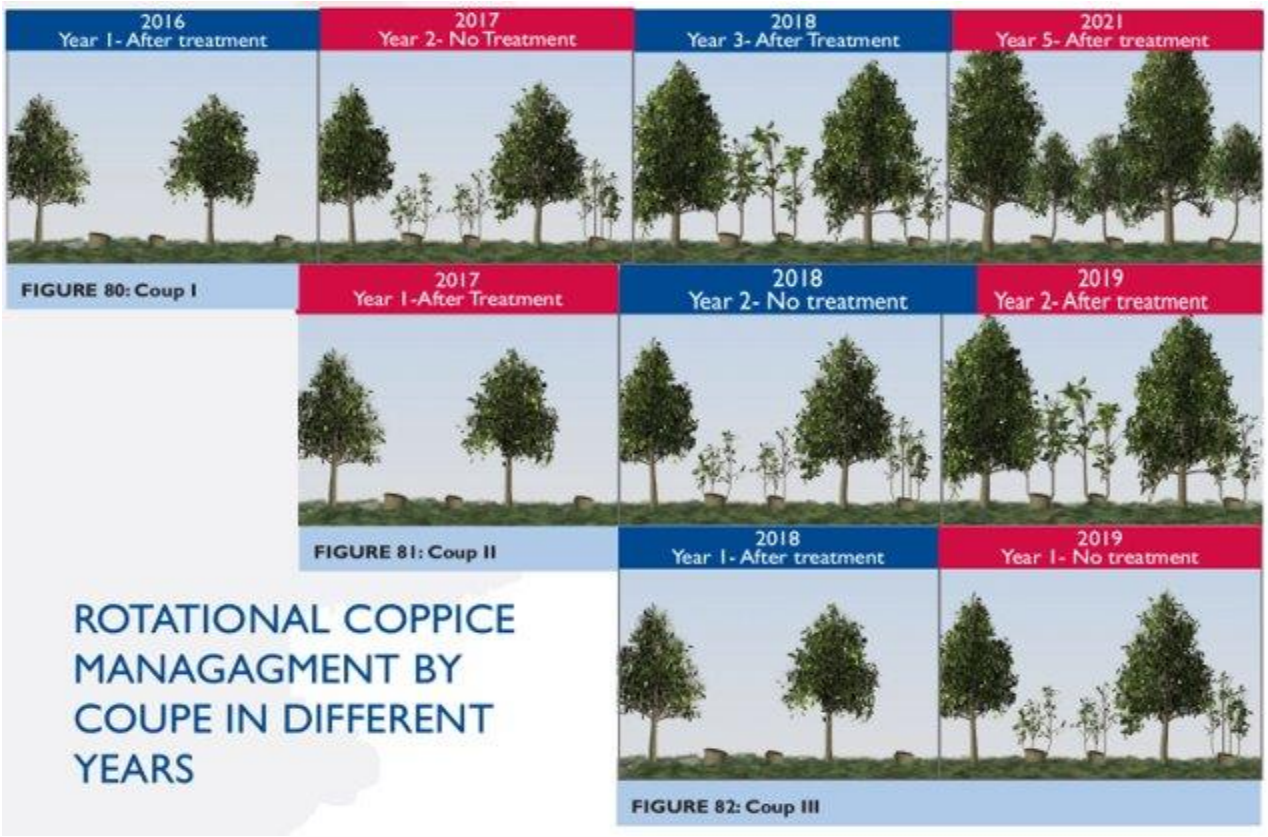


Figure 4: Illustration of rotational coppice management by coupe

This resultant crop will be of two distinct forms:

i. A lower canopy consisting of even-aged crop which is treated under the principles of simple coppice, grown for firewood and poles.
ii. An over-wood consisting of scattered trees of different age-classes and treated as a high forest system under the principles of selection system, grown for larger size timber.

Thus, there are two rotations; one for simple coppice which is relatively short, and standard is multiplication of coppice rotation (Table 9).

Table 10: Application and main activities of coppice with standard system

Applicable when	Main activities
• There is a need of firewood and poles quickly that can provide coppice and large size timber. • Climatic factors inhibit the simple coppice system. • Forests are mostly dry-deciduous. • Examples: *Shorea spp., Dipterocarpus spp., Syzygium spp and Anogeisus spp.*	• Selection of vigorous standards of seedling origin or desired species maintaining around 1/3 of canopy. However, if the objective is to produce larger size timber, they can be more. • Distribute the standard uniformly, preferably every 10–20-meter square. • Fill gaps by artificial regeneration or assisted natural regeneration. • The coppices are managed as in the simple coppice system and standards are managed as per selection system in the high forest system.

C.5) Coppice with reserve system:

This is the system in which felling is done only in suitable areas that are likely to benefit. Other trees which are financially immature, valuable miscellaneous species, either singly or in optimally spaced groups, tree yielding products of economic importance are retained for protective reasons. In this system, emphasis is given for conservation. Regeneration is obtained by coppice, advanced growth as well as by seed. The resultant crop is even aged in nature. Table 9 below summarizes the application and activities of this system.

Table 11: application and main activities of coppice with reserve system

Applicable when:	Main activities
• Emphasis is given to conservation. • The crop varies in density, composition and quality of valuable species proportion is low. • Most of the species are good coppices with high coppicing power. • The valuable species are light demanders.	• Felling may vary from clear felling to no felling by reserving all trees. Felling and reservation is done in the following ways: - No felling in some areas where density<0.4, erosion prone areas and around water resources. - Reserve all the socially, commercially, and ecologically valuable species. - Reserve trees of certain diameter for seed production and maintaining healthy mixture of species.

C.6) Coppice selection system:

The coppice selection system is defined as a silvicultural system in which felling is carried out based on principles of selection system, but regeneration is obtained by coppice and in some cases from seed. The crop produced in this system is uneven aged (Table 10).

Table 12: Application and main activities of coppice selection system

Applicable when:	Main activities
• Site quality is very poor. • Mixed products are required. • Forests have high coppicing power. • The area is flat sloped. • There is high disturbance from grazing.	• Exploitable diameters are fixed according to the size of materials required, based on which felling cycle is determined. • The forest is divided into coupes, only stems of over exploitable size are removed. However, as in selection system, some criteria are fixed to remove other deformed, unhealthy, and undesirable trees to increase the light penetration to the ground.

Accessory system:

Accessory system refers to those high forest system which originated from other even-aged systems by modification of techniques, resulting in an irregular forest.

D.1) Two-storied high forest system:

The system forms a crop of trees of two canopy strata and each of which the dominant species is different and approximately same aged (even-aged) tree of seedling origin. The lower canopy is obtained by natural regeneration by seed brought from other places or by planting of the desired species. Table 11 summarizes the application and activities of this system.

Table 13: Application and main activities of Accessory System

Applicable when:	Main activities
• There is a need for soil conservation as upper storey crops cannot provide protection. • Need to increase productivity. • There is a need to grow shed bearing species. • There is a need to change species composition both vertically and horizontally.	• Conduct operations to maintain around 40% canopy (120-150 trees/ha). Retain a mixture of high value species of good health and form. • Conduct ANR by bringing seed from other sources or enriching planting of other desired species. • Fixed rotation is of two storied species. The lower storey species can be a faster growing species of short rotation age than upper one.

D.2) High Forest with reserve system:

In this system, trees of the crop being regenerated are retained for a part or whole of the second rotation, to produce large-sized timber. Reserving some trees of the old crop in Clear Felling System (CFS) and trees retained at the final felling under Uniform Systems (US) are some examples of the Reserve System (RS).

Improvement felling:

Large areas of community forests in many countries are degraded and of poor quality. They need intensive management operations to bring them back to a more natural state. In such cases, improvement felling is required which is defined as a method of treatment involving the removal of inferior growing stock in the interests of better growth of the more valuable individuals. Table 12 below summarizes the application and activities of this system.

Table 14: Application and main activities of improvement felling

Applicable when	Main activities
• The quality of forest is very poor. • Forest has large canopy covered with mixed age and species. • Forest consists of a huge amount of 3D, overmature, old, wolf and less preferred species. • High levels of climbers and shrubs.	• This system mostly focuses on the improvement of existing stands, while encouraging natural regeneration. The operations carried out in this system are: - Remove dead, dying (>75%) dead and diseased trees. - Remove saleable unsound overmature trees. If not saleable, they are felled and retained in the forest. - Remove unsound or badly shaped mature or immature trees. - Remove congesting trees or poles to provide benefit to sound trees/poles. - Remove damaged or deformed saplings. - Remove undesirable undergrowth and climbers.

Sub-session- 2.3.2: Silviculture operations

Background information

Silviculture operations are activities to improve growth, health, and quality of forests. Silviculture operations are carried out in between seedling and before final harvesting age. Most of the foresters and communities are well known for different operations but their use in right time and right ways always been limited by difference in level of understanding.

Learning objectives

At the end of the session, Participants will be able to

- Define the silviculture operations and tending operations,
- Develop a list of various types of silviculture and tending operations,
- Explain the methods of operations and their applications with examples.

Time 2:00 Hours

Equipment and materials requirements

- Power-point presentation on definition, types, and application of silviculture operations.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins.
- Multimedia projector

Session facilitation process

A. Define silviculture operations

1. Explain the objective of the session.
2. Ask participants (randomly) in plenary to tell the meaning and difference between (if) silviculture operations and tending operations.
3. Receive feedback from peers and finalize the definition and differences. Present the PP slides for definitions.

4. Types of silviculture operations

1. In plenary, randomly select participants and ask which one of the operations they can explain better. List down them in the flip chart. Through the plenary, list out all the operations.
2. From plenary discussion, finalize the main silviculture operations.
3. Brainstorm and discuss in plenary on each of the operation- meaning, why, how and when to use them. Facilitate gallery presentation by four groups (5 minutes each group).
4. Present the PP slides.

5. Conclusion

1. Allow participants to raise questions and address them. Give priority from peer to answer.
2. Ask a few questions to participants to gauge their understanding.
3. Conclude the session with summary.

Handout 2.3.2: Silvicultural operations

Introduction

Silvicultural operations are the procedures that aim to achieve stand-specific objectives by using silvicultural techniques. In other words, these are the individual actions performed to maintain and regulate the quality of a forest stand according to the purpose of management. Silvicultural operations can include regeneration, site preparation, weed control, spacing, harvesting and other activities done at a concentrated time to change the growth trajectory of the stand. They act as 'inputs' to make a stand grow in the desired way.

The operations require equipment, labor and expertise that suits specifically for an operation, terrain, and biological characteristics of the species on which operation is being carried out and are called tending operations. These are carried out for the benefit of a forest crop at any stage of its life between the seedling and the mature stages. The purpose of tending operations is to produce higher quality timber and maximize the possible income. It must be done several times from seedling to maturity stage and requires considerable staff and funds. Different tending operations include:

1. Weeding
2. Cleaning
3. Thinning
4. Improvement felling
5. Singling
6. Pruning
7. Climber cutting

1. Weeding:

Any unwanted plant that interferes with the growth of desired species is called weed. And the tending operation in which all the weeds are either removed or cut to support the growth of the desirable species is called weeding. Removal here means complete uprooting of the unwanted species and cut back refers to cutting the upper portion but his does not control weeding.

Why: The main purpose of this operation is to protect the crops from suppression, reduce the root competition for moisture and nutrients available in the soil and improve light conditions to the seedlings of desired species. The operation must be carried out before the weeds start suppressing the main crop. At this stage the weeds have tender roots and shoots so that it can be easier to uproot them.

Where: The operation is performed in the areas where weeds are tall and dense, light cannot reach the ground easily, which not only affects the regeneration but also obstructs the growth of species because weeds grow at a faster rate than the crop species.

When: In plantation forests or forests where different forms of shelterwood system is practiced, weeding begins from the second year. The process starts in the beginning of the dry season and continues until the plantation is fully established (2/3 years).

2. Cleaning:

Cleaning is specially done in the natural forests where the invasion of thrones, weeds and similar undesirable species is noticeable. This must be done before the crop crosses the sapling stage. In mixed crops, this helps in regulating the crop composition. For the promotion of regeneration and growth of desired species, cleaning can either be performed singly or combined with thinning, pruning or singling operations.

3. Thinning:

Thinning is defined as a feeling made in an immature stand for the purpose of improving the growth and form of remaining trees. One thing to be considered while thinning is that the removal of trees should be done in a way that the canopy should not be broken. In simpler form, thinning can be understood as a treatment where the number of forest crops are reduced. It is only done in the pure and even-aged or nearly even-aged crops. Thinning is carried out after the crop reaches sapling stage and is continued till the regeneration starts. Usually, the thinning cycle ranges from 4-6 years in young or fast-growing crops and about 10 yrs. for older or slower growing crops. In many cases, thinning intensity and cycle length is controlled by the number of trees to be retained or removed at different ages.

Thinning may be performed in two ways:

a) Systematic thinning: where criteria for thinning is predetermined and removal of trees is based on the same irrespective of the tree quality.
b) Selective thinning: where removal of trees is determined by their quality. Selective thinning again has two types.

i. Crown/high thinning

In an uneven-aged forest, crown thinning is done to remove the dominant trees which compete with other dominant as well as lower canopy.

ii. Low thinning

Trees are removed from the lower canopy. Suppressed, sub-dominant and deformed trees which affect the growth of dominant trees in upper canopy are selected and hence removed in this system.

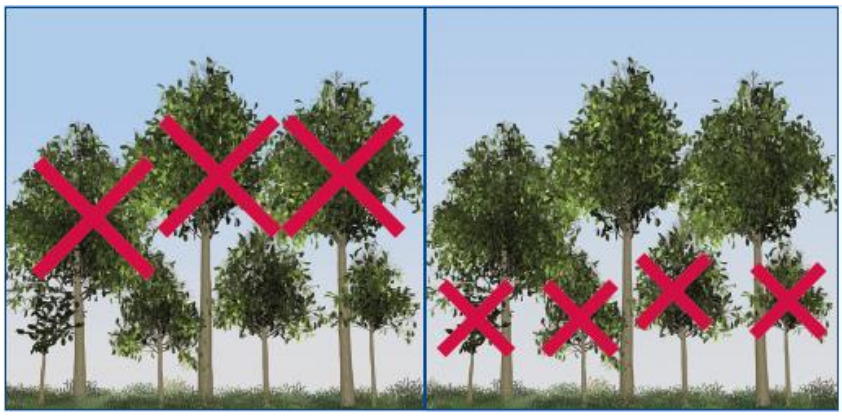


Figure 5: Crown vs Low Thinning

Why thinning:

The main objective of thinning operation is to improve the hygienic condition of forest so that remaining trees can grow well with enough supplements under proper environmental conditions. However, it provides intermediate forest products. It also helps to obtain desirable composition of crops and offers improvement in quality of timber. Thinning results in an increase of net yield and hence, increases the financial return from the forest.

When:

Thinning is done mostly in plantation and even-aged forest; hence, the timing of thinning depends upon the age of forest composition and management objective of the forest. In plantation forest, it can be started from fifth year of plantation. Very light thinning may be done in the early stage of plantation. However, plantation density determines the requirement of thinning. For sustainable management of forest and optimum use of potentiality of the site, thinning regimes are needed for different species. It guides how we can remove all the trees from the beginning of

thinning to final felling. When we design a thinning regime, the rotation is of number and regeneration management need to know.

How:

The selection of trees which need to be removed and which need to be retained can be done by making small plots. The trees to be removed must be marked and numbered. The measurement records of those trees should be done to estimate the yield. Once the selection process is completed, the harvesting operation must be performed.

Generally, following criteria should be considered while selecting the trees to be removed:

- Dead, dying and diseased trees.
- Forked, damaged and malformed trees.
- Matured / Over-matured trees
- Undesired species affecting the growth of principle species
- Congested trees and trees with multiple stems
- Lower quality competing species

Order	Criteria		
I	Dead, Dying, Diseased	Image of Dying Tree 	Image of Diseased Tree 
II	Deformed, Forked, Crocked, Wolf trees	Image of Deformed Tree 	Image of Forked Tree 

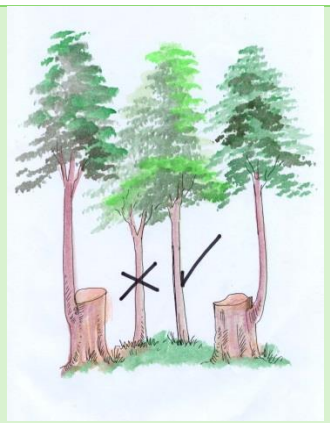
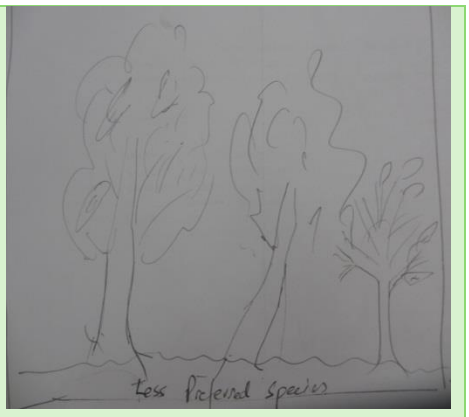
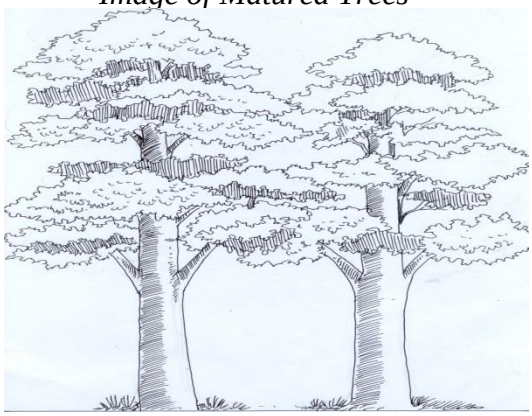
III	Trees of Less Preferred Species		
IV	Matured/ over matured trees (above the exploitable diameter)-retain vigorously growing trees having long cylindrical knot free boles of any size	*Image of Matured Trees* 	
V	Immature/congested trees (including from multiple stems of different aged to create opening- to make balanced proportion of different age in case of uneven aged forest		

Figure 6 Criteria for selecting trees for removal with some modification.

4. Singling:

Singling is termed as an operation to make one stem from multiple stems coming from a single stool/stump. When a tree is cut, it gives coppice shoots and among these multiple shoots, the strongest is selected to retain and rest are removed.

Singling is also considered as a part of thinning operation. Normally, we find multi-stem mature trees in natural forests as well as plantation forests. This affects the growth and quality of timber that can be obtained at its optimum. Hence, singling operation is carried out to ensure the quality from a mature crop.

When:

Singling is done in the early stage. If singling operation is carried out late, the stem that is retained might not be able to withstand the adverse climatic factors affecting the growth. Hence, the preferable season for the operation is at the end of growing season.

How:

Identification of healthiest and strongest bole which is to be retained must be done as the first step of singling. The selection can also be based on the requirement and objective of management. After selecting such trees, the remaining should be removed. It should be considered that there should be no damage to the trees to be retained during this process. The cutting should always be slanted (approximately 45 degrees) facing the North. Also, safety measures and improved harvesting tools are recommended to perform the operation.

5. Pruning:

Pruning is the removal of unwanted branches from a tree either for reducing risk or improving tree health and structure, or even in some cases, to improve the appearance of trees. This operation is performed on all kinds of fodder, fruit, or forest trees according to the needs. The main objectives of pruning are to minimize the number of knots and increase the timber strength. In some cases, trees have self-pruning ability. In that case, manual pruning is not required because the lower branches of trees are self-pruned in dense forests. It is done in sparse forests and in the species which do not have self-pruning ability, number of branches in a tree occurs which affects the timber quality. Hence, pruning is required in such cases.

Why:

- To produce knot-free boles
- To remove dead, dying and diseased branches
- Enhance tree growth by removing low quality branches.
- Improved natural regeneration of trees or grasses.

When:

The best time of pruning is in the winter months of January and February when the tree growth is least affected. Pruning is always done when the crowns of adjacent trees start to touch each other.

In most cases, the first pruning should be done in the fifth year. And the operation is carried out only in the lower branches of the tree. The top of the tree is always left intact.

At areas where grasses are required for the animal feeding, pruning can be done starting at the age of 3-4 years by removing all branches at the two bottom whorls of the tree. But where there is no requirement of such grasses, it can be started at 5-10 years. The last pruning can be done at the age of 10-15 years.

To perform the pruning operation perfectly, the pruning height of the plants must be fixed:

- Until the age of 10 years, the pruning height should be at one-third of the height of the tree.
- After the age of 10-15 years, the pruning height is fixed at half of the total height of the tree.

Pruning should be carried out by trained personnel under proper supervision by experienced ones who have years of experience in horticulture, arboriculture, and tree care. The upper branches must be cut first and moved downwards to other branches. This allows the person to use lower branches as footsteps. Using sharp instruments such as pruning saw is preferable to conduct this operation.

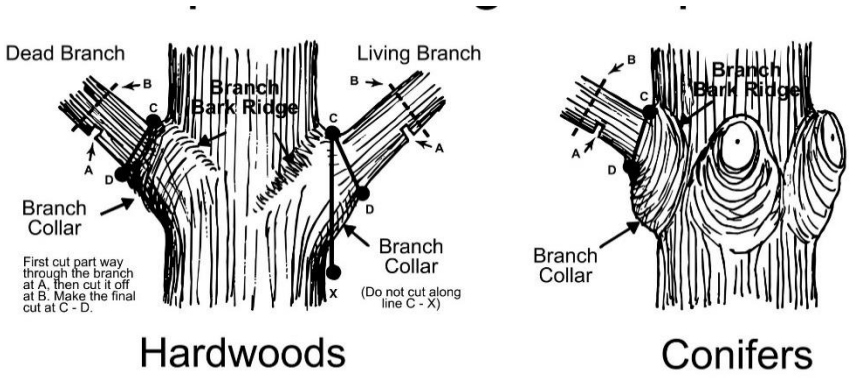


Figure 7: Illustration for proper pruning technique

One should consider if there is over pruning or not. This could affect the healthy growth of trees. A good practice is to limit the removal of crown to not more than one quarter of the original coverage in each pruning operation.

6. Climber cutting:

Climbers are those plants which attach themselves to any other plants or objects or walls as they grow. These climbers cause reduction in timber quality as they create shade and limits growth of the desirable species. Sometimes climbers completely girdle the shoots and plants die due to

suffocation. Removal of climbers from a forest is required to increase the timber quality, increase sunlight availability at ground level, reduce competition and reduce water loss through transpiration of climbers.

When: Climbers should be removed before they mature and cause damage to the desirable species. The timing may vary from species to species of the climbers. This operation can be performed simultaneously with thinning operation.

How: If the climbers are valuable, some of them should be retained because of their value. In case of coppicing climbers, they should be removed along with their tubers.

7. Improvement felling:

Improvement felling has been defined as the removal of less valuable trees in a crop with the interest of better growth of the more valuable crops. The operation is usually applied to a mixed, uneven aged forest. It may include thinning of closely stoked groups along with clearing and general assistance to young growth of valuable species.

Module 3: Understand your forest and society/markets

Module 3: Understand your forest and society/markets.

Module 3 is designed to recap the understanding of our forest and society/markets to build common insight among the participants. In the end of this module, participants will be able to

- Explain Analysis of demand and supply of goods and services of forest products
- Explain and demonstrate rapid assessment of forest quality, condition, and mapping.

Session-3.1: Analysis of demand and supply of goods and services of forest products

Background information

One of the fundamental requirements for determining forest management prescriptions is to understand a long-term demand of forest goods and services. Forest managers, especially community members, should be able to forecast the requirement of forest products and services in long run says 30-40 years from now based on trend of demand and supply of forest products. Based on long term demand, forest management prescriptions are designed to meet those objectives. However, identifying short- and medium-term demand for goods and services is equally important. Hence, forest management prescriptions are designed in such a way that it can fulfill short-, medium- and long-term demand of the forest goods and services.

Learning objectives

At the end of the session, participants will be able to

- Demonstrate how to estimate the current demand and demand trend, and supply source and trend.
- Map the requirements of forest products and services in 15 and 30 years from now.
- Sketch the vision map of forests and its service flow in next 30 years.

Time 2:00 Hours

Equipment and materials requirements

- Power-point presentation on analysis of forest product and service demand.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Multimedia projector

Session facilitation process

1. Identifying current trend of forest products and services demand and supply at local level and in markets

    1. Explain the objectives of the session.
    2. In plenary discussion, list out the current supply of forest goods and services in general from various forest management regimes. Quantify those demands such as give 10 units as baseline for current use.

3. Based on the 10 points for current demand, estimate from plenary discussion how much it was 10 and 20 years ago was and how much it will be in 20 and 30 years from now. This trend to be developed each of products receiving from the forests.
4. From plenary discussion, again how the current and past demands were met? Which were the sources- estimates in percentage.
5. Ask participants to list out the potential forest services what would be in high demand in future. Discuss the reason and trend of those demands.
6. Conclude the demand and supply trend- past and future.

7. Vision mapping for forest products and services

1. Divide the participants into three groups- homogenous group (based on institutional involvement, experience etc.).
2. Ask each group to discuss and develop a sketch of the vision map of forests, and its goods and services. (20 minutes)
3. Facilitate gallery presentation and discussion.
4. Agree on a common vision if possible.

5. Conclusion

1. Allow participants to raise questions and address them. Give priority from peer to answer.
2. Ask a few questions to participants to gauge their understanding.
3. Conclude the session with summary of the session.

Handout 3.1: Analysis of forest product and service demand

3.1 (a): Method of assessing demand and supply of forest products

Introduction

The term 'Demand' gives an idea of the requirements of the community while 'Supply' says how the community fulfills their requirements.

Estimating demand and supply of forest products is a very important process in a participatory forest management. This indicates the level of the dependency of the community on forest products. Therefore, a basic knowledge of demand and supply for forest products will help to develop forest management prescriptions and utilization plan.

Identification of the needs of the community

The requirements of forest products differ according to the community. In the remote areas of Nepal, firewood, fodder, and litters are highly demanded. Whereas villages which are in the process of urbanizing gradually reduce consumption of these products. Firewood, timber and other NTFPs can be considered as the main requirements for any community.

- Firewood: Most of the communities in rural areas use firewood as fuel and only within urban areas; LP gas and electricity are popular.
- Timber: Although now a days some people use substitute materials for their timber requirements, most of the people in the community prefer timber for furniture and building constructions etc.
- NTFPs: There are various kinds of NTFPs collected and used. Mainly they are medicinal plants and their parts, seeds, game, bee honey etc.

Sources of forest products supply

There are three types of sources that the community fulfills its requirements. They are

1. Private Lands
2. Market
3. Forest

Importance of estimating demand and supply of forest products

The community requires a certain amount of forest product monthly or annually. A considerable portion may be provided from private lands / farmland and some from the market. However nearby forest is basic source who don't have access of former two.

For sustainable forest management, the last option must be ensured within the forest. If the community gets a certain amount of timber from the forest, they can save money they spend buying timber from the market. The saving can be used for other requirements such as education, food, or health.

While preparing a management plan, we must estimate the amount of demand and supply and the gap between them. Based on the gap, the community can decide the possible options to fil the gap. For example, improving forest management practice can give better yield and plantation in private land add supply.

Methods to estimate the demand and supply

It is not easy to estimate the demand and supply of forest products at community level. These days there is a high demand for soft as well as hardwood species in the market. Market demand for the product can be identified through surveys with local as well as buyers at the market hub. The trend of forest products sold from a community also shows the demand in quantity, species, and price.

The ongoing demand for and supply of forest products within the community can be guess from the record maintain by the executive committee. However, exact estimate should be done through sampling methods as described below.

Selecting of a sample

Appropriate sample intensity will be used. Mostly it can be ten percent of the total number of families. Three economic ranks - poor, medium and rich - are included proportionally in this ten percent. (Findings form wealth ranking can be used for this purpose).

Information about demand and supply is obtained from this sample group.

Example: The total number of families is 100 then the number of families in the sample is 10

Introduce of tables

There is no fixed format to create tables; however, the following tables can be used as a guideline.

Table 15 Monthly demand and supply of firewood

Family No.	Monthly demand kg or *bhari*	Monthly Supply in Kilogram (kg)		
		Private lands	Market	Forest
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Table 16 Annual supply of Non-Timber Forest Products (NTFPs)

Product	Unit	No. of collecting families (a)	No. of turns per year (b)	No. of units per year (c)	Total (a)x(b) X(c)

Example: Honey in kg, if the no. of collecting families is 5, No. of turns per year is 3 and no. of units per turn is 1, the total is 3x5x1=15 kg

Table 17 Demand and supply of timber for house constructions - for the period of last five years

House rank	No. of houses built	Used timber volume in cubic feet (cft.)	Total volume in cft.	Supply		
Small						
Medium						
Big						
Total						

Example:

Table 18 Demand and supply of timber for house repairing - for the period of last five years

House rank	No. of houses	Used timber volume (cft.)	Total volume (cft.)	Supply		
Small						
Medium						
Big						
Total						

Examples:

Table 19 Calculation of demand and supply for one year

1. Firewood

Source	Monthly demand of 10 % Sample (a)	Annual demand of community (a)X10
Private lands		
Market		
Forest		
Total		

Example

2. NTFPs

Product and unit	Annual collection

3. Timber - house construction

Source	Demand for five years	Annual demand
Private lands		
Market		
Forest		
Total		

4. Timber - house Repair and Maintenance (R/M)

Source	Demand for five years	Annual demand
Private lands		
Market		
Forest		
Total		

Market demand survey

The market demand for certain products can be assessed through local buyers and sawmills in the market hubs. At least 3 local buyers and 3 big sawmills/furniture industries should be surveyed. The survey checklist should include quantity, quality, and price trends for the last 3 years. Based on this information future demand in the market can be projected.

Session-3.2: Rapid assessment of forest quality, condition, and mapping

Background

Before planning for forest boundary survey, blocking, and designing forest inventory, it is necessary to understand the overview of bio-physical conditions of the forests. Many foresters often miss this process and go directly for forest boundary survey and forest inventory. As a result, they experience errors. The Rapid Forest Assessment (RFA) is tool to understand the forest in general and must be done collectively by a team comprising a forester, community members (at least 2-3), a local government representative if possible. There is a specific way to conduct rapid assessment and sketching of forest areas and forests patches.

Learning objectives

At the end of the session, participants will be able to

- Explain the need for conducting rapid forest assessment and mapping,
- Demonstrate the method of conducting rapid assessment and mapping,
- Develop a sketch map depicting forest areas, geographic features, different forest types and conditions within the forest area.

Time 4:00 Hours

Equipment and materials requirements

- Power-point presentation on rapid assessment of forest condition and mapping.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Measuring tape, rapid assessment sheet/checklist etc.

Session facilitation process

1. Importance and process of conducting RPA (1.0 Hour)
    1. Explain the objectives of the session.
    2. Ask participants to raise their hand and explain how they did if they have experience in doing rapid forest assessment and mapping.
    3. In plenary, explain the process of conducting rapid forest assessment and documenting them.

4. Allow participants to raise questions and address them. Give priority from peer to answer.
5. Ask a few questions to participants to gauge their understanding.
6. Conclude the session with summary.

7. Preparation for field exercise

1. Divide the participants into three groups- mix groups based on institutional involvement and experience.
2. Make sure participants/each group has checklist, brown paper, copy, pen, compass/GPS etc. for field exercise.
3. Allow each group to have different forest patches within or different forests.
4. Debrief the task of the group to conduct in given forests.
5. Brief the logistic arrangement to conduct assessment.

6. Field exercise

1. Demonstrate the process collectively in a small patch of a forest.
2. Ask participants to go to their respective forest and conduct the exercise.
3. Tell them the time of assembly after completion of work.

Handout 3.2: Rapid assessment of forest condition and mapping

Introduction:

RFA is an important step in the forest management planning process. In general, forest species composition, age groups and tree size; terrain, drainage, slope, and aspects; forest protection threat such as fire, grazing, pest, and disease within a forest block are very important aspects to understand at the initial stage. Hence, before we start a detailed boundary survey, blocking and forest assessment process, we need to understand general conditions on various bio-physical aspects of the forests. RFA gives an idea on boundary, potential boundary disputes, possible blocks and coupes and scale and intensity of inventory. RFA also guides us the potential forest management prescriptions within the forests. Hence RFA is a critical tool for the planning process.

Process:

1. Development of participatory sketch map: When the geo spatial map of the forest is not available, we facilitate discussion with the key informants of the community to draw boundary of the forests, rivers within the forests, writing forest status in small areas etc. These days it can be confirmed in the geospatial printed maps- received from various means such as google earth. Once the geo spatial map is ready, the community is asked to allocate boundary of the forests in the map, name of the patches with forest quality within the forests. The process provides an overall impression on the forest boundary, terrain, disturbance, and quality of forests.

1.1 Transect walk: Once sketch map is ready, a transect line is drawn within the map. Facilitators ask key informants to locate a way to walk across the forest in such a way that most of the forest situation is observed during the walk. If needed, transect lines are drawn across the forests in two directions. A field note is taken to note down the overall conditions of the forests- in every change in forest conditions or terrain, the situation is noted drawing a line and what is on the left and what is on the right side of the transect. The following characteristics are generally noted.

Table 20 General characteristics noted for transect walk.

Flora	Topographical/edaphic	Fauna	Conservation threats
Tree, shrub, and herb species Ground cover Size of trees dominancy by species Dominant species Key stone species	Slope, aspect, drainage, soil type, depth, soil quality, spring/pond etc.	Species seen, dominant and rate species. Pugmark or facet, Corridor or habitat	Forest fire Grazing Illegal cutting Pest and Disease

These characteristics are later written on the map so that a clear picture of the forest is seen.

1.2 Boundary clarification: During the process, the team with Key Informant (KI) visit the boundary and if any conflict exists, they are solved through proper mechanism. Unless boundaries are clear, further processes can't take place.

1.3 Sample plot measurement: To understand the growing stock, temporary plots of maximum 3-5 number and 10 m. x 10 m. size are established in different locations that represent the good, medium, and poor quality of forest. In addition to collecting information as noted during the transect walk, counting and height and diameter measurement of trees, shrubs, regeneration is made as appropriate. Sample form for rapid sample plot is provided in annex 1 (this is like general inventory form).

1.4 Interpretation and use of collected information:

The exercise will assist to clarify the boundary of the forest to enable survey team to complete survey and demarcation smoothly without disturbance. The RFA exercise provides a tentative idea on forest and topographical condition. This will help field officer to estimate several blocks/zones and identify their boundaries.

The forest and topographical conditions also guide us on designing inventory methods. For example, if the area is rich in NTFPs, a particular inventory method for that species is used. If forests are potential for conservation zones, less intensive inventory is designed. In the area where potential for intensive operation for timber is high, detailed inventory shall be designed. Similarly, grass lands are inventoried with quadrant method.

Information related to topographical, and disturbance are used during the development of management prescriptions.

Module 4:

Forest management planning and implementation

Module 4: Forest management planning and implementation

Module 4 is the core part of the training. This module deals with the process and techniques for developing Forest Operational Plan (FOP)/Forest Management Plan (FMP) in any type of forest management regimes. However, it is targeted to community-based forest management systems. The main objectives of this module are to

- Develop common understanding on the fundamental and process of developing forest management plan,
- Equip with tools and techniques in conducting social analysis and consultation process,
- Enhance capacity of participants in conducting surveys, mapping, forest resource inventory and analysis and interpretation; and
- Enable participants in developing forest management prescriptions of different types and quality forests with different objectives.

Session-4.1: Legal provision on forest management planning

Background information

Policy and legal aspects are one of the pillars in determining forest management objectives and prescriptions. In addition to provision on forest act and rule, directives and guidelines are important to consider while developing management plan. For example, if some species are legally band, endangered or need to follow legal protocol for developing and utilization, it should be well considered. Similarly, government does not promote monoculture and give priority for indigenous species. In addition, environmental impact assessment or initial environmental examination is required in large scale forest management and utilization. Forest policy encourages enhancing forest production and productivity through sustainable forest management. Participants need to understand the key legal and policy provision in promoting forest management.

Learning objectives

At the end of the session, participants will be able to

- List out the policy and legal documents to be reviewed while developing silviculture prescription; and
- Identify key provisions on those policies and legal documents that are related to forest management and its impact.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, develop a list of policy and legal documents, international treaties and directives related to forest management,
3. Divide the participants in to four small groups and allocate them key policy documents (half to two groups and half to two groups)
4. Allow participants to discuss in a group and list out key provisions in those documents related to forest management.
5. Facilitate group presentations of those provisions and add if missing anything.
6. Present the key provisions to be considered.

7. Allow participants to raise questions and address them. Give priority from peer to answer.
8. Ask a few questions to participants to gauge their understanding.
9. Conclude the session with summary.

Handout 4.1: Legal and policy provisions on forest management planning

National Forest Policy 2075

The National Forest Policy 2075 prioritizes the sustainable and participatory management of forest resources to increase forest productivity and production.

The Forest Act 2076 (2019)

The provisions included in the Forest Act 2076 (2019) are as follows:

> **18 (5):** The users' group may, based on its desire and need, make the work plan of the community forest, or amend it as per necessity, in consultation with the concerned Local Level (LL), to make effective the forest management. Prior to implementing the work plan so made or amended, the users' group shall give information thereof to the Divisional Forest Officer (DFO).
>
> **22. Expenditure to be made for the development of forest:** (1) The users' group shall spend at least twenty-five percent amount of the annual income earned derived as per the work plan in the development protection and management of the forest, and at least twenty-five percent of the remaining amount in poverty alleviation, women empowerment, and entrepreneurship development activities, in coordination with the concerned LL.
>
> **22(2):** The amount remaining after the expenditures made pursuant to subsection (1) shall be used in the interest of the users' group.
>
> **34. Forest enterprise and eco-tourism programs may be operated:** (1) The users' group may, upon following the procedures as prescribed, operate such forest enterprise and eco-tourism programs as specified by the approved work plan on its own or in partnership with the Local Level or organization or the private sector or cooperatives.

The Forest Regulation 2079 (2022)

Forest Rule 2079 (2022) has the following provisions related to forest management.

> **22. Provide timber and firewood to the District Forest Product Supply Committee (DFPSC).** (4) Community Forest Users Group (CFUG) and Collaborative Forest Management Users

Group (CFUMG) shall allocate at least 25% of timber and firewood of Sal species to the DFPSC and in case of other species they shall allocate as per the demand of the committee.

48. Forest management and collection of forest products: (1) CFUG shall manage their community forests as per the approved Operational Plan (OP).

(3). The harvesting of forest products should not exceed the annual allowable cut mentioned in approved OP.

(5). However, the harvesting of 4D trees and trees affected by calamities can be done exceeding the AAC.

49. Sale distribution of forest products and approval letter: (2) CFUG shall auction and sell the remaining timber and firewood after internal distribution and allocation to DFPSC. In doing so, the CFUG should decide through general assembly and get approval of DFO.

(4) CFUG shall provide forest products to the forest based small enterprises operated by CFUG or individual users not reducing the rate and collection cost.

51. Operation of forest enterprises: (1) CFUG shall register and operate forest enterprises as directed by OP outside the forest area.

(2) The CFUG is interested in operating the forest enterprises as per Sub-rule (1) shall provide the business plan along with the potential amount of forest products and activity plan along with the recommendation letter from Divisional Forest officer.

Community Forestry Directives 2052 (1995)

The Community Forestry Directives (CFD) 2052 (1995) includes the following provisions.

8. Establishment of an Industry: 1) The DFO shall make a recommendation for the establishment of an industry pursuant to sub-rule (4) of Rule 32 only after considering following matters:

a) Whether or not the User's Group (UG) has had the management capacity to run that industry.
b) Whether or not the forest product to be yielded according to the operational plan of the community forest is sufficient.
c) The sale and distribution arrangement of the produced goods.
d) Matters relating to utilization of the funds collected from the sale and distribution.

2) In case more than one user's group jointly ask for a recommendation to establish an industry recommendation shall be required to be made by considering the following matters in addition to the provisions under subsection (1)

a) The quantity of the forest product to be made available according to the operational plan by each user's group.
b) The manner of distributing among themselves the amount earned by the sale.

Community Forest's timber/fuelwood/NTFPs collection and sales-distribution guideline, 2071

Harvesting from Community Forests (CF) are directed by the CF timber/fuelwood/NTFPs collection and Sales-Distribution Guideline, 2071. Aligning with the Rule 32(4) of Forest Regulation (FR) 2051 and Article 8 of Community Forest Guideline 2052, the guideline has prioritized the collective action for sustainable harvest and efficient sale-distribution of forest products from the CFs. It has mentioned that user's group can annually sale-distribute timber more than 5000 cubic feet (cft.) individually or collectively through forest cooperative. In addition, if any CFUG extracting less than 5000 cft. of timber are allowed to sale-distribute through cooperative if interested. In addition, Users groups can establish the sawmill or other forest enterprises through forest cooperative following the rule 32(4) of Forest Regulation (FR) 2051 and Article 8 of CFD 2052. Despite the Forest cooperative's registration and operation being in accordance with the Cooperative Policy (CP) 2048, the membership and other management of the registered forest cooperative will be in accordance with its own norms.

Financial procedure guideline of community forest users' group 2073

The main aim of the guideline is to guide CFUGs to mobilize the annual income generated through several sources like sale-distribution of forest products, government subsidy, support from NGOS, etc., and their audit. It has been prepared following the Forest Act 2049, Forest Regulation 2051 (Rule 67) and Community Forest Guideline 2052, Community Forest Directives 2071 and Community Forest's timber/fuelwood/NTFPs collection and Sale-Distribution Guideline 2071.

Forest strategy 2016-2025

One of the major outcomes of the Forest strategy 2016-2025 is to achieve sustainability in production and supply of forest products and service enhancement. Furthermore, it has mentioned that improvement in harvesting technologies along with the capacity and skills development of users in forest management and improved research helps in achieving the expected outcomes. The strategy has also aimed at bringing 50% of forests in the Terai and

Siwalik and 25% of forests in the mid-hills under sustainable forest management by 2025 (2081 BS).

Fifteenth five-year plan 2020-2024 (2076/77-2080/81 BS)

This national plan has prioritized the sustainable management of forest resources to increase the production and productivity of forests and increase its contribution to national prosperity.

Sustainable Forest Management Procedure, 2079 (Bagmati province)

This procedure emphasizes and suggests the appropriate silviculture system based on factors such as forest types, condition, regeneration status, slope, and community preferences.

Table 21 Recommended Forest management matrix for various forest types.

S.N	Forest Type	Major species	Regeneration condition (per ha.)	Requirement and use of forest services and products	Silviculture system
1	Terai and Siwalik Sal Forest (Slope less than 19 degrees)	Sal	Seedling > 5000	Timber, firewood, and soil conservation	Selection system
			Sapling > 2000		
			Seedling < 5000		Indian Irregular Shelterwood System
			Sapling < 2000		
2	Terai and Siwalik Sal Forest (Slope between 19 to 31 degrees)	Sal	Seedling > 5000	Timber, firewood, and soil conservation	Single Tree Selection with felling cycle
			Sapling > 2000		
			Seedling < 5000		Group Selection System
			Sapling < 2000		
3	Siwalik Sal forest (Slope greater than 31 degrees)	Sal		Soil conservation	Protection
4	Khair/ Sisso (Plantation Forest)	Khair, sisso		Timber, firewood, and soil conservation	Seed tree method

5	Riverine forest	Sisso , Khair, Simal, Karma, Jamun, Asna, Siris		Timber, firewood, and soil conservation	Improvement felling Method
6	Terai and inner terai degraded forest	Sal		Protection and utilization of limited NTFPs	Improvement Felling
7	Hill Sal Forest	Sal, Chilaune, Saj, Khote salla	Seedling > 5000	Timber, firewood, and soil conservation	Selection system with Felling Area based on Felling Cycle or Group Selection System or Single tree selection
			Sapling > 2000		
			Seedling < 5000		Coppice with Standard or Irregular Shelter wood system
			Sapling < 2000		
8	Natural Pine Forest	Khote salla , Gobrea Salla , Pate salla	Seedling > 5000	Timber, firewood, and soil conservation	Group Selection system with felling cycle
			Sapling > 2000		
			Seedling < 5000		Irregular Shelterwood System
			Sapling < 2000		
9	Plantation Pine Forest	Khote salla , Gobrea Salla , Pate salla	Seedling > 5000	Timber, firewood, and soil conservation	Group Selection system with felling cycle or Irregular Shelterwood System
			Sapling > 2000		

			Seedling < 5000		Irregular shelterwood system
			Sapling < 2000		
10	Pine and broadleaf mixed forest	Khote salla , Gobrea Salla , Pate salla, Chilaune, Katus		Timber, firewood, and soil conservation	Irregular shelterwood system/Selection System with felling cycles
11	Hill broadleaf mixed forest	Chilaune, Katus, Utish, Kafal, Gurans		Timber, firewood, and soil conservation	Coppice with standard or Coppice selection System
				Fodder, Firewood, leaf litter	Coppice Selection System / Reserve
12	Temperate broadleaf mixed forest	Katus, Khasru, Banjh, Falat, Gurash, Okhar		Timber, firewood, and soil conservation	Selection system with Felling Area based on Felling Cycle or Group Selection System
				Fodder, Firewood, leaf litter	Coppice with standard system
13	Temperate Conifer Forest	Gobre salla,Dhupi salla, Spurs, Juniper dhupi,		Timber, firewood, and soil conservation	Uniform shelterwood system (Felling area based on felling cycle) or Selection System

		Thingrea salla etc.			(Group Selection system)
14	Plantation pine forest to broadleaf conversion	Removal of major species: Khote salla, Pate salla and Gobre salla	Species to be established: broadleaf forest species	Timber, Fodder, Firewood, leaf litter, Soil conservation	Broadleaf Species 75% and Pine mixed forest 25%

Session-4.2: Fundamental requirement and process for developing forest management plan

Background

Forest is a long rotation crop. For sustainable forest management, a proper diagnosis of forest conditions and its potential to produce future desirable crops is very crucial. In addition, the possibility of obtaining desirable crops is also influenced by policy instruments for promoting those desirable goods and services. Similarly, whoever manages the forest, their full ownership and leadership is very important hence thorough consultation process and capacity building is required targeting to the forest managers.

Learning objectives

At the end of the session, Participants will be able to

- List out and define fundamental requirements for forest management planning,
- Brief the summary information required for management planning,
- Identify community groups/interest groups and outsider supporting organization to be consulted in developing the plan, and
- List out and explain the consultation process involved in developing plan.

Time 2:00 Hours

Equipment and materials requirements

- Power-point presentation on fundamental requirement and process for developing FMP.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Multimedia projector

Session facilitation process

1. Fundamental of forest management planning

1. Explain the objectives of the session.
2. Ask participants randomly in plenary to tell fundamental basis of determining forest management objectives and prescriptions.
3. List down the answer in flip chart paper/white board. Summarize discussion to conclude three fundamental bases in designing forest management objectives and prescriptions,

Forest Conditions (FC), demand of forest products and services and policy environment to achieve the objectives.

4. In plenary, agree on key information requirement in three pillars of management and methods to collect and analyze them.

5. Process involved in FMP development

1. Divide the participants into three groups- homogenous groups (based on institutional involvement, experience etc.).
2. As each group to discuss and come up with the participatory process involve in developing forest management plan
3. Ask each group to present in plenary.
4. Develop a common process through plenary discussions.

5. Conclusion

1. Present the PP slides summary on fundamental and process.
2. Allow participants to raise questions and address them. Give priority from peer to answer.
3. Ask a few questions to participants to gauge their understanding.
4. Conclude the session with summary.

Handout 4.2: Fundamental requirement and process for developing Forest Management Plan

4.2.1: Process for developing Forest Management Plan

Background information

Planning is the tiles of activities determining goals and objectives projecting future requirements. In the forestry sector, planning is an integral component of forest management expressing goals and objectives defining multilateral activities concerning government rules and regulations and/or owners future dreams. Forest management plan addresses the issues/problems of specific forest area seeking with perennial and annual action of activities. All five assets' details must be incorporated during the planning process (social, environmental, economic, physical, and human) to build a Sustainable Forest Management Plan. In Nepal, both Community Based Forest Management (CBFM) and Block Forest Management Plan (BFMP) preparation at governmental part and implementation practices are existed for better forest output achievement.

Importance of inclusive planning process

Prosperity from forest management is the main aim of Government of Nepal (GoN). FMP should address elements, horizons, legislation, balance of production, social and environment as well as participation along with utilization and marketing to empower local forest users. An inclusive planning process highlight review of traditional forest management practice and current changing policies, management modalities (use right, intensive management, capacity development, gender-equity, social inclusion, transparency, enterprise) addressing socio-economic and technical aspects. For inclusive planning, it is genuine to consider identifying and involve local stakeholders, agree on management objectives and strategies, negotiate, and agree on benefit sharing, responsibility and cost and combine local knowledge with technical information.

Key consideration on planning process

- **Legal and social aspect:** Societal participation during any type of planning is crucial to achieve goals and objectives of a plan. Local community status such as ethnicity, gender, religion, culture, traditional practice must be noticed during the planning process. On the other hand, use right of local community, identifying marginalize and disadvantage groups to uplift their livelihood, capacity of community, other social norms, indigenous and traditional knowledge to catch up with science must include during planning process. Also, ever evolving, and contentious policies also influence the forest management practices in Nepal.

- **Bio-physical aspects:** It is an important part of forest management plan which reflects the existing status of forest condition accordingly geographic condition of and guides to way

forward to meet goals and objectives of forest area. A detail of physiographic condition of land, aspect, climatic condition, soil type, terrain type, major species, wildlife, species composition, rivers, and land configuration on management plan shows dreams for management prescriptions.

- Economical aspect: A management plan should trigger input and output after implementation in terms of financial status. Different types of economical assessment like MRV (maximum revenue value), B/C (benefit cost) ratio, IRR (internal rate of return) etc. are usable for decision making process of management plan preparation and implementation. Economical assessment prescribes technical method selection, coverage of area and legal implementation.

A well-crafted forest management plan in Nepal delivers a multifaceted economic boost by providing sustainable livelihood opportunities for impoverished communities, generating national revenue through timber, non-timber forest products, and eco-tourism, while also conserving biodiversity, sequestering carbon, and offering vital ecosystem services. This strategy aids in poverty reduction, fosters economic development, and contributes to global environmental initiatives, illustrating the profound impact of responsible forest management on local, national, and international scales.

Steps in preparing an FMP

There are multiple steps on forest management plan preparation. Forest resource assessment, demand and supply of forest products, socio-economic condition of local community, environmental condition, interest groups identification, legal documents addressing, and approval are key assessment factors during planning process. The following are key steps during forest management plan preparation.

Steps 1: Action plan preparation

A detailed action plan for developing forest operational/management plan should prepared before starting forest management plan preparation addressing How, Who, When, Where, Whom, What (5WH) questions. This type of action plan guides what to do and what will achieve after implementation during planning process.

Step 2: Participatory mapping

A participatory map should prepare involving local people and knowledgeable key informants to assess key resources on forest area, residential condition, and preliminary prick out geographic scenario of given area. At the same time, community/local people project their imaginary forest condition in future which support to select technical aspect during planning.

Step 3: Socio-economic assessment

During the plan preparation process, study the convention management practices and collect social and historical data to give a future direction to plan. An assessment of management gaps (productive or protective or community management) support on people participation assessment during management plan preparation. Detailed study of socio-culture of community, culture, stakeholders' assessment provides information regarding partnership during forest management plan implementation.

Step 4: Rapid assessment forest condition

A rapid assessment of forest condition should be carried out participating all the stakeholders, interest group, leaders, and key informants to prick out key threats/challenges on forest.

Step 5: Vision and objective setting

Socio-economic assessment and rapid assessment of forest condition ensure to assess threats/problem of forest and social culture according to historical background. These types of threats and problems support setting vision, objectives, and probable activities according management aspects according to condition of forest.

Step 6: Forest boundary survey

Forest boundary surveys are carried out using Global Positioning System (GPS) instrument supporting by land use topographical map. During the survey all physical obstacle assessment, permanent structures, land terrain type, rivers, roads etc. should record which support for zoning of total forest.

Step 7: Resource measurement and analysis

Total forest should stratify according to species types, terrain condition, geological structure, aspect, configuration, slope to design sample plots and measures details of forest resources. A clear picture of forests is obtained through Rapid Forest Resources Assessment (RFRA) process. A detailed inventory of forest species carries out addressing technical and legal aspects forecasting by government of Nepal rules and regulations. This type of zonation /stratification according to productive, protective, and other type of purposes supports setting objectives, strategies and activities for each zone according to bio-physical and social consideration as well as legal provision.

Block, sub-block and working unit demarcation, research plots allocation, total growing stock estimation, finding of Annual Allowable Cut (AAC), determination of thinning regime, mother tree selection, cultural prospective area determination, wildlife hot area determination and demarcation, silvicultural prescription are key message during this step.

Step 8: Environmental service

It is keen and urgent to address the environmental services given by forest and surroundings. Water resource conservation, biodiversity pocket area demarcation, ecotourism area separation, carbon stock and sequestration assessment are key environmental services, and these services should be addressed during management plan preparation.
Likewise, key hazard of climate change on given area, probable mitigation and adaptation measures should incorporate to address climate change.

Step 9: Revisit with stakeholders

They should negotiate and agree on the main roles and responsibilities of each stakeholder. This is a critical step since it deals with the five practical questions: who, what, when where and how? So, who is to be responsible for the activity and how will they be supervised?, What tasks will need to be undertaken and in what order?, When will the activity and tasks be started and how long will the work take?, Where, in what part(s) of the forest?, How, what methods and techniques will be used? should be finalized before drafting the management plan.

Step 10: Draft management plan preparation

- Vision mapping
- Strategy development
- Silviculture and other forest protection, development, and management prescription development
- Technical and financial resource estimation, leverage from stakeholders and management

After completion of detailed inventory of forest and social assessment, a draft of management plan including technical, financial, and social consideration will be prepared. This type of draft management plan presents on different stakeholders like sub-division forest office, Local Government (LG), Federation of Community Forest Users Nepal (FECOFUN), different interest group to receive comments and suggestion from them. Finally develop a final reviewer team for peer review of plan before submission to approval team.

Step 11: Audience comments incorporation

Once the draft plan has been formulated it should be presented publicly at the local area so as to allow people to react and respond. The planning team will need to prepare in advance for these meetings, bearing in mind that some of their audience will be non-literate and therefore much of the information will need to be presented in a visual format. Meeting dates should be planned well in advance to allow the information to be communicated throughout the area even where households are dispersed, and meetings should be arranged so that neutral facilitators can manage the meeting.

Step 12: Approval process

After including all comments and suggestions from public and technical association regarding to forest management, plan preparation team finalize activities base plan from ground and take over for approval process to concern DFO office for approval process. A pilot work carried out on a patch of activity which will support for full implementation of management plan.

Session-4.3: Boundary and block survey and mapping- theory and field practice

Background information

Most of the foresters are known to have skill in conducting boundary and block survey using instrument- GPS and developing maps using relevant software. However, refresher exercise is required to those who were graduated long time ago and have not used the instrument for a long time. In addition, all the foresters should have similar skills and understanding on the tools and techniques.

Learning objectives

At the end of the session, participants will be able to

- Explain the advantage of using GPS for boundary surveys over other traditional methods,
- Demonstrate the use of GPS and conduct boundary survey and maintain field book, and
- Develop a complete map using appropriate software.

Time 9:00 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Measuring tape, GPS, field book etc.

Session facilitation process

1. Boundary survey methods using GPS (1.0 Hour)

    1. Explain the objectives of the session.
    2. Allow participants to present the findings of Rapid Forest Assessment (RFA) exercise.
    3. In plenary, list out different types of methods of conducting boundary survey. Agree on common latest methods used in Nepal.
    4. Agree on what are the main features in GPS instrument to be recorded.
    5. Agree on the format of a field book of survey.

6. Preparation for field exercise (0.5 Hour)

    1. Divide the participants into three groups- mix groups based on institutional involvement and experience etc.

2. Make sure participants/each group has Field book, copy, pen, GPS etc. for field exercise.
3. Debrief the task of the group to conduct in given forests.
4. Allow each group to have different forest patches within or different forests.
5. Brief the logistic arrangement to conduct assessment.

6. Field exercise (4.5 Hours)

1. Demonstrate the process collectively in a small patch of a forest.
2. Ask participants to go to their respective forest and conduct the exercise.
3. Tell them the time of assembly after completion of work.

4. Preparation and presentation of map (3.0 Hours)

1. After returning and refreshing, ask each group to develop maps.
2. Ask known participants to explain the process to download and create a map.
3. Let the group finalize the map.
4. Ask them to make ready their map for presentation for the next session.
5. Discuss the experience of participants in survey and mapping using GPS and software.

Handout 4.3: Boundary and block survey and mapping

4.3.1 Use of GPS receiver in forest boundary survey and block division

The use of GPS is considered more appropriate for surveying and mapping the forest area because it can achieve greater accuracy with less time, cost, and manpower. GPS is used to get the coordinates of the forest or Reduce Emission Forest Degradation and Deforestation Plus (REDD+) project area and it can be used not only for forest mapping, but also for forest leveling, establishing sample plots, and demarcating other areas. Therefore, it is necessary to know about its use in the context of Nepal, setting method. The method of taking the coordinates and the information to download the coordinates to the computer is very necessary, so this information has been given.

(a) Use of GPS in the context of Nepal:

G. P. S. Before using it, some setting should be done based on the longitude of the country. In the context of Nepal, three bases have been fixed for its setting and accordingly it should be set before starting work in the field. Under those bases, 81 is used for the west (west of Dang district), 87 for the east (east of Sarlahi district and 84 for the middle). In addition, since the details about this are given in the map of the surveying department, it is better to set it as a basis.

(b) GPS setting

There are six pages in GPS.

- Main menu page,
- Satellite page,
- Compass page,
- This trip composer,
- Altimeter and
- Map page

These pages have separate functions, but out of this,
GPS Main menu page is required for setting. The procedure for its setting is presented below.

GPS setting method:

First, go to the main menu page by using the GPS page key.

General set up:

Highlight the setup menu and press enter then the setup page will appear and highlight the system icon and press enter and with the help of Rocker Key, make settings as shown below.

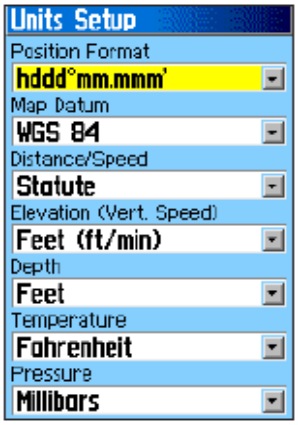
1. GPS –Normal
2. WAAS/EGNOS – Disabled
3. Battery Type – Alkaline
4. Text Language – English
5. External Power Lost–Turn Off
6. Proximity Alarms – On

After this, exit the page with the help of Quit Key.

This is how the GPS setting is done.

To set units in GPS

- First go to the Setup menu page and highlight the Units icon and press Enter.
- After this, with the help of Rocker Key, make the settings as shown below.

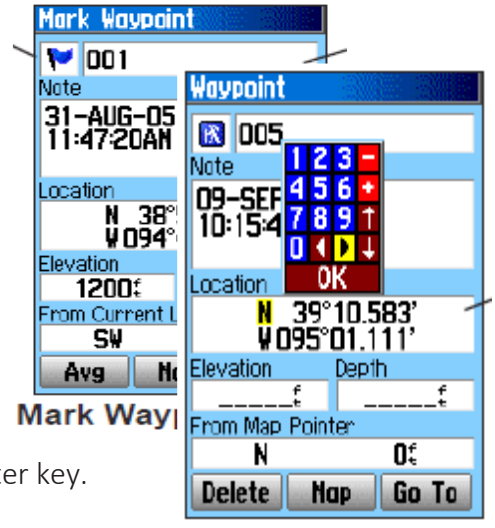


    - Position format - Users/UPS: Determine which coordinate system is in your working area. The Topographic Map published by the surveying department should be taken as the reference. If you want to overlay on the Google map, you should set UTM/UPS.

1. Map datum – WGS 84 (It varies from place to place, and can be obtained mainly from the maps published by the survey department)
2. Distance/speed – metric
3. Elevation (vert. Speed) – meter
4. Depth – meter
5. Temperature – Celsius/Fahrenheit
6. Pressure – millibars

Now your GPS units have been setup.

(c) How to get co-ordinates using GPS



First, note down the coordinates of your current location or press the Mark key and hold the Mark key. Keep it until the Mark Waypoint page comes up. In addition, three digits appear at the top of the screen. And what to name the way point will appear, highlight it and press enter key.

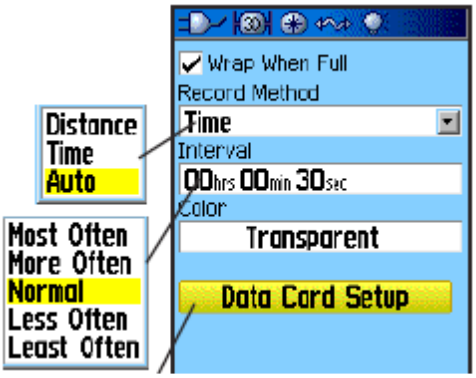
Then name the waypoint with the help of Rocker Key and press OK. (Waypoints can also be placed on GPS itself)

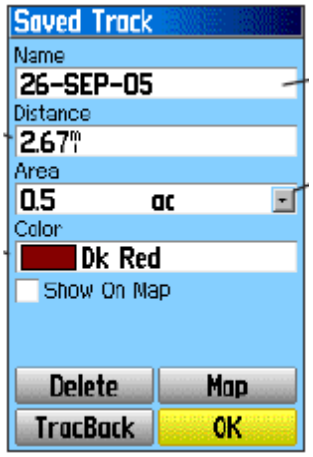
After finishing this, press Quit Key to exit. Repeat the process mentioned above to get the waypoint of another place and keep marking the waypoint.

Press Find Key to find the waypoint and go to the waypoint to get the waypoint information you need, Highlight the point and press Enter. After this, the information of the way point is displayed on the screen.

(D) Forest boundary survey using GPS

GPS Tracks are used to distinguish the boundaries of the forest. The procedure to be followed to do this is presented below.

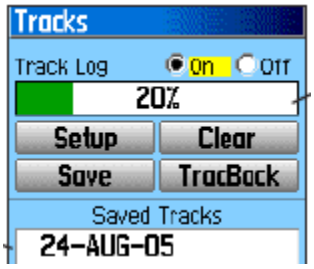




Saved Track Page

To set up the track log, double-click the Main menu to open the Main menu page. Select the tracks icon and press enter to open the track page. Similarly, highlighting the Setup button and pressing Enter will open the Track log setup page. And following the procedure as shown below, Track log setup is done.

Record method – distance
Interval – 5m
Color - transparent



And to survey the boundary of forest, select track log and turn it on and press Enter.
But if you don't want to work in “track log”, select track log and turn it off and press Enter.
If you have worked on the track log, open the “track button”, and press the “save button” to save it.
At this time a message will appear that the entire track, do a survey whole track? Yes or No. If you want to survey, highlight “Yes” and “Press Enter”.

Tracks can be named while surveying way points. Press the “Quit button” to exit this page.

In this way, the polygon feature, which is used to separate the boundaries, can be used to make a map of the forest area according to your needs or for segmentation work.

Use of GPS receiver in forest area mapping

It is appropriate to do the mapping of the forest area in two ways:
Using GPS coordinates and using satellite image of the area. Details about this are presented below.

(a) Method of making maps by downloading coordinates from GPS:

Coordinates or waypoints recorded by GPS can be downloaded in two ways.
i. Using software and ii. Manually

i. Using the Software:

Data is downloaded from GPS using GPS Utility software which is often available for free. For this work, it is necessary to adopt the following procedure:

a) First of all, open the GPS Utility software
Click option and click "map setting", Option setting window will open. Then click on "General" and check the following.

- Track and route information
- Backup data set file automatic
- Data selection

Similarly, check as shown below in the "Loadable Grid of the Window".

- User Grid (Nepal 87 –east)
- User Grid (Nepal 84 –Middle)
- User Grid (Nepal 81 –West)

If you want to overlay coordinate on Google Earth, you should set it in "UTM grid".

b) Then click on Map setting and check as below.

- Way Point (symbol and Text)
- Routes (Leg info arrowhead)
- Tracks (Lines, start symbol and points)
- Colours for waypoints, routes and tracks and press the OK button.

c) Downloading Waypoints:

Click GPS on the main window of GPS Utility, click on "Download" all and all way points will download to the computer from GPS.

d) Datum Setting

Click "Datum" on View of Coordinate format, then Datum Sensitive window will open. Select India Bangladesh from the Datum available and click on it.

e) Select user grid

Click View of Coordinate format and select User grid Nepal 84. Then after click file and save to your specified folder and Click Exit button of GPS Utility.

We can generate maps using ArcGIS, ArcView, Erdas, ILWIS, QGIS, etc. software on the computer from the coordinates (from the downloaded waypoint).

ii. Manually

When the coordinates are taken by GPS in the field, they are saved in the GPS or recorded in the field-book. The coordinates obtained in this way are entered in the Excel sheet and it should be saved as DBF4 or Text (tab delineated).
After that, you can make a map using software like ArcGIS, ArcView, Erdas, ILWIS that you find convenient. However, it is important to be careful when entering the coordinate computer manually from GPS.

Session-4.4: Forest assessment, analysis, and interpretation: theory and practice

Background information

Information related to forests is very crucial for developing forest management plans. There are several parameters used to determine the forest quality and site quality. Primary information on those parameters is essential to collect through participatory approach. Foresters should have in-depth and similar understanding in collecting, analyzing, and interpreting them.

Learning objectives

At the end of the session, participants will be able to

- Explain different methods of collecting information related to forests,
- Estimate the number of sample plots required for collecting bio-physical information of the forests,
- Delineate sample plots on map developed using GIS software,
- Conduct forest assessment-inventory to collect data/information; and
- Analyze and interpret the collected data.

Time 10 Hours (1.5 days)

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Linear tape, GPS instrument, height measuring instrument- clinometer/range finder/relascope etc. inventory form, pen, diameter tape, *khukuri*, numbering chalk, rope, ribbon etc.

Session facilitation process

1. Explain the objectives of the session.

2. Methods of collecting bio-physical information of a forests (1.5 Hours)

    1. In plenary, develop a list of bio-physical information required for forest management planning.
    2. Facilitate discussion on different methods of collecting that information. Choose the appropriate and common methods recommended by the authority.

3. Ask participants to tell formula to determine sample size, plots, and numbers.
4. Ask groups who made a map to present their findings- map, areas, etc.
5. Estimate the number of sample plots based of formula and delineate them on map using coordinate position. Record all coordinates into GPS instrument.

6. Preparation for field exercise (30 minutes)

1. Divide the participants into three groups- mix groups based on institutional involvement and experience etc. It can be the same group as before.
2. Make sure participants/each group has necessary equipment-GPS, Range Finder, Linear tape, diameter tape, Khukuri, forms, rope, numbering chalk etc.
3. Debrief the task of the group to conduct in the given forest.
4. Allocate each group to different forest patches within or different forests. Will be the same forest as they did previous exercise.
5. Brief the logistic arrangement to conduct assessment.

6. Field exercise (4.15 Hours)

1. Demonstrate the process collectively in a small patch of a forest.
2. Ask participants to go to their respective forest and conduct the exercise.
3. Tell them the time of assembly after completion of work.

4. Data analysis, developing summary tables and interpretation (3.0 Hours)

1. After returning and refreshing, discuss on formulas and summary tables in plenary.
2. Ask each group to analyze all data using appropriate formulas.
3. Let the group finalize summary tables and interpret the findings.
4. Ask them to make ready their map for presentation for the next session.

5. Presentation of the findings of forest assessment (1 Hour)

1. Allow each group to present their findings through the gallery walk method.
2. Facilitate discussion on the interpretation of the findings.
3. Allow participants to ask questions if any.
4. Reciprocate questions to few participants to gauge their confidence in conducting assessment and interpretation.

Handout 4.4: Forest assessment, analysis, and interpretation

Background information

Forests are a complex biotic and abiotic phenomenon. Estimating species diversity, horizontal and vertical structure, growing stock, increment rate, annual harvestable products and other forest cover study refer as forest assessment. Forest assessment process also includes parameter of site quality, slope, aspect, drainage, soil depth, color, structure etc, opportunity and challenges/threat for forest protection etc. Forest assessment or inventory is a crucial tool for sustainable forest management. Forest inventory plays a pivotal role in preparing inventory-based forest management plans and enhancing forest productivity. Assessment of the present status of trees, shrubs, herbs, and NTFPs probable growth rate and prescription of harvesting quantity are key message of this manual during management plan preparation and training conduction.

Total enumeration on forest area is somewhat lengthy, time consuming and costly, so estimate of by species and size class with sampling method is suitable nowadays. Estimation of total quantity support on silvicultural prescription and technology adaptation.

Sampling Design

Stratified systematic sampling with random start is adopted for forest resource assessment which include stratification of forest area with stable strata according to forest condition (species distribution, stage of forest, land terrain type, abundance of species). Stratification is the process of grouping of population which have relatively homogeneous because it is easy to measure on sub-population.

Sample plots

The shape of sample plots is determined based on geomorphology, landform, and climate (square, rectangle, circular), in case of forest resource inventory, Concentric Circular Sample Plots (CCSPs) are used for tallying trees. FRA used 20 m. radius for big size tree or greater than 30 cm dbh, 15 m radius for 20-30 cm dbh, 8 m radius for 10-20 cm dbh and 4 m radius for 5-10 cm dbh.

According to CF Inventory Guideline-2061 of Nepal, following steps are key process for forest resource assessment.

A) Preparation for forest resource inventory

a) **Discussion with CFUG and Community Forest User Committee (CFUC)-**Before forest inventory takes over, a keen discussion with CFUGs and CFUG should for why this is doing, what type of result will achieve and what will reflection after the inventory activities. The main objective of these discussion is to aware CFUG and EC members the important of

forest inventory, brief the process and necessity of their engagement/active participation in the process

b) **Consultation about objectives of inventory-** User groups must be familiar with inventory process, why it is incorporated in OP and what will happened in future after inventory take place.

c) **Division on block and sub-block-** According to management prospective, species diversification and land terrain, all the forest should divide into multiple blocks, sub-block ie Stratification of forest for homogenous formation the Rapid Forest Resource Assessment results can provide basis for block division.

d) **Sampling Intensity (SI)-** SI refers to the % of area taken to assess different parameters of forest resources that represent the entire forest area and the blocks. The inventory guidelines 2061 Bikram Sambat (BS) recommends 0.1% sampling intensity for grassland or regenerating areas whereas 0.5% medium to dense forests having pole and trees. However, for intensive forest management, more sampling intensity with at least 80% level of accuracy is required. In such cases, statistical methods of determining sample size are used but the size of sample plots should be known in advance. Shape and size- rectangular, circular, and square sample plots size and shape can be used according to land terrain. The inventory guidelines suggest xx M^2 for trees, and nested plots of xx M^2 for Pole and xx M^2 for regeneration. However, they should be flexible to adopt terrain and density of forests without deviating the total sampling intensity. The greater the number of sample-plots the more the distribution of plan results more representation of forests in inventory.

e) **Sampling Method (SM)-** Stratified systematic sampling with random start reduces bias and it is more accurate than random method. For homogenous forests, random sampling methods are also used.

f) **Others-** Inventor should know and discuss with community about what type of inventory should require. Apart from only forest species, assessment of biodiversity component, forest products for marginalized groups, required equipment for inventory, human resource, resource map and inventory plan must prepare with discussion with community by technician.

B) **Data collection-** Before data collection from field, stratification of forest area, sampling method determination, data collection from plot are key activities of data collection.

a) **Stratification or block division of forest-** Blocking is carried out due to develop managerial unit formation, reduce cost and time, easy for inventory activities. Especially forest areas are stratified accordingly to forest condition, natural sign or structures, objectives of forest management unit, geographic coverage, and area of forest.

b) **Process of blocking-** Primarily user groups define, and block activities carried out according to objectives of forest management. Blocking point will pin out on map and GPS location find then establish on field too. Then after total productive area and effective will

determine for forest inventory. If needed according to management perspective, sub-division of block will carry out.

c) **Sampling method-** Stratified systematic sampling method is highly recommended to reduce bias during data collection process. Random sampling also obeys on homogeneous forest. Circular, rectangular, or square shape sample plots can be established according to terrain, species, and objective of management.

Locating sample plots in study area map and identifying them in field

Field inventory surveys are an important source of information but are expensive. For increasing the emphasis on narrowly targeted subpopulation of interest, like in the below figure (figure 1); GIS can be a cost effective, practical solution that can result in better surveys.

So first we need to specify the sampling frame that is the study area. Representative estimates typically require probability sampling. Probability sampling is in practice most performed with lists from the entire population (cover type in the case given in the figure below) in the study area. So, in the case of figure 1 below out interest of area is the forest (both broadleaved open and closed forest types).

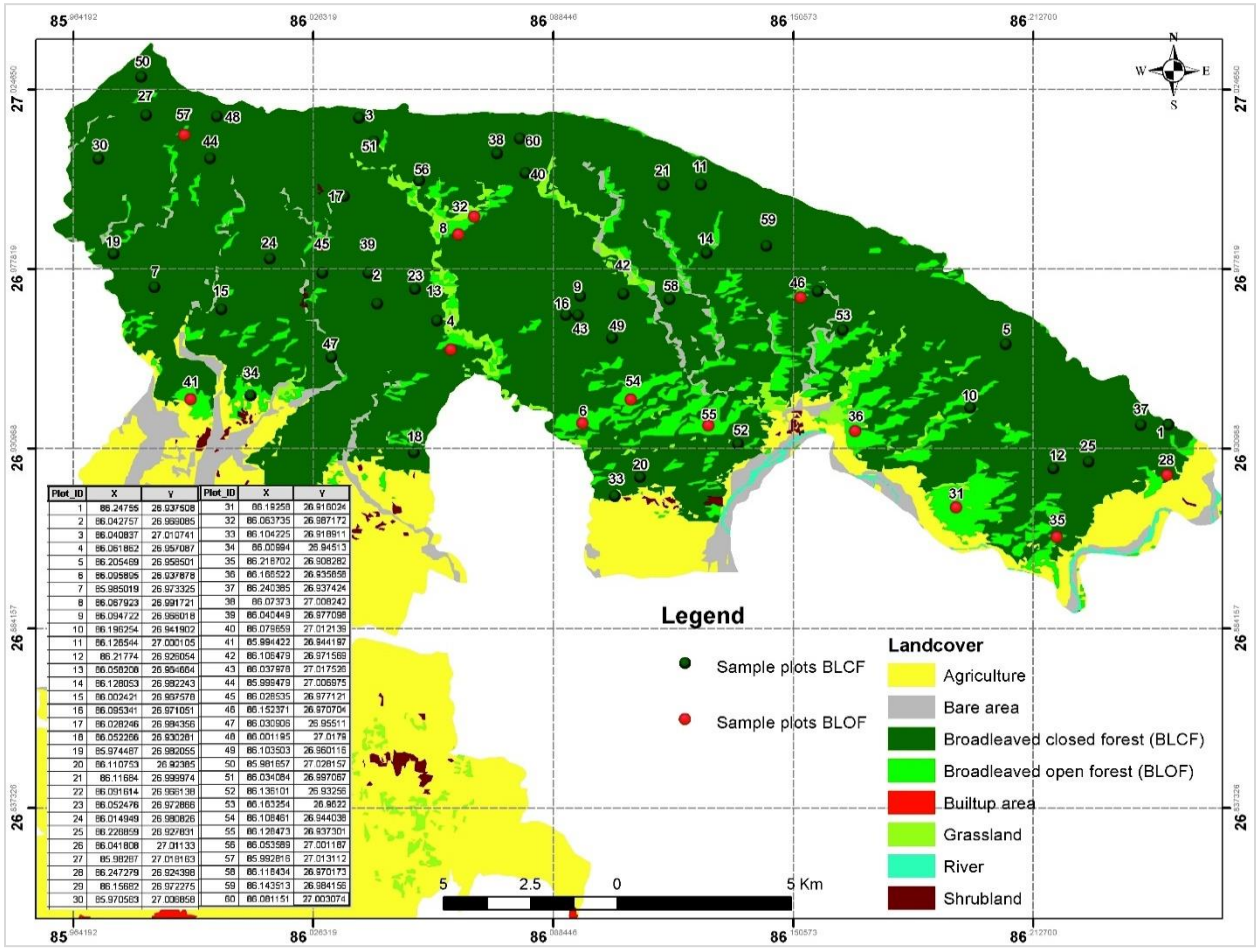


Figure 8 Map showing the stratified random sample distribution in a forest area of a watershed (Jalad khola) in Nepal.

We need to put random sample plots around the forest cover I the study watershed. To calculate the number of samples required, there are different algorithms, but they depend on what criteria we are going to measure and, we require the secondary data of these variables. Alternatively, we can also use thumb rule to take sample plot greater than 30 for field inventory in smaller in watershed areas considering the budget we have. As for the figure above, we have we have taken 60 sample plots.

Then we go for how we want these sample plots to be spread in our study area. Then we go for the stratification. Sampling can be stratified by dividing the frame into mutually exclusive and exhaustive separate frames for different subpopulations. Here in the figure above, we can stratify the study area into broadleaved closed and open forest types. This will give us the ability to sample far more from the sub-population for a given survey cost. So, when taking about the forest type in the above figure 1 watershed area, the broadleaved open forest is 23% of the total forest and the closed forest is 77%. So, we can take this proportional ratio and divide the total sample plots as 14 for open and remaining 46 for the closed forest. This will form a representative estimate from a sub population for different strata.

Next, we randomly spread these allocated sample plots over these strata. This can be done in several GIS software with the command of generate random points and give the barriers as out strata and assigned sample numbers. For verifying them in the field we can make a bigger A1 or A2 size map like in the figure above with the overlay of the actual image instead, and the coordinates and sample numbers or sampling ease.

Then, all study location data and field notes are stored in a downloadable CSV file on the user's device. The sample plots are positioned with a GPS-device and then plan the route to the plots. Use the map to navigate to the point and check the point with the GPS. Plan the easiest and shortest possible route from one plot to another by considering their reachability. Then collect GPS data followed by other inventory measurements.

The marking in the plots center is very valuable for periodic monitoring, as GPS alone could give a few meters of difference in locating the center of the permanent plot. Furthermore, a natural landmark is determined and located near the plot to help the localization of the plot center at the time of measurement. Appropriate landmarks are large stones, boulders, and large trees, for instance. The distance between the natural landmarks (fixed points) from the plot center should not be more than 15 meters, if possible. For each landmark, bearing and distance from the center of CCSP must be recorded. If the landmark is a tree, then record its diameter at breast height as well.

d) Size of plots- For trees strata (more than 30 cm dbh), sample size is 100-500 Square Meter-sqm, for pole strata (10-29.9 cm dbh) only 100 sqm, sapling (up to 1 m Height-ht and less

than 10 cm dbh)-25 sqm, regeneration (30-100 cm ht)-10 sqm and all type medicinal plants-10-100 sqm sample plots size used for data collection. The nested plot should allocate for tree to seedling measurement.

e) Measurement or data collection

- **Regeneration:** All seedling and sampling should count according to species and record on specific format
- **Tree and pole:** On both classes, diameter should measure at breast height with Diameter (D)-tape and tree height can measure with Hypsometer, Clinometer, Suntometer or Range lighter. Different types of class should classify tree and pole according to length of clean bole size after harvesting such as 1st, 2nd and 3rd class.
- **Other products:** Grass, firewood, slash etc. will measure within a sqm using total harvesting and measurement.
- **NTFPs:** Pure NTFPs forest inventory will be measured according to NTFPs inventory guideline, but on mixed forest assumption method apply for measurement.

C) **Forest resource inventory data analysis-** All types of data should project on hector. Seedling, sapling, pole, tree, NTFPs data analyze according to objective of management, needs of community and government rules and regulations. On the basis analyze data, forest can distinguish as good, medium, or weak/bad forest. Standing tree volume calculated according to forest regulation 2079. Based on regeneration status (seedling and sapling) and stock volume of wood, forest condition are categories as

Table 22 Forest condition according to regeneration status

Category	Good	Medium	weak
Seedling number per ha.	>5000	2000-5000	<2000
Sapling number per ha.	>2000	800-2000	<800

Table 23 Forest condition according to stock volume of wood

Wood stock	>200 cum			50-200 cum			<50 cum		
Regeneration status	Good	Medium	weak	Good	Medium	weak	Good	Medium	weak
Forest condition become	Good	Good	Medium	Good	Medium	Weak	Medium	Weak	Weak

Table 24 Annul increment of stock.

Species class	Annual increment %		
Forest condition	Good	Medium	Weak
Fast growing	5	4	3
Medium growing	4	3	2
Slow growing	3	2	1
Annual harvesting of annual increment	75%	60%	40%

D) **Use of forest resource inventory-** Assessed data will utilize and implemented for sustainable forest management concept. Total stock, determination of forest condition, annual increment and annual allowable cut are key utilizing data for forest management prospective and determine the technical methodology to be utilized. Assessed data refers as

- **Prescription of silvicultural technique:** According to acquired and analyzed data, what type of silvicultural technique to be applied for better improvement of forest will be determined. Only protection, simple thinning pruning activities or sustainable harvesting plan implementation technique (shelterwood system applied) recommendation carried out by assessed data.
- **Recommended activities for marginalized groups:** Based on final assessed data, a plan can be formulated for interest and marginalized groups for IGA, enterprise, Livelihood improvement plan and so on.
- **Replication of activities:** Learning by doing scheme will develop after implication of assessed data on forest. Demo plot establishment, research plot establishment and replication can be done from assessed inventory data.

Thinning Guideline 2064

The GoN approved Thinning Guideline 2064 for especially thinned operation of *Pinus roxburghii and Pinus patula* in Sindupalchowk and Kavrepalanchowk planted forest. This guideline recommended ground thinning as A, B, C, D and crown thinning. Guideline recommended as

- Principle of Thinning- Only for Khote and Patule pine
- Determination of Rotation age- Patule-45 year and Khote-75 year
- Time- Dry season
- Method- Selection thinning

Session- 4.5: Growing stock and increment

Background information

Growing stock of a forest is obtained normally through forest inventory process. But rate of increment can't be obtained from a single measurement and hence needs repeated measurements or use secondary information for the same species with similar geographical situation. However, for even aged forests, if age is known, it can easily be estimated. Understanding the growing stock and increment is the key information to understanding the forest conditions that helps to determine how much growing stock to be retained and how much to be harvested.

Learning objectives

At the end of the session, participants will be able to

- Define normal growing stock and method to estimate the growing stock,
- List out the types of increment,
- Explain various methods of estimating increments; and
- Correlate the growing stock, increment and their implication to forest management prescriptions.

Time 1.5 Hours

Equipment and materials requirements

- Power-point presentation concept of growing stock, increment and implication to forest management prescription.
- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb.
- Multimedia projector

Session facilitation process

1. **Define growing stock**

1. In plenary, ask participants to tell the meaning of growing stock and its key factors (living materials, per unit area, in volume or number with different units). Agree on definition and key factors.
2. Ask participants their understanding of Normal Growing Stock and ideal situation for Normal growing stock. Agree on NGS and Conditions.
3. Discuss the need to understand GS for sustainable forest management and list out the importance.

4. Increment and management prescriptions
    1. Divide participants to four heterogeneous groups in terms of sex, experience, and institutions.
    2. Ask two groups to come up (though group work) with types of increments, definition, and methods to estimate increments and rest two groups on the relations among growing stock, increments and management prescription (20 minutes each)
    3. Allow each group to present through gallery walk method, take feedback from other groups, provide inputs, and finalize them.
5. Conclusion
    1. Allow participants if they have questions for clarification.
    2. Conclude session presenting the summary of growing stock, increment and their relationship with the forest management prescriptions.

Handout 4.5: Increment, growing stock, method of estimate and implications.

4.5.1 Increment:

Increment is the increase in growth, diameter, basal area, height, volume, quality or value of individual trees or crops in each area at a given time. In simple words, it is the increase in growth of a tree or a crop with age. Increment can be calculated by measuring the parameters as mentioned above at the start and the end of the specified period. Usually, increment refers to the increase in wood volume of forests, the volume of crops and not individual stands. Basically, there are three types of increment.

i) Current Annual Increment (CAI): Increment of trees or stands in each year.

ii) Periodic Annual Increment (PAI): the average annual increment of crop within certain period

iii) Mean annual increment (MAI): Average volume acquired by a tree from its beginning till it reaches the specified age.

Relation between CAI and MAI and its implication:

CAI is small in the early stage of a stand. It increases slowly during the first few years and then increases rapidly when the crop enters the pole stage. And reaches maximum at its desired age. After this period, growth starts declining. This point where CAI starts declining is called culmination point. CAI may also become negative with the decline in growth of the stand and end with mortality.

Mathematically, CAI can be expressed as: Volume of a crop at measured year minus volume of crop a year before the measurement.

Whereas MAI is obtained by adding all the CAIs of a stand divided by the age till which CAI is considered. Hence, MAI is the average volume obtained by a stand until it reaches the desirable stage. MAI starts flattening at the point where CAI reaches culmination point.

The CAI and MAI of a stand meets only at two stages in their span: the first time in starting phase of their growth and the other during maximum MAI. At the second culmination the crop can provide maximum average volume per unit area per year. At this point, CAI is less than MAI and MAI also start decreasing after this point. CAI may be either zero or negative depending on the stand. But the MAI is never zero or negative. Hence, if maximum wood volume to be obtain, the time when CAI and MAI culminate, should be considered for final harvest of the crop.

The figure below gives a clearer illustration of the relationship between CAI and MAI in the age vs volume graph of a stand.

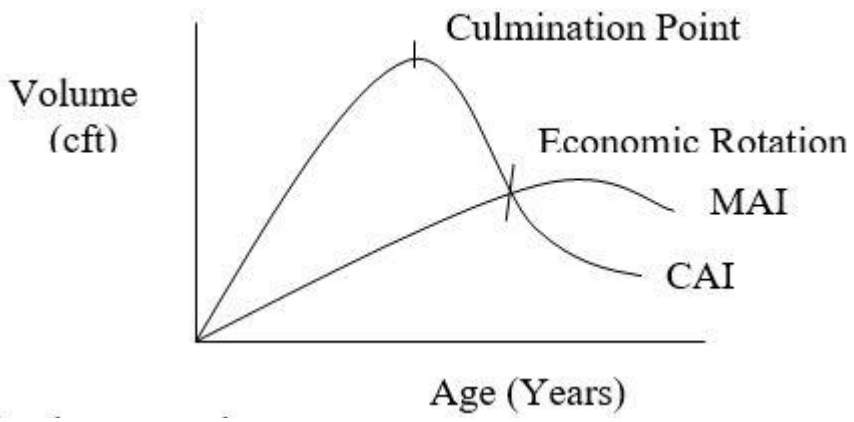


Figure 9:Graphical representation of CAI and MAI interaction

For more insights regarding growing stock and increment, please visit the following link:

https://www.youtube.com/results?search_query=relation+between+growing+stock+and+increment

4.5.2 Growing stock:

Growing Stock (GS) is one of the basic characteristics of any forest that helps to understand the forest condition. It is defined as the sum of all trees growing in a forest or a specified part of it. Growing stock in terms of volume is normally measured as volume or basal areas of total living tree above 10 cm diameter at breast height. It is usually measured in Cubic Meter (m^3).

It is also known as the living tree component of the standing volume. Standing volume includes tops of stems, large branches, dead trees lying on the ground that can still be used for fiber or fuel and excludes small branches, twigs, and foliage (FAO, 2000).

In general, there are three types of growing stock.

i) Overstocked: When a forest is not harvested even after it reaches the maturity stage; the forest has more volume per hectare than normal and hence, is called overstocked forest. When several matured trees are high, the forest usually will have over stock.
ii) Understocked: Generally, when the volume per hectare of a forest is lower than the normal expected volume, the forest is understocked. There are three conditions which cause understocking of a forest:
    - More trees from younger age class
    - Sparse forest because of poor forest management
    - Extension of a rotation period

Neither of the above-mentioned conditions are a good characteristic for proper and sustained yield. Hence, to obtain sustained yield from a forest, it is necessary to maintain normal growing stock in the forest.

iii) Normal growing*:* it can be defined as the total volume of trees in a fully stocked forest with normal distribution of age-classes for a given rotation. It is often difficult to determine normal growing stock.

Method to estimate Normal Growing stock in different silviculture system are described below.

a) Normal GS in clear felling system

Based on final mean annual increment

The simplest example may be taken of a firewood Eucalyptus plantation of ten hectares, one hectare of which has been planted annually for ten years. If each year's growth in each plantation is represented by i, the volume of each gradation starting from one year old will be i, 2i, 3i.... 10i.

The yield of normal forest is equal to the volume of oldest age-gradation in a forest. Or the volume at rotation age (r). Hence, total growing stock of the forest with r age-gradations can be estimated as the sum of i, 2i, 3i, ……, (r-1) i, ri. In arithmetical progression, at the end of growing season and before the oldest, r-year old, plantation is felled.

This sum is = (i+ri) r/2 or ri/2+r/2 (r*i)

r*i is the volume at rotation age, can be denoted as I.

Hence, the equation becomes, = I/2+(I+r/2)

And if the oldest plantation is removed, volume at the beginning of next growing season will be I/2+(I+r/2)

Now, the normal growing stock of the forest in the middle of growing season will be equal to the average of these two values: i.e., NGS from MAI = I*r/2

Based on yield table

A yield table is a form of tabulated data which gives the information on expected yield of a forest at different age-gradations. The table includes information such as stand age, top height, number of trees per hectare, mean diameter at breast height, basal area per hectare, volume per hectare, etc. Though the yield table helps in predicting the probable amount of volume that can be extracted from the forest, the data may not always be accurate because growth of trees and forest stands depend on various environmental, physiological, and anthropogenic factors as well. But in

the case of yield tables, the data are predicted by assuming some specified characteristic which when applied may vary with the actual growth conditions of the forest.

A yield table usually gives data for the intervals of five or ten years. In that case, the normal growing stock of the forest can be accurately determined by plotting the yield table data on a graph paper, drawing a smooth curve, and computing the area below the curve using either planimeter or counting the squares.

a) Normal GS in uniform regular shelterwood system

The growing stock in uniform regular shelterwood system is generally determined following the similar method as in clear felling system, i.e., using the yield tables. But this is not the authentic method to obtain required data. Hence, in a situation where some area of the forest is removed by regeneration felling, formula developed by Fischer can be applied to determine the normal GS.

NGS = (V+V1) *P/2*D;

Where, V= initial GS,

V1 = GS at the end of regeneration period,

P= Regeneration period,

D = Crown density

b) Normal GS in selection system

Generally, the forest which is maintained under selection system is like the even-aged forests. Hence, to determine the normal GS in a uniform regular shelterwood system, method of GS determination based on MAI is used.

However, Munger has derived a formula based on CAI to calculate the NGS in a selection system which shows as:

NGS=(i*fc)/2+reserved timber per felling area*the number of areas

Where, i = Total CAI of whole reserved timber

fc = Felling cycle

Implication of GS

There is a direct relation between these three types of growing stocks with the forest management prescription. When the forest has normal growing stock, total volume of annual increment of the forest can be harvested as allowable cut.

When the forest is overstocked, the volume to be removed annually will be higher than the annual increment of the forest. It means, when we estimate the ideal normal stock, the excess volume can be removed from forest in one year or can be distributed into years. For example, 50% volume of overstock is harvested,

Annual allowable harvested = Volume of total annual increment+ ½ of the volume of overstock.

In the case when the forest is understocked, certain % of the annual increment volume is left to increase forest capital volume. The amount to remain in the forest depends on the level of forest degradation i.e., volume deficit to be normal GS and demand of the products. Normally 50% annual increment volume is normally left community forest assuming that most of CF are understock. It can be 25%, 50, 75 or 100%. If 25% volume is left, we can calculate allowable harvest as

Annual allowable harvest = Average annual increment (volume)- 25% of average annual increment.

3.3.3 Determination of GS

Growing stock of a forest can be determined using following methods:

i. Total enumeration: Enumeration of each tree within the study area must be enumerated, measured. This method is not applicable in the case of large areas where time and money are consumed in a huge amount by the method, but no result is seen. In that case, enumeration of a small area is done and then sampling is carried out for other purposes.
ii. Sampling: Sampling method is applied is large areas where a sample from the population can represent the diversity of whole population. Representative areas are selected for sampling purposes because the data for the whole population is estimated based on results obtained from the selected samples.
iii. Image analysis: Aerial photography or image analysis method for determining the forest growing stock is applied in case of inventory in large and inaccessible forest areas.

Session-4.6: Development of management prescriptions

Background information

This session is a critical and important part of the whole module. Forest management or silviculture prescriptions are developed based on long term demand and supply of forest products and services, enabling socio-political and legal provisions and biophysical condition of the forests. In the previous sessions of this module, most of these aspects have been discussed. Now based on those fundamental requirements, participants should be able to develop a comprehensive forest management prescription to defined forests with given objectives.

Learning objectives

At the end of the session, participants will be able to

- Define forest management prescriptions,
- List out components included in the prescriptions; and
- Design forest management prescriptions for different types of forests.

Time 4 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.

Session facilitation process

1. Explain the objectives of the session.

2. **Define and list out components/section involve in forest management prescription (30 minutes)**

    1. Brainstorm and agree on the meaning of forest management prescriptions in plenary.
    2. Discuss and list down the components of management prescription.
    3. Form 4 small groups ask them to come up with ingredient of in the components (10 minutes)
    4. Allow group to present in plenary (10 minutes)

5. **Setting vision and objectives of forest management (45 minutes)**

    1. Divide the participants into three groups- mix groups based on institutional involvement, experience etc. It can be the same group as before.

2. Ask each group that based on exercise they did in previous sessions, develop vision map and list down short-, medium- and long-term objectives. Link this to demand and supply session (30 minutes)
3. Allow each group to present their group work through gallery walk (15 minutes)

4. Development of forest management prescriptions (2.5 Hours)

1. Present the example matrix of forest management prescriptions.
2. Identifying major forest types is important for production-oriented forest management. Pick the top 5 forest types.
3. Divide the group in to five and allocate one type to each group to develop a complete forest management prescription (in bullet points)- Pine (planted and natural), Sal (hill and Terai), Broadleaves, Fodder (Quercus)
4. Facilitate presentation through gallery walk method.

5. Conclusion (15 minutes)

1. Allow participants to raise questions and address them. Give priority to peers to answer the question.
2. Ask a few questions to participants to gauge their understanding.
3. Conclude the session with summary.

Handout 4.6: Forest management prescriptions

4.6.1 Development of forest management objectives & prescriptions

Forest management objective

Forest management objectives and prescriptions are developed based on forest condition, short, medium, and long term demands of forest products for the community and the market, and the legal provision on forest management. The information on forest resources and physical condition is obtained through forest resource assessment while the demand of forest products and services (environmental) are discussed during the social analysis process. Review of existing laws and regulations provides legal provision for managing forests for certain objectives. With all this information, a forester/facilitator can help the community in identifying short-, medium- and long-term objectives of forest management. Once forest management objectives are developed, forest management prescriptions that can meet the objectives are developed. These prescriptions involve a set of silviculture operations and systems. The forest management objectives should be short/clear, measurable, achievable, reliable and should be obtained in design time frame.

Developing forest management objectives is a very difficult task. The objectives can be related to products and services that the forest is supposed to provide in the long term say in the next 20-30 years. The potential of forest in producing desired products and service can be forecasted through the analysis of forests resource assessment or inventory data however, long term demand of forest products and services is hard to forecast since the current demands for products and services would be different in the next 20-30 years. This can be supported by the fact that the demand for firewood and timber in the semi urban areas have been reduced drastically in the last 20 years. Similarly, due to market force, the community who are lobbying for pine conversion to broadleaved now want to promote pine. We should keep in mind that the forest we wish to develop is not for the current generation as long rotation crop, we should aim at for the new and next generation. Hence, we should be able to forecast their need in the next 20-30 years. Commercialization of forest products has been priority of most of the youth while the previous generation/old generation were enjoying the existing subsistence level service provided by the forests and all inputs were volunteered.

Within a forest area, the potential of producing goods and services by the forest may vary with aspects, soil and altitude. One forest and block can produce multiple forest products and services and they are not necessarily similar among the blocks.

Based on this information, facilitators encourage to map their vision that what compositions/types/species of forest they would like to develop and what products they want in the next 20-30 years. They can do pictorial mapping of their vision that also depicts long term impacts. The vision should reflect long term objectives. The following information will be helpful for vision mapping.

- The present condition of the forest according to the appearance of the surrounding area in the sample plot.
- The past (that is about 30 years ago) condition of the forest.
- Reasons for the changing forest conditions
- The future forest condition if no management system is applied.
- List of benefits that the community is expecting (only from the block.)
- The expected forest (what community want to see after 20 years For eg. economically valuable timber forest of mix age and mixed species, same age economically valuable forest, Diversified species forest etc.)
- Biological information of the forest and block: i.e., species, number and volume of tree per hectare, species and number of regenerations per hectare, species and availability of NTFPs.
- Physical condition of the area

Once vision is clear and agreed, long term forest monument objectives are developed. However, short term and medium-term objectives should be developed based on the existing use practices and patterns. The objectives should be broad- overall- related to impacts as well as specific to products and services. There is also a need for developing objectives for each block if conditions and potential of forest block and expected services differ among blocks.

Development of forest management prescriptions

Three factors (see figure 10) are very important to consider while selecting the appropriate silviculture system and operations. Missing any factor while selecting appropriate silviculture system and operations will affect to achieve the desired goal. Forest is a long-term crop. Unlike agriculture, failing to identify appropriate operations can affect the entire ecosystem for long term (more than 50 years) whereas if any agriculture crop fails, it will have short term i.e., 1-2 years impact. Hence, it is important to decide carefully considering all the associated factors that contribute to success. Some important fundamental requirements that help in decision making process are summarized below.

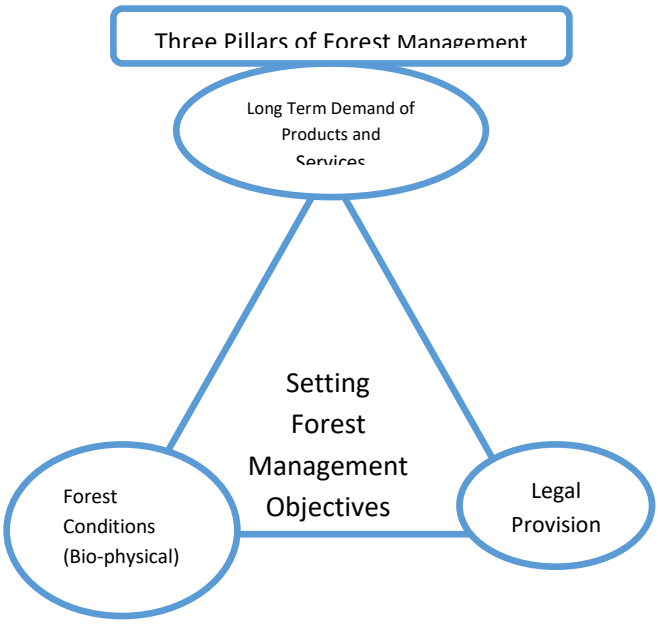


Figure 10 Three pillar of forest management

1. Community needs and management objectives (short, medium, and long term)

Forest is a common property resource to enjoy its tangible and intangible goods and services. Users of its goods and services are beyond a particular group or communities or human being. For example, a particular community could enjoy from goods such as timber, firewood, poles and NTFPs but a range of other services, such as clean air, clean water, soil protection, increase amount of ground water, cooling effect of forests, carbon accumulation and oxygen release, are offered by forest ecosystem consumed beyond the groups. In addition, several wild animals, birds, reptiles, insects and so on depend on forest goods and services. When setting forest management objectives and prescriptions, one should consider benefits of forest ecosystem beyond a particular group or community. For instance, when timber or pole production is the target for which clear felling and mono-culture plantation, there is a need to compromise several goods and services including NTFPs, biodiversity services, soil protection, clean water, wildlife habitat and so on. Hence, while facilitating to identify objectives of forest management and designing prescriptions in a community, the community members should clearly understand users of forest goods and service beyond their community and accordingly appropriate silviculture systems and operations could be selected.

2. Bio-physical conditions of the site

As explained in the earlier section, application of silviculture operations in a forest depends on the objective of forest management which depends on the existing forest condition, topographical factors, edaphic factors, and climatic factors. Parameters under forest conditions include species composition, succession stage, current growing stock and its quality and age of dominant species. Parameters such as altitude, slope and aspects are considered under topographic factors whereas soil texture, structure, color, depth, moisture, and nutrition are considered under edaphic factors. Similarly, temperature, seasonal variation on temperature, amount of sunlight days and Hour, amount of rainfall, rainfall pattern, and humidity are key parameters under climatic factors. During the process of developing forest inventory, information related to all these parameters are to be collected and analyzed. In several cases, analyses of these parameters and linking them into forest management objectives and silviculture operations are missing in community forest management plans. As a result, all CFs ended up with no or very low scale operations and Government staff, field facilitators and community members are reluctant to adopt standard practice due to their limited knowledge of these linkages.

3. Legal framework

Forest Stewards Council (FSC) Principle 1 “Compliance with Laws” promotes to comply with all applicable laws, regulations and nationally ratified international treaties, conventions, and

agreements for sustainable forest management. The GoN /Ministry of Forests and Environments (MoFE) has developed standards for sustainable forest management to its local context. One important principle under the standards is compliance with policies and legal frameworks. While developing forest management prescriptions the prevailing legal frameworks and provision should clearly be followed. Most of the cases, the legal framework doesn't prefer to conduct clear felling and mono-culture plantation or similar operations that is environmentally unsound. Those prescriptions which are against the legal provision should be avoided. The following are a few key policy documents to be reviewed.

- Forest Act 2019
- Forest Regulation, 2022
- Standard for Sustainable Forest Management, 2022
- Forest Inventory Guideline 2065
- Sustainable Forest Management Procedure, 2079 (Bagmati province)

Session-4.7: Assessment of sustainability of forest management

Background information

All the forest management activities must be socially accepted, ecologically sound, technically feasible and financially sound. The FSC has approved standard for sustainable forest management in Nepal. Under the 10 principles, several criteria and indicators are included in the FSC standard. If forest sustainability to be ensured, the forest management plans are to be evaluated against the key indicators of the sustainability. One can use the Program for Forest Certification (PFC) criteria to judge sustainability. Forest managers, especially forestry should have clear understanding on those indicators and have capacity to use them.

Learning objectives

At the end of the session, participants will be able to

- Define the meaning of sustainable forest management.
- Identify and list out major principles, criteria, and indicators to be used in forest management; and
- Examine forest management plan against the indicators agreed.

Time 3 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides showing definitions and standards.
- 3 management plans

Session facilitation process

1. Explain the objectives of the session.

2. Introduce SFM principle and criteria (30 minutes)

1. Brainstorm and agree on the meaning of sustainable forest management in plenary.
2. Present the principles and key criteria and indicators that can be used to gauge the sustainability of forest management.
3. Discuss the presentation and agree on the indicators to be used.

4. Exercise on assessing sustainability (2 Hours)

1. Form 3 small groups, provide one forest management plan to each group.
2. Demonstrate how to do assessment and marking.
3. Ask the groups to read through the forest management plan and assess them based on agreed indicators. Ask them to provide numbers and identify gaps and recommendations.
4. Support group if needed.

5. Presentation and wrap up (30 minutes)

1. Allow each group to present their findings including score, strength, gaps and recommendations.
2. Ask participants what they learned from the exercise and how they can apply this in their respective field.
3. Allow participants to pose questions for clarification.
4. Conclude sessions with summary.

Handout 4.7: Assessment of forest management sustainability

Sustainable Forest Management (SFM) is the process of managing forests to achieve one or more clearly specified objectives of management with regards to the production if a continuous flow of desired forest products and services, without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment.[1]

Standards for assessing sustainability.

Recently the MoFE has developed standards for SFM. These standards were developed adapting the international practices with local context. A total of 5 principles, 26 Criteria (Standards) and 104 indicators to monitor if standards are met through SFM. The standards also include sources of information to verify if indicators are fulfilled. The five principles and associated standards are presented below.

Principle 1: Compliance with law and governance

1.1: The forest manager should be authorized legal entity

1.2 Appropriate methods should be adopted for the protection of forests from illegal smuggling of forest products, encroachment as well as other illegal activities.

1.3 Prevailing Local, Provincial, and National laws and international treaties should be followed for collection, sale and distribution, transportation, and trade of forest products.

1.4 Traditional practices related to forest management should be respected and addressed.

1.5 Necessary approaches should be adopted to enhance forest management governance.

1.6 Forest manager should fully be responsible for implementation of forest management plan.

Principle 2: Gender equity, social inclusion, and cultural values

2.1 Access and rights to the forests and forest products and ecosystem service of Local indigenous peoples and local as well as traditional users should be identified and address.

2.2 The formation of forest user group should follow gender and socially inclusive and participatory process and the process should be documented.

2.3 Areas having unique spiritual, cultural and ecosystems should be identified, protected, and documented.

2.4 Local and traditional knowledge and traditional practice should be identified, respected, documented, and used with consent.

2.5 The forest management decision process should be inclusive and ensure meaningful participation of local indigenous people, local communities, women, Dalit, forest dependent people and traditional users.

2.6 Employment and training opportunities for forest management should be based on gender equity and social inclusion.

2.7 Appropriate training, professional health and safety arrangement of forest workers, staff and labors should compulsory be adopted while developing and implementing of forest management plan.

Principle 3 Production, productivity enhancement and economic prosperity

3.1 Forest management vision, goal and objectives should be determined based on short-, medium- and long-term demand of forest products and services, and production capacity of forests estimated through forest resource survey and analysis.

3.2 Aligning with forest management vision, goal and objectives and adopting principle of silviculture and forest management, forest management plan should be developed and implemented based on forest conditions, species, regeneration, and topography considering traditional knowledge and practice.

3.3 While developing forest management activities, natural or artificial regeneration should be ensured to maintain different species and age group forest.

3.4 Forest products should collect, store, use and sale transparently according to laws.

3.5 The forest manager should estimate and secure funds to implement forest management plan.

3.6 Forest based enterprise should develop according to prevailing laws through public, private and community partnership.

3.7 Forest manager should develop and implement community development and targeted groups' economic development activities in participation of local level government and users.

Principle 4 Environmental safety

4.1 Forest managers should ensure the protection of rare and endangered species and their habitat.

4.2 Forest managers should protect and rehabilitate sensitive wetlands, water course and water bodies.

4.3 Forest manager should minimize environmental damage during collection and transportation timber and non-timber products.

4.4 Forest managers should identify potential risk and plan to minimize risk during the implementation of forest management plan.

Principle 5: Monitoring, evaluation, research, and knowledge management

5.1 Forest managers should monitor and evaluate progress and results of forest management activities and social and environmental impacts.

5.2 Upon local and national need, forest managers should establish forest research plots and conduct regular monitoring, measurement, documentation, analysis, and knowledge transfer.

Process of assessing sustainability

When:

Assessment of sustainability can be done at any stage. However, it is recommended to conduct the assessment before approval of the forest management plan and every five years of management plan implementation. Internationally it is practiced in the beginning after the management plan has been approved and audited every year. This practice is very costly and often doesn't provide clear recommendations if there are gaps while approving management plans.

Who:

Normally sustainability assessment is done by a third party. There are already Forest Stewardship Council PCI trained auditor in Nepal. But it can be done by a team of forester, environmentalist and anthropologists who are familiar with forest management in Nepal. In community forestry or collaborative forestry, a joint team among community representative and DFO representative can conduct however they should be trained the process. In such cases, they can hire trained or knowledgeable auditors to join the team.

How

Sustainability assessment or auditing is done based on indicators for each of the criteria (Table 1 below). Using the source of information for each criterion, the assessor ranks the status 1-5 being 1 weak and 5 strong. The assessor justifies the rational giving such number and recommends actions for its improvement. There is no pass or fail on SFM but to ensure the forest is sustainably managed most of the criteria should have 4-5 marks or in total over 400 points. However, there is no compromise to some criteria such as compliance with laws, adoption of silviculture and forest management principles based on community demands and social and environmental safeguards. To understand by the community the number can be replaced with dots or figures.

Plan for mitigating negative impact and enhancing positive impact

Once assessment is done, the assessor team must produce a report along with strong recommendations in 2-3 pages note. The report should include team members, methods used, strength and area for improvement and recommended action to mitigate negativity and enhance positivity for each of criteria. However, if they are fully met with 5 marks, the report can be silent in such indicators.

Session-4.8: Annual action plan development and implementation

Background information

Once the forest operation/management plan has been approved by the concern authority, a detailed annual plan has to be developed to implement it. The detail plan includes key action steps by month/week, resource requirements (finance and human), capacity building, management of tools, post-harvest operation, approval of detail plan and so on. Participants are required to be equipped with the techniques of developing a detailed annual action plan.

Learning objectives

At the end of the session, participants will be able to

- Explain the need to develop an annual plan.
- List out the key areas to be covered by the annual action plan; and
- Develop a skeleton of a draft annual action plan.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.

Session Facilitation Process

1. Explain the objectives of the session.

2. Introduction of annual action plan (30 minutes)

1. Discuss the importance of action plan preparation in plenary.
2. List things to be included in annual action plan.
3. Present the key aspect of annual plan.

4. Exercise to develop annual plan (45 minutes)

1. Divide the participants into three groups- mix groups based on institutional involvement, experience etc. It can be the same group as before.
2. Ask each group to develop an action plan of the forest they did assessment and develop management prescription.
3. Allow each group to present their group work through gallery walk (15 minutes)

4. Divide the group in to five and allocate one type to each group to develop a complete forest management prescription (in bullet points)- Pine (planted and natural), Sal (hill and Terai), Broadleaves, Fodder (Quercus)
5. Facilitate presentation through gallery walk method.

6. Conclusion (15 minutes)

1. Allow participants to raise questions and address them. Give priority to peers to answer the question.
2. Ask a few questions to participants to gauge their understanding.
3. Conclude the session with summary.

Handout 4.8: Development of annual action plan

Background information

In general, annual activities included in forest management plan provide broad plan to be implemented in given year. Detailing of such a broader plan is required so that it facilitates community easy and effective implementation of the plan. Detailing of action steps with methods, place and responsibility is termed as Action Plan. For example, the operation plan includes thinning in a particular block or coupe, but it does not include preparation, management, technical detailing (how much to remove, selection criteria and process), tools and human resource require, timeline by week or month etc.) and use of the products. Specifically, the action plan describes what the community wants to achieve, what activities are required during a specified period within a year, what resources (money, people, and materials) are needed for successful implementation. Annual action plan should become a framework for implementing the activities that are decided by the community itself. Producing the annual action plan helps people to take realistic and concrete steps toward participatory development planning to improve users' participation and ownership toward community forest. By bringing everyone together to think and discuss resources and group involvement, this action plan tool increases awareness in users.

Approaches and steps

All the action plans should be realistic, implementable, and owned by communities or stakeholders involved in the forest management and community development process. The higher the level of consultation, the greater the chances of community taking ownership on the action plan. Ideally, in each September/October, the community should approve the annual action plan. To do so the following steps are suggested.

1. ***Formation of subcommittee and preparation by subcommittee:*** By around the end of July each year, the executive committee of the community forest users formulate a sub-committee to engage in the process of action plan development. The sub-committee can be a maximum of 3-5 people who can facilitate drafting action plans. The membership should be inclusive of women, Dalits (if significant) and Indigenous Peoples. The subcommittee shall take support from subdivision forest office or forest technicians and local planner. The subcommittee reviews the operation plan and extracts activities that are to be implemented in the current year. Once the activities are extracted, a check list of discussion points is developed to be used in focus groups as well as settlement meetings. They also develop a plan of action for Focus Group Discussion or Settlement Meeting, meeting with key informant, Presenting in Executive Committee Meeting subcommittee

meetings as well as other logistics. The subcommittee provides information related to meetings well in advance and reminds in day before the meeting time.

2. ***Conduction of settlement or focus group meeting:*** Series of meetings with specific interest groups or in settlements are conducted. The interest groups or settlement HHs are informed earlier on meeting time and agenda of the meeting. The subcommittee makes the agenda of the meeting in very simple language so that grassroots level people easily understand. The checklist normally includes detailed action steps of each activity, where, how, who should involve and who benefits etc. One of the members in the subcommittee clearly records the findings of the discussion of each meeting.
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5. Executive Committee Meeting (ECM) – The findings from the meetings with interest groups, key informants and stakeholders are presented in the executive committee meeting for further discussion. Recommendation from executive committee is taken and during the meeting itself a final draft of the Annual action plan is agreed. The sample action plan is presented in the annexes below.
6. Plans approved by General Assembly (GA)- The final draft of the action plan is written in flip charts that community members can easily see. Executive committee or subcommittee members read loudly on the action plan. If the number of households in the CFUGs is too high to concentrate in a single meeting, 2-3 separate meetings according to settlements can be organized and final meeting can be organized with the representative of settlements. Once the final meeting or assembly approves the plan, a copy is provided to concern stakeholders from whom technical or financial support is expected. If possible, representatives of such stakeholders are invited to the assembly.

Table 25 Template of Annual Action Plan

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1.3										
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2.1										
2.2										

Module 5:

Harvesting and logging operations

Module 5: Harvesting and logging operations.

Module 5 deals with the key requirements for improvement of harvesting and logging tools in an effective and efficient manner. A few things are required to consider harvesting and logging tools and up to date in safety including safeguard plan for harvesting & logging operations. They include detailed safety and safeguard planning; prepare necessary harvesting/operating tools for logging operations, grading, and marking.

- Develop common understanding on the introduction of improved harvesting tools.
- Enhance capacity of participants in safety measures in forest operations and formulate environment management plan, and
- Capacitate participants in tools used for harvesting and logging operations with its maintenance.

Session-5.1: Introduction of improved harvesting tools

Background information

To increase efficiency of forest harvesting and logging operations, several equipment are available in the market. Selection of appropriate harvesting tools and their operation is very important for the participants. Though participants are not supposed to use them in the field directly, they should have a clear understanding of the selection of right tools and how they can be used by the forest harvesting team.

Learning objectives

At the end of the session, participants will be able to

- List down all the traditional and modern tools and equipment available for tree felling, bugging and transportation.
- Prioritize the important tools relevant to their respective field based on terrain, affordability, and skill to use them; and
- Explain how to use those important tools.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Photo gallery presentation on various types of tools used globally and a stock of a set of harvesting tools available locally.

Session facilitation process

1. Explain the objectives of the session.

2. Identification of appropriate equipment (30 minutes)

1. Provide 3 meta-cards to each participant and ask them to write three harvesting and transportation tools they have heard (one tool in one card)
2. Collect them read loudly and arrange them in green board in group.
3. Present the prepared photo gallery of tools.
4. In plenary agree on the tools/equipment useful to local context.

5. Introduction of each tools/equipment (45 minutes)

    1. Brainstorm in plenary on the availability, tentative cost, and use of each tool
    2. Present slides on introduction of tools- usefulness, availability, and price on each tool.

3. Conclusion (15 minutes)

    1. Allow participants to raise questions and address them. Give priority to peers to answer the question.
    2. Ask a few questions to participants to gauge their understanding.
    3. Conclude the session with summary.

Handout 5.1: Introduction of equipment for harvesting and logging operation.

Forestry is a multifaceted field that encompasses the sustainable management of forest resources, including the careful planning and execution of harvesting and logging operations. These operations are vital for ensuring a continuous supply of timber and other forest products while conserving the ecological integrity of forest ecosystems. The responsible management of forests is crucial not only for economic reasons but also for environmental preservation, biodiversity conservation, and the well-being of communities that depend on forest resources.

Key Components of Harvesting and Logging Operations:

- **Assessment and Planning**: The journey of harvesting and logging operations begins with a comprehensive assessment of the forest stand. Forest managers and professionals evaluate the composition, health, and structure of the trees in a given area. This assessment serves as the foundation for planning, determining which trees should be harvested and which should be preserved for regeneration.
- **Sustainability**: Sustainability is at the core of harvesting and logging operations. Sustainable forest management aims to balance the extraction of forest resources with the regeneration and growth of new trees. This ensures that the forest remains productive and resilient over time, providing a continuous supply of wood and other products without depleting the resource.
- **Harvesting Methods:** Different methods are employed based on the specific objectives of the operation and ecological considerations. Clearcutting, selective cutting, shelterwood cutting, and seed tree cutting are some of the techniques used to manage forests while minimizing environmental impact.
- **Logging Equipment:** The tools and machinery used for logging vary widely depending on the scale of the operation. Mechanized logging involves heavy machinery for efficient tree felling and log transport. In contrast, manual logging utilizes handheld tools like chainsaws and crosscut saws for more selective and environmentally sensitive operations.
- **Environmental Stewardship:** A cornerstone of modern forestry practices is the commitment to environmental stewardship. Measures are implemented to protect soil and water quality, wildlife habitat, and overall forest health. These include creating buffer zones around water bodies, erosion control techniques, and leaving dead standing trees for wildlife habitat.
- **Transportation and Processing**: Once logs are harvested, they are transported to mills or processing facilities for conversion into a wide range of products, from construction materials to paper and pulp. The transportation methods can vary, and infrastructure, such as roads and railroads, plays a significant role in this phase.

- Reforestation and Regeneration: Post-harvest, efforts are made to ensure the forest regenerates and remains productive. Reforestation activities involve planting new trees or encouraging natural regeneration, allowing the forest ecosystem to recover.
- Economic and Community Impact: Harvesting and logging operations can have a profound economic impact, providing employment opportunities and contributing to local and national economies. Rural communities often rely on the forest sector for their livelihoods, making sustainable practices crucial for their well-being.
- Continuous Monitoring and Adaptive Management: Forest managers and regulatory agencies engage in ongoing monitoring and adaptive management. This ensures that operations comply with environmental regulations and evolve to incorporate new research and technologies for responsible forest management.

Major equipment for harvesting and logging operation.

Equipment for harvesting and logging operations in forestry, especially for manual or small-scale operations, plays a crucial role in the sustainable management of forests. These tools and machines are designed to facilitate the felling of trees, processing of timber, and the transportation of logs in an efficient and safe manner while minimizing the impact on the surrounding environment. Here's an introduction to some of the key equipment used in manual forestry operations:

- Chainsaw: The chainsaw is one of the most fundamental tools in forestry. It is used to fell trees, cut branches, and prepare logs for processing. Chainsaws come in various sizes and configurations, and operators must be well-trained to use them safely.
- Axe and Wedges: Hand tools like axes and wedges are used for precision felling of trees and splitting logs into manageable pieces. They are essential for manual tree cutting and log processing.
- Crosscut Saw: A crosscut saw is a two-person manual saw designed for felling and bucking (cutting logs into specific lengths) trees. It requires two operators to work in tandem, making it more labor-intensive but environmentally friendly.
- Forest Safety Gear: Protective gear like helmets, safety goggles, ear protection, and cut-resistant clothing are vital to ensure the safety of manual loggers.
- Log Tongs and Grapples: Log tongs and grapples are used to securely grip and lift logs, making it easier to transport them within the forest.
- Skidding Cone: A skidding cone is a device used for dragging logs out of the forest. It reduces the impact on the forest floor by creating less ground disturbance compared to traditional skidding methods.
- Log Carriers and Carts: These are used to transport logs within the forest or from the harvest site to a loading area.

- Portable Sawmill: In some manual logging operations, portable sawmills are used to process logs into lumber on-site. This can save time and transportation costs.
- Winches: Hand-operated or small-scale winches can be used for skidding logs uphill or across difficult terrain.
- Safety and First Aid Equipment: Safety should be a top priority. This includes first aid kits, communication devices, and emergency equipment for immediate response in case of accidents.
- Felling Axes: Felling axes are used to make precision cuts in the tree before it is felled. They are also used for notching and making plunge cuts.
- Bucking Saws: Bucking saws are designed for cutting logs into shorter, manageable lengths after a tree has been felled. They come in various sizes and types.
- Pole Saws: Pole saws are used to trim and prune branches in high and hard-to-reach areas. They can be operated manually or powered.
- Pruning Saws: Pruning saws are designed for trimming and shaping the canopy of trees, especially in orchards and urban forestry settings.
- Limbing Saws: Limbing saws are used to remove branches from a felled tree, making it easier to process and transport the timber.
- Bowsaws: Bowsaws are compact, lightweight manual saws suitable for a variety of cutting tasks, including pruning and bucking.
- Sculptor's Saw: This is a specialized saw used for intricate and precise cutting tasks, often employed by craftsmen and artists working with wood.
- Froe: A froe is a tool used for splitting wood, particularly for tasks like shingle-making or splitting logs into boards.
- Broad Axes: Broad axes are used for shaping and smoothing timber, particularly for creating flat surfaces on logs or beams.
- Drawknives: Drawknives are used for removing bark and shaping wood by pulling the blade toward the user. They are handy for debarking logs.
- Hookaroon and Cant Hook: These are hand tools used to roll or move logs on the ground, making them easier to handle during the processing and transport stages.
- Sledgehammer and Wedges: These tools are used for splitting logs or large rounds into smaller pieces.
- Peavey: A peavey is a tool used to roll and maneuver logs. It has a spiked end for gripping the log and a hook for leverage.

Session-5.2: Safety measures in forest operations

Background information

All the operations carried out in the forest should have a minimum negative impact. No harm approach should be taken during the operations. Since we tend to use improved harvesting tools, the risk of injuries to forest workers and damage to surrounding often becomes high. Participants should understand the potential impacts of inappropriate harvesting, logging, and transportation operation.

Learning objectives

At the end of the session, participants will be able to

- List down the possible aspects to be considered for safe forest harvesting operation.
- Explain the ways to minimize negative impact to those aspects; and
- Demonstrate safe harvesting and logging operation.

Time 3.0 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for safe harvesting operations.
- Harvesting, bucking and transportation tools.

Session facilitation process

1. Explain the objectives of the session.

2. Identifying safety measures (1.0 Hours)

1. In plenary, list out four key aspects for safety: Safety of forest workers, Safety of equipment, safety of harvested products, and safety of remaining crops.
2. Divide the participants into four groups and assign one area of safety to each group to come up with safety measures. (15 minutes)
3. Ask each group to present and add anything left. If required present the slides.

4. Introduction of power chain saw and its use (2.0 Hours)

1. Introduce the power chain saw with its use.
2. Through picture explains the method of tree felling and bucking using power chain saw.

3. Demonstrate how to do maintenance and assemble power chain saws.
4. Demonstrate the proper method of use and filling of oil and lubricants.
5. Discuss and prepare for field exercise. Develop a protocol for field exercise.

6. Field exercise (4 Hours)

1. Bring the participants to a forest block.
2. Demarcate a quarter of a hectare for operations.
3. Ask participants to use safety gear.
4. Demonstrate the use of power chain saws and other equipment.
5. Let participants conduct operations.

7. Conclusion

1. Assemble the participants in a corner of forests.
2. Ask them about their learning from the exercise and let participants ask questions.
3. Conclude session with summary of the session.

Handout 5.2: Safety measures in forest operations

Background information

Forest harvesting continues to be one of the most hazardous jobs in most countries. The trend of accidents and loss and damage due to improper operation is increasing. Broadly, there are two groups of forestry-jobs: those related to silviculture (cultivation and management of forest tress) and those related to harvesting.

Silviculture activities include tree planting, fertilization, weed and pest control, and pruning. Tree planting is very seasonal and involves a separate group of workers exclusively dedicated to this activity. These activities are less risky to health and safety. The riskiest activity is chain-saw operation during the forest harvesting operations for chain saw operators and log collection and loading operation. The forest harvesting job is considered as a 3-D job: dirty, difficult, and dangerous. For instance, forestry work must be done outdoors. Workers are thus exposed to the extremes of weather such as heat, cold, snow and rain. Similarly, workers are exposed to natural hazards such as broken terrain or mud, dense vegetation, and a series of biological agents. Work sites tend to be remote, with poor communication and difficulties in rescue.

To ensure a safe and healthy working environment in the forestry sector, everyone involved has health and safety duties and responsibilities. This material contains guidance to help employers, the self-employed and those in control of work in forestry meet their duties when involved in forestry activities.

Since forestry work is a high-risk activity, proper assessment and planning is required to minimize or make zero risk operation. To ensure that the following actions to be performed.

i. Conduct risk assessments.
ii. Select suitable equipment for the operation.
iii. Develop safe working code.
iv. Train forest workers adequately- use of tools, techniques of operation, safety measures, first aid and so on.
v. Make close supervision of the work.
vi. Buy Insurance of forest workers

Risk and hazards to forest workers

The nature of forestry work is characterized by manual operations which include logging, debranching, crosscutting and debarking. Forest workers who fell trees with chainsaws are perhaps exposed to the greatest risks. High-risk operations include bringing down “hung ups”, taking care of wind throw, and cleaning up after forest fires. Tree planters are also at risk from

carrying heavy loads of seedlings and planting in awkward positions. Pesticides and fungicides used on seedlings are also a hazard. The risk in forestry operations is associated with the following four hazards including physical, chemical, biological and machinery.

i) Climatic hazards

Working outdoors, subject to climatic conditions, is both positive and negative for forest workers. Fresh air and nice weather are good, but unfavorable conditions can create problems. Working in a hot climate puts pressure on the forest worker engaged in heavy work. Among other things, the heart rate increases to keep the body temperature down. Sweating means loss of body fluids.

Heavy work in high temperatures means that a worker might need to drink 600 ml of water per Hour to keep the body fluid balance. In a cold climate the muscles function poorly. The risk of musculoskeletal injuries (MSI) and accidents increases. Adequate clothing for different climatic conditions is essential to keep the forestry worker warm and dry.

ii) Chemical hazards

- **Fuel and oils for portable machines:** Portable forestry machines such as chainsaws and portable band saw are sources of exhaust emissions of fuel in logging and sawing operations. The portable machines used in forestry are powered by two-stroke engines, where lubricating oil is mixed with fuel. The exposure to fuel and lubrication and chain oil may occur during mixing fuel and filling as well as during logging. Fuels are also a fire hazard, and therefore require careful storage and handling. Oil aerosols may create health hazards such as irritation of the upper respiratory tract and eyes, as well as skin problems. During maintenance and repair operations, the hands of machine operators are exposed to lubricants, hydraulic oils, and fuel oils, which may cause contact-dermatitis. To avoid irritation, the skin must be protected from oil-contact by protective gloves, washing of hands after use and applying barrier creams.
- **Pesticides, herbicides, and colorants:** Pesticides are used in forests and forest nurseries to control fungi, insects, and rodents. The risk of exposure is like that in other pesticide applications. The symptoms caused by excessive exposure to pesticides vary greatly depending on the compound used for application, but most often occupational exposure to pesticides will cause skin disorders. Other chemicals commonly used in forestry work is colorants used for timber marking. Timber marking is done either with a marking hammer or a spray bottle. The colorants contain glycol ethers, alcohols, and other organic solvents, but the exposure level during the work is probably low. To avoid exposure to pesticides, forestry workers should use personal protective equipment (PPE) (e.g., caps, coveralls, boots, and gloves). Applications should be planned for the coolest Hours of the day and

when it is not too windy. It is also important to wash all spills immediately with water and to avoid smoking and eating during spray operations.

iii) Biological hazards

- **Plants and wood:** Many People are allergic reactions to plants and wood products (wood, bark components, sawdust), especially pollen. Injuries can result from processing (e.g., from thorns, spines, bark) and from secondary infections, which cannot always be excluded and can lead to further complications.
- **Poisonous snakes:** Poisonous snakebites are always medical emergencies. They require correct diagnosis and immediate treatment. Identifying the snake is of decisive importance.
- **Bees, wasps, hornets, and ants:** Insect poisons have very different effects, depending on the locale. Removing the stinger from the skin (and being careful not to introduce more poison during handling) and local cooling are recommended first-aid measures. The most-feared complication is a life-threatening general allergic reaction, which can be provoked by an insect sting.

iv) Machinery hazards

Avoiding hazards due to the use of machines is very important in forestry operations. In forest harvesting operations, power chainsaws are widely used but safety procedures are seldom adopted. Few risks due to power chain saw use are described below.

- **Noise:** It is a problem when working with a chainsaw, brush saw or similar machines. The noise level of most chainsaws used in regular forest work exceeds 100 dBA. The operator is exposed to this noise level for 2 to 5 Hours daily. Employees exposed to noise at or above 85dBA without hearing protection devices may suffer from noise-induced hearing loss. The use of hearing protection devices is therefore essential.
- **Hand-arm vibration:** This is another problem with chainsaws. "White finger" disease has been a major problem for some forest workers operating chainsaws.
- **Whole-body vibration:** Whole-body vibration in forest machines can be induced by the terrain over which the machine travels. A specific problem is the shock to the operator when the machine comes down from an obstacle such as a rock. The vibrations also increase the risk of repetitive strain injuries (RSI) to the neck, shoulder, arm or hand. The problem can be minimized with modern chainsaws with the use of efficient anti-vibration dampers. To reduce vibrations, machines can be fitted with vibration-damping seats. When no engineering approaches to controlling the hazards are used, the only available solution is to reduce the hazards by lowering the time exposure, for instance, by job rotation.

- **Body injuries:** There are many incidences of worker loss their body parts including death due to improper use of power chain saw, low maintenance and old spares used such as guard, and chains.
- **Eye injuries:** There is a high chance of damaging the eye due to dusty substances. Proper use of fully covered goggles is required.

Safety and safeguards

Everyone involved in forestry activities has a duty to meet the requirements of the Driven Machinery Regulations and General Machinery Regulations. General machinery must have proper guarding, have brakes, tires, steering and other control systems that are in good working order, have booms, grapples, cables, shackles, linkages, and chokers designed and maintained to cope safely with the loads, and have maximum mass load clearly marked on the lifting machinery. The supervisor should thoroughly examine as specified in the driven machinery regulations and guide competent operators.

i) Personal safety

- **Use first aid:** Field operations need to comply with the first aid requirements to follow Occupational Health and Safety Guidelines for a workplace that contains a high risk of injury. If you are going to be involved in forestry work, you must follow certain personal safety rules.
- **Generic code of conduct:** If you are in doubt about the safe or proper way to do a job, get instructions from your supervisor.
  - ✓ No person shall do any job if it is considered unsafe.
  - ✓ Use Personal Protective Equipment (PPE). The supervisor should not allow workers without PPE.
  - ✓ No person shall enter or remain at a work site while his ability to work is affected by substance abuse (i.e., alcohol, drugs), or outside problems.
  - ✓ No person shall operate machinery or equipment without proper authorization from their supervisor or foreman.
- Watch closely and ensure safe footing. Avoid walking on logs or moveable objects if possible. Use extreme caution when it is necessary to walk on log decks.
- Watch closely for overhead hazards (snags, limbs, twigs, etc.) and danger trees. Find a safe location in the event of windy conditions.
- Stay at least 1.5 times the height of the trees away from potentially hazardous trees.
- Evacuate the area if trees are seen or heard falling from wind or snowfall.
- Hardhats are required whenever there is an overhead hazard.

List of compulsory Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) for forest harvesting is crucial to ensure the safety of workers. The specific requirements may vary depending on the country, regulations, and the nature of the work, but generally, the following items are commonly considered compulsory:

- Hard Hat: Protects the head from falling objects and branches.
- Ear Protection: Earplugs or earmuffs to reduce noise exposure from chainsaws and other equipment.
- Eye Protection: Safety glasses or goggles to shield the eyes from flying debris, sawdust, and branches.
- Chainsaw Chaps or Pants: Special chainsaw-resistant clothing that protects against accidental chainsaw contact.
- Steel-Toed Boots: Sturdy, steel-toed boots with good traction for foot protection and support.
- Gloves: Cut-resistant, leather or chainsaw gloves for hand and wrist protection.
- High-Visibility Clothing: Brightly colored clothing to enhance visibility, especially in areas with heavy equipment.
- Respiratory Protection: Dust masks or respirators to protect against airborne particles and pollutants.
- Safety Harness and Lanyard: For workers operating at heights or in tree climbing operations.
- First Aid Kit: Essential for treating minor injuries and having readily available in case of accidents.
- Fire-Resistant Clothing: In regions prone to wildfires, fire-resistant clothing may be necessary.
- Face Shield or Visor: For protection against flying debris, especially for workers operating brush cutters.
- Sunscreen: Protection against sunburn for outdoor work in sunny conditions.
- Insect Repellent: Essential in areas with a high prevalence of biting insects.
- Emergency Communication Device: In remote areas, a communication device such as a two-way radio or satellite phone is important for emergency response.

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Module 6: Post harvest management and forest protection

Module 6: Post harvest management and forest protection

Forest management/operational plans are a comprehensive document that covers all the activities required for management of forests. They include forest development, forest management operations, post harvesting operations and utilization of forest products. In many cases, post-harvest management is given little attention during forest management. Module 6 deals with key tools and techniques of post harvesting operation in the forests.

- Explain and enhance the capacity of participants to protect sites from fire, grazing and illegal cutting of trees.
- Enabling participants knowledge and skills in regeneration management- existing and new regeneration

Session-6.1: Fire management

Background information

Protection of a forest from fire is one of the very important forest management activities. Fire is not always bad but uncontrolled fire has always been devastating for the health of forest ecosystem and human life. This session deals with key generic tools and techniques to protect forests from forest fire. For in-depth understanding and skill development, a separate training module is required.

Learning objectives

At the end of the session, participants will be able to

- List down action needed for preventive, suppressive and curative measures; and
- Explain how these measures are applied for fire protection.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for fire management tools and techniques.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, list out three key measures of forest fire management.
3. Divide the participants into three groups and assign one measure each group.
4. Ask group to list down activities of each measure with details (30 minutes)
4. Ask each group to present their group work in plenary and add anything left. If required present the slides.
5. Allow participants to ask questions for clarification.
6. Ask a few questions to participants to gauge their understanding.
7. Conclude session with summary of the session.

Handout 6.1 Fire management: preventive, suppressive and curative measures

Background:

Forest fire occurs globally on various scales every year, causing economic, social, ecological, and environmental damage. Forest fire is considered as a problem in forest management system in Nepal. If natural disasters are excluded, then forest fires come close to being the worst kind of all known disasters. Fire- induced loss of soil cover negatively affects hydrological regimes and soil properties, leading to severe erosion and loss of productive topsoil. High economic losses are caused by damaging valuable timber and non-timer resources, natural regeneration, and planted forests.

Causes of fires.

Forest fire destroys many more trees than all other natural calamities. It not only destroys living forest vegetation but also consumes the dead vegetation and destroys the litter.

Natural Causes:

1. Lightening, rolling stones and rubbing of dry bamboos
2. Lightening is more responsible

Manmade cause: (95%)

1. Man's carelessness
2. Man's deliberate and intentional action
3. Debris burning
4. Campfires and picnics
5. Poaching

Classification of fire:

Based on causative factors:

a. Natural fires
b. Accidental fires
c. Deliberate fire

Based on place their action.

a. Underground fire: all the matter of organic matter origin situated below the ground surface level.

b. Ground fire: Burns the ground cover only. Common where there is thick accumulation of organic matter.

c. Creeping fire: Forest fire spreading slowly over the ground with low flame in absence of strong wind.

d. Surface fire (damage up to pole): Fire that burns not merely the ground cover but also the undergrowth.

e. Crown fire: a forest fire which spreads throughout the crown of trees and consumes all or part of the upper branches or foliage.

Fire management includes a range of measures to prevent, suppress, and manage fires in various environments, such as forests, grasslands, and urban areas. The three primary approaches to fire management are:

a) Preventive measures

Preventive measures for fire management aim to reduce the likelihood of fires starting and spreading. These measures include:

- **Fuel management:** This involves reducing the number of flammable materials on the ground, such as dry leaves, twigs, and branches, through activities such as controlled burns, mowing, or grazing. This reduces the amount of fuel available for a potential fire.
- **Fire breaks:** These are areas of cleared or reduced vegetation that can help to contain a fire and prevent it from spreading. Fire breaks can be created by clearing vegetation, using plows, or digging trenches.
- **Land-use planning:** This involves developing land-use plans that consider the risk of fire and avoid building structures in high-risk areas, such as in areas prone to wildfires.
- **Fire education campaigns:** Educating the public about fire safety and prevention is crucial in reducing the likelihood of fires. Campaigns can include information about safe campfire practices, smoking safety, and how to report a fire.
- **Fire weather monitoring:** Monitoring weather conditions can help predict the likelihood of a fire occurring, and preventative measures can be taken accordingly.
- **Early detection systems:** Early detection systems, such as cameras or sensors, can detect fires in their early stages, allowing for faster response times and reducing the risk of the fire spreading.

b) Suppressive measures

Suppressive measures for fire management are focused on extinguishing fires as quickly and safely as possible. These measures include:

- **Firefighting**: This involves using a range of equipment, including fire trucks, hoses, and hand tools, to extinguish a fire. Firefighters are trained to use different techniques to control and extinguish fires, including direct attack, indirect attack, and backburning.
- **Water supply**: Water is essential for firefighting, and establishing a reliable water supply is crucial. This can involve accessing nearby water sources, such as lakes or rivers, or using water tankers to transport water to the fire scene.
- **Aerial firefighting**: Helicopters and planes can be used to drop water or fire retardants onto fires to slow or halt their spread.
- **Fire retardants:** Fire retardants are chemical compounds that can be applied to vegetation or structures to reduce their flammability and slow the spread of fire.

- Firebreaks: In addition to being a preventive measure, firebreaks can also be used as a suppressive measure. By creating a barrier of cleared vegetation, firefighters can prevent the fire from spreading further.
- Mopping up: Once a fire is extinguished, the remaining hotspots and smoldering debris need to be fully extinguished to prevent the fire from reigniting. This process is called mopping up and is done using tools such as shovels and water.

c) Curative measures

Curative measures of fire management focus on restoring ecosystems and communities affected by fires. These measures include:

- Ecosystem restoration: After a fire, the ecosystem may be damaged, and it may take years to recover fully. Ecosystem restoration involves activities such as reseeding or replanting the damaged area to promote regrowth and biodiversity.
- Habitat restoration: Habitat restoration is focused on restoring the habitat of the wildlife that may have been affected by the fire. This can involve activities such as creating new habitats or rebuilding habitats that have been destroyed.
- Soil stabilization: Fires can cause erosion and soil degradation, which can impact the ecosystem's ability to regenerate. Soil stabilization involves techniques such as mulching, seeding, and erosion control to stabilize the soil and promote regrowth.
- Community support: Fires can have a significant impact on communities, causing damage to homes, businesses, and infrastructure. Curative measures for fire management can involve providing support to affected communities, including assistance with rebuilding homes and businesses, and providing mental health support to those affected by the fire.
- Hazard mitigation: After a fire, there may be hazards present, such as unstable trees, debris, or contaminated soil. Hazard mitigation involves identifying and addressing these hazards to ensure the safety of people and the environment.

As a forest manager, one key step for fire management in forests is to prioritize prevention efforts. Prevention is often the most effective and cost-efficient way to manage forest fires. Here are some specific actions you can take to prevent forest fires:

- Develop a fire management plan: A fire management plan should outline the strategies and procedures for preventing and responding to forest fires. It should include information on fire risks, fire suppression techniques, and restoration efforts.
- Conduct regular fuel reduction activities: Fuel reduction activities, such as prescribed burns, thinning, and brush clearing, can help reduce the amount of fuel available for a potential forest fire. Regular fuel reduction activities can also improve forest health and reduce the severity of fires.

- **Monitor weather and fire conditions:** Regular monitoring of weather and fire conditions can help predict and prevent forest fires. This includes monitoring temperature, humidity, wind, and precipitation levels.
- **Establish fire breaks and fire access roads:** Fire breaks and fire access roads can help contain and control fires by creating barriers that limit the spread of flames.
- **Collaborate with local communities:** Collaboration with local communities is essential for effective fire management. This includes educating the public about fire safety, conducting community outreach, and involving local volunteers in fire prevention and suppression efforts.
- **Educate the public:** Educate the public about fire safety and the importance of preventing forest fires. This includes outreach efforts such as distributing informational materials, hosting community events, and engaging with local schools.
- **Train and equip staff:** Proper training and equipment are essential for effective fire management. This includes training staff on fire safety and suppression techniques, as well as providing them with appropriate firefighting equipment.
- **Coordinate with other agencies:** Effective fire management often involves coordination with other agencies, such as local fire departments, state forestry agencies, and federal agencies. It is important to establish communication and coordinate efforts to ensure a comprehensive and effective response to forest fires.

Session-6.2: Grazing management

Background information

Livestock is one of the major sources of income of rural people in Nepal. Forest should be able to support local people for forage and fodder if required ensuring sustainable management of forest resources. There are several ways to protect forests from uncontrolled grazing. This session aims to develop understanding on sustainable grazing management.

Learning objectives

At the end of the session, participants will be able to

- Advantages and disadvantage of livestock grazing in forests.
- Explain ways to minimize grazing pressure in forests.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for grazing management tools and techniques.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, discuss the advantage of control grazing for forest health.
3. List out the disadvantage of grazing in the area where harvesting operations are carried out.
4. List out different ways of protecting forests, especially operated areas from grazing by livestock and wildlife. Rotational grazing, collection of forage/fodder and stall feeding, stop sites until regeneration is fully established etc.
5. Discuss the methods to do each way in detail and write down the key points.
6. Allow participants to ask questions for clarification.
7. Ask a few questions to participants to gauge their understanding.
8. Conclude session with summary of the session.

Handout: 6.2 Forest grazing management

Background:

Grazing management can be defined as the manipulation of livestock grazing to accomplish a desired result.

Grazing management in forests refers to the planned and controlled use of domestic livestock (such as cattle, sheep, and goats) to maintain the ecological balance of forested areas. The goal of grazing management is to ensure that livestock can graze in a way that supports the health and productivity of the forest ecosystem, without causing damage or degradation.

Effect of grazing on forest management

- Decrease soil productivity, erosion, surface runoff, compaction of soil, reduces permeability and water holding capacity.
- Destroys the seedlings, saplings.
- Overgrazing destroys the perennial and better grass species.
- Development of unpalatable grazing resistant herbs in place of palatable species.
- Reduces the organic matter content in soil.
- Makes scientific forest management difficult.
- Reduces species diversity.
- Soil productivity loss in longs term

Key considerations for grazing management in forests:

Grazing management in forests involves the planning, monitoring, and control of the movement and impact of livestock on forest ecosystems. Forest grazing management is important to balance the needs of livestock with those of the forest ecosystem, to prevent damage and promote the sustainability of forest resources. Here are some key considerations for grazing management in forests:

- **Determine the carrying capacity of the forest:** The carrying capacity refers to the number of livestock that can graze in the forest without causing environmental damage. This capacity is determined by factors such as vegetation type, topography, and soil fertility.
- **Develop a grazing plan:** Once the carrying capacity is determined, develop a grazing plan that outlines the number of livestock, duration of grazing, and specific areas of the forest to be grazed. The plan should be designed to avoid overgrazing and ensure the recovery of vegetation after grazing.
- **Use rotational grazing:** Rotate livestock through different areas of the forest to allow vegetation to recover in previously grazed areas. This can also help to distribute grazing pressure evenly throughout the forest.
- **Fence off sensitive areas:** Fence off sensitive areas such as water sources, riparian zones, and areas with rare or endangered species to prevent damage from livestock grazing.

- **Monitor the forest:** Regularly monitor the forest to ensure that grazing is not causing environmental damage. This can include monitoring vegetation growth, soil erosion, and water quality.
- **Manage invasive species:** Invasive plant species can quickly take over a forest and outcompete native vegetation. Implement a management plan to control invasive species and prevent their spread.
- **Work with local communities:** Work with local communities to develop sustainable grazing practices that benefit both the environment and the livelihoods of local people.

Types of grazing management

There are several types of grazing management strategies that can be used in forests. Some of the most common types include:

I. **Continuous Grazing:**

This is a traditional method in which livestock are allowed to graze freely on a particular area of the forest throughout the grazing season. It is the most simple and easy method of grazing management but can result in overgrazing if not properly managed. One disadvantage of continuous grazing is the difficulty in controlling the timing and intensity of grazing. Another limitation of this system is during slow forage growth periods animal numbers need to be adjusted, or more acreage available for grazing.

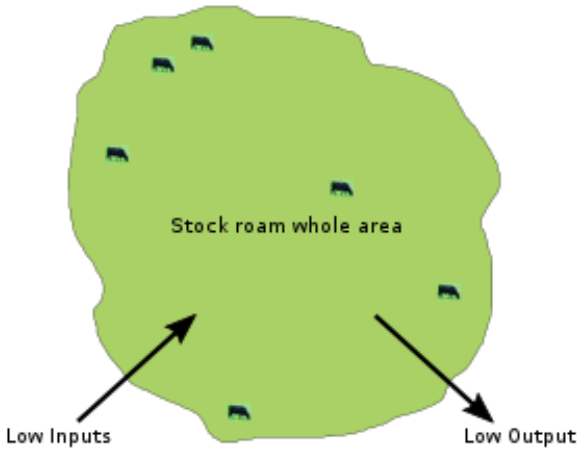


Figure 11 Continuous grazing

II. **Rotational Grazing:**

In this method, the forested area is divided into several paddocks or grazing areas, and livestock are rotated between them at regular intervals. This allows for rest and recovery of vegetation in some areas while others are being grazed, which helps to prevent overgrazing.

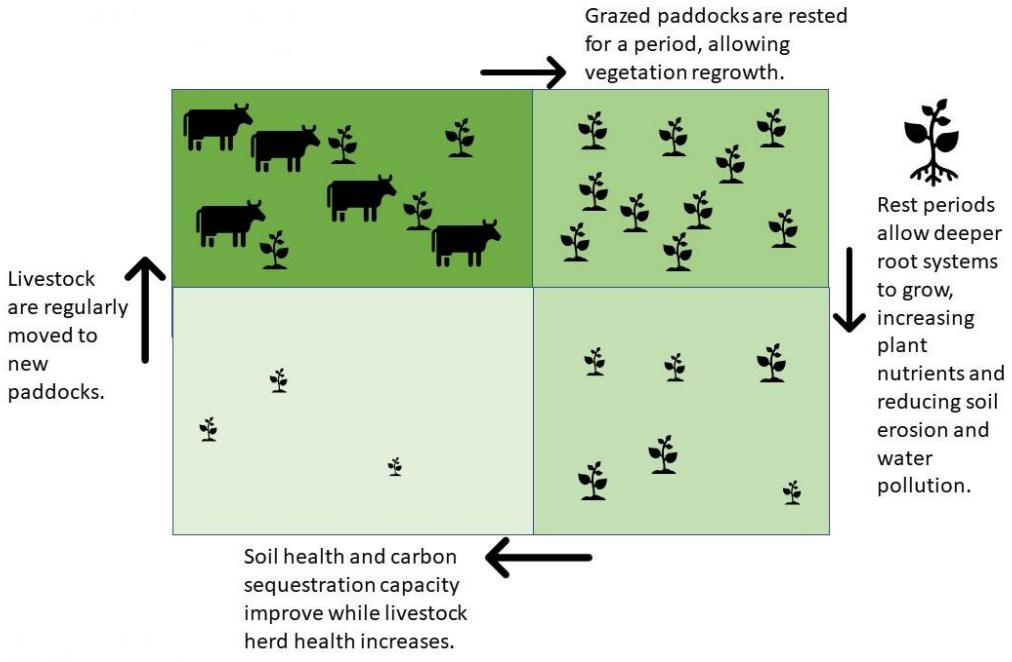


Figure 12 Rotational Grazing

III. High-intensity Short-duration Grazing:

This method involves allowing livestock to graze on a small area of the forest for a short period of time, typically one to three days, before moving them to another area. The grazing intensity is high, but the duration is short, which allows for rest and recovery of vegetation in between grazing events.

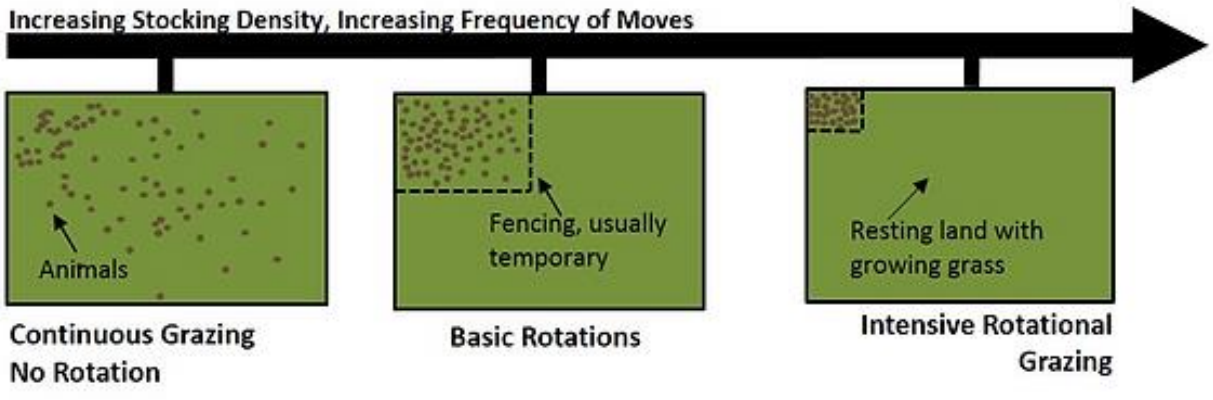


Figure 13 High-intensity Short-duration Grazing

IV. Deferred Grazing:

This strategy involves temporarily excluding livestock from a particular area of the forest during a sensitive period of the growth cycle, such as during the flowering or seed production stage. This allows the vegetation to recover and ensures that adequate seed production occurs. Deferred grazing has multiple benefits.

- It increases the tiller density of perennial grasses.
- Pasture growth has been recorded to increase after deferring.
- It results in the provision of high-quality feed at the end of the summer.
- Areas prone to drought have been witnessed to benefit by deferred grazing as it provided valuable feed at the end of summer.
- Deferred grazing helps maintain pasture quality in the rest of the paddocks.
- Indirectly, it leads to increased livestock growth and ultimately, more profits for the farm.
- It helps farm management proactively manage pastures and introduces flexibility.
- Farms with a spring surplus get more benefit by deferring some paddocks as it eases the management.

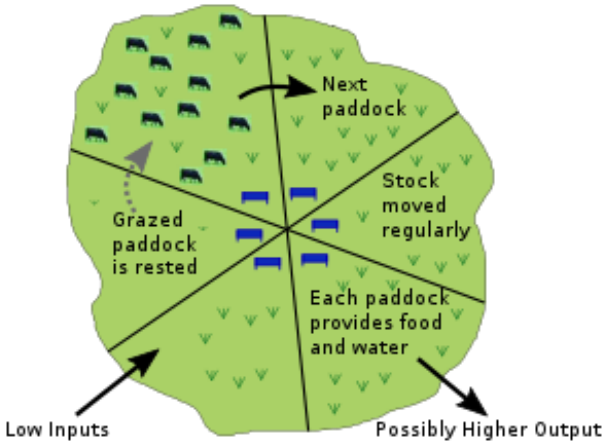


Figure 14 Deferred grazing

V. Seasonal Grazing:

In this method, livestock are only allowed to graze in the forest during certain seasons of the year, such as the wet season when vegetation is more abundant. This helps to prevent overgrazing during the dry season when vegetation is limited.

Important of forest grazing management

Grazing management is the practice of managing the use of grazing lands, such as pastures and rangelands, to ensure the sustainable use of these resources. Grazing management is important for several reasons:

- Sustainable use of resources: Grazing management ensures that grazing lands are used in a sustainable manner, which helps to maintain the health and productivity of the land over the long term.

- Improved animal health and productivity: Proper grazing management can lead to improved animal health and productivity, as animals are provided with high-quality forage that meets their nutritional needs.
- Increased biodiversity: Grazing management can help to increase biodiversity by creating a mosaic of different vegetation types and habitats that support a wide range of plant and animal species.
- Economic benefits: Grazing management can provide economic benefits to farmers and ranchers by improving the productivity of their land and reducing the risk of overgrazing or degradation.
- Reducing erosion: Grazing animals can help to reduce soil erosion by trampling and compacting the soil, which can reduce the risk of soil erosion during heavy rains or winds.
- Preserving soil quality: Proper grazing management can help maintain soil quality by ensuring that grazing is done in a sustainable manner. Overgrazing can lead to soil degradation and reduce the fertility of the soil, which can have long-term negative effects on forest health.
- Controlling invasive species: Grazing management can help control invasive plant species that may threaten the health of the forest ecosystem. Grazing animals can help to control the growth of these species, which can reduce their impact on the environment.
- Enhancing forest health: Grazing management can contribute to the overall health of the forest ecosystem by controlling vegetation and maintaining soil quality. This can in turn support the growth of healthy trees and other vegetation, which can help to maintain the balance of the forest ecosystem.

Session-6.3: Advance growth and regeneration protection and management

Background information

When harvesting is conducted to promote regeneration, the existing regeneration, advanced growth, and remaining trees and NTFPs are to be protected and managed carefully. One year after the harvesting operation, natural regeneration starts. In many cases seedlings from natural regeneration are not evenly distributed and may appear less or more than required. Participants should know how to manage remaining advance growth as well as regeneration.

Learning objectives

At the end of the session, participants will be able to

- Advantage of keeping advance growth; and
- Explain ways to manage advance growth and regeneration.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for regeneration management.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, list out the importance of keeping and managing advance growth and regeneration.
3. Divide the participants into three groups; ask the group to discuss methods of enhancing regeneration and advance growth in the forests where regeneration harvesting has been carried out. Gap plantation with wildlings, phase wise regeneration thinning, protection from insect and pest, etc.
4. Ask each group to present their group work in plenary and add anything left. If required present the slides.
5. Allow participants to ask questions for clarification.
6. Ask a few questions to participants to gauge their understanding.
7. Conclude session with summary of the session.

Handout: 6.3 Regeneration management

Background information

Natural regeneration is a cost-effective way of attaining continued forest cover of the desired species if there are sufficient seed trees available. Although the presence of seed trees or natural regeneration of desired species is abundant, unfavorable conditions for seed germination and growth of seedlings are often limited. In such cases, interventions are needed to promote natural regeneration and establishment. This process is known as Assisted Natural Regeneration (ANR). The main objective of the ANR is to create a favorable micro-environment to enhance natural regeneration and establishment.

Once regeneration starts on the ground they need to be tended and protected from fire, grazing and insects and pests. In Patula pine forests after application of seed tree system, a carpet of regeneration has been experienced whereas it was observed to be bit sparse in local Chir pine and are competed by several weeds especially invasive species. The major tending and protection activities in natural regeneration are summarized below.

i. Weeding

All the weeds in the regeneration area must be removed after at least 3 years of regeneration. Weeds can be removed through repeated cutting or uprooting. Uprooting of weeds in their early growing stage is effective as cutting process remains root stock which provided new shoots again and again means competes for minerals and water with required seedling. However, uprooting should be done carefully using local tools without disturbing the prime species regeneration.

ii. Thinning

In natural conditions, thousands of seedlings are regenerated in the forests but due to various factors the survival are far less than they regenerated. As in plantation, there is a need to maintain regeneration stocking to accelerate the growth rate by avoiding competition among seedling that are to be removed or naturally die. In general principle, after 2 years of regeneration, spacing between plant to plant can be maintained as 1.5 meters. Healthy regenerations are selected and marked using ribbon keeping an average distance of 1.5 meters. The rest unmarked are removed manually. This will maintain stocking of around 4450/ha. But if the species and area is sensitive to climatic condition, average 1 meter distance can be maintained with stocking of 10,000/ha. However, within five years, these stockings be maintained around 1000-1100 by maintaining an average of 3meter spacing between seedlings. If the site is a bit steep, 4m x 2.5m distance can be maintained. After this thinning regime of species can be applied. The retaining seedlings should

be provided support as they tend to weaken. Support can be given using sticks available in the forest itself.

iii. Protection of regeneration site

Most of the regeneration failed due to weak protection mechanism. The regeneration should be strictly protected from grazing till the regeneration is fully established. The establishment phased generally rage between 5 and 10 years. Live fencing is recommended to avoid grazing by wild as well as domestic animals. Especially entry points are to be closed.

Fire is another critical threat to the forest's regeneration area. Once mother trees are removed if fire caught up by fire, it will be hard to regenerate. Even repeated fires while mother trees are still alive and providing viable seeds can affect the quality of regeneration we achieved. Fire makes the area dry, and the young new juvenile regeneration easily die by fire shock or drought shock. Hence, removal of fire hazards at least thrice a week, creating and cleaning fire line regularly especially wild direction is critical action to take. The width of the fire line should be well enough so that fire can't jump from outside into inside the regenerating areas.

Grass and fodder collection from this area should be carefully done. Normally grass and fodder availability in regeneration area can be better than other areas due to light exposure and low competition, the available grasses or fodder should be collected carefully without damaging regenerated seedlings. It should be done with strict guidance and observation of a trained person.

Regeneration damage by wild animals such as monkeys, deer and boor has been common. As grazing control patrolling and chasing up of these animals during the dry season is very crucial. The entry point is closed, and harmful animals can be chased away through various local means.

Many regenerations chopped by Cricket. It is not easy to control cricket. If the problem is not severed, cleaning of debris and collection of crickets can be done. But to avoid sever destruction cricket trap can be established using light, water, poly shield etc.

The regeneration should be drain off creating water ways in several places. Damping off or wilting disease are very common in dump or water logging areas. Boron deficit can be complemented by putting boron manual to the regeneration areas. Similarly, use of ass can act both as pesticide as well as fertilizer-calcium carbonate.

Module 7: Forest governance

Module 7: Forest governance

Improved forest governance is one of the main pillars for SFM. Often, forest managers undermine the need to sufficiently address the governance aspect of forest management. Only strong governance can enhance participation and contribution of relevant stakeholders. Module 7 deals with the key governance aspects for SFM that comprises Gender Equality and Social Inclusion (GESI) led forest management planning process, budgeting for post-harvest management and their documentation and communication (public audit).

- Enhance capacity of participants to institutionalize inclusive management planning process while developing forest management planning,
- Explain and demonstrate documentation and communication as public audit knowledge and skills throughout SFM planning, and implementation, and
- Enable capacity of participants to do planning and budgeting for post-harvest management.

Session-7.1: Inclusive management planning process

Local people especially Forest Users' Group (FUG) take ownership on management plan and implement them effectively if they lead the process of developing the plan. In community-based forest management process, it is important that every section of communities understand what they want to do, why and how. This session is designed to recap among the participants for inclusive planning process in developing a sustainable forest management plan.

Learning objectives

At the end of the session, participants will be able to

- List out the 10 steps involve in developing community forest management plan: and
- Explain community consultations process within 10 steps of developing forest management plan.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for regeneration management.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, ask participants to explain the process of developing management plan from their experience.
3. Present 10 steps process of developing forest management plan based on CF development guideline 2071.
4. Discuss in plenary, within these 10 steps, how to maximize the consultation process. Note: in the first steps while developing action plan community should understand what and why they are doing? Community engagement is in every step but exclusively in interest group/tole meeting and assembly.
5. Ask the participants in five groups, allocate each group- 2 steps and ask them to write key consultation methods and checklists. (20 minutes)
6. Allow participants to present their findings in the gallery.
7. Allow participants to ask questions for clarification.
8. Ask a few questions to participants to gauge their understanding.
9. Conclude session with summary of the session.

Handout 7.1 Inclusive management planning process

Inclusive management planning process

Inclusive simply means including everyone. It is about embracing all people irrespective of their race, gender, disability, wellbeing and so on, providing equal opportunities. Inclusive planning is the self-governing process practicing the democracy and valuing the equal rights (Koirala, 2019). Forest management planning generally gives in hand the written management plan (Khanal and Straka, 2020). The inclusive process of such planning involves all the stakeholders in its development addressing the concerns of diverse groups of users.

Why inclusive forest management planning?

Different interest groups have different interactions with the forest resources. The significant changes in the forest ecosystem, in resources and in legal provisions may affect them in different ways. Ignoring their differences and preferences can lead to severe consequences. For instances, considering the voice of men only in species selection for utilization may not favor the women's choice of species for livelihood and may increase their problems in day-to-day life. Similarly, consulting the elite only to introduce forest management techniques may not be appropriate for all forest users especially women and marginalized forest dependent groups. Therefore, it is essential to consider their issues while developing forest management plans and in every stage of forest management planning process. Such an inclusive management plan ensures the sustainable management of forest resources as such planning can be easily owned by the users.

Steps for inclusive forest management planning

The forest management planning process includes several following steps where the collaboration of relevant stakeholders is essential to ensure ownership and its effectiveness.

a. Preliminary assessment

Preliminary assessment should be conducted at the beginning of the planning process. Such assessment helps in identifying the environmental, social, legal, and economic factors that affect the sustainability of the planning process and decide accordingly. The assessment may consider the several aspects like

- Land and its tenure status,
- Biophysical and socioeconomic environment,
- Trade of forest goods and services and market accessibility,
- Legal provisions,
- Social surveys, and so on.

Gender norms and intersectional analysis in every aspect mentioned above in collaboration with relevant stakeholders are crucial to make this process inclusive.

b. Detail assessment of forest resources (Forest inventory)

Unlike the past forest inventories that were primarily focused on timber availability, inventories in recent years also incorporate the complex ecosystem with users' interaction with forest resources. A forest inventory provides detailed estimation on wood and non-wood forest resources, site classification, social aspects, and biodiversity. Detailed inventory of the forest management unit may be carried out periodically to update the change in the forest condition. The inventory information is applicable to estimate the annual allowable harvest of timber and non-timber forest products. Technical assistance for the inventory should be taken from forest technician of the S/DFO.

The forest inventory should have clearly defined targeted audience and the collected data should meet the information need of the users from diverse interest groups.

c. Participation and consultation

Conducting household level surveys, discussion with interest groups and community level meetings are essential to assess the dependency and needs of targeted users. The dissemination of the collected information in general assembly and addressing their feedback is crucial for increasing the ownership of local users upon the management plans.

Inclusive participation of stakeholders during such events and consideration of the voice of intersectional groups in decision making is essential for sustainable forest management planning.

d. Setting management objectives

The measurable management objectives clearly defined based on sociocultural, environmental, and economic conditions as well as policy provisions are crucial for sustainable forest management. The forest managers are responsible for balancing such management objectives.

While setting those objectives, stakeholders should include a perspective of gender and marginalized groups, to respond to their needs equally.

e. Zoning or stratifying the forest area.

A forest management unit may have different functions or values, for example, conservation, production, research, ecotourism, etc. and are to be managed in different ways. Such units should be allocated to separate compartments. The process of forest mapping, zoning, and modeling the alternative management options can adopt geographic information system or other technique in consultation with relevant stakeholders that helps in decision making.

The zoning of the forest management unit should consider the interaction of intersectional groups with the goods and services of the forest.

f. Calculating sustainable yields (timber and NTFPs)

Annual Allowable Cut (AAC) is the commonly used measure to estimate the volume of timber and is calculated based on the management objectives, the standing stock and growth rate of commercially valuable tree species, and the area of forest under management. The AAC can be used to monitor forest production and define limits for forest use.

In such, the calculation of sustainable yields should consider the users' demand of forest resources mainly of women, marginalized and poor users.

g. Developing the forest management plan

The forest management plan involves the planned forestry activities, for example, inventory, yield calculation, harvesting, silvicultural operations, protection, and monitoring to be conducted in forest area to meet the specified objectives. The plan also ensures the participation of, and communicating forest objectives and strategies to, people living in or near the forest and other stakeholders in the implementation of sustainable forest management. The forest management plan must specify the harvesting area of forest and annual allowable harvest in each period, forest protection measures, prescribed silvicultural system for management, and other prerequisites to achieve the management objectives including inclusive social survey and public consultation.

h. Approval of the forest management plan by the forest authority

Sub/Division Forest Office (S/DFO) not only has its role in technical assistance in planning process, but also is responsible to approve the forest management plan. The management plan needs to be approved by the Division Forest Office prior to its implementation.

It is the responsibility of the S-DFO to review the management plan through the perspective of gender equality and social inclusion and assist forest managers in incorporating them in the document if missing before approval. They are equally responsible for monitoring and assist in its effective implementation.

i. Periodic revision of the plan based on monitoring and evaluation on the ground

The forest management plan should be reviewed and, where necessary, revised periodically since accumulated experiences, and changing socioeconomic contexts. Each revision is an opportunity for forest managers to reconsider the management objectives and plan in concessions.

Session- 7.2: Enhancing forest governance

Background information

One of the important actions under governance enhancement is proper documentation and communication of all the process, decisions, and financial status to members of the community and relevant stakeholders. Participants should have a clear understanding of how they can support communities to enhance their governance practices.

Learning objectives

At the end of the session, participants will be able to

- Define good governance practices.
- List out criteria and indictors of good governance; and
- Explain different aspects and ways of enhancing governance system.

Time 3.0 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for governance practice.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, ask participants to write down what do they understand of Governance in community forestry.
3. Take a couple of answers and discuss them and agree on the definition of governance/good governance.
4. Distribute 3 meta-cards to each participant and ask them to write three indicators of good governance (15 minutes).
5. Collect the meta cards and group them/indicators (diamond ranking)- One group one broad criteria. (15 minutes)
6. Discuss each indicator and define how to measure the indicators. (30 minutes)
7. Divide the participants into three groups and ask to discuss the process to maintain- i). Accountability, ii) Transparency, and iii) Participation (20 minutes)
8. Present the findings through gallery walk and facilitate discussion (30 minutes)

9. If needed present the power point slides on governance
10. Allow participants to ask questions for clarification.
11. Ask a few questions to participants to gauge their understanding.
12. Conclude session with summary of the session.

Handout 7.2 Enhancing governance practice.

Governance is the exercise of economic, political, and administrative authority to manage a country's affairs at all levels. It comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences (UNDP 1997). In a similar fashion, the World Bank defines governance as the way power is exercised in the management of a country's economic and social resources for development (WB: 2003). Therefore, the question of governance is centered around: Who has power? Who makes decisions! How do stakeholders make their voices heard? In general, governance is generally broadly about direction, performance, accountability, fairness, legitimacy, and voice. Governance is generally considered "good" if it is characterized by transparency, accountability, rule of law, stakeholder participation. Efficient and effective management of natural, human, and financial resources, and sharing of their fair and equitable benefits to legitimate claimants and stakeholders further strengthens the notion of good governance.

Forest governance can be defined as the way in which public, civic and private actors, including local communities and indigenous peoples discuss, negotiate, make, and enforce binding decisions about the conservation, management, and wise use of forest resources. The concept of forest governance has evolved to engage multiple actors at multiple scales, from local to global. According to PROFOR and FAO (2011) when we apply good governance in forest sector, its six principles: transparency, accountability, participation, equity, efficiency, and effectiveness must be observed. These governance principles are adopted in three pillars of forest governance: i) policy, legal, institutional, and regulatory frameworks; ii) planning and decision-making processes; and iii) implementation, enforcement, and compliance.

The policy dimension considers policies, laws, regulations guidelines and lower levels of implementation instruments such as working procedures and circulars and seeks clarity and coherence among them. Both the content and process of developing this framework include recognition and respect of forest tenure and rights, and the functioning of key institutional frameworks. Equally important is the broader coherence with citizen's fundamental rights, state policies, obligations, incentive, and service delivery.

The planning and decision-making pillar considers the degree of accountability, transparency, inclusion, and institutional attributes. Major concerns are how indigenous people and local communities can participate, voice their concerns, and influence forest sector plans and decisions. These are particularly crucial in the case of those forests in which communities have a direct stake and are likely to be impacted from those plans and decisions. From governance perspective it is important to examine the extent, characteristics, and quality of participation of IPLCs and stakeholders and their capacity to participate and contribute. It is also important to consider

accountability and transparency of forest management related decision-making and resource allocation and implementation mechanism.

Implementation, enforcement, and compliance make up the third pillar of governance which considers how and to what extent the policies, plans and institutions are implemented and operated on the ground. Here forest administration, law enforcement, extension activities and implementation of periodic plans are the important aspects. In good governance, these functions of public forest agency can facilitate and promote people's rights, economic opportunities, minimize corruption, ensure timely, quality service to communities and individual farmers gain highest achievement from implementation of forest development plans and program. If these functions facilitate and ensure towards achieving aspirational goals of forest policies and programs that can be termed as good governance.

National standards

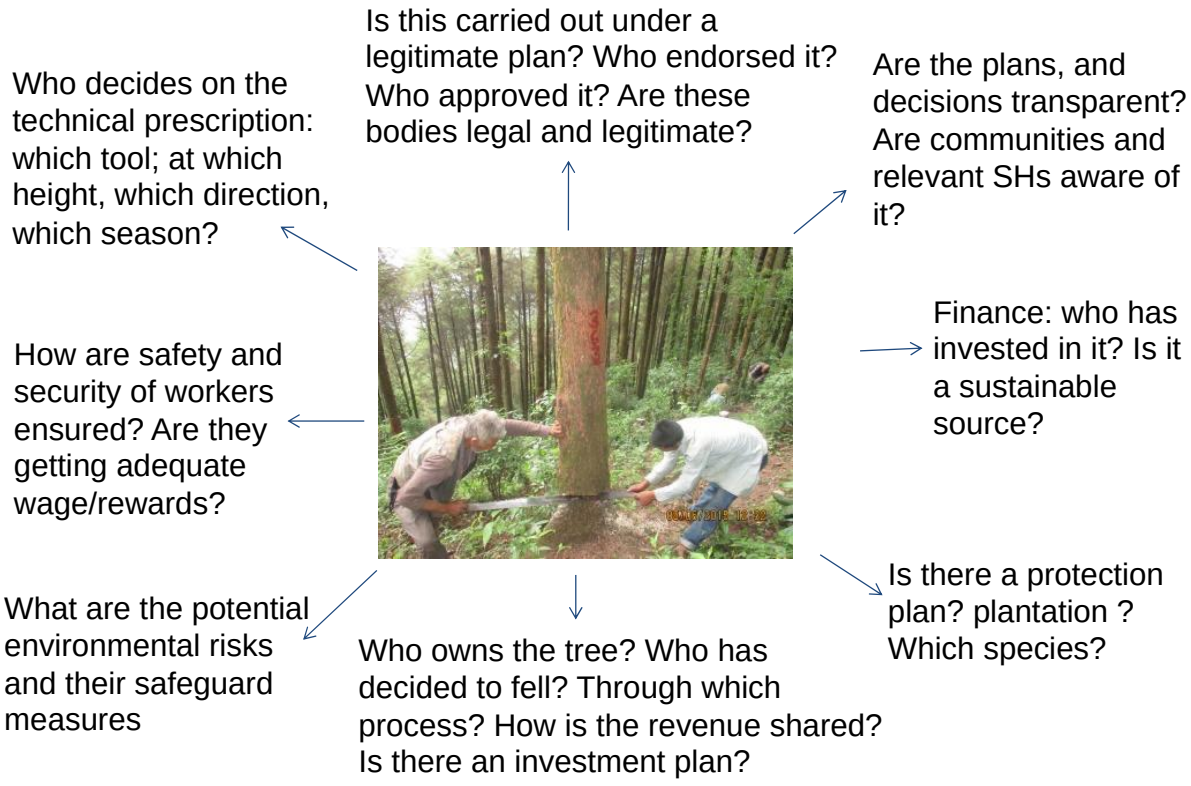
Following these governance principles, the MOFE has recently developed national standards for sustainable forest management. The National Standard has adopted five principles, 26 standards and dozens of indicators to define sustainable forest management. Five principles are: i) rule of law and good governance; ii) GESI, and cultural norms; iii) improved production, productivity, and economic prosperity; iv) environmental security; and v) monitoring, evaluation, research, and knowledge management (MOFE 2022).

Out of total 26 standards, the majority are dedicated to governance issues especially transparency, accountability, rule of law, participation, efficiency, and equity. There are adequate provisions around compliance of national and international laws while collecting, sale and transportation of forest products. These standards suggest respecting indigenous people and local communities' access, roles, and benefits; respect their institutions, knowledge, and management systems, and ensure equitable benefits between state and communities and among different groups of people. Make sure that local forest user groups are inclusive and encourage them to adopt deliberative democracy. Protect/conserve cultural and spiritual values of forests and associated practices. Ensure meaningful participation and influence of the diverse groups, especially the women, Dalits, Janajati, Madhesi and other marginalized groups of people in planning, management and benefits sharing from SFM. Their capacity, health and security risks are properly assessed, enhanced, and mobilized during management activities. It is important to consider the type and condition of forests, users interests and management capacity in choosing silvicultural options. It is important to assess the potential environmental risks and adopt appropriate safeguards measures. Involve IPLCs in regular monitoring and periodic evaluation of the management interventions, reflect upon them, document lessons and feed in those lessons in future planning.

Sustainable forest management and good governance

Governance and management are closely associated in the context of sustainable forest management. However, to better appreciate them and adopt them in everyday practice, these need to be understood as distinctly separate concepts. While forest governance is about exercise of power and authority by a range of actors through a legitimate process that sets policies and regulatory framework and broader level decisions; management is associated with operational issues around protection, silvicultural operations, harvesting, processing, selling, and realizing the income and employment benefits. As the following figure shows, felling a single tree must be navigated through a complex governance question questions and issues.

Felling a tree involves several governance issues beyond management



Session-7.3: Planning and budgeting for post-harvest management

Background information

Often budget in community forests are mostly used within a few years. A forest needs continuous tending and cultural operations to improve the quality of forests. But normally, no budgets are secured for those activities especially for post harvesting operation. Participants need to understand that the community reserves a necessary amount of money for post harvesting activities.

Learning objectives

At the end of the session, participants will be able to

- Recall and list down post forest harvesting operations carried out in the forests; and
- Prepare resource plan with sources for those operations/activities.

Time 1.5 Hours

Equipment and materials requirements

- Training materials: Flip chart paper, markers, masking tape, meta-card, thumb pins, writing pad and pen.
- Slides for planning post harvesting operation and budget.

Session facilitation process

1. Explain the objectives of the session.
2. In plenary, list down the post harvesting operations or routine operations that community should carried out in their forest.
3. Group these activities into three groups.
4. Explain how to develop resource plan including cost and source forecast to carry out listed activities.
5. Divide participants into three subgroups and allocate one group of activities to each group to develop resource plan.
6. Ask each group to present their findings in plenary.
7. Facilitate discussion to clarify if needed.
8. Allow participants to ask questions for clarification.
9. Ask a few questions to participants to gauge their understanding.
10. Conclude session with summary of the session.

Handout 7.3 Planning and budgeting for post-harvest management

Silviculture systems and treatments emulate forest disturbances that support or discourage certain types and amount of regeneration. The treatments, protection program and management regimes following silviculture operation determine the development of future stand. Post-harvest management refers to activities that promote growth of regeneration, either natural or artificial, as governed by type and size of disturbance.

Ecology of regeneration

In forest management, if a forest is left to natural processes and devices following a disturbance, it is not a question of whether there will or not be a vegetation to follow but rather of what type. The natural vegetation that follows a disturbance is dictated by the ability of different species to adapt and colonize the microclimate afforded by the disturbance. This same rule applies to exotics – where it can only be successful if the new habitat is favorable to its native counterpart. When a certain type of forest is desired as the next vegetation, it is therefore important to know the type of natural disturbance that can bring it to thrive in nature. Once this is known, it is possible to simulate such disturbance through artificial methods. Moreover, it is important to note that natural disturbance can be lethal to some tree species but advantageous to others and that knowing how individual species responds to all or any disturbances is necessary in predicting the kind of ecological succession.

Landslides, melting of glaciers or formation of new landform by wind, water or volcanic activity constitute the most severe disturbances. It is only from these geological events that true “primary succession” can emerge. The pioneer species to colonize such spaces are likely to be herbaceous than trees. Trees do not ordinarily initiate themselves in such spaces until other vegetation has developed organic matter or sufficient shade to shelter tree seedlings from climate extremes.

Fire is another widely known disturbance which the world has seen devastation of forests, lives, and properties. Obviously, it kills small trees more easily than larger ones; in other words, it kills a forest from forest floor upwards. In response to fire events, tree species can therefore be divided into two categories. One category consists of those tree species that can sprout from roots or from below the fire-girdled stem like eucalypts and some pines. The other category comprises those that germinate from small seeds dispersed by wind and adapted to germinate on degraded soils bared by fire which several forest species had evolved as prolific post-fire seeders.

The last category of disturbance relates to wind or pests that kills large trees from top downward sparing plant species in the lower strata. Species adapted to such disturbances are tolerant to shade, primarily characterized by slow growth of juveniles. While these species can endure

stunted seedlings or saplings for a long period, they can initiate rapid height growth whenever canopy above them is opened by wind or pests.

Preparation and treatment of the site

Silviculture systems place logical emphasis on the pattern of cutting or crown opening to promote regeneration of a desired forest and that site capture is predicted with high degree of certainty. As discussed in the previous section, the ability of some vegetation to capture site should not however masked the vital role of site preparation and treatments in ascertaining the quality and health of regeneration and the new forest stand. While some site treatments may resemble to regimes in agriculture land preparation, forest treatments are not as intensive because most forest trees, being a later successional species, require a microclimate that is totally different to agricultural crops. The aim of preparation and treatment of sites following harvest, cutting or disturbance include reduction of fire hazard, supporting growth of healthy regeneration, and ensuring soil nutrients and moisture are directed to growth of desired forest species. The following are key preparation and treatments practices.

1. Disposal of logging debris
2. Treatment of the forest floor and competing vegetation
    a. Prescribed burning
    b. Mechanical treatments – can include manual raking and sweeping, plowing, dozing.
    c. Herbicide treatments
    d. Flooding – particularly in flat lands
3. Site improvement
    a. Fertilizer application
    b. Erosion control – specially in steep terrain
    c. Constructing drainage – in water-logged areas
    d. Installing irrigation – in dry and easily drained sites

Disposal of logging debris

The condition of the forest floor following harvesting is obviously unappealing because of offensively messy accumulation of forest slash. Although leaving these debris can have ecological benefits such as deposition of organic matter and creating habitat for small fauna, they can be a major forest fire hazard. In addition, the unusually huge volume of green debris can impede growth of regeneration because of heavy shading and covering of forest soils. Regeneration in sites uncleared of logging debris can only happen once they are in advance state of decomposition, by that time the site may have been captured by undesired forest vegetation. Logging debris can be accumulated and left to decay on specific location on site where fire can be easily suppressed

or can also be processed into mulched or sold as fuel. Alternatively, piled debris can also be burnt with high caution, preparation, and anticipation of fire control.

Treatment of the forest floor and competing vegetation

Logging operations and disposal of debris left the site with heavily damaged advanced regeneration and often vigorously growing sun tolerant species that captured the site for the interim period from cutting to debris removal. The forest floor is also left with a layer of twigs, fallen leaves or needles, and other biomass unincorporated to soil which will impedes emergences of regeneration particularly of fine-seeded species. It is therefore necessary to implement seedbed preparation which involves raking or sweeping small debris to evenly distribute fine unincorporated biomass and slightly expose mineral soils. The implementation of any treatments listed above will be dependent on capacity of forest owners, available resources, and social and cultural perceptions about the different treatments.

Site improvement

Once the site or forest floor is prepared, it is important to implement site improvement or amelioration practices to promote establishment of healthy regeneration. Fertilizer application and erosion control are the practices commonly applied in most forest areas while drainage is constructed in waterlogged areas and irrigation construction is needed for dry and easily drained sites like sandy riverine planes.

Protection of regeneration

The growth of regeneration, either natural or artificial, is dependent upon provisions of the right amount and kind of growing spaces favorable for the species desired. This should not however discount the necessity of protecting regeneration for damaging agents such as winds, fire, pests, wildlife, and humans. Fire is the most dangerous damaging agents of most forests and therefore forest fire protection measure such as establishment of fire lines and treatment of logging debris should be implemented to protect regeneration just as they are needed for established forests. Heat and drought can also severely damage young seedlings in which mulching or leaving vegetation surrounding the seedlings during dry season are necessary. Wild and marauding domesticated animals can also cause serious injuries to young seedlings of which damage such as broken main stem and browsed seedlings tips can be irreversible.

Socio-economic considerations in post-harvest management

Up until this point, our discussion of post-harvest forest management had focused on trees. However, forest management in general is not just managing trees and stands but of people as well particularly when forest management directly and indirectly involves voluntary participation

of private individuals and families in managing public forests. In Nepal, a sizable proportion of public forest is under community forest management. Thus, forest use, values and perception of forest users must be considered when planning and implementing post-harvest management.

Forest users value their community forests not just for timber but also for other products like fodder, leaf litter, bedding material, fuelwood, and forest foods. The multiplicity of forest use can present both opportunities and challenges in implementing site preparation and treatment activities. For example, a considerable amount of top logs branch wood and twigs and leaves left in the forest floor could be distributed to forest users for firewood and bedding materials. This is a useful way of disposing of logging residues. However, the timing of such firewood collection should be planned so that the regeneration capacity of the forest is not adversely affected.

The dynamics of socio-economic conditions of forest user groups are likely affecting the forest management objectives. Changes of forest management objectives could mean alteration of existing silviculture systems and tending operations to meet the socio-economic needs of forest users and the wider public. For example, while timber is an important extractable resource to provide materials for house construction in the villages, affluence and improvement of income meant that houses are increasingly using more concrete, still and aluminum products and less wood in recently constructed houses. It is thus important that treatment of forest disturbances or harvested areas suits current and predicted future use and values of forests.

Annexes

Annex: 1 Detail Session Plan on Forest Management

Day/Time	Session	Key contents	Methods	Preprations	Facilitator/s
Day-I					
8:00-8:30	Breakfast				
8:30-9:15 (45 minutes)	Ice Breaking	Informal Opening, Participants Introduction, Expectation, objectives and schedule, logistic, pre-tests etc.	Presentation and explain, test by participants	Slides on objectives and schedule. Pre-test questionnaire Banner Proverbs	Shambhu Dangal
9:15-10:30 (1 Hrs and 15 min)	Sustainable Forest Management (SFM)-Learning from experience	Participants share their understanding and experience. List out what went well and challenges. Potential solutions	Brainstorming Fishbowl exercise Plenary discussion	Sufficient space for fishbowl exercise	Shiva Sapkota
10:30-11:00(30 minutes)	Tea break				
11:00-13:00 (2 hours)	Forest Certification and Sustainable Forest Management Standers	Concept of forest certification Proposed SFM standard for Nepal REDD+ Benefits of SFM	Brainstorming-forest certification, principle, standards and indicators Presentations on standards Presentation on mitigation	Power-point presentation	Shambhu Dangal

		SFM for Climate Adaptation	and adaptation opportunity		
13:00-14:00 (1 hour)	Lunch break				
14:00-15:30 (1.5 Hrs)	Review the process of Developing Forest Management/Operation Plan	Steps involve in the management planning process. How these steps can be robust as well as participatory	Snow Balling in groups Gallery presentation and interaction	Markers, masking tape, meta-card, thumb pins, writing pad and pen	Shiva/ Bidhyanath
15:30 - 15:45(15 minutes)	Tea break				
15:45-17:15 (1.5 hours)	Process of Forest Mapping, Zoning and Blocking	Review of current mapping process and tools use- what worked well and what to be improved to make more accurate as well as participatory. Requirement for participatory resources assessment and mapping Mapping for whole forest management	Small group work and gallery presentation Slides presentation and discussion	Power-point presentation on rapid assessment of forest condition and mapping. Whole forest management and current practices	Rakesh and Pawan

17:15-17:30 (15 minutes)	Day wrap-up with mood meter				
Day-II					
8:00-8:30	Breakfast				
8:30-8:45(15 minutes)	Recap Day I		Recap by task team		
8:45-10:45 (2 hours)	Forest Inventory and Its Application	Application and importance of inventory in forest management Update of contemporary/cutting edge technologies using in forest resource inventory Basic overview and field practice with existing equipment; range finder, relascope, and vertex Analysis of field data according to Sustainable Forest Management Procedure 2079	Brain storming Lecture Presentation	Power-point presentation on forest inventory and its application Training materials: Flip chart pater, markers, masking tape, meta-card, thumb pins, writing pad and pen.	Bidhya Nath Jha
10:45-11:00(15 minutes)	Tea break				
		Forest Rotation	Brain storming	Power-point on each concept	Edwin and Shambhu

11:00-13:00 (2 hours)	Key elements to SFM Review of important silvicultural system and operations Rotation age Yield Regulation	Silviculture and System Yield regulation	Group work on applications (Forest rotation, Silviculture system and yield regulation) Gallery walks presentation and discussion.		
13:00-14:00 (1 hour)	Lunch break				
14:00 -15:30 (1.5 hours)	Forest Management Prescriptions for various types and objectives of forest management in Bagmati Province	Review the forest management prescription and link to inventory data Exercise (prescribed forest management option for different forest types, conditions, and management objectives) Rational of selection of silvicultural system and operations in respective forest types Exercise based on SFM procedure	Brain storming Buzz group discussion Lecture	Power-point presentation on forest management prescriptions for various types and objectives of forest management	Shiva/Shambhu/Rakesh

15:30 - 15:45(15 minutes)	Tea break				
15:45-17:15 (1.5 hours)	Improved Harvesting and Logging tools	Tools used for Harvesting and Logging Operations, Their Maintenance	Brain stroming, Buzz group discussion, lecture	Presentation and Group Discussion	Edwin
17:15-17:30 (15 minutes)	Day wrap-up with mood meter				
Day-III					
8:00-8:30	Breakfast				
8:30-8:45(15 minutes)	Recap Day II		Recap by task team		
8:45-10:45 (2 hours)	Safe Harvesting techniques (human safety, product safety, environment safety)	Felling Techniques; Transportation and Stocking Methods Human, product and environment safety	Brain storming Buzz group discussion Lecture	Presentation and Group Discussion	Edwin
10:45-11:00(15 minutes)	Tea break				
11:00 - 13:00 (2 hour)	Forest governance	Inclusive management planning process. Enhancing governance practice. Sustainable forest management and good governance	Brain stroming, Buzz group discussion, lecture	Presentation and Group Discussion	Naya Sharma Paudel
13:00-14:00 (1 hour)	Lunch break				

14:00-17:00 (3 hours)	Field Exercise / Observation	Tools use, maintenance and harvesting and logging, grading and marking Observation of silviculturebased forest management	Group division and field exercise	Presentation and Group Discussion	Madan and Pawan
17:15-17:30 (15 minutes)	Day wrap-up and closing				
Day-IV					
8:00-8:30	**Breakfast**				
8:30-8:45(15 minutes)	Recap Day III		Recap by task team		
8:45-10:15 (1.5 hours)	Post-Harvest Management and Protection Regeneration Management	Protection of sites: Fire, Grazing, cutting etc Management of new and existing regeneration until the crop is fully established	Brain storming Buzz group discussion Lecture	Presentation and Group Discussion	Shiva Sapkota
10:15-10:30 (15 minutes)	**Tea break**				
10:30 - 12:00 (1.5 hour)	Knowledge transfer	ToT Skills	Brain stroming Buzz group discussion	Group Discussion	Shambu Dangal
12:00-13:00 (1 hour)	**Lunch break + closing ceremony**				

Annex 2: Form for forest management sustainability assessment

दिगो वन व्यवस्थापनको लागी राष्ट्रिय मापदण्ड सहितको कार्यविधी निर्देशिका २०७८ मा समावेश भएका सिद्धान्त, मापदण्ड र सूचकहरु	मुल्याङ्कन तालिका					कैफियत	आवश्यक पहलहरु
	0	1	2	3	4		
सिद्धान्त १: कानूनको परिपालना र सुशासन							
मापदण्ड १.१: वन व्यवस्थापन गर्नका लागि प्रचलित कानून वमोजिम अधिकार प्राप्त निकाय (वन व्यवस्थापक) हुनु पर्नेछ ।							
सुचक १. वन व्यवस्थापनका र यस संग सम्वन्धित क्रियाकलापहरु लागि वन कार्यालय वा सामुदायिक वन उपभोक्ता समुह वा साझेदारी वन समुह वा प्रचलित कानुनले तोकेको निकाय रहनेछ ।							
सुचक २. प्रचलित कानूनले तोके बमोजिमको निकायबाट स्वीकृत वन व्यवस्थापन योजना वमोजिम वनको संरक्षण, बिकास, व्यवस्थापन र सदुपयोग भएको हुनेछ ।							
मापदण्ड १.२: वनमा हुने वन पैदावारको चोरी निकाशी, अतिक्रमण तथा अन्य गैरकानूनी क्रियाकलापहरु नियन्त्रण गरी वनलाई व्यवस्थित रुपमा संरक्षण गर्नको लागि उपयुक्त उपायहरुको अबलम्बन गर्नपर्नेछ ।							
सुचक १. वन व्यवस्थापन योजनामा वन पैदावारको चोरी निकाशी, चोरी शिकारी, पासो थाप्ने, गैरकानूनी संकलन गर्ने, वन अतिक्रमण गर्ने जस्ता गैरकानुनी क्रियाकलापहरु नियन्त्रणका उपायहरु उल्लेख भएको हुनेछ ।							
सुचक २. वन पैदावारको चोरी निकाशी, चोरी शिकारी, पासो थाप्ने, गैरकानूनी संकलन गर्ने, वन अतिक्रमण गर्ने जस्ता गैरकानुनी क्रियाकलाप नियन्त्रणका उपायहरुको पूर्ण पालना भएको हुनेछ ।							

सुचक ३. वनभित्र वा बाहीर गैरकानूनी र अबैध कार्यहरु भएको पत्ता लागेमा तत्काल प्रचलित कानून वमोजिम नियमन निकायसंगको समन्वयमा सम्बोधनका उपायहरु लागु गरिएको हुनेछ ।							
मापदण्ड १.३: वनपैदावारको संकलन, बिक्रि-वितरण, ओसार पसार र व्यापार गर्दा प्रचलित राष्ट्रिय र प्रादेशिक कानून, नेपाल सरकारद्वारा अनुमोदन गरिएका अन्तर्राष्ट्रिय महासन्धिहरु र अन्य बाध्यात्मक किसिमका आचारसंहिताको पालना गर्नुपर्नेछ ।							
सुचक १. वन पैदावारको संकलन, बिक्रि-वितरण, ओसार पसार र व्यापार गर्दा प्रचलित कानुन तथा वन कार्ययोजनामा व्यवस्था भए वमोजिम निर्धारित प्रकृया पुरा भएको हुनेछ ।							
सुचक २. वन पैदावारको संकलन, बिक्रि, वन पैदावारको ओसार पसार र व्यापार गर्दा अनुमोदन गरिएका अन्तर्राष्ट्रिय महासन्धिहरु र बाध्यात्मक किसिमका आचारसंहिताको पालना भएको हुनेछ ।							
मापदण्ड १.४ प्रचलित कानुनी व्यवस्था र परम्परागत प्रथाजनित व्यवस्थाको बिचमा विवादहरु हुन नदिने र विवाद रहेमा पहिचान गरी त्यस्ता विवादहरु समाधान गरिएको हुनुपर्नेछ ।							
सुचक १. प्रभावित सरोकारवालाहरुको संलग्नतामा गुनासो सुन्ने र विवाद समाधान गर्ने प्रकृया र संयन्त्रको निर्माण भई सार्वजनिक गरिएको हुनेछ।							
सुचक २. व्यवस्थापन कृयाकलापहरुको प्रभावसंग सम्वन्धित विवादहरु गुनासो सुन्ने र विवाद समाधान गर्ने प्रकृया र संयन्त्रवाट समाधान गरिएको हुनेछ र समाधान गर्न प्रयोग गरिएको विधि र प्रकृया तथा समाधानको विषय सार्वजनिक गरिएको हुनेछ ।							
सुचक ३. विवाद समाधान भएको वा विवाद समाधानको प्रयास प्रक्रियामा रहेको छ भन्ने बारेमा निर्धारित समयमा नै सम्बोधन र अभिलेख भै सम्वन्धित पक्षलाई जानकारी गराइएको हुनेछ ।							

मापदण्ड १.५: वन व्यवस्थापकले कुनै पनि किसिमको गैरलाभ प्राप्त गर्ने वा माग गर्ने कार्य गर्ने छैन भन्ने प्रतिवद्धता सार्वजनिक गरिएको हुनु पर्नेछ र वन व्यवस्थापनका क्रियाकलापको गहनता र मात्रा तथा तहको आधारमा हुने भ्रष्टाचारजन्य जोखिम नियन्त्रणका उपायहरु कार्यन्वयन गरेको हुनुपर्नेछ ।							
सुचक १. प्रचलित कानुनको अधिनमा रही शुसासन र भ्रष्टाचार नियन्त्रण सम्बन्धि आचारसंहिता तयार र पालना गरी वन व्यवस्थापकवाट सार्वजनिक सेवा निःशुल्क र प्रभावकारी रुपमा उपलब्ध भएको हुनेछ ।							
सुचक २. भ्रष्टाचार नियन्त्रण सम्बन्धि आचारसंहिताको पूर्ण पालना नगरेको पाईएमा तत्काल कानुनको दायरामा ल्याईएको हुनेछ ।							
मापदण्ड १.६. व्यवस्थापकले लैंगिक समानता तथा समाजिक समाबेशीकरणको आधारमा रोजगारीको अवसर, प्रशिक्षणका अवसर, ठेक्का सम्झौता जस्ता गतिविधीहरू सञ्चालन एवं वढावा गर्नेछ ।							
सुचक १. लैंगिक समानतालाई बढावा दिदै सबै लिंग, जाति र वर्गलाई रोजगारीका अभ्यास, प्रशिक्षण र व्यवस्थापन गतिविधि सञ्चालन गर्न व्यवस्थापकले समान अवसरहरू प्रदान गरेको हुनेछ ।							
सुचक २. वनमा आश्रित महिला तथा विपन्न र दलित लगायतका सीमान्तकृत समुदायलाई रोजगार, प्रशिक्षण र अन्य सेवाको अवसरहरूमा विशेष प्राथमिकता दिइएको हुनेछ।							
सुचक ३. महिला र पुरुषलाई समान कामको लागि समान ज्याला दिइएको हुनेछ।							
सुचक ४. व्यवस्थापन योजना तयारी र कार्यान्वयन गर्न प्राबिधिक तथा समाजिक परिचालनको लागि आबश्यक शिक्षा तथा तालिम प्राप्त महिला र पुरुषलाई बराबरी अबसर दिइएको हुनेछ।							

सुचक ५. व्यवस्थापन योजना तयारी र कार्यान्वयनमा संलग्न महिला कर्मचारी, महिला कर्मी र महिला कामदार को लागि सुरक्षित तथा मर्यादित कार्यस्थल बनाउन आचारसंहिता विकास गरी अनिबार्य रुपमा लागु गरिएको हुनेछ ।							
सुचक ६. लैंगिक, वैवाहिक स्थिति, अभिभावक वा यौन अभिमुखीकरणको आधारमा यौन उत्पीडन र भेदभावको घटना रिपोर्ट गर्न र हटाउनको लागि गोप्य र प्रभावकारी संयन्त्र स्थापना भई लागु गरिएको हुनेछ ।							
मापदण्ड मापदण्ड १.७.: व्यवस्थापकले व्यवस्थापन योजना कार्यान्वयन गर्न वनकर्मी कर्मचारी तथा श्रमिकहरुलाई विशेष प्रशिक्षणको यथोचित प्रबन्ध मिलाउनु पर्दछ । वनकर्मी कर्मचारी तथा श्रमिकहरुलाई व्यवसायिक सुरक्षा र स्वास्थ्य सम्वन्धि जोखिमबाट जोगाउन स्वास्थ्य र सुरक्षाका अभ्यास तथा उपाय अनिवार्य लागू गर्नु पर्दछ।							
सुचक १. सबै व्यवस्थापन गतिविधिहरू तयारी र कार्यान्वयन गर्न वनकर्मी कर्मचारी तथा कामदारहरूको लागि विशेष प्रशिक्षण दिइएको हुनेछ । व्यवस्थापन गतिविधिहरूमा उपलब्ध भएसम्म प्रशिक्षित व्यक्ति मात्र कार्यरत रहेका हुनेछन् ।							
सुचक २. प्रशिक्षणमा वनकर्मी, महिला कर्मचारी र पुरुषलाई समान अवसर दिइएको हुनेछ ।							
सुचक ३. वन श्रमीकको अद्यावधिक रेकर्ड राखिएको हुनेछ ।							
सुचक ४. व्यवसायिक सुरक्षा र स्वास्थ्य सम्बन्धी प्रचलित असल अभ्यासको आधारमा सुरक्षा र स्वास्थ्यका उपायहरु विकास गरी कार्यान्वयन भएका हुनेछन् ।							
सुचक ५. वनकर्मी कर्मचारी तथा कामदारहरूलाई तोकिएको कार्यहरूको लागि उपयुक्त व्यक्तिगत सुरक्षात्मक उपकरणहरू प्रदान गरिएको हुनेछ र काममा खटिंदा व्यक्तिगत सुरक्षात्मक उपकरणहरूको प्रयोग गरिएको हुनेछ ।							

सुचक ६. कामदारहरूलाई जोखिमपूर्ण कार्यहरू जस्तै चेन सः प्रयोग, आगो निभाउने र रातको समयमा सुरक्षाको लागि उचित बीमा (मेडिकल र जीवन) को व्यवस्था गरिएको हुनेछ ।							
सिद्धान्त २. लैंगिक समानता, सामाजिक समावेशीकरण र साँस्कृतिक मूल्यमान्यता							
मापदण्ड २.१ व्यवस्थापकले वन व्यवस्थापन कृयाकलापबाट प्रभाव पर्ने रैथाने आदिवासी जनजाती र स्थानीय समुदायको पहिचान गरी तीनको वनमा पहुँच, व्यवस्थापन र वातावरणीय सेवाको उपयोगको अधिकार पहिचान र सम्मान गर्नुपर्नेछ ।							
सुचक १. वन व्यवस्थापनका कृयाकलापबाट प्रभाव पर्ने रैथाने आदिवासी जनजाती र स्थानीय समुदायको पहिचान गरिएको हुनेछ ।							
सुचक २. पहिचान गरिएको समुदायको वन स्रोतमा स्वामित्व, पहुँच र उपयोग सम्वन्धी कानूनी र परम्परागत अधिकारको अभिलेख राखिएको हुनेछ ।							
सुचक ३. पहिचान गरिएका अधिकारहरु व्यवस्थापन गतिविधिमा सामेल गर्दा रैथाने आदिवासी जनजाती र स्थानीय समुदायसँगको सहमती र सहकार्य गरिएको हुनेछ ।							
मापदण्ड २.२ वन व्यवस्थापकले वन उपभोक्ता समूह गठन र नविकरण गर्दा लैगिंक तथा सामाजिक समावेशी र सहभागितामूलक प्रक्रियाबाट पारदर्शी तरिकाले अभिलेखिकरण गर्नुपर्नेछ ।							
सुचक १. वन उपभोक्ताहरू सहभागितामूलक प्रक्रियाबाट पहिचान गरिएको हुनेछ ।							
सुचक २. उपभोक्ता भित्र सम्पन्नतामा आधारित समूहहरु र चासो राख्ने वा वनजन्य पेशागत समूहहरू पहिचान गरिएको हुनेछ ।							
सुचक ३. वन उपभोक्ता समूह गठन प्रक्रियामा समुदायको विभिन्न सम्पनतामा आधारित समुहहरु र चासो राख्ने वा वन जन्य पेशागत समूहहरूसँग श्रृंखलावद्ध परामर्श गरिएको हुनेछ ।							

सुचक ४. सामुदायिक वन उपभोक्ता समुहको कार्यसमितिमा समानुपातिक समावेशीको आधारमा प्रतिनिधित्व हुने गरी कम्तिमा ५० प्रतिशत महिला लोकतान्त्रिक प्रक्रियाबाट चयन गरिएको हुनेछ र साझेदारी वन समुहमा हाललाई कम्तीमा ३३ प्रतिशत नघटाई १० वर्षसम्ममा ५० प्रतिशत पुराउने गरी कार्य गरिएको हुनेछ। यसका साथै कम्तिमा अध्यक्ष वा सचिव मध्ये एक र उपाध्यक्ष वा कोषाध्यक्ष मध्ये एक गरी दुई महत्वपूर्ण पदमा महिला चयन गरिएको हुनेछन ।							
सुचक ५. समुहको बिधान उपभोक्ताहरूसँग श्रृंखलावद्ध परामर्शबाट आम सहमतिको आधारमा निर्माण गरिएको हुनेछ ।							
मापदण्ड २.३ व्यवस्थापकले वन क्षेत्रभित्रका विशेष सांस्कृतिक, पर्यावरणीय, आर्थिक, धार्मिक वा आध्यात्मिक महत्त्व भएका स्थानहरू पहिचान र संरक्षण गरी अभिलेख राखिएको हुनुपर्नेछ ।							
सुचक १. वन क्षेत्रभित्रका सांस्कृतिक, पर्यावरणीय, आर्थिक, धार्मिक वा आध्यात्मिक महत्वका विशेष स्थानहरू पहिचान गरिएको हुनेछ ।							
सुचक २. बिशेष र महत्वपूर्ण स्थानहरूको संरक्षण गर्ने उपायहरूमा सहमत भै अभिलेखिकरण गरी कार्यान्वयन भएको हुनेछ ।							
मापदण्ड २.४ व्यवस्थापकले स्थानीय र परम्परागत ज्ञान र प्रथाजनिक अभ्यासलाई पहिचान, सम्मान, अभिलेखिकरण र सहमतिमा प्रयोग गर्नुपर्नेछ ।							
सुचक १. वनसँग सम्बन्धित परम्परागत ज्ञान र प्रथाजनिक अभ्यासहरू पहिचान भई अभिलेखिकरण गरिएको हुनेछ ।							
सुचक २. परम्परागत ज्ञान र प्रथाजनिक अभ्यासहरू सम्वन्धित समुदायहरूको सहकार्यमा प्रयोग भई अभिलेखिकरण गरिएको हुनेछ ।							
मापदण्ड २.५ व्यवस्थापकले वन व्यवस्थापन सम्बन्धी योजना तयारी र निर्णय प्रक्रियामा रैथाने आदिबासी जनजाती, स्थानिय समुदाय, महिला, दलित र वनमा आश्रित विपन्न लगायतका सरोकारवालाको समावेशी र अर्थपूर्ण सहभागितालाई सुनिश्चित गर्नुपर्नेछ ।							

सुचक १. सामुदायिक र साझेदारी वनश्रोत मापन र योजना निर्माणका विधिहरू सरल भाषामा विकास भएका हुनेछन ।							
सुचक २. वनश्रोत सर्वेक्षण सम्बन्धमा आवश्यकता अनुसार उपभोक्ताहरू अभिमुखीकरण भई श्रोत सर्वेक्षण प्रक्रियामा संलग्न हुनेछन ।							
सुचक ३. स्थानीय उपभोक्ताहरूको सहभागितामा वनबाट उत्पादन हुने वस्तु र सेवाको मागको अहिलेको अवस्था र भविष्यको परिदृश्य (छोटो, मध्यम र दीर्घकालीन) आकंलन गरिएको हुनेछ।							
सुचक ४. सामुदायिक र साझेदारी वन व्यवस्थापन योजनाको मस्यौदा तयार गर्दा वन उपभोक्ताहरूलाई वन सम्बर्धन र व्यवस्थापन सिफारिसहरू -के, किन, कहिले, कसले, कसरी गर्ने भन्ने_ सम्बन्धमा अभिमुखीकरण गरिएको हुनेछ।							
सुचक ५. सामुदायिक र साझेदारी वन व्यवस्थापन योजना सरल भाषामा लेखीएको र सहमतिको आधारमा पारित गरिएको हुनेछ।							
सुचक ६. वन व्यवस्थापन योजनाको सारांश सरोकारवालाले सजिलैसँग बुझ्न सक्ने गरी तयार भई सार्वजनिक रुपमा उपलब्ध हुनेछ।							
सुचक ७. वन व्यवस्थापनको दिगोपनाको मूल्यांकन गर्न सरल प्रकृया र संयन्त्र निर्माण गरी लागु भएको हुनेछ।							
मापदण्ड २.६ वन व्यवस्थापक वन व्यवस्थापन योजना कार्यान्वयनमा उत्तरदायित्व, पारदर्शिता र दक्षताका लागि जवाफदेही हुनुपर्नेछ ।							
सुचक १. वन व्यवस्थापन योजना कार्यान्वयन गर्नु कम्तिमा छ महिना अघिदेखी समुहलाई प्राविधिक र संस्थागत रुपमा सुदृढ बनाउन क्षमता विकास कृयाकलाप लागु गरिएको हुनेछ।							
सुचक २. व्यवस्थापन कृयाकलापहरूको अभिलेख राखी उपयुक्त बिधीबाट त्रैमासिक रूपमा जानकारी गराइएको हुनेछ ।							

सुचक ३. सामुदायिक र साझेदारी वन समुहमा कोषको प्रयोग साधारण सभाबाट स्वीकृत वार्षिक बजेट र योजनाको आधारमा परिचालन गरिएको हुनेछ।							
सुचक ४. वित्तीय अभिलेखहरू न्यूनतम लेखा परीक्षणको आवश्यकता अनुसार पारदर्शी रूपमा राखियको हुनेछ। सामुदायिक र साझेदारी वन समुहमा सकभर नगद कारोवारलाई शुन्य वनाउन रकम प्राप्ती गर्ने र भुक्तानी दिने कार्य बैंक मार्फत गरिएको हुनेछ। वार्षिक कारोवारको मान्यता प्राप्त लेखापरिक्षकबाट लेखापरीक्षण गरिएको हुनेछ।							
सुचक ५. सामुदायिक र साझेदारी वन समुहहरुमा सार्वजनिक लेखापरीक्षण र व्यवस्थापन लेखापरीक्षण समयमै सम्पन्न गरी समुहको साधारण सभाले अनुमोदित गरेको हुनेछ।							
सुचक ६. सामुदायिक र साझेदारी समूहको वार्षिक वित्तीय अवस्था उपभोक्ता र वन कार्यालयमा कम्तिमा एक पटक तोकिएको ढाँचामा पेश गरिएको हुनेछ।							
सिद्धान्त ३. उत्पादन, उत्पादकत्व वृद्धि र आर्थिक समृद्धि							
मापदण्ड ३.१:प्रचलित कानुनको अधिनमा रही वन श्रोत सर्वेक्षण र विश्लेषण गरी वनबाट उत्पादन हुने वस्तु र सेवाको अल्पकालीन, मध्यकालीन र दीर्घकालीन माग तथा वनको उत्पादन क्षमताको आधारमा वन व्यवस्थापनको दुरदृष्टि, लक्ष्य तथा उद्देश्य तय गर्नुपर्नेछ ।							
सुचक १. वन स्रोत सर्भेक्षण गर्दा समग्र वनको स्थिति प्रतिनिधित्व हुने गरी वन मापनको उपयुक्त प्रविधि अपनाई वनको अवस्था, प्रजाति, पुनरोत्पादन, भु-धरातलीय स्वरुप र वनबाट प्राप्त हुन सक्ने पैदावार र पारिस्थितिकीय सेवाहरुको आँकलन -सर्वे_ तथा विश्लेषण गरिएको हुनेछ ।							
सुचक २. परम्परागत रुपमा प्रयोग हुँदै आएका र उपलब्ध आधुनिक प्रविधि र उपकरण वन मापनका लागि प्रयोग गरिएको हुनेछ ।							

सुचक ३. वनको अवस्था र वनबाट उत्पादन हुने वस्तु र सेवाको आधारमा वन व्यवस्थापनको दुरदृष्टि, लक्ष्य र उद्देश्य निर्धारण गरिएको हुनेछ ।							
मापदण्ड ३.२ वन व्यवस्थापकले व्यवस्थापनको दुरदृष्टि, लक्ष्य तथा उद्देश्यहरूसँग मेल खाने गरि वनको अवस्था, प्रजाति, पुनरोत्पादन र भु-धरातलीय स्वरुप अनुसार वन सम्बर्धन र ब्यवस्थापन को सिद्धान्त साथै स्थानीय परम्परागत ज्ञान तथा अभ्यासको आधारमा वन व्यवस्थापन योजना तयार पारी कार्यान्वयन गर्नुपर्नेछ ।							
सुचक १. वन व्यवस्थापनको उद्देश्य र वनको अवस्था, प्रजाति, पुनरोत्पादन र भु-धरातलीय स्वरुप अनुसार वन सम्बर्धन र ब्यवस्थापनको सिद्धान्त साथै स्थानीय परम्परागत ज्ञान तथा अभ्यासको आधारमा वन व्यवस्थापन योजना तयार गरिएको हुनेछ ।							
सुचक २. वनको अवस्था, प्रजाति, पुनरोत्पादन र भु-धरातलिय स्वरुप अनुसार वन सम्बर्धन को सिद्धान्तको आधारमा उपयुक्त वन संबर्धन प्रणाली (Silvicultural System) अपनाईएको हुनेछ ।							
सुचक ३. वन पैदावारको दीगो उत्पादनका लागि वन श्रोत सर्वेक्षणको नतिजा तथा वन व्यवस्थापनको लागि प्रस्तावित वन सम्वर्धन प्रणाली अनुरुप् वार्षिक उत्पादन हुन सक्ने परिमाण लाई नै वार्षिक स्वीकार्य कटान परिमाण निश्चित गरिएको हुनेछ ।							
सुचक ४. वन श्रोत सर्वेक्षणको नतिजा विश्लेषणको आधारमा गैह्रकाष्ठ वन पैदावरको वार्षिक रूपमा संकलन गर्ने परिमाण निर्धारण गरी व्यवसायिक रूपमा गैर-काष्ठ वन पैदावर संकलन गरिएको हुनेछ ।							
सुचक ५. वन व्यवस्थापन योजनाको अबधि कम्तिमा दश बर्षको हुनेछ ।							
सुचक ६. वन व्यवस्थापन योजना समयमै र प्रभावकारी ढंगले कार्यान्वयन गरिएको हुनेछ।							

सुचक ७. वन पैदावार भण्डारण/घाटगद्धी सबैको पहुँच हुने, बाटोको सुविधा भएको र सुरक्षित स्थानमा गरिएको हुनेछ ।							
सुचक ८. वन पैदावर संकलन गर्दा वन क्षेत्रमा बाँकी रहने रूख तथा अन्य वातावरणीय अवस्थाको क्षति नहुने व्यवस्था मिलाईएको हुनेछ ।							
मापदण्ड ३.३ वन व्यवस्थापनका कृयाकलापहरू निर्धारण गर्दा विभिन्न प्रजाति तथा उमेर समुहको वन कायम हुने गरी प्राकृतिक वा कृतिम विधिबाट पुनरोत्पादनको सुनिश्चितता गर्नुपर्नेछ ।							
सुचक १. वन व्यवस्थापन गरी वन पैदावर संकलन गरिएका क्षेत्रहरू समयमै पुनरोत्पादन भएको हुनेछ ।							
सुचक २. बृक्षरोपण वा प्राकृतिक विधिबाट पुनरोत्पादनका लागि छनौट गरिएका प्रजातिहरू ईकोलोजिकल रूपमा वन क्षेत्रमा राम्रोसँग अनुकुलित भएका स्थानीय प्रजातिहरू हुनेछन् ।							
सुचक ३. पुनरोत्पादनको लागि छनौट गरिएको प्रजातिहरू व्यवस्थापन उद्देश्यसँग मिल्दोजुल्दो हुनेछन् ।							
सुचक ४. वन व्यवस्थापनबाट प्राकृतिक वनको वास्तविक प्रकार र परम्परा देखिको (Principle Species) प्रजातीमा (Forest type and species composition) परिवर्तन भएको हुनेछैन। तर व्यवस्थापनको उद्धेश्य अनुसार र वन समुहहरुको सहमतिमा वनमा प्रजातीको अनुपात फरक हुन सक्छ ।							
सुचक ५. उपभोक्ता समुहद्वारा व्यवस्थापन गरिएको वन क्षेत्रमा वृक्षारोपण गरिएको वनलाई उपभोक्ता समुहको सहमति भएमा मिश्रीत प्रजातीको वनमा विकास गरियको हुनेछ ।							
सुचक ६. वनको भूउपयोगमा परिवर्तन भएको हुनेछैन ।							

सुचक ७. आगन्तुक प्रजातिहरू (Exotic species) वैज्ञानिक अनुसन्धानको नतीजाले नकरात्मक प्रभावहरू नियन्त्रण गर्न सकिन्छ भनेर संघीय, प्रादेशिक र स्थानीय स्तरमा अधिकार प्राप्त अधिकारीहरूको सिफारिसको आधारमा मात्र प्रयोगमा ल्याईएको हुनेछ ।							
सुचक ८. विविध प्रजाति, आकार, उमेर समुह, क्षेत्र र पुनरोत्पादन चक्रको उपयुक्त परिदृश्य (mosaic) भूपरिधि स्तरमा मिलाएर व्यवस्थापन गरिएको हुनेछ ।							
मापदण्ड ३.४: वन्जन्य उत्पादन पारदर्शी ढङ्गले ब्यबस्थापन र बिक्री बितरण गर्नु पर्नेछ .							
सुचक १. वन पैदावारको बिक्रि वितरण तथा ओसारपसारको व्यवस्था कानुनद्वारा व्यवस्थित गरिए अनुरुप हुनेछ ।							
सुचक २. वन पैदावार मापन गर्दा नाप साइज, ग्रेड, थान र जात प्रस्ट हुने गरी नम्बरिङ्ग गरिएको हुनेछ ।							
सुचक ३. व्यवस्थापकले स्रोत माथि सबैको समान पहुँच हुने गरी निजी उद्यमी, सरकारी कम्पनी, सामूहिक कम्पनी र अन्य वन पैदावार कारोबार गर्ने उद्योगमा प्रतिस्पर्धाको आधारमा सम्भब भएसम्म e-bidding मार्फत पारदर्शी रुपमा बिक्री वितरण गरेको हुनेछ ।							
सुचक ४. समुहले आफ्ना उपभोक्ताको माग पुरा भएपछि मात्र बाहिर बिक्रि गरेका हुनेछन ।							
सुचक ५. सल्ला लगाएत अन्य तोकिएका नरम प्रजाती हरुको वनको हकमा वन पैदावारको बजार र मुल्य सुनिस्चितताको लागि वन समुहहरुले प्रतिस्प्रधाबाट बढीमा पाँच बर्षको लागी वन पैदावारको पूर्ण प्रोसोधन गरी वजारिकरण गर्ने कम्पनीसँग कार्ययोजनामा उल्लेखित वन सम्वर्धनका कार्य गरी वन पैदावर							

सकलन गरी लैजाने समेतको सम्झौता गर्नेछन । यो प्रकृयामा एक भन्दा बढी समुहहरु सम्लग्न हुन सक्नेछन ।							
सुचक ६. वन व्यवस्थापन, बिकास, वन पैदावार संकलन, कटानि, ढुवानी आदि क्रियाकलाप संचालन गर्दा स्थानीय मानव स्रोतको अधिकतम सदुपायोग गरिएको हुनेछ ।							
सुचक ७. वन व्यवस्थापन, बिकास, वन पैदावार संकलन, कटानि, ढुवानी आदि क्रियाकलापहरुको ब्यबस्तित र परदर्शी रुपमा अभिलेख राखियको हुनेछ ।							
सुचक ८. सामुदायिक र साझेदारी वनमा वन पैदावार बितरणमा गरीब, असहाय, एकल महिला, दलितहरुलाई प्राथमिकता र सहुलियत दिइएको हुनेछ। साथै वनमा आधारित परम्परागत व्यावसायिक अभ्यासहरूको जगेर्ना गरिएको हुनेछ ।							
सुचक ९. वन पैदावारको उत्पादन देखि बजारीकरण सम्मका सवै क्रियाकलापहरु समय सिमायुक्त कार्यतालिकामा आधारित भएर संचालित भएको हुनेछ । बिक्री वितरण, रकम दाखिला गर्ने देखि निकासी इजाजत गर्ने कार्यको समय तोकिएको हुनेछ ।							
सुचक १० वन ब्यवस्थापकले वन ब्यवस्थापनका लागि गरेका सवै श्रमजन्य क्रियाकलापहरु र वन क्षेत्रवाट उत्पादन भएका सवै किसिमको वन पैदावारको मौदिक मुल्य निर्धारण गरि अभिलेख राखेको हुनेछ।							
मापदण्ड ३.५: व्यवस्थापकले आफ्नो दायरा, उद्देश्य र क्षमता अनुरुप दीर्घकालीन वन व्यवस्थापनका लागि आवश्यक पर्ने लागत अनुमान र श्रोत सुनिस्चिता व्यवस्थापन योजनामा उल्लेख गर्नुपर्दछ ।							

सुचक १. वन व्यवस्थापन योजनामा व्यवस्थापनका कृयाकलापहरू र वनबाट उत्पादन भएका बस्तु तथा सेवाको आर्थिक लाभ तथा लागत विशलेषण गरी लागत अनुमान समावेश गरी र खर्चको स्रोत सुनिश्चित गरिएको हुनेछ।							
सुचक २. सरकारको तर्फबाट दिगो वन व्यवस्थापनका लागि व्यवस्थापकलाई कार्यक्रम सन्चालन गर्न आर्थिक सहयोग, क्षमता विकास र बजार व्यवस्था गरिएको हुनेछ ।							
सुचक ३. वन व्यवस्थापनकालागि आवश्यक लागतका लागि सरकार, अन्तराष्ट्रिय वित्त र निजी क्षेत्रको लगानी समेत पारदर्शी रुपमा परिचालन गरिएको हुनेछ ।							
सुचक ४. वनश्रोतलाई आय र रोजगारीको प्रमुख क्षेत्रको रुपमा विकास गर्न आवश्यक पर्ने दीर्घकालिन लगानी सार्वजनिक निजी साझेदारीका माध्यमले वा वैक तथा विमा कम्पनीहरु समेतको साझेदारी र लगानीवाट जुटाईएको हुनेछ ।							
सुचक ५. वनबाट उत्पादन भएका सम्पूर्ण बस्तु तथा सेवाको मूल्याँकन गरी राष्ट्रिय आयमा गणना गर्ने व्यवस्था गरिएको हुनेछ ।							
मापदण्ड ३.६: वन उद्यमशीलता विकासमा स्वदेशी लगानी र सीप प्रवर्धन गर्नेगरी स्थानीय क्षमता विकास र सार्वजनिक निजी सहकारी तथा सामुदायिक साझेदारीता विकासगरी आवश्यकता अनुरुप बाह्य प्रविधिको समेत उपयोग गर्नु पर्नेछ ।							
सुचक १. आर्थिक र वनश्रोतको दिगो उपलब्धताको आधारमा वनमा आधारित उद्यमहरुको पहिचान तथा संचालन गरिएको हुनेछ ।							
सुचक २. समूह वा समूह सदस्यले प्रचलित नेपाल कानुन बमोजिम संचालन गर्ने लघु उद्यमका लागि निश्चित मुल्य र परिणाम निर्धारण गरी वन पैदावार उपलब्ध भएको हुनेछ ।							
सुचक ३. वन ब्यवस्थापन योजनामा आधारित भएर वनश्रोतको उपयोग र बजारीकरणका लागि ब्यवसायिक योजना (Business plan) निर्माण गरी							

सार्वजनिक-निजी-सहकारी तथा सामुदायिक साझेदारीमा संचालन गर्ने गरी ब्यवस्थापन करार गरिएको हुनेछ ।							
सुचक ४. उद्यम सन्चालनको लागि स्थानीय बस्तु, प्रविधि, श्रमिक र लगानी लाई प्राथामिकता दिई क्षमता विकास गरिएको हुनेछ। आवश्यकता अनुसार बाह्य बस्तु, प्रविधि, श्रमिक र लगानीको अबसर दिइएको हुनेछ ।							
सुचक ५. ब्यवसायिक योजना कार्यन्वयनका लागि आवश्यकता अनुसार वित्त क्षेत्रसँग सहकार्य गरिएको हुनेछ ।							
सुचक ६. वन ब्यवस्थापकले वनश्रोत तथा वन पैदावारको यथासम्भव विमा गरेका हुनेछन ।							
मापदण्ड ३.७: व्यवस्थापकले स्थानीय तह र उपभोक्तहरुको संलग्नतामा समुदायको सामाजिक र लक्षित वर्गको आर्थिक विकासमा योगदान पुऱ्याउने कार्यक्रमहरु तयार गरी कार्यान्वयन गर्नु पर्नेछ।							
सुचक १. स्थानीय समुदाय र अन्य सम्बन्धित सरोकारवालाहरुलाई स्थानीय सामाजिक र आर्थिक विकासको अवसर प्रदान गरिएको हुनेछ ।							
सुचक २. समुदायको अतिविपन्न वर्गका उत्थानका लागि स्थानीय सरकारसँग सहकार्य गरिएको हुनेछ। सामाजिक र आर्थिक लाभमा योगदान पुर्‍याउने गतिविधिहरू पहिचान गरी कार्यान्वयन भएका हुनेछन् ।							
सिद्धान्त ४. वातावरणीय सुरक्षा							
मापदण्ड ४.१ व्यवस्थापकले वन क्षेत्रका दुर्लभ र जोखिमपूर्ण प्रजाति र उनीहरूको बासस्थानको संरक्षण गर्ने कृयाकलापहरूको विकास गर्नु पर्नेछ।							
सुचक १. व्यवस्थापन क्षेत्रभित्र वा आसपासमा रहेका वा संभावित दुर्लभ र लोपोन्मुख प्रजातिहरू तथा तिनका बासस्थानहरू, CITES प्रजातिहरू (जहाँ लागू हुन्छ) र							

राष्ट्रिय, प्रादेशिक तथा स्थानीयस्तरका दुर्लभ र लोपोन्मुख प्रजातिहरूको सूचीमा रहेका प्रजातिहरू पहिचान गरिएको हुनेछ।							
सुचक २. व्यवस्थापनका संभावित कृयाकलापहरूबाट दुर्लभ र लोपोन्मुख प्रजातिहरू तथा तिनको वासस्थान संरक्षणमा पर्नसक्ने संभावित प्रभावहरूको पहिचान गरी नकारात्मक प्रभावहरूबाट संरक्षण गर्न उपयुक्त व्यवस्थापनका कृयाकलापहरू निर्धारण गरिएको हुनेछ ।							
सुचक ३. दुर्लभ र लोपोन्मुख प्रजातिहरू र तिनको बासस्थानको संरक्षण गर्न, संरक्षण क्षेत्रको व्यवस्था, जैविक मार्गका साथै प्रत्यक्ष रूपमा प्रजाति पुर्नस्थापना कार्यक्रमहरू समेत लागु भएको हुनेछ।							
मापदण्ड ४.२ वन व्यवस्थापकले प्राकृतिक जल वहाव क्षेत्र, जलभरण क्षेत्र, ओशिलो क्षेत्र तथा तिनीहरू विचको सामञ्जस्यता संरक्षण वा पुर्नस्थापन गर्ने कार्यहरु गर्नुपर्दछ।							
सुचक १. प्राकृतिक जल वहाव क्षेत्र, जल पुनरभरण क्षेत्र, ओसिलो क्षेत्र र पानीको मात्रा र पानीको गुणस्तर लगायत कनेक्टिभिटीलाई जोगाउन र पुनर्स्थापना गर्न संरक्षणका उपायहरू लागू गरिएको हुनेछ।							
मापदण्ड ४.३. व्यवस्थापकले वन व्यवस्थापनको क्रममा काठ र गैर-काष्ठ वन पैदावरहरूको संकलन र निकासी गर्दा वनको वातावरणीय मूल्यहरू (values) **को संरक्षण हुने गरी गर्नुपर्दछ** ।							
सुचक १. काठ र गैर-काष्ठ वन पैदावरहरूको संकलन र निकासीका कृयाकलाप सञ्चालन गर्दा वातावरणीय सेवाहरुको संरक्षण गर्ने गरी कार्यान्वयन गरिएको हुनेछ ।							
मापदण्ड ४.४ वन व्यवस्थापकले व्यवस्थापन योजना तय गर्दा कार्यान्वयनका जोखिमहरू (जस्तै आगलागी, चरिचरण, कीट तथा रोग, वन अतिक्रमन्, वन पैदावार को अवैध संकलन र ब्यापार), र संरक्षणका उपायहरू पहिचान गरी लागु गर्नु पर्नेछ ।							

सुचक १. वन डढेलो, जलवायुजन्य विपद, रोग किरा, चरिचरण लगायतका अवैध गतिविधीबाट हुने सक्ने जोखिम, विपद र सिमान्तकृत क्षेत्रको पहिचान र नक्सांकन गरिएको हुनेछ ।							
सुचक २. उत्तम उपलब्ध विधिहरूको प्रयोग गरी जोखिम कम गर्न अपनाइने व्यवस्थापनका क्रियाकलापहरू तय भई समयमै लागु गरिएको हुनेछ ।							
सुचक ३. रासायनिक कीटनाशक प्रयोगहरूको घटाउन वा हटाउन, परम्परागत रुपमा प्रयोग हुदै आएको ज्ञान शिप मूल्य-मान्यतालाई प्राथमिकता दिदै एकीकृत कीट व्यवस्थापन विधीको प्रयोग गरिएको हुनेछ ।							
सुचक ४. वन डढेलो, जलवायुजन्य विपद, रोग किरा, चरिचरण लगायतका गतिविधीबाट भएका नकरात्मक असर र क्षेतीको अभिलेख रखियको हुनेछ ।							
सुचक ५. वन डढेलो, जलवायुजन्य विपद, रोग किरा, चरिचरण लगायतका गतिविधीबाट भएका नकरात्मक असर र क्षेतीको ब्यबस्थापन र क्षतिग्रस्त वनको पुनरुत्थान योजना तयार भई लागु भएको हुनेछ ।							
सिद्धान्त ५. अनुगमन, मूल्यांकन, अनुसन्धान र ज्ञान व्यवस्थापन							
मापदण्ड ५.१ वन व्यवस्थापकले व्यवस्थापन योजनाको कार्यान्वयनबाट सामाजिक र वातावरणीय प्रभावहरू, र व्यवस्थापन गतिविधिहरूको प्रगति तथा उपलब्धि को अनुगमन तथा मूल्यांकन गर्न संयुक्त संयन्त्र स्थापना गरी लागू गर्नुपर्दछ।							
सुचक १. व्यवस्थापन योजनाको कार्यान्वयन अनुगमनका लागि अनुगमन तथा मूल्यांकन गर्न संयुक्त संयन्त्र स्थापना गरिएको हुनेछ ।							
सुचक २. वन व्यवस्थापन योजना कार्यान्वयनका सम्भावित र भोगीएका सकारात्मक र नकरात्मक प्रभावहरू (आन्तरिक र बाह्य) मूल्यांकन एउटा सरल प्रक्रिया र खाकाको निर्माण गरिएको हुनेछ ।							

सुचक ३. वन व्यवस्थापन योजना कार्यान्वयन हुनु अघि सम्भावित सकारात्मक र नकरात्मक प्रभावहरू (आन्तरिक र बाह्य) संयुक्त संयन्त्रद्वारा मूल्यांकन गरिएको हुनेछ र नकारात्मक प्रभावहरूलाई कम गर्ने कृयाकलापहरु तय भई लागू गरिएको हुनेछ।							
सुचक ४. व्यवस्थापनका गतिविधिहरुमा नकारात्मक सामाजिक र वातावरणीय प्रभावहरुलाई न्यूनीकरण गर्न सम्बन्धित लागत व्यवस्थापन योजनामा अनुमान गरिएको हुनेछ र सो को श्रोत समेत सुरक्षित गरिएको हुनेछ ।							
सुचक ५. व्यवस्थापन गतिविधिहरूको कार्यान्वयनबाट परेको सामाजिक र वातावरणीय प्रभावहरूको योजना अवधिको मध्य र अन्तिममा संयुक्त संयन्त्रद्वारा अनुगमन गरिएको हुनेछ ।							
सुचक ६. वन तथा वातावरण मंत्रालयले उपयुक्त संयन्त्र मार्फत यस मापदण्डमा उल्लेखित सुचकहरुका आधारमा वन समुह (वन व्यवस्थापक) हरुको बर्गीकरण र उत्पादनको प्रमाणिकरण गरि सो को पहिचान चिन्ह उपलब्ध गराएको हुनेछ। ब्यवस्थापकले सो उत्पादन बजारमा पठाउदा सो पहिचान चिन्हको उपयोग गर्नेछन ।							
सुचक ७. अनुगमन मूल्यांकनको परिणामहरू अवलम्बन गर्दै व्यवस्थापन योजना परिमार्जन गरिएको हुनेछ ।							
सुचक ८. मूल्यांकनको परिणामहरूको सारांश सार्वजनिक रूपमा निशुल्क उपलब्ध गराइन्छ।							
मापदण्ड ५.२ वन व्यवस्थापकले सरकारी अनुसन्धान केन्द्रको सहयोगमा राष्ट्रिय वा स्थानीय आवश्यकताको आधारमा अनुसन्धान प्लटको निर्माण, अनुगमन र दस्ताबेजीकारण गरी प्राप्त नतिजाहरू प्रसार गर्दछ। यस्ता कार्यमा विश्वबिद्यालय एव गैर सरकारी संस्थासग सहकार्य र सहयोग प्राप्त गर्न सकिनेछ ।							

सुचक १. स्थानीय देखी राष्ट्रिय स्तरमा वन सम्बन्धी अनुसन्धान गर्ने सम्भाव्य अनुसन्धान संस्थाहरू (सरकारी र गैरसरकारी) सँग मिलेर अनुसन्धान तथा मूल्यांकन गरिएको हुनेछ ।							
सुचक २. कार्यगत अनुसन्धान गर्ने संस्था (संघीय वा प्रादेशिक) को नेतृत्वमा व्यवस्थापकद्वारा डिजाइन, कार्यान्वयन र अनुगमन गरिएको हुनेछ ।							
सुचक ३. अनुसन्धानका निष्कर्षहरू अनुसन्धान संस्थानहरू (संघीय वा प्रादेशिक) र व्यवस्थापकद्वारा उपयुक्त माध्यमबाट लिपिबद्ध गरी प्रशारित गरिएको हुनेछ ।							
सुचक ४. अनुसन्धानमा भएका निष्कर्षहरूको आधारमा आवश्यकता अनुरूप व्यवस्थापन योजना संशोधन गरिएको हुनेछ ।							

Annex 3: Sample Action Plan

A. Forest Management Activities

SN	Activities	Time and Date	Blocks no	Quantity	Cost Management			External Agencies
					CFUG	Users (Labor contribution)	External (GOs/NGOs)	
1	Plantation:	May -July	As per OP	2 hectares	Snacks support	1 person /household for 2 days	Seedling Support	DFO/Local Government
2	Forest Cleaning	September-December	As per OP	2 hectares	Snacks support	1 person /household for 3 days	Technical assistance support	DFO
3	Thinning	September-December	As per OP	1 hectare	Snacks support	1 person /household for 2 days	Technical assistance support	DFO
4	Prunning	September-December	As per OP	1 hectare	Snacks support	1 person /household for 2 days	Technical assistance support	DFO
5	Forest fire line cleaning and maintenance	February-April	As per OP	2 km	Snacks support	1 person /household 3 days	Technical assistance support	DFO
6	Forest demo plot establishment	August-December	As per OP	1 hectare	Snacks support	1 person /household for week	Technical assistance support	DFO
7	Forest Harvesting	August-April	As per OP	4 hectares	Snacks support	1 person /household for week	Technical assistance support	DFO

B. Social development Activities

SN	Activities	Time	Units	Quantity	Cost Management			External Agencies
					CFUG	Users (Labor contribution)	External (GOs/NGOs)	
1	Community road/trail construction	Within Fiscal Year	Km	1	Snacks	Labor contributions		Local government

2	Irrigation cannel/ Drinking water improvement/ construction	Within Fiscal Year	Km	1	Snacks	Labor contributions			Irrigation office
3	Support in education/school	Within Fiscal Year	No	2	Snacks	Labor contributions			Local government
4	Support in Health post	Within Fiscal Year	No	1	Snacks	Labor contributions			Local government
5	Community house and electronification	Within Fiscal Year	No	1	Snacks	Labor contributions			

C. Income generation Activities

SN	Activities	Time	Units	Quantity	No of Beneficiaries	Total Cost	Cost Management			External Agencies
							CFUG	Users	External (GOs/NGOs)	
1	Multipurpose fruits plantation	May-July	No HH	All			Cash Support		Seedlings	DFO/ Local government
2	NTFP seed distributions	May-July	No HH	20			Cash Support		Seedlings	DFO/Agriculture office
3	Livestock support	August-December	No HH	15			Cash Support		Goats	Livestock office/ Local government
4	Vegetable tunnel support	August-December	No HH	8			Cash Support		Seedlings	Agriculture office/ Local government

D. Institutional/Capacity development Activities

SN	Activities (Training, workshops, exposure visits)	Time	Units	Quantity	No of Beneficiaries	Total Cost	Cost Management			Remarks
							CFUGs	Users	External (GOs/NGOs)	
1	Women leadership Training	August-December	No	2	40	25000	Snacks		Resource person support	Local government

2	Business plan development training	August-December	No	1	20	50000	Snacks		Resource person support	Local government
3	Legal literacy class of Act, Regulation and OP for Users in tole level	August-December	No	4	80	40000	Snacks		Resource person support	DFO
4	Record keeping Training	August-December	No	2	20	20000	Snacks		Resource person support	DFO
5	Exposure Visit	August-December	No	1	50	1,00,000	Logistics supports	Per person contribution		DFO/ Local government

List of contributors

Session	Title	Key content	Contributor
Module 1		Overview of Silviculture and Forest Management	
1.1	Growing stock, increment and implication	Growing stock, Increment, Methods to estimate and Relations between GS, I and Prescriptions	Shambhu Dangal
1.2	Forest Rotations	Definition, Types and Applications	Shambhu Dangal
1.3	Yield Regulation	Definition, Types, Methods	Dipak Gyawali
1.4	Concept and Application of Silviculture System	Definition- silviculture system and operation, Types and Applications	Shambhu Dangal
1.5	Silviculture operations	Tending and Silviculture operation, Types, Methods	Shambhu Dangal & Susmita Satyal
Module 2		Forest Management Planning	
2.1	Process for Developing Forest Management Plan	Fundamental requirement/three pillars, list of information required, inclusive consultation process and methods	Hari Acharya
2.2	Analysis of Forest Product and Service Demand	Estimation methods, Trend analysis and Vision mapping- goods and service requirement	Shambhu Dangal
2.3	Rapid Forest Assessment	Meaning, Need, Methods and Mapping	Shambhu Dangal
2.4	Boundary and Block Survey and Mapping	Different methods, use of GPS, Method to use and mapping	Madan Bashyal
2.5	Forest Assessment, Analysis, and Interpretation	Methods, plot allocation on map, plot identification, plot establishment and measurement, analysis, and interpretation	Hari Acharya
2.6	Legal and Policy Provision on Forest Management	Key policies, policy instruments and provisions	Srijana and Sarada Tiwari
2.7	Forest Management Prescriptions	Definition, Components, and management prescriptions for different types of forests with objectives	Shambhu Dangal
2.8	Assessment of Forest Management Sustainability	Define sustainability, principle, criteria and indicators, applications of SFM standards	Shambhu Dangal
Module 3		Forest Management Plan Implementation	
3.1	Development of Annual Action Plan	Need, key areas and skeleton	Kapil Dahal

3.2	Introduction of Equipment for Harvesting and Logging Operation	Listing improved tools, their uses, methods of use/tree felling, efficiency, and cost	Edwin
3.3	Safety Measures	Different aspects of safety/safeguards, safe operation and how to minimize negative impact	Madan Bashyal
Module 4		Post Harvesting Management	
4.1	Forest Fire Management	Fire- causes, details of preventive, suppressive and curative measures	Pawan Karki & Pradeep Budhathoky
4.2	Grazing Management	Advantage and disadvantage, methods of managing forest grazing	Pawan Karki & Pradeep Budhathoky
4.3	Regeneration Protection and Management	Advance growth, management of advance growth and regeneration to establishment	Shambhu Dangal
Module 5		Forest Governance	
5.1	Inclusive Management Planning Process	Meaning of inclusive, Steps and methods of consultations and development of ownership	Mani Ram Banjade & Sarada Tiwari
5.2	Documentation and Communication	Meaning of Good Governance, Component, Criteria and Indicators, methods of ensuring GG practice	Naya Sharma Poudel
5.3	Planning for Post-Harvest Management	Meaning, listing activities, plan development, resource mapping and forecast	Edwin

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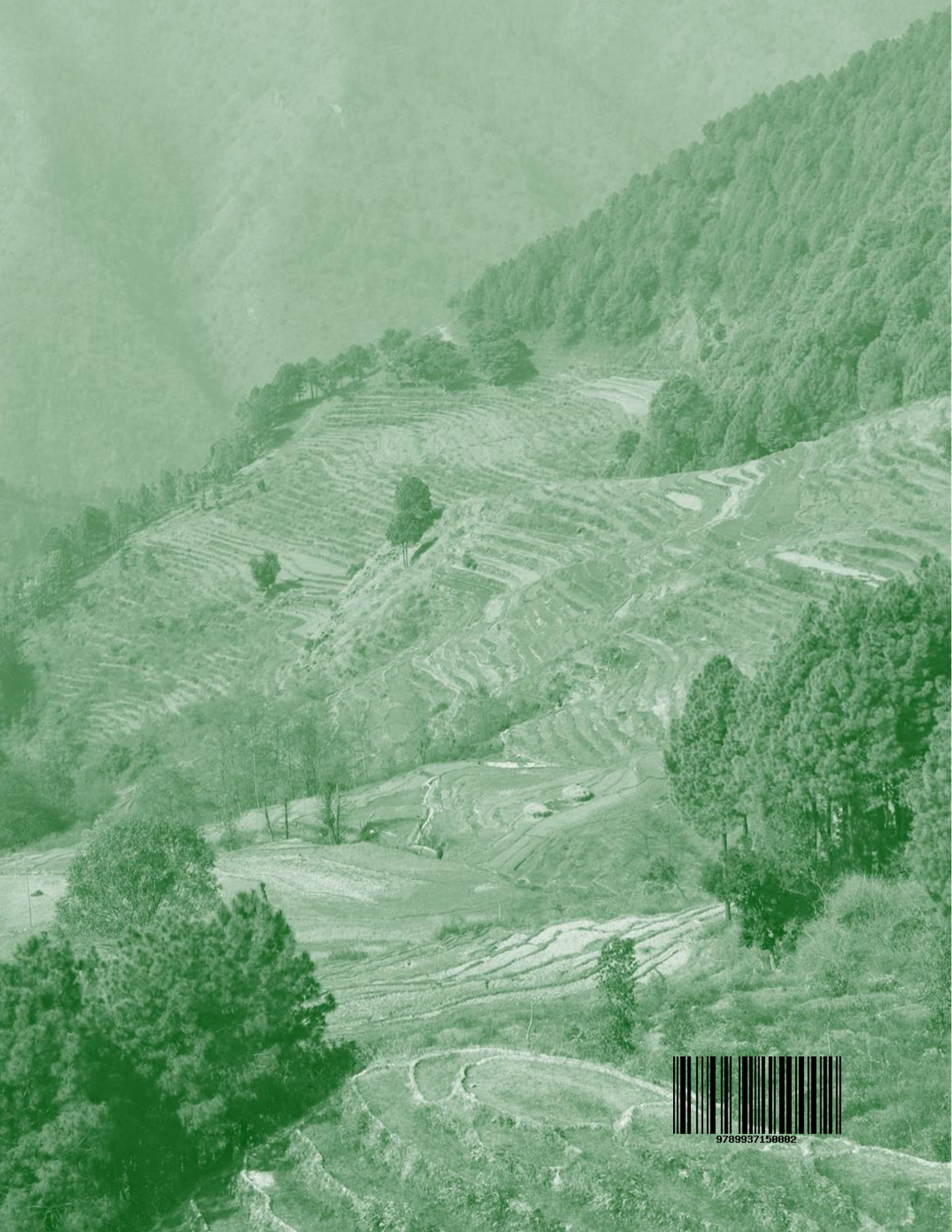
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