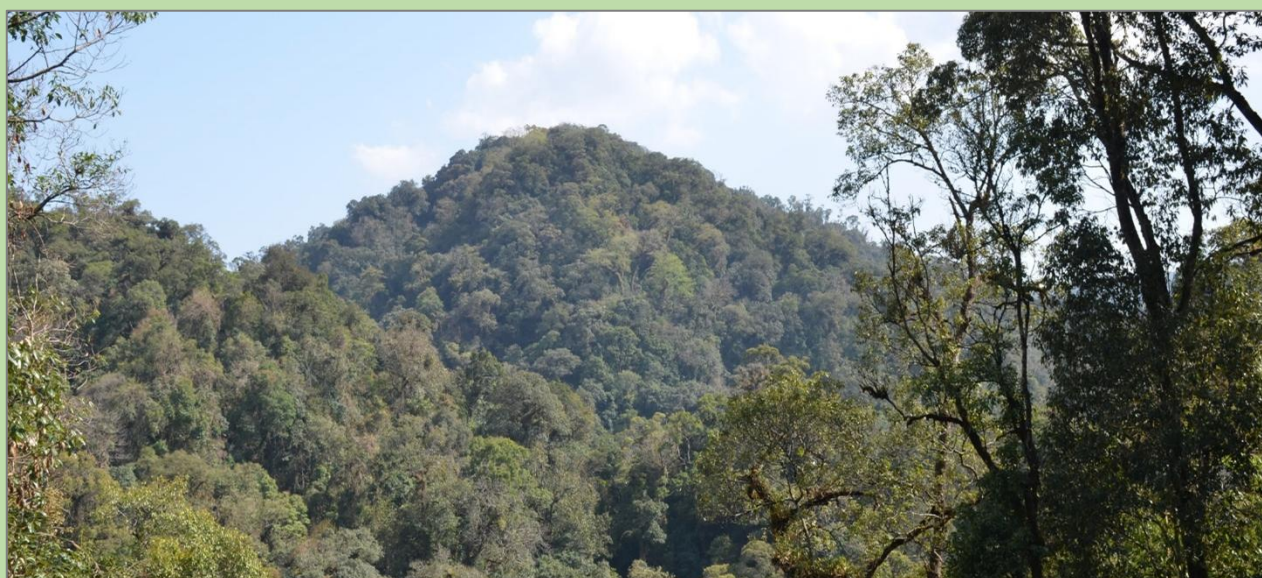




COMMUNITY BASED SUSTAINABLE FOREST MANAGEMENT FOR WATER RESOURCE CONSERVATION

TECHNICAL GUIDELINE

Forestry Measures



Project Result 2: Restoration and sustainable management of upper watersheds

Target group: (DPMU, NGOs, CSOs)

Version: August 2022

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Address: Manipur Forest Department Sanjenthong, Imphal - 795 001 Manipur

Phone: 03852 450 165

Fax: 03852 452 504

Email: pccf-mn@nic.in

Abbreviations

CBOs	Community-based Organisations
CDLOs	Community Development Livelihood Officers
COSFOM	Community-based Sustainable Forest Management for Water Resources Conservation in Manipur
CPF	Community Planning Framework
DFO	District Forest Office
DPMU	District Project Management Unit
EPA	Entry Point Activity
ESCAP	Environmental & Social Codes of Practice
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
FMP	Forest Management Plan
FPIC	Free Prior Informed Consent
GFA	GFA Consulting Group, Germany
GRM	Grievance Redress Mechanism
KfW	Kreditanstalt für Wiederaufbau (German development bank)
LIP	Livelihood Improvement Plan
MFD	Manipur Forest Department
MoU	Memorandum of Understanding
NGO	Non-government Organisation
PLUP	Participatory Land Use Planning
PMU	Project Management Unit
PRA	Participatory Rural Appraisal
VA	Village Authority
VMP	Village Micro Plan
WRCC	Water Resource Conservation Committee
WRCG	Water Resource Conservation Group

1 Background

Manipur is rich in flora and fauna, with a recorded forest area (RFA) of 17,41,800 ha. (78.01% of total State area). With the increasing population and the resultant human interference in the forest, the forest is shrinking both in size and stocking. There are however ample opportunities to improve, revitalize and restore the forest area with various technical interventions. Presently, only remote, inaccessible and high-altitude forests remains dense and moderately dense forests. In contrast, accessible forest areas nearby villages are mostly degraded, poorly stocked, and losing the forest land area. It has resulted in firewood, timber, poles, and other forest products such as fodder being scarce and added the high risks of soil erosion, landslides, and flood.

Still, there is ample opportunity to improve and restore the existing forests with the people's high commitment and effective participation in forest management. There are several forestry practices (technically Silvicultural prescriptions) to apply to regenerate and improve the stocking. Overall, people's participation and commitments are crucial and must be followed along with silvicultural prescriptions. Generally, people are aware of afforestation/plantation activities to restock the forests, but seed collection, nursery raising, transport and plantation can be expensive. This guidelines will cover cost-effective forestry practices to regenerate the forest stocking.

2 Management Objectives of Forestry Interventions

The overall objectives of the guidelines are

1. To understand COSFOM forestry measures with various interventions including mixed afforestation, ANR and forest closer both in forests and riparian zones;
2. To apply silvicultural prescriptions in a cost-effective manner;
3. To contribute to decision making in the forest management options.

Specific objectives of the forestry interventions are as follows.

Objectives of Mixed Afforestation

1. To afforest with mixed indigenous species in forest/ community land with bare and/or shrubby areas to enhance forest productivity to meet the timber and firewood demands;
2. To increase vegetative cover of watershed areas for soil and water conservation and springshed recharge;
3. To improve and restore the habitat of the biodiversity

Objectives of Aided Natural Regeneration

1. To restore the degraded forest area by adopting low cost restoration strategies based on natural regeneration for conserving biodiversity and enhancing ecosystem services, improving pollinator diversity, which affect the productivity of the crops along with Carbon sequestration and watershed protection;
2. To restore and rejuvenate forests with aided technical interventions;
3. To rejuvenate the forest naturally with aided natural regeneration

Objectives of the forest closure

1. To identify the forest areas that can naturally regenerate with the effective forest closure and protection to restock and rejuvenate;
2. To assess the closure period to rejuvenate the forest of desired species for woody mass production and biodiversity conservation

The user-friendly guidelines is targeted to use by village leaders, WRCC Chairperson and officials, WRCG members, key informants, forestry staff, NGOs and facilitators.

3 Application of Forestry Measures

The main forestry measures of COSFOM are as follows.

- a. Mixed afforestation – forest and riparian (F-AF, R-AF1)
- b. Forest Area Closure – forest and riparian (F-FC, R-AR)
- c. ANR – forest and riparian (F-ANR, R-ANR)

These forestry measures have to be applied to improve, restore and rejuvenate the village forests enhancing the forest productivity and biodiversity conservation. Figure 1 decision making tree provides the options for the forestry measures.

Vegetation Cover	Density	Forestry Measures
Shrub/vegetation with scattered main species	Heavy/dense vegetation with some natural regeneration of major species	Forest closure for regeneration
	Sparse/random	Forest closure and ANR application
Natural Regeneration of main species	Random/ scatter	ANR allowing to establish the regeneration
	Profuse regeneration of main species	ANR with spacing of promising seedlings
Undergrowth with big trees	Scattered regeneration	Forest closure and ANR with enrichment plantation
	Profuse/dense regeneration	Forest closure and canopy opening

Figure 1 Decision Making Tree for Forestry Measures

Forest zonation by altitude, species composition, project forestry measures and interventions are described¹.

3.1 Forest Zonation

Based on the forests, human interference for various uses, accessibility and most approachable forests, watershed areas are divided into three altitudinal zonation.

1. Higher altitude zone,
2. Mid-altitude zone, and
3. Low land zone

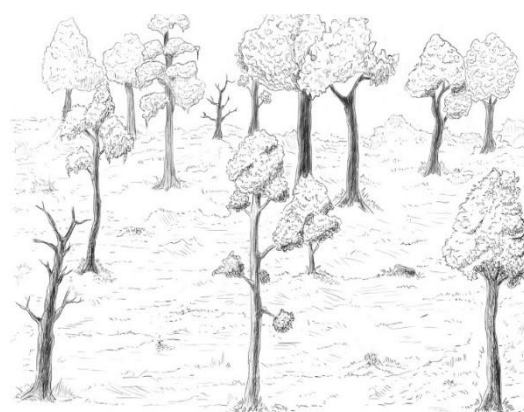


Figure 2 Degraded Forest

Table 1 Terrain Zonation for Village Forest Management

¹ Mission Report: Forest, Riparian Buffer and Biodiversity, COSFOM August 2019

Elevations	High (1800m - >3000m)	Middle (1300m - 1800m)	Low land (< 1300m)
Main species	Quercus serrata (Uyung), Castanopsis indica (Thangji), Schima walichii (Usoi), Phoebe hainesisana (Uningthou), and others	Alnus nepalensis (Pareng), Schima walichii (Usoi), Michelia champaca (Leihao), Morus leueigata (Bela), Phoebe hainesisana (Uningthou), Albizzia lucida (Wangkhoi), A. lebbeck (Uil), A. procera (Khak)...	Gmelina arborea (Wang), Alnus nepalensis (Pareng), and others
Forest condition	Moderately dense, few patches of primary forest exists, moderate regeneration	High density in community protected areas, others moderately dense, and open. Mostly poor regeneration except for few mother trees with good regeneration in the community protected areas	Forest and forest land minimum/negligible Community land River flood plain Private tree wood lots
Regeneration	Moderate	Good near mother trees sparsely regeneration	Not applicable
Present management and traditions	Low human interference	Human interference extensively high for firewood (excepting community protected areas), timber, stones, hunting and other NTFPs	Forest area is negligible
Jhuming intensity	Low, only in small patches	High and extended in large areas	Common in some areas
Forest utilization	timber, firewood, other forest products (large size trees are available and harvesting carried in some areas)	Timber, firewood, other NTFP	Community tree use Social group tree use Private tree use
Watershed condition	Patches with vegetation cover, bamboo, banana. Headwater of the watershed needs more protection with land use improvements; Spring sources common	Erosion prone, low vegetation, open areas and degraded (except for patched with community protection) Over water use	Some mixed tree cover in private land

Elevations	High (1800m - >3000m)	Middle (1300m - 1800m)	Low land (< 1300m)
Biodiversity	Some mithun, bear, deer, jackal, wild boar and others Hunting is prevailing	Some mithun, bear, deer, jackal, wild boar and others Hunting is prevailing,	Wild animals negligible
Forest disturbances	Seasonal fire, timber/firewood collection, land slides	Jhum cultivation, charcoal production, seasonal fire, firewood collection, land slides	Heavy stone mining, flood, river bank erosion
COSFOM Interventions	Forest closure F-FC Riparian buffer conservation R-AR	Mixed species plantation Aided natural regeneration Riparian buffer plantation R-AR1 Jhum conservation J-CB	Bare forest land/community land plantation (consent from community) Riparian buffer plantation R-AR1

3.2 High Altitude Forest Area

These forests are headwaters of the watershed areas. There are very few patches of primary forests and urgently require protection and management. The settlement is almost negligible with some hamlets in lower areas. Forest exploitation is mainly for timber and some of the logging is in operation in areas like Ukhrul district, South Changoubung and Konshakhul villages and neighborhoods. Community protected forests in Konshakhul village are extensively used for Mithun rearing in semi-wild conditions.

Main species: *Quercus serrata*, *Castanopsis indica*, *Terminalia chebula* (Manahi), *Terminalia myriocarpa* (Tolahau), *Alnus nepalensis* (Pareng), *Schima wallichii*, *Phoebe hainesiana* (Uningthou).

Forest conditions: Moderately dense forests with patches of regeneration Open forest with scattered trees are in some patched

Forest Management Purposes

1. The headwater of the watershed area protection, conservation and restoration
2. Production of medium size poles and large size timber
3. Suitable areas for NTFP production

Forest Management and Silvicultural Treatments

1. Complete forest area closure for two monsoon seasons.
2. Forest fire control with fire-lines construction at strategic areas specially to restrict the spread of fires from Jhum areas.
3. Selection felling with improvements in year 3 and 5
4. Dead, dying, crooked trees, moribund trees, singling of coppicing trees removal from year 3 onwards.

COSFOM Interventions

1. Natural Forest: Forest area closure F-FC

2. Aided Natural Regeneration F-ANR
3. Riparian buffer conservation area closure R-A

3.3 Mid-altitude Forest Area

This zone covers moderately dense forest - open and bare forest land. This zone is heavily exploited for firewood, timber, jhum, charcoal production, stone mining and other NTFP collections. Most of the forests are secondary forests. Some patches of the forests are covered by traditional protection with the provision of wardens. The forests are easily accessible by the households, and they collect forest products regularly. As a result, the forest is degraded and over exploited.

The forests are continuous and/or fragmented by various forest areas. There are settlements nearby the fragmented forest patches especially in the Nepali community area (Lungphou and Maohing villages) otherwise the settlements of Kukis and Nagas are not confined to particular forests.

Main species: *Albizzia procera* (Khal), *Albizzia lebbeck* (Uil), *Albizzia stipulate* (Khok), *Ficus rumphii* (Heibong), *Ficus hispida* (Asiheibong), *Castanopsis hystrix* (Thangji), *Terminalia chebula* (Manahi), *Terminalia myriocarpa* (Tolhao), *Alnus nepalensis* (Pareng), *Schima wallichii* (Usoi), *Cinnamomum zeylanica* (Dalchini), *Zanthoxylum almatum* (Mukthrubu).

Forest conditions: Moderately dense, open forest with scattered trees

Mostly secondary forests with degraded nature

Scrub forests and bare open forest land

Forest Management Purpose:

1. Production of medium size poles and large size timber
2. Firewood production
3. Riparian buffer improvements
4. Suitable areas for NTFP including charcoal production

Forest Management and Silvicultural Treatments:

1. Forest management with coppice with standards
2. Improvement felling – dead, dying, crooked and moribund trees, bifurcation trees removal
3. Singling
4. Pruning for canopy opening for regeneration
5. Mixed plantation

COSFOM Interventions:

1. Mixed species plantation F-AF
2. Aided natural regeneration F-ANR
3. Jhum conservation buffer J-CB
4. Natural Forest: Forest area closure F-FC
5. Riparian buffer plantation R-AF1

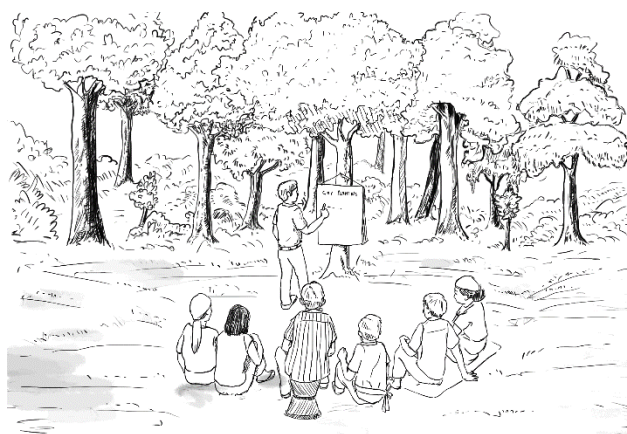


Figure 3: Participatory WRCG Meeting

6. Riparian buffer conservation area closure R-AR
7. Bare forest land/community land plantation

3.4 Low Land Area

This zone is mostly covered by agricultural land, community land, and river flood plains. Rivers are highly eroded with the potential to flood during the rainy season. River cuttings are a common phenomenon especially after rains and vast area of arable land is susceptible to quick flood. Some riverbanks are privately planted for river bank protection. There are also small patches of woodlots and bamboo groves privately owned. Terrace farming is practiced in some areas but not common.

Households in the low land area are mostly secondary users of the forest where they do not directly involved in the protection and management of the forest but use/purchase the forest products for household use. They are extensive water users for farm irrigations, water supply and others. High and mid-altitude zones forest are the lifeline to them for farming and water use. The primary users in the first zones are utmost important to the low land households.

Community fallow land and riparian buffers as flood plain areas are available for the forest plantation. In addition to vegetative cover, torrent control measures by close to nature technical intervention should be applied. The private plantations are also common in this zone.

Plantation Purpose

1. Production of medium size poles and large size timber
2. Firewood production
3. Riparian buffer improvements

COSFOM Interventions

1. Mixed species plantation F-AF
2. Riparian buffer plantation R-AF1
3. Bare forest land/community land plantation
4. Close to nature – torrent control measures

4 Forest Area Location

With the understanding of the forest structure and regeneration status, the WRCG should identify and priorities the forest area for technical interventions desired by the group members.

All members of the group should participate and thoroughly discuss the purpose and responsibilities that have to be followed. The approved PLUP provides the forest areas in terms of vegetation covers and land use. The plan is prepared with people's participation and identifies the area of forestry interventions. The group should visit the forest for real time assessment.

Forest Location

Selection of the forest area should be prioritized with urgent needs for restocking. It should be discussed among the forest users and a common decision should be made. All household members should agree and understand the forestry measures that will be applied in the said area.

Regeneration Status

Forest structure and regeneration status of the forest is important to assess. While visiting the forest, regeneration status should be estimated by observation and should be duly recorded.

Table 2 Assessing the Regeneration

No	Regeneration Status	Density
1	Shrub/vegetation density	Heavy/dense Sparse/random Barren/open
2	Natural Regeneration	None Random/ scatter Profuse regeneration of species-.....
3	Coppicing	Some coppicing stumps Highly degraded coppice
4	Undergrowth with tall trees	Scattered regeneration Profuse/dense regeneration

5 Understanding Forestry Measures

COSFOM forestry measures contributes to forest restoration and rejuvenation of village forests with different interventions. Appropriate silvicultural treatments have to be prescribed and adopted to understand by WRCG members to implement the forest management plan.

5.1 Mixed Afforestation

The list is provided as check list only (Table 3) , however, the plantations will not be mixed with more than two to five species depending upon the WRCG decisions. Exercising with the WRCG, species ratio will also be decided providing higher number of species to priority species (70: 30 or 80: 20 i.e. main species: mixed species). There will not be mono-culture plantation in COSFOM. WRCG should jointly select the species based on multi-dimensional criteria especially economic, social and ecological aspects. This will be exercised during the forest management plan preparation.

Table 3 Example of Mixed Plantation

1. Species	2. Species	3. Species	Altitude
<i>Gmelina arborea</i>	<i>Terminalia spp.</i>	<i>Alnus nepalensis</i>	Middle, Lowland
<i>Agar (Acquillaria spp.)</i>	<i>Chukrasia tabularis</i>	<i>Castaonopsis spp.</i>	Middle, Lowland
<i>Bischoffia spp.</i>	<i>Schima wallichii</i>	<i>Alnus nepalensis</i>	High, Middle, Lowland
<i>Cinnamomum spp.</i>	<i>Bauhinia vareigata /racemosa</i>	<i>Albizzia spp.</i>	Middle, Lowland

Fast growing with short rotation is preferred for early returns to beneficiaries. It will be further exercise with the WRCG members and particularly with research institutes in the region.

Criteria for mixed plantation

1. Bare forest land to cover by tree planting to increase canopy coverage
2. Open forest with scattered few old growths where natural regeneration is not possible
3. Restore and rejuvenate the wildlife habitat with mixed plantation in open forests
4. Increase canopy coverage of stream/rivulets where the banks are barren to improve water quality and riverbank protection

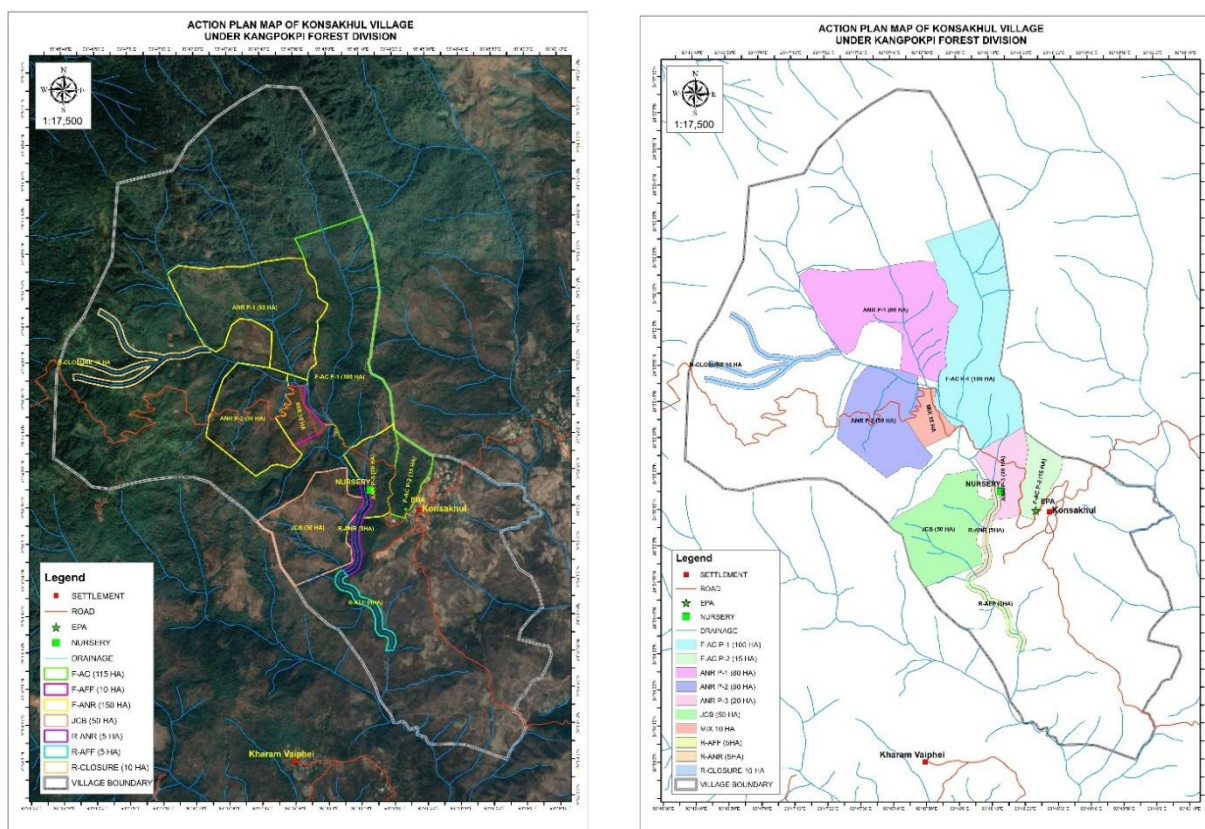


Figure 4 Forestry Measures in Konshakhul based on PLUP

Activities to follow with the COSFOM Cost Norms² provision are as follows.

Mixed Afforestation in the Forest

Pre-operation

- **Site Clearance:** Site clearance, removal of rank vegetation, brushwood, removal of stumps wherever necessary by retaining advance growth of density of rank vegetation above 50% @ 12 person-day per ha
- **Stake Collection:** Collection of stakes @ 320 in numbers per person-day
- **Collection and Burning:** Collection of cut materials and controlled burning @ 7 Person-days/ha
- **Pit Layout:** Laying out of planting pits and staking at prescribed spacing @ 300 pits per person-day
- **Pit Layout:** Digging of planting pits (the dugout soil to be heaped near the pit, uphill side) for pits of size 30 cm x 30 cm x 30 cm @ one person-day per 60 pits
- **Pit Refilling:** Refilling of planting pits with the dugout soil, after proper weathering and breaking of clods for pits of size 30 cm x 30 cm x 30 cm @ one person-day/180 pits

² COSFOM Cost Norms 2019

- Farmyard Manure: Provision for farmyard manure @ 550 kg/ha

Post Monsoon Operation

- Planting: Planting out of polythene raised seedlings by removing the polybag and without disturbing the root system @ 50 seedlings per person-day including fertilizer application
- First Weeding: First weeding operation to a width of 0.50 m radius all around the plant including hoeing @ 125 plants per person-day
- Casualty Replacement: Beating up of casualties with polythene raised seedlings with 20% of seedlings
- a. Transportation of polythene raised seedlings from field nursery to planting pits @ 200 poly seedlings per person-day
- b. Planting out of polybag seedlings to the planting pits @ 65 seedlings per person-day
- Second Weeding: Second weeding operation to a width of 0.50 m all around the plant including hoeing @250 seedling per person-day
- Mulching: Mulching operation with dry leaves to a thickness of 15 cm and to a radius of 0.4 m around the plant including collection of mulch @ 90 plants /person-day
- Chiloing: i.e. cutting of grass in whole plantation area @ 10 person-day/ha (Chiloing i.e. cutting of grass in whole plantation area at the start of dry season)
- Fencing: Fencing at vulnerable points(@ 84 Running m/ha @ 6 Running m per person-days)

Second Year Maintenance

- First Weeding: First weeding operation to a width of 0.50 m radius all around the plant including hoeing @ 125 plants per person-day
- 2nd and 3rd Weeding: 2nd and 3rd weeding operation to a width of 0.50 m all around the plant including hoeing @250 seedling per person-day
- Mulching: Mulching operation upto 20% with dry leaves to a thickness of 15 cm and to a radius of 0.40 m around the plant including collection of mulch @ 90 plants/person-day
- Chiloing: Chiloing i.e. cutting of grass in whole plantation area @ 10 person-day/ha

Third Year Maintenance

- One round of weeding operation to a radius of 0.50 m all around the plant including hoeing @ 125 seedling per person-day
- Chiloing: Chiloing i.e. cutting of grass in whole plantation area @ 10 person-day/ha

The number of seedlings is 1100 and 1333 per ha. for forest - mixed afforestation and riparian - mixed afforestation respectively. All the activities are same both for forest and riparian, however, there are following variations for riparian - mixed afforestation.

Preliminary Operation

- Site clearance, removal of rank vegetation, brushwood, removal of stumps wherever necessary by retaining advance growth of density of rank vegetation 25% to 50% @ 10 person-day per ha

Post Monsoon Operation

- Second Weeding: Second and third weeding operation to a width of 0.50 m all around the plant including hoeing @250 seedling per person-day

Third Year Maintenance

- First Weeding: One round of weeding operation to a radius of 0.50 m all around the plant including hoeing @ 250 seedling per person-day

For details, refer to COSFOM Cost Norms 2019.

5.2 Forest Area Closure

Large areas of village forests are degraded and overexploited due to products collections such as firewood, poles, timber, fodder, wild fruits and tubers, leaves of various plants for vegetables etc, grazing and others. Many of the forests are continuously exploiting for such products to fulfil the local demands and marketing. Sometimes, due to overuse of resources there is high rate of biotic pressures, which is posing threat to the natural vegetation and especially plants of economic importance and firewood species as well. Moreover, long continued overgrazing by livestock



Figure 5 Dense Forests

resulted the compaction of forest soil and eventually converted the forest to open scrub of unpalatable species of grasses. Even though degraded to some extent, majority of such forests can flourish with regeneration and coppicing enhancing the canopy coverage. Forest closure is very important for forest regrowth and cost effective to manage.

Thus, the status of forests found degraded and open to active erosion which need immediate efforts for managing such areas. To adopt forest closure to such areas for a limited period and suggest some alternative area for the use of villagers may be a good effort to restore the native vegetation of the area.

It will be followed both in the forest area and riparian zone.

Criteria for Forest Closer:

1. Assess the forest regarding the natural regeneration of main species and its status.
A regeneration survey will contribute to monitor the forest growth over time.
2. Priorities the forest area with heavy degradation in the neighborhood of the settlements to rejuvenate and restocking.
3. Always allow alternate forest area for forest products collection for domestic use.
4. Organise WRCG level meetings following FPIC for common consensus on forest closers.

5. Forest for biodiversity conservation, watershed protection for soil and water conservation and springshed areas.

Steps to implement forest closure

1. Forest area depends upon the assessment of the forest and Village Forest Management Plan
2. Closing will be primarily for intense regeneration for limited period
3. Repeated collection of firewood and illicit felling practices influencing the regeneration of tree species and reducing the biodiversity of the area that to be close for a fixed period.
4. Control and rotational grazing practices to be adopted in some alternative site for the period of closer.
5. If any species of invading extensively in the area, its management to be taken care (*Lantana camera*, *Eupatorium spp.* or any other if found on the ground). Site clearance, removal of weeds, brushwood etc., and collection of such cut materials into small heaps either disposal of cut materials or controlled burning to be made whenever available to retain all regeneration (> 5 cm diameter).
6. Regarding the Soil and Moisture Content (SMC) work, staggered trench can propose. SMC measures will help in improving the soil moisture conservation in the area, which assist in regenerating.

Improvement of palatable grasses – seed balls of some palatable grasses can be broadcasted along the water channels and other areas if the area found under highly degraded state. This will help to establish those palatable grasses in the closure area Having forest closure in different areas of the village, there should be alternate forest area for the villagers to collect forest products and grazing. There should be in-depth discussion among the WRCG members following FPIC.

Activities to follow with the COSFOM Cost Norms provision.

- Watcher: Engagement of watcher (warden) along with duties of tree demarcation and management of competitors at 30 ha per watcher for 12 months (360 person-days) (F-AC)
- Watcher: Engagement of watch warden along with duties of carry out tree demarcation and management of competitors @ 20 ha per watchman for 12 months (30X12 = 360 person-days) (R-AC)
- Watchers continue to 6th year with reduced days (refer to COSFOM Cost Norms 2019)
- Install sign boards at strategic forest entry points with the forest closer notice and closer period. It is suggested to keep both in script and graphics.



Figure 6 Fire influencing the Natural Habitat



Figure 7 Infestation of Lantana camera in Natural Forests



Figure 8 Uncontrolled firewood collection

5.3 Aided Natural Regeneration

Compared to afforestation/plantation, Aided Natural Regeneration (ANR) is cost-effective and technically applied to restock the forest. COSFOM intends to apply ANR for forest improvements in a broader scale with other forest management objectives to produce firewood, poles and timber. Many forest areas/patches in the neighbourhood of the village settlements are degraded and devoid of big trees; vegetation cover ranges from sparse ground cover to shrubby areas with few favourable tree species saplings. Most forests are devoid of seed-bearing trees for regeneration and are degraded due to heavy lopping, firewood collections, grazing, forest fires



Figure 9 Forest Area for ANR

and others. In many cases, mature trees have already been removed. There may be tree species with coppicing capacity, but coppices are lopped for fodder, cut for firewood and others uses. ANR is a technique through which deforested or degraded forestland could be transform to good woody forest through improving the natural regeneration with lowest investment.

The work plan should remain flexible, and the treatments are adjusted according to how the vegetation responds to interventions. A variety of technical methods are used in applying ANR, and the following basic steps can be modified according to site conditions, restoration objectives, and resource availability.

Applied for larger areas Assisted Natural Regeneration (ANR) is suggested to be more effective, comparatively easy to adopt and less expensive with reduced labour cost. Management of the secondary forests, if restored or rehabilitated properly they have ample potential to generate significant environmental and livelihood benefits for the local users' communities. This will provide environmental functions to make valuable contributions to biodiversity conservation as well while comparing to commercial plantations.

In the village forest, forest conditions are degraded mostly triggered by human influence and forest fire. Table 4 highlights the forest structures, regeneration status and interventions requirements.

Table 4 ANR Options

No.	Forest Structure	Regeneration Status	Intervention Opportunity
1	Non-vegetation forest land	Bare land, grazing area	Afforestation
2	Shrubby land with some favourable tree saplings, no mature trees Mature trees are removed, poor cover Heavily harvested	Heavily degraded, low regeneration, tree saplings are heavily lopped and damaged	Afforestation
3	Shrubby area with some overwood or scarce canopy cover, some regeneration and taller	Degraded forest but seed bearing trees with canopy cover, regeneration of various ages exists	Seeding Natural regeneration Afforestation

	saplings Heavily harvested		
4	Shrubby area with some canopy covered overwood, some coppicing under growths	Degraded forest but some tall trees with canopy cover exists, coppicing stumps exist, and degraded, natural seedlings exist	Coppicing Singling Canopy opening Seedling spacing Afforestation
5	High forest with regrowth and natural seedling	Heavily covered with tall tree canopies, regeneration devoid of light and space	Canopy opening Seedling spacing (Harvesting)



Figure 10 Tending and Ground Clearing

Technical applications for forest restocking are not as challenging as compared to people's commitment to forest management and protection. The concerned people of the villages must be aware of the Aided Natural Regeneration application to protect and follow the prescriptions to improve the forest. Hence the WRCGs must follow management prescriptions and forest protection measures.

Side by side with the forest management, people management in relation to forest protection should be followed. All the technical interventions in the forest should be discussed with WRCG members, transparently, answering

to why, what and when. All the members must know and understand what is going on in the forest so that forest management results can be achieved on time with the enhancement of forest productivity. Having tangible benefits, the users should also be informed of the intangible benefits such as prevention in soil erosion, landslides, flood prevention, water source increase, biodiversity development, carbon sequestration and others.

Steps of ANR Techniques to be implemented in identified site:

- Cultural operations:
 - Identification of coppices of various existing tree species, their number and quality to be identified.
 - Stumps/Coppice dressing to be adopted for promoting the regeneration and better growth in the existing forest.
 - Thinning and tending of existing saplings, woody species in the area
 - Climber cutting, to provide open area to the regenerating saplings in the area.
- SMC Works: Staggered trenches to be made for improving the soil moisture conservation in the area.
- Deep Peripheral Trench do be dug on the boundary of identified forest patch
- Bund Stabilization: Planting of some bushes on trench mounds to stabilize the bunds and species would be of the choice of community which can provide some benefits (medicinal plants, lemon grass, *Aloe vera* or *Colocasia* spp. (Taro) etc. of local importance)

- Creation of fire lines: Inside the plot fire lines to be created for managing the forest fire by removing weed and other bushes from that patch.
- Removal of invasive weeds: Unwanted invasive species to be identified and removed from the area, to provide ideal habitat to the new regenerating tree species.
- Gap planting: If density of existing woody species found low and are not of the choice, few fruit bearing and economically important tree species can be planted in the area with specific number.

Activities to follow Forest ANR (F-ANR) with the COSFOM Cost Norms provision.

Pre-operation

- Site Clearance: Site clearance, removal of rank vegetation, brushwood, removal of stumps wherever necessary by retaining advance growth of density of rank vegetation above 50% @ 20 person-day per ha
- Stake Collection: Collection of stakes @ 320 in numbers per person-day
- Collection and Burning: Collection of cut materials and controlled burning @ 7 Person-days/ha
- Pit Layout: Laying out of planting pits and staking at prescribed spacing @ 300 pits per person-day
- Pit Layout: Digging of planting pits(the dugout soil to be heaped near the pit (uphill side) for pits of size 30 cm x 30 cm x 30 cm @ one person-day per 60 pits
- Pit Refilling: Refilling of planting pits with the dugout soil, after proper weathering and breaking of clods for pits of size 30 cm x 30 cm x 30 cm @ one person-day/180 pits
- Farmyard Manure: Provision for farmyard manure @ 100 kg/ha

Post Monsoon Operation

- Planting: Planting out of polythene raised seedlings by removing the polybag and without disturbing the root system @ 50 seedlings per person-day including fertilizer application
- First Weeding: First weeding operation to a width of 0.50 m radius all around the plant including hoeing @ 125 plants per person-day
- Casualty Replacement: Beating up of casualties with polythene raised seedlings with 20% of seedlings
 - a. Transportation of polythene raised seedling from field nursery to planting pits @ 200 poly seedlings per person-day
 - b. Planting out of polybag seedlings to the planting pits @ 65 seedlings per person-day
- Second Weeding: Second weeding operation to a width of 0.50 m all around the plant including hoeing @ 250 seedling per person-day
- Mulching: Mulching operation with dry leaves to a thickness of 15 cm and to a radius of 0.4 m around the plant including collection of mulch @ 90 plants /person-day
- Chiloing: Chiloing i.e. cutting of grass in whole plantation area @ 10 person-day/ha (Chiloing i.e. cutting of grass in whole plantation area at the start of dry season)
- Fencing: Fencing at vulnerable points (@ 84 Running m/ha @ 6 Running m per person-days)

Second Year Maintenance

- First Weeding: First weeding operation to a width of 0.50 m radius all around the plant including hoeing @ 125 plants per person-day
- 2nd and 3rd Weeding: 2nd and 3rd weeding operation to a width of 0.50 m all around the plant including hoeing @ 250 seedling per person-day
- Mulching: Mulching operation with dry leaves to a thickness of 15 cm and to a radius of 0.40 m around the plant including collection of mulch @ 90 plants/person-day
- Chiloing: Chiloing i.e. cutting of grass in whole plantation area @ 10 person-day/ha

For Riparian ANR, the number of seedlings is 600 per ha. The Cost Norms activities are same as above (for Forest ANR) with the difference as follows for Riparian ANR.

Preliminary Operation

- Farmyard Manure: Provision for farmyard manure @ 125 kg/ha

Riparian plantation should be ideally designed reflecting detail land use (30 m both side of the stream with 1000 m length = 6 ha.) with choice of species. This area should be identified as net land for plantation.

For details, refer to COSFOM Cost Norms 2019.

Regeneration Survey

After finalisation of the forest location, a regeneration survey should be conducted with the help of Forest Department staff. It should record the number of seedlings, different sizes such as small, medium, and tall per unit ha. This will provide an improvement scope over time, and also reflect if there is improved forest stocking. It should be conducted every year over three to five years while applying the ANR. It should record the following.



1. Number of regeneration seedlings
2. Regeneration of selected species height class (less than 0.50 cm)
3. Saplings height between 0.50 cm and 1 m.

Follow the exact sizes over time to compare the improvements of forest stocking. Survey methodology is not described here in detail as forestry staff should support in conducting the survey.

Figure 11: Regeneration Survey

6 Regeneration Methods

6.1 Natural Regeneration

The main species composition of the forest in the project area are Oak, *Castanopsis* spp., *Alnus* spp. (Parang), *Schima* spp., and *Parkia*. Most of the Oak and *Castanopsis* forests are in higher

altitudes and others are in the lower area, especially near the settlement and accessible to people. *Alnus*, *Schima* and other tree species are heavily degraded due to the collection of firewood, fodder, timber and others. The natural forests are generally uneven aged with negligible mature trees and low regeneration, especially in lower altitude. Depending on the forest condition, forest areas can rejuvenate if proper treatments are applied. The forests will invigorate in a given period with appropriate treatment and adequate protection.

Natural regeneration aims to improve the quality of the forest stocking through natural seeding and regeneration. Prioritizing the species, the natural regeneration area should be identified and proper treatments should be applied. Where the natural regeneration is negligible and not possible, the area should be afforested with the same composition of the species. This will be applied in patches of open forest where natural regeneration is not possible.

The purpose of forest restocking is to manage the forest for the production of timber, firewood, and fodder of the desired species within a short rotation.

Seedling/saplings selection

After assessing the regeneration, depending upon the seedling density, spacing between the saplings should be 1 m if the saplings are less than 0.5 m in height. Weeds should be cleaned at a radius of 0.5 m from the centre of the sapling. With the increase of the height of the saplings, the distance between the saplings should be 2 m, apart from the same weed cleaning area. As growth of the saplings increases, the distance between the saplings should increase over time.

Other unnecessary seedlings/saplings should be removed from the area. They should be uprooted without any taproot damage if the seedlings are intended be planted in other sites.



Figure 12: Weed clearance

Natural Seeding

If there are vigorous and healthy mother trees, and seeds are scattered well on the ground, such seeds should be allowed to grow with proper care. The mother trees should be protected and the tree health should be assessed. Remove the dead branches, and for insects and for reducing fungal attacks suitable treatments should be applied. After selecting such trees, this should be reported to Rangers and Forest Guards for timely technical support. The ground should be cleared to some extent for seed germination; however, proper care must be taken to protect the area from landslides and erosion if the terrain is steep.

While weeding unwanted species, a ground cover should not be less than 30%, but preferably more than 70%.

With the seedling growth over time, seedling/saplings spacing should be followed as above "Seedling/Sapling Selection".

Heavy unwanted weed growth in the area prevents the favourable conditions for regeneration such as low soil exposer for germination, overgrowth of weeds covering the seedlings and low sun light on the ground.

Tending around the seedlings should be applied to allow the germination and invigorate the seedlings/saplings to enhance their growth.

- Unwanted weeds should be removed between 30% to 70% depending upon the terrain and treatment required. Bush clearance should be properly assessed.
- The soil should not be exposed unless there is germination of selected species favoured.

Canopy opening is one of the important operations to allow sunlight on the ground. Medium/big tree branches and /or canopies some time over shadow the ground not allowing the sunlight to the ground. Good saplings/seedlings may be under big tree branches that do not allow sunlight and block saplings' growth.



Figure 13 Canopy opening

- Looking up at the canopy, one must visually assess the existing canopy cover and assess the opening intensity.
- Removing such branches or even sometimes removing big trees (old, unwanted and larger trees) to open the canopy is appropriate. So, the assessment should be conducted properly. Removing such trees will provide some timber, firewood and other forest products to community members.

6.2 Coppicing

There are some priority species in the project area that coppice well. Presently most of the coppicers are degraded and heavily lopped and cut. Main coppicing species are *Schima* spp., *Quercus* spp., *Pareng* and others. Simple coppice are produced from old tree stumps.

The purpose of simple coppicing is to produce poles, firewood, and fodder quickly. There are already several stumps that are coppicing but not properly managed. The coppice is overcut, not allowed to grow for a long time, and haphazardly cut for firewood and fodder.

- If new tree cutting is applied for coppicing, make it a slanting stump to keep the surface dry.
- Initially allow some number of coppices to allow and later remove the coppicing shoots keeping the best two coppices only.
- Do not attempt to cut and utilize until a full canopy develops. It allows providing an annual yield of fodder and some firewood.



Figure 14 Coppicing

6.3 Singling

- While singling the coppice, keep the vigorous, well-grown coppice only, keeping two in the beginning.
- These two coppices should be in the opposite side of the stump but not close to each other.
- Canopy opening in neighbouring trees should be followed to allow sunlight to coppicer.

6.4 Afforestation (Enrichment Plantation)

Afforestation under ANR should be applied where natural regeneration is not possible. It should be larger area/gaps in the forest where afforestation from nursery seedlings is feasible. For detailed information COSFOM Plantation Guidelines should be followed.

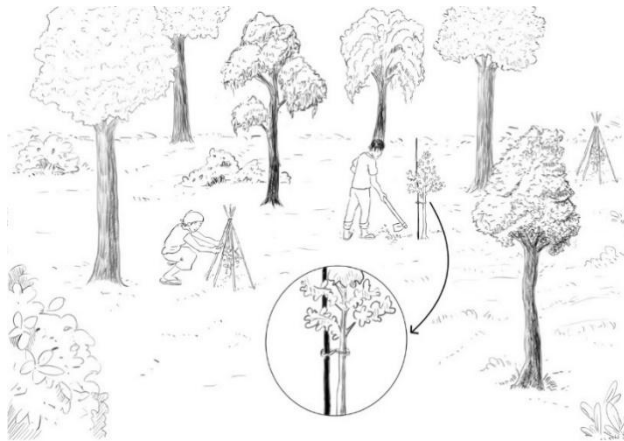


Figure 15 Enrichment Plantation

7 Forest Protection

Various forest management-related prescriptions are applied at various sites of the forest area. The efforts to meet the management objectives of the forest management with the enhancement of productivity can be achieved if the forest areas are effectively protected forever. The protection from the following influences should be strictly followed.

- a. Unwanted human disturbances
- b. Animal grazing restriction
- c. Fire protection
- d. Not allowing other disturbances such as stone, sand, soil and other forest products collection

8 Monitoring, Reporting and Follow up

WRCG records all the forest management-related applications regularly and correctly. It should be updated in a timely manner. There should be a record keeper who will update all the forest management applications. COSFOM Plantation Guidelines and COSFOM M&E System should be followed.



COMMUNITY BASED SUSTAINABLE FOREST MANAGEMENT FOR WATER RESOURCE CONSERVATION

List of related Technical guidelines

- Forestry Measures

- ...

- ...

Address: Manipur Forest Department Sanjenthong, Imphal - 795 001 Manipur

Phone: 03852 450 165

Fax: 03852 452 504

Email: pccf-mn@nic.inagement